



PORTLAND CEMENT CONCRETE LEVEL II INSTRUCTION MANUAL

2024-2025



**TECHNICAL TRAINING AND
CERTIFICATION PROGRAM**

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- 19. IM 535 PCC Plant Monitor
- 20. IM T-203 General Aggregate Source Information

TECHNICAL TRAINING AND CERTIFICATION PROGRAM

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Chapter 1

GLOSSARY

LEVEL II PCC GLOSSARY

Absolute Volume – Space occupied by materials in a cubic yard of concrete.

Absorption – The condition of an aggregate when all of the aggregate's pores are not full so it can absorb water.

Accelerator – A chemical admixture used to speed up the set of cement in a concrete mixture.

Adjusted (Wet) Batch Weights – The weights of the ingredients of a batch of concrete after the aggregate weights have been adjusted for moisture.

Aggregate – Sand, rock, or gravel used as a portion of a concrete mixture.

Air – A chemical admixture used in concrete to produce air voids.

Batch – One cubic yard of concrete. When on a project you may hear someone reference a batch of concrete as the total cubic yards of concrete being mixed at one time but for this training a batch of concrete is considered one cubic yard.

Cement – The fine gray powder that holds aggregates together in a concrete mixture.

Chemical Admixture – A chemical (air, water reducer, etc.) that is added to concrete to produce varying results on the concrete.

Concrete – A mass of sand and rock bound together by cementitious materials.

Dry Batch Weights – The weights of the aggregate, cementitious materials, and water calculated from the absolute volumes and specific gravities before the aggregate weights are adjusted for moisture content.

Fly Ash – A common mineral admixture used in concrete mixtures. Fly ash is a by-product of the burning of finely ground coal in electricity generating power plants. The two types of fly ash are Type C (cementitious) or Type F (non-cementitious).

Free Moisture – The excess water on an aggregate after the aggregate is completely saturated.

Ground Granulated Blast Furnace Slag (GGBFS) – A mineral admixture that is a by-product of steel production. GGBFS is made from slag floating on top of an iron blast furnace.

Instructional Memorandum (IM) – Four volumes of manuals issued by the Iowa DOT Materials Department containing specifications on material's inspection and testing.

Load – The total amount of concrete being batched out.

Lot System – The system used in the decision of when to sample materials i.e., in a paving plant a lot is one day's run.

Pozzolan – A finely divided, siliceous or aluminosiliceous material that reacts with water and calcium hydroxide released by Portland cement hydration to form cementing compounds.

Retarder – A chemical admixture used to delay the set of cement in a concrete mixture.

Saturated Surface Dry – The condition of an aggregate when it contains all the water it can hold but has no moisture on the surface.

Specific Gravity – The ratio of the density of water to the density of a material.

Water to Cement Ratio (W/C) – The ratio of the amount of water in a batch of concrete to the amount of cement. Maximum W/C is the highest ratio of water and cement that can be used in concrete and still be within specification.

Water Reducer – A chemical admixture used in concrete to reduce the amount of water required to produce slump which allows the lowering of the amount of cement required.

References

Instructional Memorandums

- Volume II
- Volume IV

Specifications

- Article 2301 – Portland Cement Concrete Pavement
- Article 2403 – Structural Concrete
- Article 4100 – General Provisions
- Article 2001 – General Equipment Requirements

General Supplemental Specifications

- GS-23003 –April 2024

Supplemental Specification (SS) or Special Provisions (SP)

- Applied to specific projects, QMC

Construction Manual

- 3.07 – Monitoring Program
- 9.00 – Portland Cement Concrete Pavement
- 11.50 - Concrete

Contract Documents

Proposals

ROUNDING & DECIMALS

Rounding is uniform throughout the certification training. You would look at the place to the right of the number you are rounding to and if it is 5 or above round up or 4 and below it remains the same.

Examples:

Rounding to whole numbers-

$$130.5 = 131 \quad 130.4 = 130 \quad 130.46 = 130$$

Rounding to tenths-

$$130.55 = 130.6 \quad 130.54 = 130.5 \quad 130.646 = 130.6$$

Rounding to hundredths-

$$130.555 = 130.56 \quad 130.544 = 130.54 \quad 130.5545 = 130.55$$

Rounding to thousandths-

$$130.5555 = 130.556 \quad 130.5544 = 130.554 \quad 130.55546 = 130.555$$

There are many equations used in Level II PCC to obtain percentages, weights, ratios, etc. The answers to these equations are expressed with the decimals in different locations. The following is a listing of how many places to round each answer.

Specific Gravity – hundredths – 2.62 2.77

Moisture – tenths – 2.7 0.6

Air – tenths – 6.5 5.8

Slump - $\frac{1}{4}$ inch – $3 \frac{1}{2}$ 2 $\frac{3}{4}$

Beam size – hundredths – 5.95 6.00 6.05

Absolute Volumes – thousandths - .082 .334

Water Cement Ratio (W/C) – thousandths - .480 .468

Cement Yield – tenths – 99.7 100.3

Pounds (lbs) – whole - 1450 385

Gallon (gal) – whole - 28 34

Cement Tons - hundredths - 117.0 54.50

Cubic Yards – hundredths – 117.00 54.50

(Concrete is batched in $\frac{1}{4}$ cubic yard increments)

There will be given numbers that are used in calculations that may be rounded differently than shown above. When given a number for use in a calculation, use the number in the form required. For example: 8.33 lbs./gal; 62.4 lbs. = unit weight of water, etc.

Concrete Specifications Summary - October 2024 (U.S. Units)

Caution: Consult the applicable specifications for required air content and slump before using this chart.

Paving	Type of Concrete	Slump (in.)		% Air Content		Specification Reference	
		Min.	Target	Min.	Target		Max.
Slip form	A, C, QMC			6	8	10	2301.02 B
Non-slip form	A, C, QMC	0.5		5.5	7	8.5	2301.02 B
Concrete Base (Non-slip form)	A, C	0.5		5.5	7	8.5	2301.02 & 2201
Curb and gutter (slip form)	C			6	8	10	2512.02 & 2301.02
Curb and gutter (Non-slip form)	C	0.5		5.5	7	8.5	2512.02 & 2301.02
Sidewalk	C			5.5	7	8.5	2511.02 & 2301.02
Intakes and manholes	C			5.5	6.5	8.5	2403.02

Repair

Patches with CaCl ₂	M	1	2.5	3	3	5	7	2530.02 B & 2529.02 B
		(prior to addition of CaCl ₂)						
Patches without CaCl ₂	M	1	3	4	5	6.5	8	2530.02 B & 2529.02 B
		1	4	5				
		<i>(when Mid-Range WR used)</i>						
Underseal and grouting, flowing mortar		By Flow Cone						2539.02 B & 2506

Overlays

Unbonded, white topping	C, QMC	same as specified concrete						2310.02
Bonded								

Lighting &

Highway Signing

Foundation	C	1	4	5	5.5	6.5	8.5	2403.02 A & B
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Concrete Specifications Summary - October 2024 (U.S. Units)

Caution: Consult the applicable specifications for required air content and slump before using this chart.

Structures	Type of Concrete	Slump (in.)			% Air Content			Specification Reference
		Min.	Target	Max.	Min.	Target	Max.	
Seal Coat	X	0		8				2405.02 D
Sub-Structure & Super-structure	C HPC	1	4	5	5.5	6.5	8.5	2403.02 A & B 2412.02
					<i>(when placed by pumping/belting)</i>			
Slope Protection	C	1		3	5.5	6.5	8.5	On the Plan Sheet
Piling encased & Piling brg. (encased)	C	1	4	5	5.5	6.5	8.5	2403 - 2501.03 E
Bridge Deck Overlay	O HPC	0	0.75	1	5.5	6.5	8.5	2413.02 D.1 2413.02 D.2
		1	4	5				
Bridge Deck - Class B Repair	C	1		3	5.5	6.5	8.5	2403.02 B, 2412 (2413.03 D)
Barrier Rail - Cast in place	C	1	4	5	6	7	8.5	2513.03 A
								2403
								2414.02
Barrier Rail - Slipform	BR				6	7	8.5	2513.03 A
								2403
								2414.02
Guardrail								
End anchors	C	1	4	5	4		7	2403.02 &
								2505.03 B

Concrete Specifications Summary - October 2024 (U.S. Units)

Caution: Consult the applicable specifications for required air content and slump before using this chart.

Paving	Type of Concrete	Slump (in.)		% Air Content		Specification Reference
		Min.	Target	Min.	Target	
Slip form	A, C, QMC			6	8	2301.02 B
Non-slip form	A, C, QMC	0.5		5.5	7	2301.02 B
Concrete Base (Non-slip form)	A, C	0.5		5.5	7	2301.02 & 2201
Curb and gutter (slip form)	C			6	8	2512.02 & 2301.02
Curb and gutter (Non-slip form)	C	0.5		5.5	7	2512.02 & 2301.02
Sidewalk	C			5.5	7	2511.02 & 2301.02
Intakes and manholes	C			5.5	6.5	2403.02

Repair

Patches with CaCl ₂	M	1	2.5	3	5	7	2530.02 B & 2529.02 B
		(prior to addition of CaCl ₂)					
Patches without CaCl ₂	M	1	3	4	5	8	2530.02 B & 2529.02 B
		1	4	5			
<i>(when Mid-Range WR used)</i>							
Underseal and grouting, flowing mortar		By Flow Cone					2539.02 B & 2506

Overlays

Unbonded, white topping	C, QMC						2310.02
Bonded		same as specified concrete					

Lighting &

Highway Signing

Foundation	C	1	4	5	5.5	6.5	8.5	2403.02 A & B
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Concrete Specifications Summary - October 2024 (U.S. Units)

Caution: Consult the applicable specifications for required air content and slump before using this chart.

Structures	Type of Concrete	Slump (in.)			% Air Content			Specification Reference
		Min.	Target	Max.	Min.	Target	Max.	
Seal Coat	X	0		8				2405.02 D
Sub-Structure & Super-structure	C HPC	1	4	5	5.5	6.5	8.5	2403.02 A & B 2412.02
					<i>(when placed by pumping/belting)</i>			
Slope Protection	C	1		3	5.5	6.5	8.5	On the Plan Sheet
Piling encased & Piling brg. (encased)	C	1	4	5	5.5	6.5	8.5	2403 - 2501.03 E
Bridge Deck Overlay	O HPC	0	0.75	1	5.5	6.5	8.5	2413.02 D.1 2413.02 D.2
		1	4	5				
Bridge Deck - Class B Repair	C	1		3	5.5	6.5	8.5	2403.02 B, 2412 (2413.03 D)
Barrier Rail - Cast in place	C	1	4	5	6	7	8.5	2513.03 A
								2403
								2414.02
Barrier Rail - Slipform	BR				6	7	8.5	2513.03 A
								2403
								2414.02
Guardrail								
End anchors	C	1	4	5	4		7	2403.02 & 2505.03 B

Proportion Table 1
Concrete Mixes
Using [Article 4110](#) and [4115](#) Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

A MIXES Basic w/c = 0.474 Max w/c = 0.532					
Mix No.	Cement	Water	Air	Fine	Coarse
A-2	0.101	0.150	0.060	0.276	0.413
A-3	0.104	0.155	0.060	0.306	0.375
A-4	0.108	0.161	0.060	0.335	0.336
A-5	0.111	0.165	0.060	0.365	0.299
A-6	0.115	0.171	0.060	0.392	0.262
BR MIXES Basic w/c = 0.400 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
BR	0.114	0.143	0.060	*	*
C MIXES Basic w/c = 0.430 Max w/c = 0.488					
Mix No.	Cement	Water	Air	Fine	Coarse
C-2	0.110	0.149	0.060	0.272	0.409
C-3	0.114	0.154	0.060	0.302	0.370
C-4	0.118	0.159	0.060	0.331	0.332
C-5	0.123	0.166	0.060	0.358	0.293
C-6	0.128	0.173	0.060	0.383	0.256
C-WR MIXES Basic w/c = 0.430 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
C-3WR	0.108	0.146	0.060	0.309	0.377
C-4WR	0.112	0.151	0.060	0.338	0.339
C-5WR	0.117	0.158	0.060	0.366	0.299
C-6WR	0.121	0.163	0.060	0.394	0.262
D MIXES Basic w/c = 0.423 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
D-57	0.134	0.178	0.060	0.314	0.314
D-57-6	0.134	0.178	0.060	0.377	0.251
M MIXES Basic w/c = 0.328 Max w/c = 0.400					
Mix No.	Cement	Water	Air	Fine	Coarse
M-3	0.149	0.153	0.060	0.287	0.351
M-4	0.156	0.161	0.060	0.311	0.312
M-5	0.160	0.165	0.060	0.338	0.277
O MIXES Basic w/c = 0.327 Max w/c = -----					
Mix No.	Cement	Water	Air	Fine	Coarse
O-4WR	0.156	0.160	0.060	0.312	0.312
HPC-O MIXES Basic w/c = 0.390 Max w/c = 0.420					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-O	0.134	0.164	0.060	0.321	0.321
HPC-S MIXES Basic w/c = 0.420 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-S	0.118	0.156	0.060	0.333	0.333

STANDARD MEASUREMENTS

Weight of water per cubic foot = 62.4 lbs./cu. ft.

Weight of water per gallon = 8.33 lbs/gallon

Cubic feet per cubic yard = 27 cu. ft.

TO FIGURE WEIGHT PER UNIT VOLUME

Absolute Volume x Specific Gravity x Unit Weight of water x cubic feet per cubic yard

TO FIGURE ABSOLUTE VOLUME

Batch Weight ÷ Specific Gravity ÷ Unit Weight of water ÷ cubic feet per cubic yard

TO FIGURE WET BATCH WEIGHTS

Wet batch weight = Batch weight, SSD x 100

(100 - % moisture)

Adjusted water for aggregate moistures = wet batch weight - dry batch weight

TO FIGURE WATER/CEMENT RATIO

Water/Cement ratio = Total weight of all water ÷ Total weight of all cementitious materials

TO FIGURE CEMENT YIELD

Cement Yield = $\frac{(\text{Total Cement Batched} + \text{Left in Scale This Check} - \text{Left in Scale Last Check})}{\text{Total Cement Billed}} \times 100$

TO FIGURE MAXIMUM WATER

Maximum water cement ratio of the mix x total cementitious materials

Chapter 2

INTRODUCTION

I. Introduction

This course is intended for the training of Certified Concrete Plant Technicians. The training manual that accompanies this course has been prepared to provide assistance not only for classroom use, but also as a self-training manual and a reference to be used in the field.

At the beginning of each section, references are given to:

- Iowa Department of Transportation Standard Specifications with the Specification Article listed
- Materials Instructional Memorandums (IM)

These references will enable the Certified Plant Technician to refer to those documents for more detailed information.

NOTE: IMs and Specifications are updated each spring and fall and the technician should always make sure they are looking at the most current IMs and specifications.



Remember to check for IM and Specification changes each spring and fall.

Chapter 3
CERTIFICATION PROGRAM

Certification Program for Certified Plant Technicians

IM 213

A. Requirements

The requirements for obtaining a Certified Portland Cement Concrete Plant Technician Level II certification are:

- Certification in Aggregate Technician
- Certification in Level I PCC Concrete Testing
- A score of at least 80% on the Level II PCC exam

In addition to the above requirements, recommended experience includes:

- Performing Gradation Tests
- Performing Moisture Tests
- Calculating Batch Weights
- Performing Specific Gravity Tests
- Checking Slump, Air and Flexural Strength
- Maturity Meter Testing
- Checking Tolerances and Sensitivity of Scales
- Complete Plant Inspection: *Stockpiling, Admixture Dispensers, Scales, etc.*
- Completing Reports
- Keeping Proper Records and Plant Diaries



The Technician should have experience performing the above duties under a certified technician before performing plant inspection duties on their own.

B. Certifications

Certifications are issued for a five-year period. Level II PCC updates are no longer required for recertification.

C. Performance Requirements

Suspension of Certification

A Certified Technician will be suspended for unsatisfactory and/or inadequate performance. (See Unsatisfactory Performance form on the following page)

- After 2 such notices, a technician will receive a three-month suspension.
- A third notice will result in Decertification.

Technician Decertification

- A Technician's Certificate will become invalid for any one of the following:
 - Failure to renew the Certificate prior to regular expiration
 - Use of false or fraudulent information to secure or renew
 - False or fraudulent actions or documentation
 - Not performing tests and duties properly in accordance with specifications

Federal Code 1020, Iowa Code 714.8

Certified Technicians need to be aware of the consequence of issuing a false statement (refer to codes on pages 3-4 and 3-5)

D. Responsibilities

IM 213

The Certified Plant Technician shall:

- Sample
- Test
- Perform prescribed inspections, all at the specified frequencies
- Be responsible for Quality Control

The Project Engineer will:

- Be responsible for monitoring inspections
- Be responsible for verification

UNSATISFACTORY PERFORMANCE NOTICE

Issued To: _____

Date: _____

This notice is to inform you that your performance as a Certified Inspector/Technician was unsatisfactory for the reason(s) listed below.

This notice and all supporting documentation will be placed in your record with the Iowa Department of Transportation's Technical Training & Certification Program (TTCP).

The goal of the Technical Training and Certification Program (TTCP) is to work with contractors, producers, cities, counties, and consultants to continually improve the quality of Iowa's construction projects. We hope you will work with us to achieve this goal.

Unsatisfactory Performance:

District Materials Engineer

cc: Program Director –Construction and Materials Engineer, Ames
TTCP Coordinator
Resident Construction Engineer

FEDERAL CODE 1020 and IOWA CODE 714.8

IM 213 discusses the Unsatisfactory Notice that Certified Technicians are given when they are not performing their job duties satisfactorily. This can be given for a number of reasons including, improper sampling and/or testing, not performing their duties and reporting in the time frame required, reporting incorrect information, etc. The technician is given one written notice, the second notice is three-month certification suspension, and the third notice is decertification. According to IM 213 the Certified Technician can automatically be decertified for false statements without going through the Unsatisfactory Notice procedure. The Certified Technician also needs to be aware of the false statement clause that is applicable to all federal-aid projects and the fraudulent practice clause that applies to all non-federal aid projects. **Certified Technicians need to read and be aware of U.S.C. 1020 and Iowa Code 714.8 since these do apply to them.** They read as follows:

FEDERAL AID PROJECTS

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

18 U.S.C. 1020 reads as follows:

“Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined not more than \$10,000 or imprisoned not more than 5 years or both”

NON-FEDERAL AID PROJECTS

Iowa Code 714.8, subsection 3, defines fraudulent practices. “A person who does any of the following acts is guilty of a fraudulent practice. Subsection 3, Knowingly executes or tenders a false certification under penalty of perjury, false affidavit, or false certificate, if the certification, affidavit, or certificate is required by law or given in support of a claim for compensation, indemnification, restitution, or other payment.” Depending on the amount of money claimed for payment, this could be a Class C or Class D felony, with potential fines and/or prison.

The above codes refer to the individual making the false statement. **Standard Specification Article 1102.03, paragraph C, section 5 refers to the Contractor.**

Article 1102.03, paragraph C, section 5 states, “A contractor may be disqualified from bidder qualification if or when: The contractor has falsified documents or certifications, or has knowingly provided false information to the Department or the Contracting Authority.”

Section 2521. Certified Plant Inspection

2521.01 DESCRIPTION.

Certified plant inspection will be required for Interstate, Primary, state park, and institutional projects. It will apply to other projects only when designated. When this specification applies, furnish or oversee certified plant inspection for the work, as specified herein.

2521.02 REQUIREMENTS.

- A. For certified plant inspection, comply with [Materials I.M. 213](#), using personnel certified for the type of inspection to be accomplished and using prescribed test equipment the Contractor furnishes. Ensure the equipment is also available for use by the Engineer for monitoring purposes.
- B. When a field laboratory or office is furnished, as provided in [Section 2520](#), exclusive use by the Engineer for inspection purposes is intended. Additional field laboratory space and equipment and/or office space for use by the Contractor to fulfill the requirements of Certified Plant Inspection are incidental to the contract unit price for the item for which this inspection is required.
- C. Delivery of samples to the District Materials Laboratory may also be required. Comply with the provisions in [Section 2534](#).

2521.03 APPLICATION.

This specification applies to all HMA, HMA patching material, PCC, structural concrete, and flowable mortar, except where excluded by a note in the contract documents.

2521.04 METHOD OF MEASUREMENT.

Certified plant inspection will not be measured.

2521.05 BASIS OF PAYMENT.

Certified plant inspection will not be paid for separately and is to be included in the contract unit price for the item for which this inspection is required.

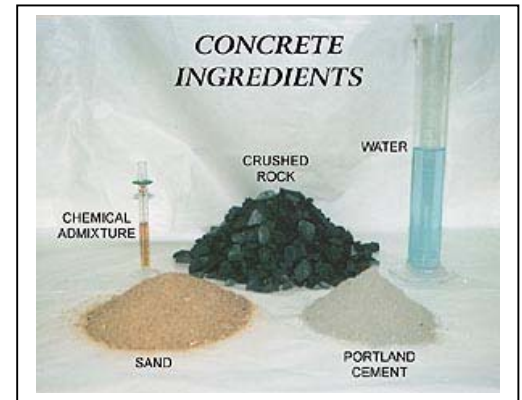
Chapter 4

MATERIALS

III. CONCRETE MATERIALS

Concrete consists of three basic components-aggregates (both sand and rock), cement, and water. When mixed together and the chemical reaction is allowed to proceed, they form concrete. This material is one of the most versatile construction materials and has tremendous compressive strength. It is widely used for both pavements and structures.

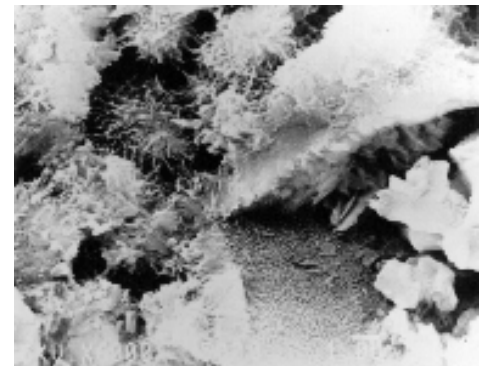
- **Cement** is the fine gray powder that holds the aggregates together.
- **Concrete** is a mass of sand and rock bound together by cement.



1. Cement - Article 4101, IM 401

Portland cement is the most important and the most expensive component in a concrete mixture. It is the glue that holds the aggregates together and is the primary ingredient that will determine the strength of the concrete. The strength is developed through a process called hydration described as follows:

- Water contacts cement grain
- Exothermic reaction occurs
- Small needle-like crystals form on the surface of the cement particle
- Crystals interlock and form a gel-like mass.



Types

ASTM C150 / AASHTO M85

I -Normal

II -Moderate Sulfate Resistance

III -High Early Strength

IV -Low Heat of Hydration

V -High Sulfate Resistance

Blended Cements

ASTM C595 / AASHTO M240

IP Up to 25% Pozzolan

IS Up to 35% GGBFS

IL 5% to 15% Limestone

IT Ternary blend of slag S(%) and Limestone L(%)

Type I or Type II cement may be used for pavements, structures, and other applications. Type III cement may be used in precast and prestressed concrete only. Type IP, Type IS, or Type IL cement may be furnished at the Contractor's option when Type I or Type II cement is specified. Use the same unit volume of Type IP, Type IS, or Type IL cement in the concrete that is specified for Type I or Type II cement.

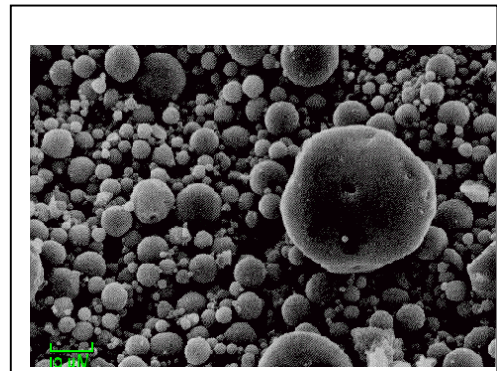
Storage and Handling

- Stored in weatherproof enclosures
- If lumps develop
 - Less than 1% okay
 - 1 to 5% requires batch weight adjustments
 - Rejected if exceeds 5% maximum on 840 μm (No. 20) sieve

2. Fly Ash - Article 4108, IM 491.17

Fly ash is a common mineral admixture used in most concrete paving mixtures. It is by-product of the burning of finely ground coal in electricity generating power plants.

This fine, powdery material, which is almost totally spherical in shape, is known as a pozzolan. Pozzolans are finely divided, siliceous or aluminosiliceous materials that react with water and calcium hydroxide released by Portland cement hydration to form cementing compounds.



Types – ASTM C618 / Article 4108

- Class C Fly Ash
 - Cementing
 - High Lime (CaO)
- Class F Fly Ash
 - Non-cementing
 - Low Lime (CaO)

Approved sources of each are listed in IM 491.17.

Some of the benefits that can often be achieved by using fly ash in the concrete include:

- Economical mix
- Increased long term strength
- Increased workability
- Reduced heat of hydration
- Reduce permeability

3. Ground Granulated Blast Furnace Slag (GGBFS) - Article 4108, IM 491.14

Ground granulated blast furnace slag (GGBFS) is a mineral admixture is a by-product of steel production. GGBFS is made from slag floating on top of an iron blast furnace. The slag is tapped off and quenched in water to produce a glassy sand-like material. This material is ground to a fine powder.



The powder has slight cementing properties and minerals similar to those found in cement such as

- Silica
- Calcium
- Magnesium
- Aluminum

Advantage to using GGBFS

- Increased workability
- Increased strength
- Reduced permeability
- Increased sulfate resistance
- Decreased alkali aggregate reactivity

GGBFS is commonly blended or inter-ground with cement to form a IS blended cement.



4. Aggregates - Articles 4109, 4110, 4111, 4112, 4115, 4117 and IM T-203

The aggregates in the concrete mixture make up the largest portion of the volume of the concrete, often about two thirds.

- Standard Iowa DOT mixes
 - Fine aggregate - sand
 - Coarse aggregate - gravel or crushed stone
- QMC mixes
 - Well graded
 - Intermediate aggregate
 - Increases workability



a. Gradation

- Gradation table

b. Durability

- IM T-203

5. Water - Article 4102

The water used in batching concrete can come from almost any source. Each source must be tested and approved if it is not potable. Often lakes or streams are used because they are close to the project. This water must meet hardness, alkalinity, and acidity requirements. During the summer, warm water may increase the temperature of the concrete, which can lead to placement problems.

6. Chemical Admixtures - Article 4103, IM 403

Admixtures can be classified by function and include:

- Air-entraining admixtures
- Water-reducing admixtures
- Retarding admixtures
- Accelerators
- Superplasticizers

Accelerators and super plasticizers are not commonly used in paving. Calcium Chloride is commonly used as an accelerator in patching work.

Reasons for using admixtures are:

- To reduce the cost
- Achieve certain concrete properties effectively
- Ensure the quality of concrete in adverse weather conditions



Admixtures cannot make “bad concrete” good, nor should they be used as a substitute for good concrete practices.

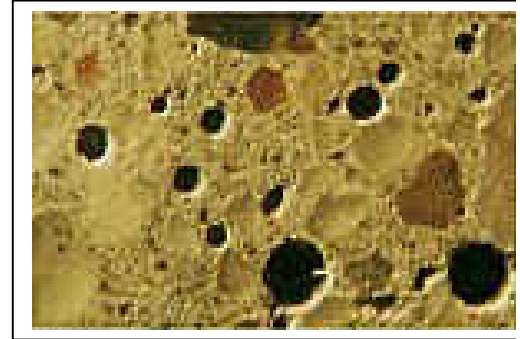
a. Air Entraining

Air-entraining admixtures are used to entrain millions of microscopic air bubbles in concrete.

- Freeze Thaw Durability
- Increase Workability

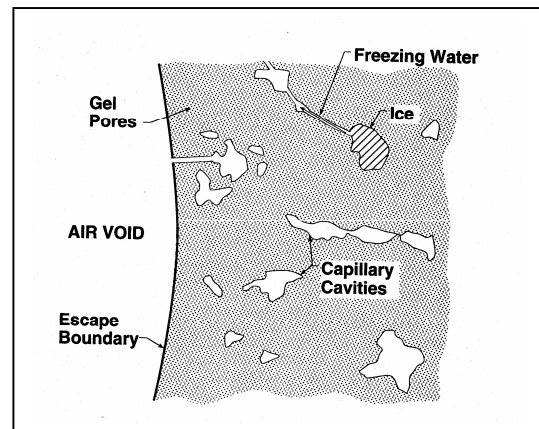
Types

1. Neutralized Salt of Pine Wood Resins (normally called Vinsol Resins)
2. Synthetic Detergents



Why entrain air in concrete?

- Concrete is a porous material
- Exposed to moisture, water moves through the pores
- Below freezing, water turns to ice at 9% more volume
- Expanding ice forces water through capillaries
- Air voids act as pressure relief

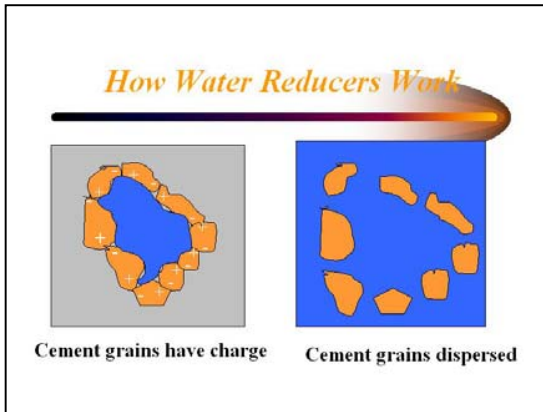


Without air voids, the repeated freezing and thawing will damage the concrete. This damage is increased with deicing salts.

A listing of the many factors affecting the air entraining ability of the concrete is found at the end of this chapter.

b. Water Reducer

- A water reducer is a liquid used to reduce the “static cling” produced by the electrical charges on cement particles.
- Reduce the quantity of mixing water required to produce concrete of a certain slump, reduce water/cement ratio, or increase slump. Typical water reduction is 7% to 10% with low range water reducers.



c. Retarders

- Delay the set of cement
- Act as water reducer
- Increase working time in hot weather

Concrete Mixes

**Classes of Mix - IM 529
Typical Uses**

• Class A	Detour Pavement, Sidewalks, Shoulders
• Class C	Primary Paving & Structures & Trails
• Class D	Structural
• Class M	Patching/ high early strength
• Class O	Deck Overlay / Structural Repair

See IM 529 for the entire list of mixes and their uses.

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Cement	Alkali Content	Air content increases with increased alkali content	Dosage may be reduced up to 40% for high alkali cements
		Very low alkali cements (less than 0.3%) reduces air content	Dosage may need to be increased by 100%
	Fineness	Air content decreases with increased fineness	Dosage may be increased up to 100% for Type III cements
	Blended Cements	As fineness of cement increases air content decreases	Increase dosage rates of up to 100%
		Air content decreases with increase in LOI	Increase dosage rates of up to 100% or more
Content	Air content decreases with increased amount of cement	Increase dosage as cement content increases	
Admixture Compatibility	Rapid slump loss is observed when a cement containing anhydrite is used in conjunction with a lignosulfonate based water reducer - hard to control air content	Use a retarding type admixture. Delay addition of water reducer by 15 secs. Increase mix time	

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Mineral Admixtures	Fly ash (LOI)	Air content decreases with higher LOI (carbon content) Carbon adsorbs the air agent reducing effectiveness	LOI's may vary as the peak load at the power plant causing variability load to load
		Air may be unstable with some combinations of fly ash, cement, and AEA's	Prepare trial mixes and evaluate air
		LOI's greater than 1% LOI's greater than 2% may cause air to be very unstable over time Finer fly ashes decreases air content	Usually increases AEA demand May increase AEA demand 5 times or more. May not be able to stabilize entrained air or attain required amount of air
	GGBFS	Air content decreases as GGBFS fineness increases	May need up to 100% or more AEA with finely ground slags
	Silica Fume	Air content decreases with increase in silica fume content	May need up to 100% increase in AEA
Chemical Admixtures	Water Reducers	Air content increases with increase water reducer dosage rates (lignin-based water reducers)	Reduce AEA dosage by up to 50%
	Retarders	Similar to water reducers	Reduce AEA dosage

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Aggregates	Maximum Size	Air content requirements decrease as maximum size increases (up to 1.5") Well graded aggregates aid in retention of smaller entrained air bubbles	Total air content required to protect concrete decreases Monitor gradations
	Sand	Air content increases with increased sand content	Decrease AEA content
	Sand Grading	Increased amounts retained on No. 30 to 50 sieves promote air entrainment	Monitor sand gradations
		Increased amount of fines passing the No. 100 sieve will decrease air content Organic contaminants may result in large fluctuations in air	Monitor sand gradations Use clean sands
	Moisture Absorption	Many coarse aggregates are highly absorptive. Some will indicate moisture and still absorb water from the mix.	Manage stockpiles - moisture contents can vary load to load causing increases and decreases in slump and air content
Minus No. 100	Increased amounts of crushed fines decreases air content Clay or silt fines in sand decrease air content Combined totals greater than 2% may decrease air contents Combined totals greater than 2.5% will decrease air contents	Total combined of greater than 2% passing the #100 sieve will affect ability to entrain air May require dosage increases up to 5 times	

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Water	Hardness	Batching air agent with hard water or wash water first will decrease air content	Increase AEA by up to 50%
	Organic Contaminants	May increase or decrease air	Test water before using if not potable
	w/c ratio	Air content increases with increase in w/c ratio	1 gallon water = 0.5 to 1" slump
	Slump	Increase in slump increases air content (Up to 6 in.) Increase in slump to greater than 6 in. decreases air content Difficult to entrain air in low slump concrete (less than 1in.)	Increase slump 1" -increase air 0.5% Increase slump

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Production	Batching Sequence	Simultaneous batching may lower air content Batching AEA on to cement reduces AEA effectiveness Blending all materials promotes better mixing and entrained air development	Discharge AEA into water or water line or on to sand
	Mixer Capacity	Air content increases as capacity is approached Overloaded mixer decreases air content	Run 80 to 85% of capacity gives best mixing action
	Mixing Time	Air content increases up to 5 min. mixing (central plant) Air content will decrease after 20 minutes of mixing (transit) Mixing times less than 60 seconds may not develop proper air void system for freeze thaw protection	1 to 3 min. mix time optimum for central
	Mixing Speed	Air content increases to 20 rpm and decreases as speed increases	
	Admixture metering	Accuracy and reliability of dispensing system affects uniformity of air Add all chemical admixtures separately	Visually check bottles for accuracy

Factors Affecting Control of Air in Concrete

Category	Characteristic	Effects	Guidance
Placement Procedures	Transport and delivery	Transport in non agitated equipment worse than for agitated	When using non-agitated haul units use smoothest and shortest haul routes
	Haul Time	Loss of 1 to 4 percent air depending on time Worse in hot weather	Use haul route that results in shortest time
	Mixing Drum	Air content decreases as mixer blades are worn or if concrete has hardened on or around the blades and pedestals	Perform regular maintenance
	Belt Conveyors	Reduces air content by up to 1 percent for less than 3000 ft.	
	Pumping	Pumping can lose up to 4% air	Don't allow high vertical drop Distance, slump, and line pressure all affect air content
	Vibration	Air content decreases under prolonged vibration at high frequencies (>10,000 vpm)	Closely spaced vibrators recommended 8000 vpm max. internal vibrators
	Finishing	Air content reduced in surface layer by excessive finishing	Avoid finishing with bleed water on surface DO NOT add water to surface to finish
	Temperature	Air content decreases with increasing temperature In low slump concrete (< 2 in.) at a temperature above 90 F is has been found to be more difficult to hold the slump and increase air contents. Likewise a small amount of water generates larger slump gains and a larger entrained air increase for concrete at 70F	Watering of stockpiles will help cool coarse aggregate and reduce absorption of mix water Utilize coldest water possible for Hot Weather Concreteing (well water)

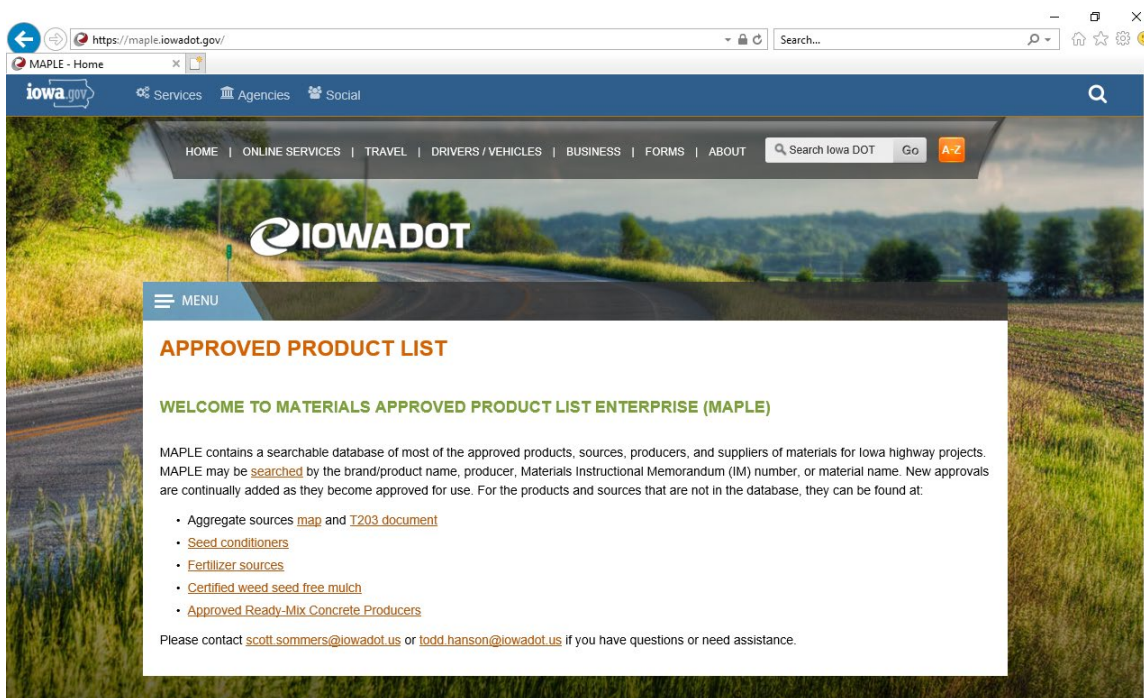
User's Guide for Materials Approved List Enterprise (MAPLE)

1. Introduction

The Iowa DOT Materials Approved List Enterprise (MAPLE) has been in service for all users since July 2014. The MAPLE allows users to check all products approved in Iowa from a single data base. This document is to provide instruction on how to use the MAPLE.

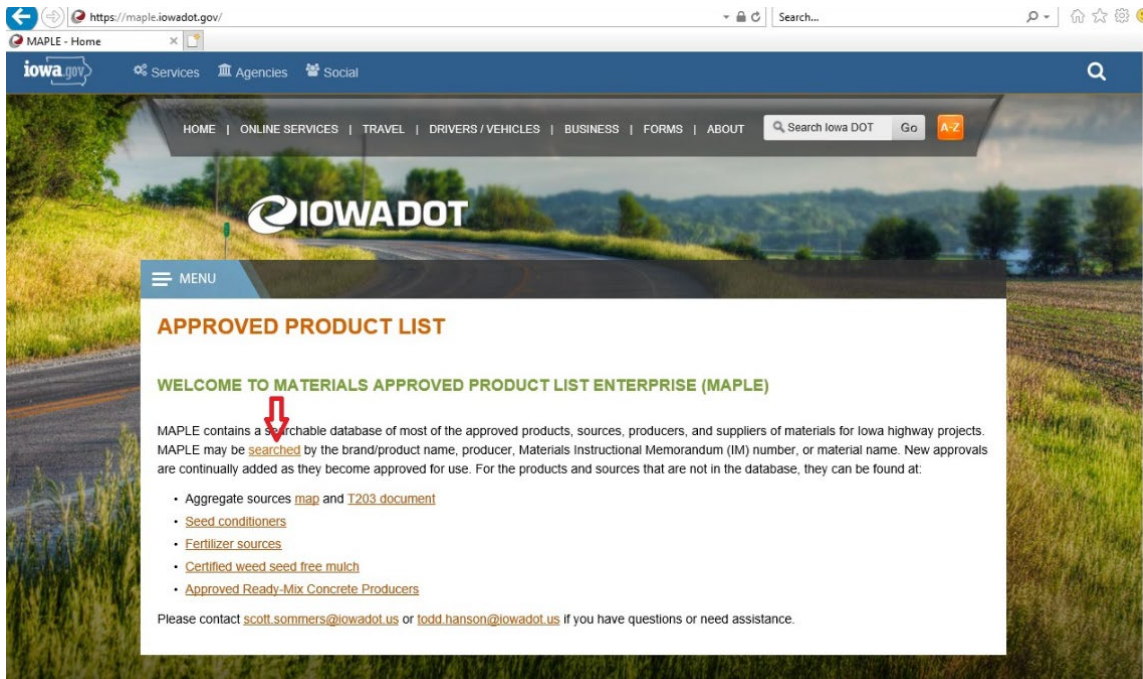
2 How to get to MAPLE

The MAPLE can be reached at: <https://maple.iowadot.gov/>

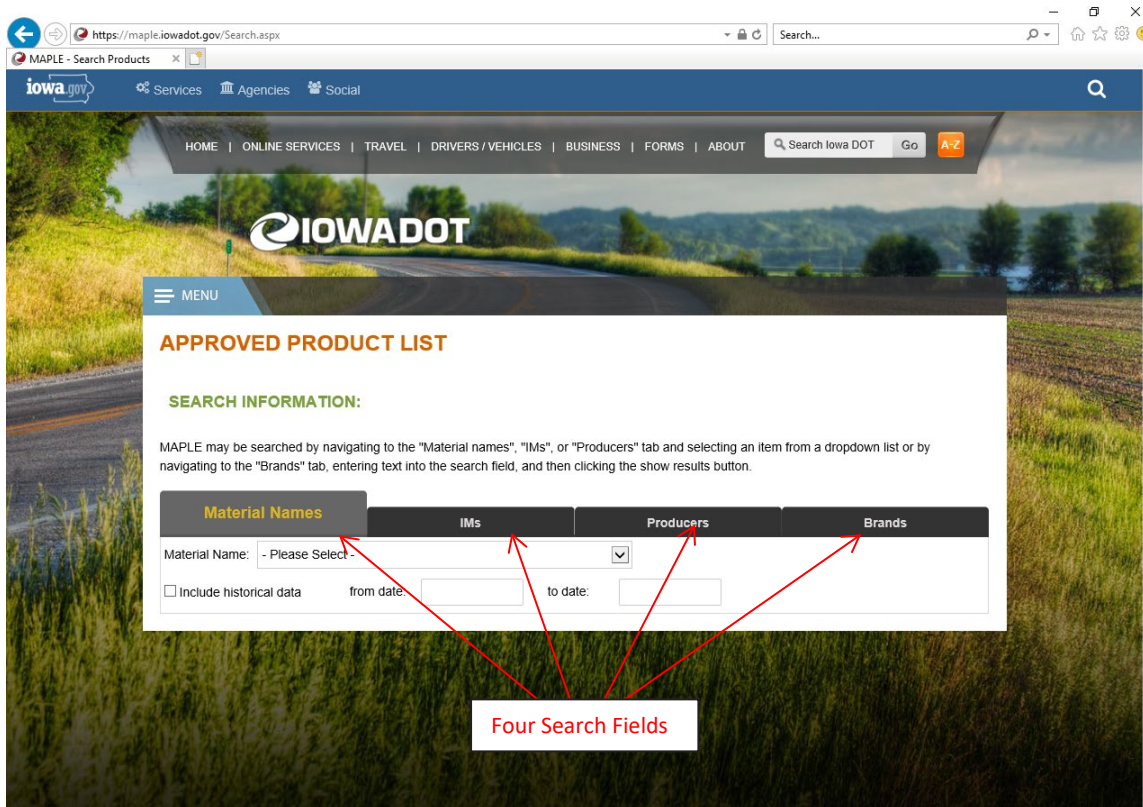


3. Searching MAPLE


Click on the **Searched** link as shown below.

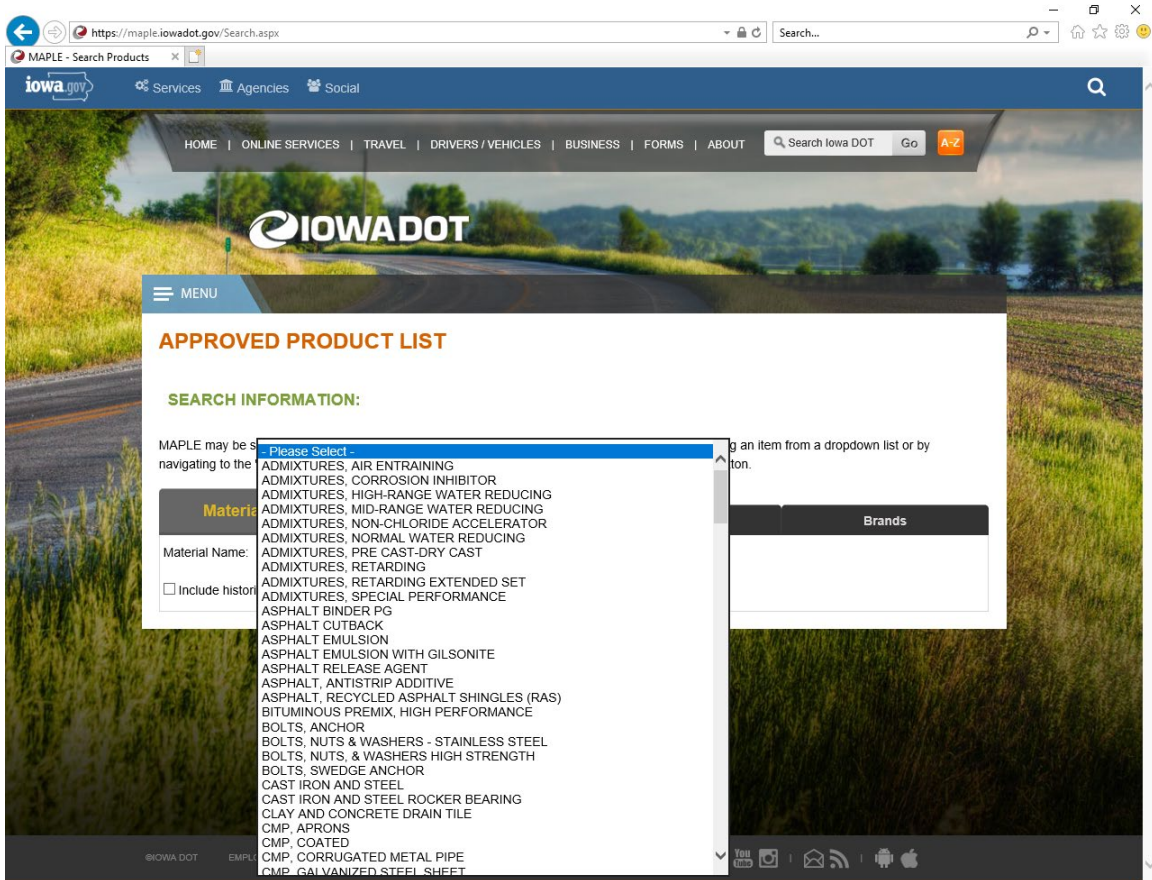
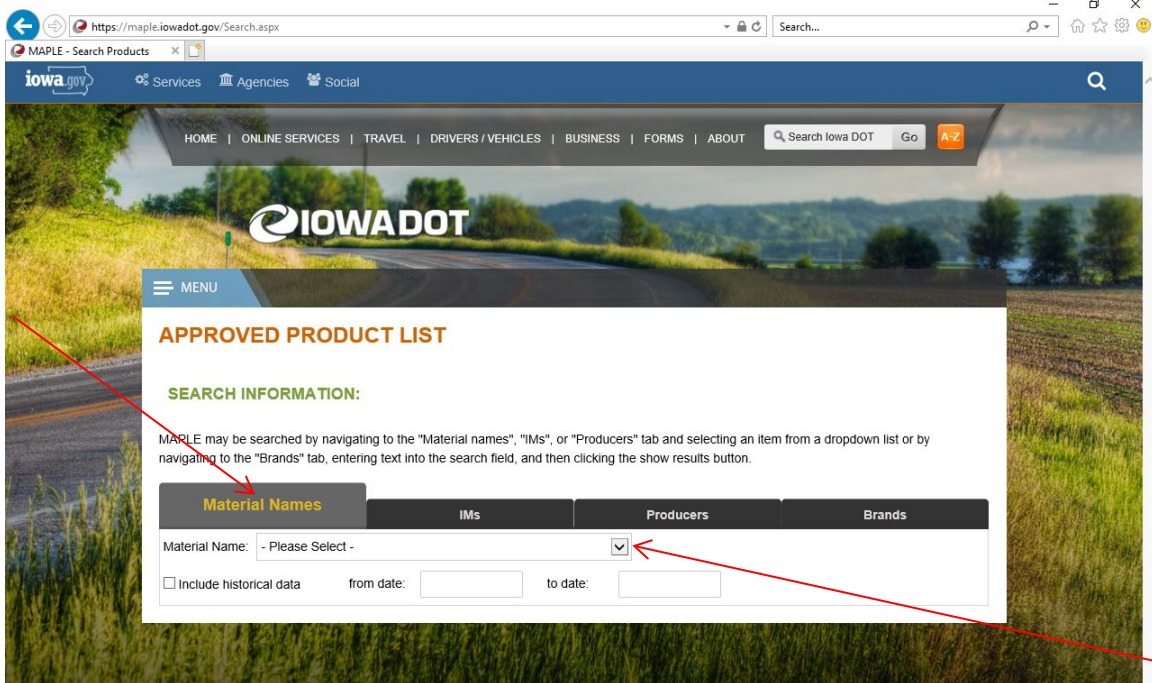


The user can search **MAPLE** through one of four fields listed: **Material Names, IMs, Producers, and Brands**.




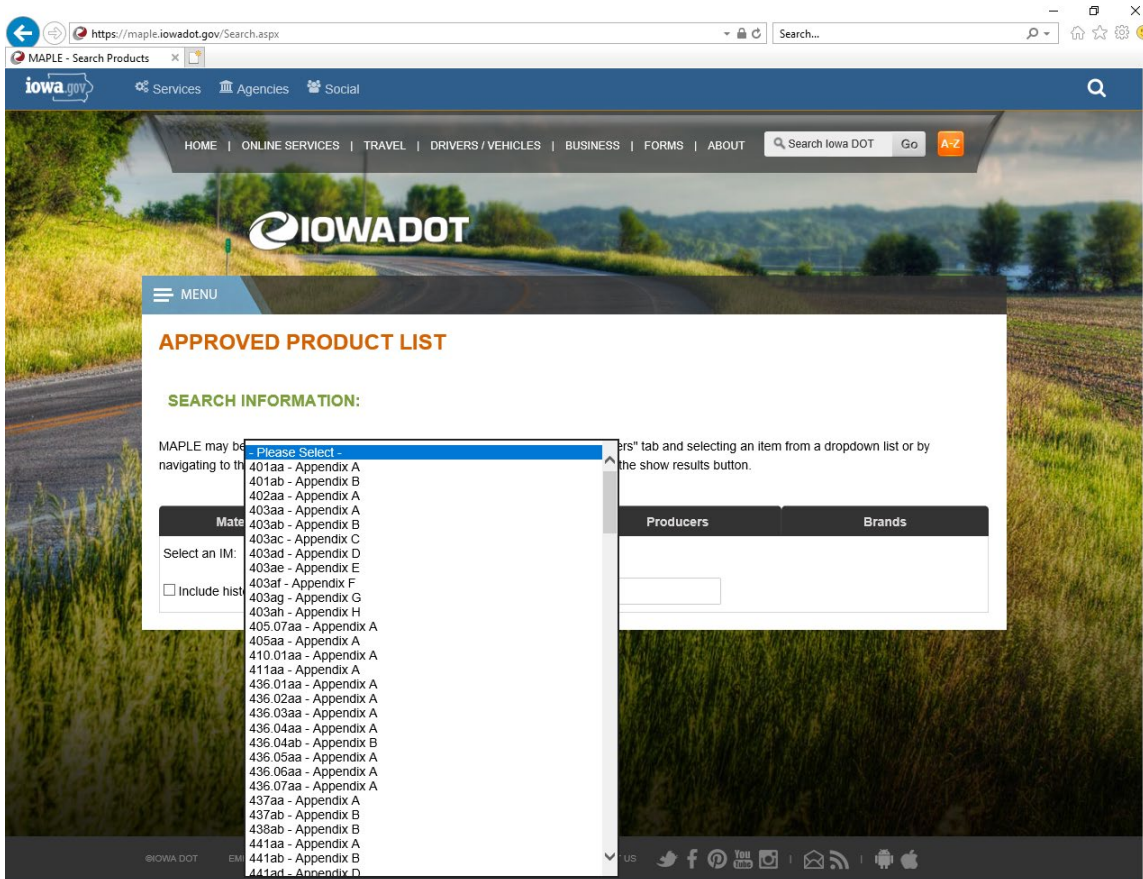
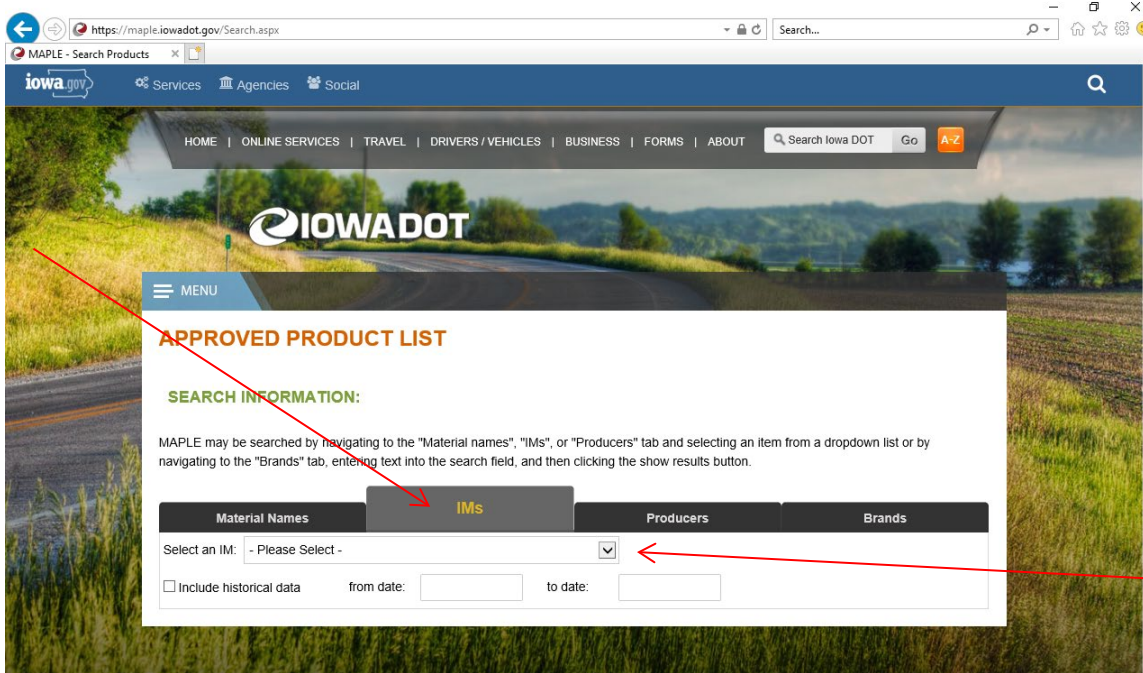
4. Search by Material Names

Click on the **Material Names** tab to search by type of material. Click on the arrow  and a list will appear as shown. Click on any of the material names to produce an approved product list.




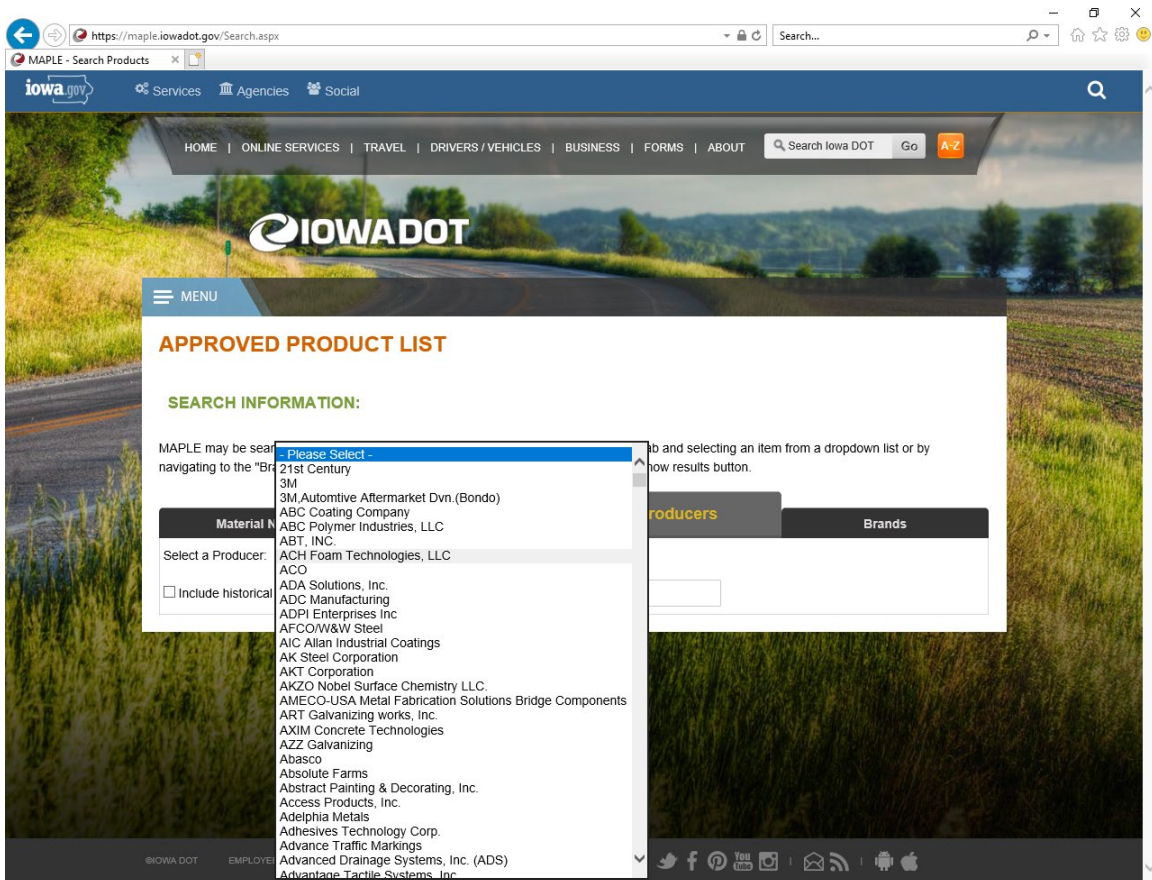
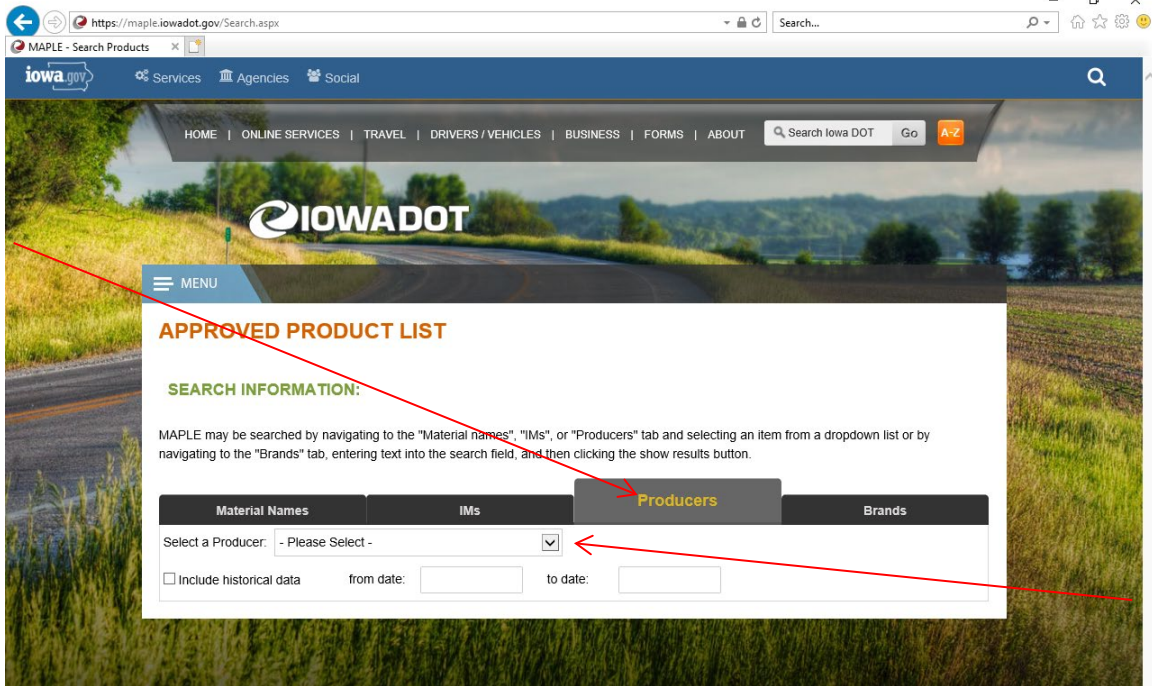
5. Searching by IMs

Click on the **IMs** tab to search by IM number. Click on the arrow  and a list will appear as shown. Click on any of the IM's listed to produce a list of approved products in that IM.



6. Searching by Producers

Click on the **Producers** tab to search by producer. Click on the arrow  and a list will appear as shown. Click on any producer for a list of all approved products manufactured by that particular producer.



7. Searching by Brand Name

Click on the Brands tab to search by freeform typing the brand name of the product.

The screenshot shows the IOWADOT MAPLE search interface. The 'Brands' tab is selected and highlighted in yellow. The search form contains the following elements:

- Material Names
- IMs
- Producers
- Brands (selected)
- Brand Name: Lehigh
- SHOW RESULTS button
- Include historical data checkbox
- from date: [] to date: []

Red arrows point from the 'Brands' tab and the 'SHOW RESULTS' button to the search form. A red box at the bottom contains the text 'Enter Brand Name'.

The screenshot shows the IOWADOT MAPLE search interface with search results displayed. The 'Brands' tab is selected. The search form contains the following elements:

- Material Names
- IMs
- Producers
- Brands (selected)
- Brand Name: Lehigh
- SHOW RESULTS button
- View Report link
- Include historical data checkbox
- from date: [] to date: []

The search results table is as follows:

Brand Name	Approved	Company Name	Material Item	IM	Plant Location (City, State)
Lehigh White I	01/07/2015	Lehigh Cement Company	PORTLAND CEMENT	401	York, PA
Lehigh White I Cimsa	01/07/2015	Lehigh Cement Company	PORTLAND CEMENT	401	Cimsa, Turkey
Lehigh I - Mason City (Code: PC0401)	01/07/2015	Lehigh Cement Company	PORTLAND CEMENT	401	Mason City, IA
Lehigh III - Mason City (Code: PC0403)	02/17/2015	Lehigh Cement Company	PORTLAND CEMENT	401	Mason City, IA
Lehigh II (10) - Mason City (Code: PC0409)	01/07/2015	Lehigh Cement Company	PORTLAND CEMENT	401	Mason City, IA

8. Selecting a Product

After a list of products has been displayed, click on the individual Brand Name to display more information about the product.

The screenshot shows the Iowa DOT website's search results for '403ab - Appendix B'. The page title is 'APPROVED PRODUCT LIST'. Below the title, there is a 'SEARCH INFORMATION' section with instructions on how to use the search tool. A table with columns for 'Brand Name', 'Approved', 'Company Name', 'Material Item', 'IM', and 'Plant Location' is displayed. A red arrow points to the 'Daratard 17' brand name in the first row of the table.

Brand Name	Approved	Company Name	Material Item	IM	Plant Location
Daratard 17	04/12/2019	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403	
Eucon Retarder 100	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH
Eucon Stasis	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	
Eucon WR-91	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH
MasterSet Delvo	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	
MasterSet R 100	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	

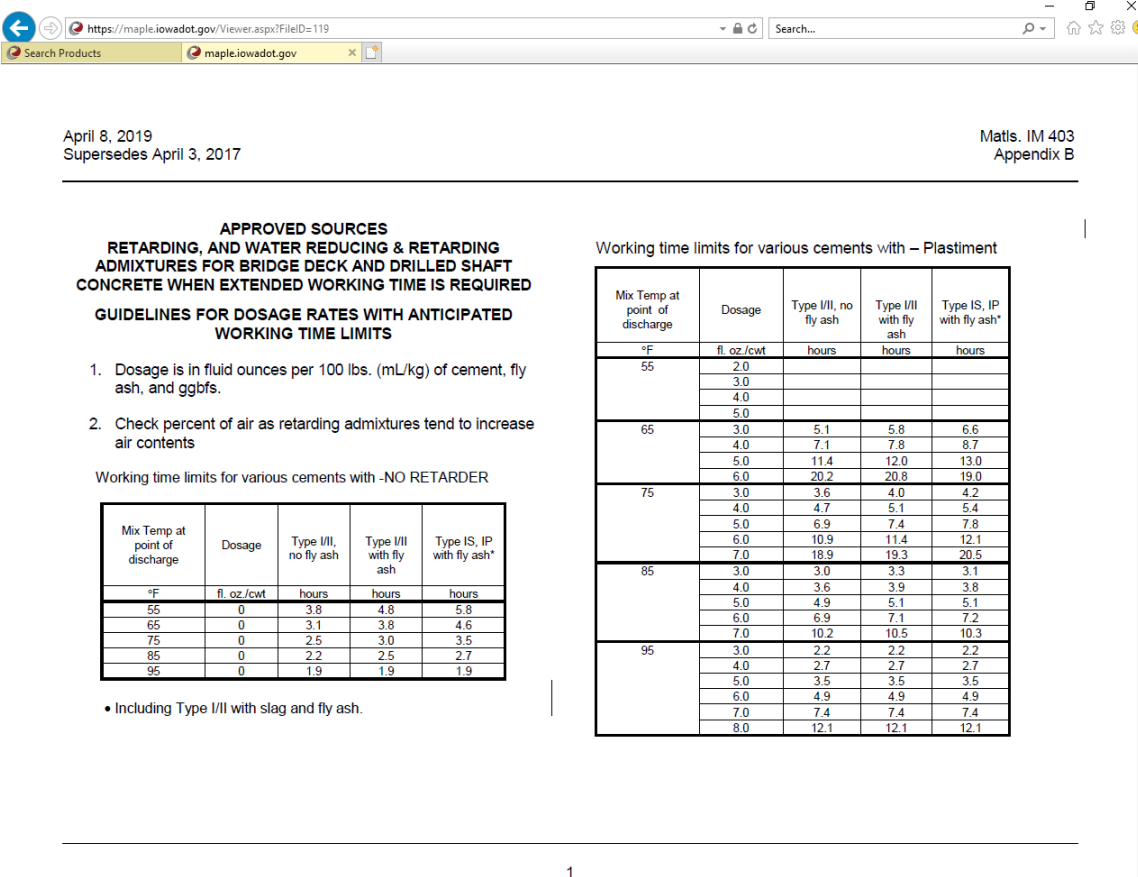
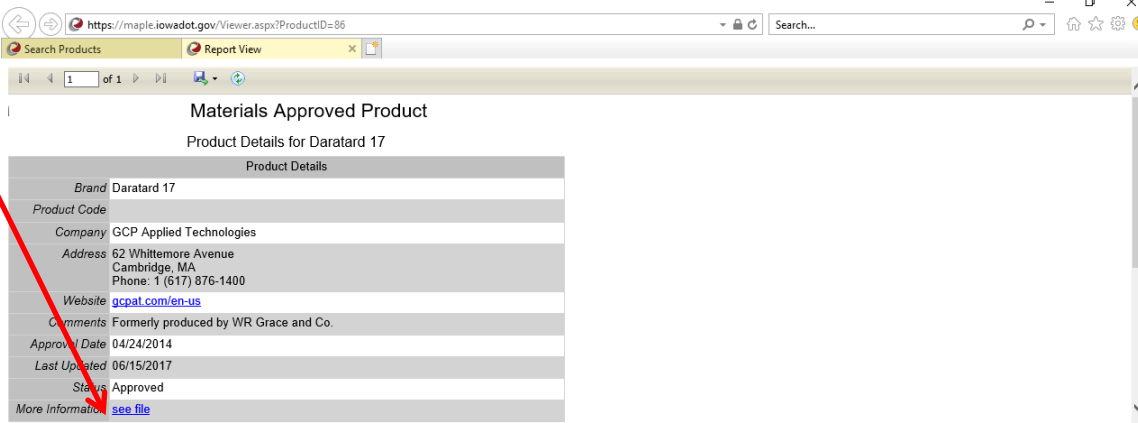
You can use the scroll bar on the right to scroll down for more information.


The screenshot shows the 'Materials Approved Product' details for 'Daratard 17'. The page title is 'Materials Approved Product' and the subtitle is 'Product Details for Daratard 17'. Below the title, there is a 'Product Details' table with the following information:

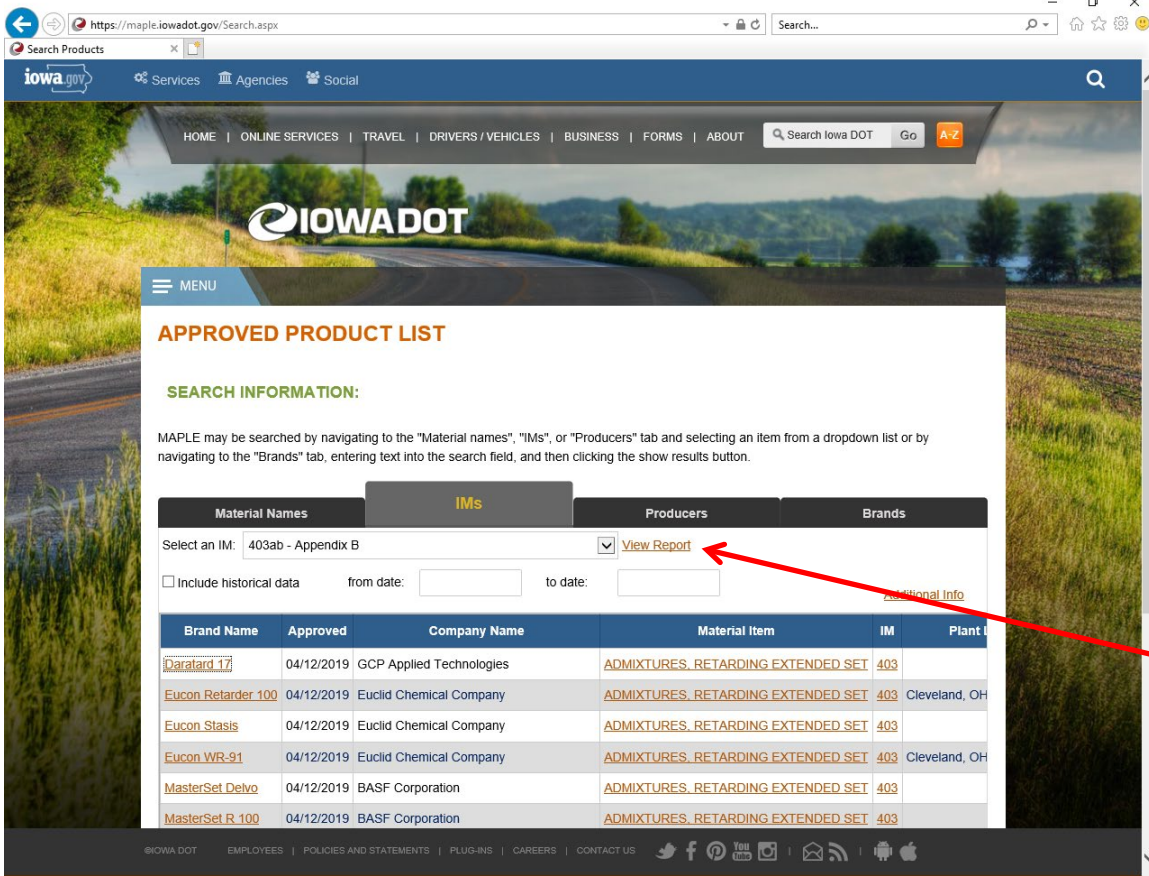
Product Details	
Brand	Daratard 17
Product Code	
Company	GCP Applied Technologies
Address	62 Whittemore Avenue Cambridge, MA Phone: 1 (617) 876-1400
Website	gcpal.com/en-us
Comments	Formerly produced by WR Grace and Co.
Approval Date	04/24/2014
Last Updated	06/15/2017
Status	Approved
More Information	see file

A red arrow points to the scroll bar on the right side of the page.

Some products may have a link in the **More Information** field. A pdf with the additional information will appear after clicking on [see file](#). Additional info may be found on the following IM's: 403ab, 445.01ab, 451ad, 455.02aa, 455aa, 462aa, and 557ab.

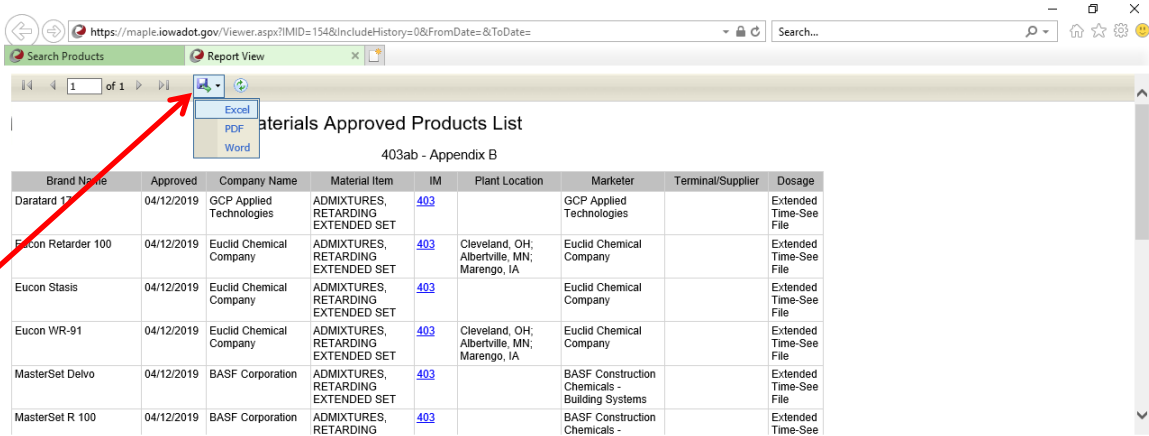


Clicking on **View Report** will enable the user to export the list  to Excel, Word, or a pdf file.



The screenshot shows the IOWADOT website's search results for '403ab - Appendix B'. The page is titled 'APPROVED PRODUCT LIST' and includes a 'SEARCH INFORMATION' section. Below this, there are tabs for 'Material Names', 'IMs', 'Producers', and 'Brands'. The 'IMs' tab is selected, and the search results are displayed in a table. A red arrow points to the 'View Report' link located to the right of the search criteria field.

Brand Name	Approved	Company Name	Material Item	IM	Plant Location
Daratard 17	04/12/2019	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403	
Eucon Retarder 100	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH
Eucon Stasis	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	
Eucon WR-91	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH
MasterSet Delvo	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	
MasterSet R 100	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	



The screenshot shows the 'Report View' page for the search results. The page title is 'Materials Approved Products List' and the search criteria is '403ab - Appendix B'. A dropdown menu is open, showing options to export the data to 'Excel', 'PDF', or 'Word'. A red arrow points to the dropdown menu.

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Daratard 17	04/12/2019	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403		GCP Applied Technologies		Extended Time-See File
Eucon Retarder 100	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH; Albertville, MN; Marengo, IA	Euclid Chemical Company		Extended Time-See File
Eucon Stasis	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403		Euclid Chemical Company		Extended Time-See File
Eucon WR-91	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH; Albertville, MN; Marengo, IA	Euclid Chemical Company		Extended Time-See File
MasterSet Delvo	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING EXTENDED SET	403		BASF Construction Chemicals - Building Systems		Extended Time-See File
MasterSet R 100	04/12/2019	BASF Corporation	ADMIXTURES, RETARDING	403		BASF Construction Chemicals -		Extended Time-See File

Chapter 5

PROPORTIONS

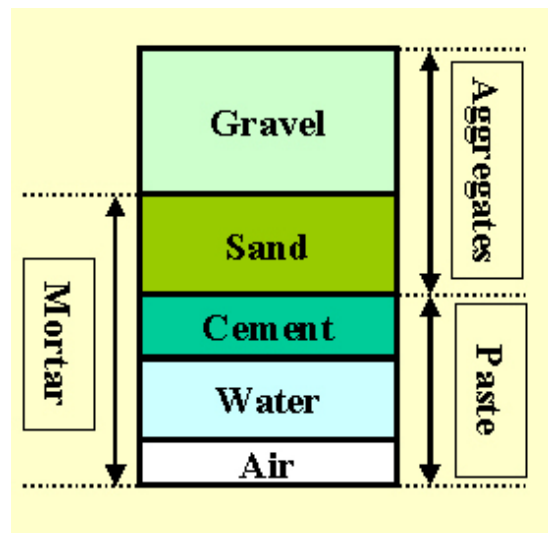
Proportions

Calculating the batch weights for Portland cement concrete is one of the duties of the certified technician. This chapter will cover calculating the batch weights in various mix types. The certified plant technician makes the batch weight calculations and the monitor will then cross check the calculations. This work is normally completed on a computer program, but it is important the Level II PCC technician knows how to perform these calculations manually. It is important that batching of the concrete does not begin until these calculations have been cross checked.

IM 529 covers proportioning of PCC. This IM includes Standard Iowa DOT mixes. This would include absolute volumes, saturated surface dry batch weights, and basic and maximum water/cement ratios.

There are a number of sources the technician will need to calculate batch weights. These sources will give the technician the specific gravities, source names, etc. Beginning October of 2014, approved sources previously printed twice per year in IM appendices will now be found in the Materials Approved Products Listing Enterprise, or MAPLE database. Maple can be accessed at <https://maple.iowadot.gov>

Instructions for using MAPLE can be found at the end of Chapter 4.



The batch weight calculations are based on the absolute volumes of the materials in the PCC mix. One cubic yard is the basic unit of volume. The illustration shows how a mix is proportioned with each material taking up a certain space or volume. All of the volume added together make one cubic yard. The aggregate is proportioned according to the mix number being used. The table showing the different aggregate proportions according to mix number is located in IM 529 and is partially shown here.

Mix No.	Percent Coarse	Percent Fine
2	60	40
3	55	45
4	50	50
5	45	55
6	40	60

Specific gravity is used to convert the volumes to equivalent weights. Specific gravity is the ratio of a material's density to the density of water. The specific gravities of all the materials are found in the various sources shown above. The specific gravity of the aggregates is also tested by the technician, but their results are used ONLY to check against the T-203 source for accuracy. **The specific gravity use for proportioning is taken from the T-203.**

Another important part of proportioning is to calculate the percent of moisture that is in the aggregate. Batch weights and water in the mix will need to be adjusted since the original proportioned weights are figured on material that is in saturated surface dry condition, without any excess moisture.

The proper ratio of water to cementitious material is critical to obtain strength requirements for PCC. The technician will calculate the water/cement ratio (w/c) to make sure they are running close to the basic w/c recommended and, more important, to make sure they don't exceed the maximum w/c allowed. The w/c is calculated by taking all the water in a cubic yard of concrete and dividing that by all the cementitious material in the same cubic yard. Always be sure to include all the water, which would include, in the materials, added at the plant, and water added in the grade. The same is true for the cementitious materials, which would include, cement, fly ash, and GGBFS.

The following pages will include instructions on proportioning, moisture corrections, and water/cement ratio.

Standard Measurements

Weight of water per cubic foot = 62.4 lbs./cu. ft.

Weight of water per gallon = 8.33 lbs/gallon

Cu. ft. per cu. yd. = 27 cu. ft.

To figure weight per unit volume

Absolute Volume x Specific Gravity x Unit Weight of water x cu. ft. per cu. yd.

To figure absolute volume

Batch Weight ÷ Specific Gravity ÷ Unit Weight of water ÷ cu. ft. per cu. yd.

Example 1 - C-3WR Mix Proportions - IM 529

<u>Absolute Volumes</u>	
Cement	0.108
Water	0.146
Air	0.060
Fine Agg.	0.309
Coarse Agg.	0.377

Assume Sp. G. of 2.65 for both coarse and fine aggregates.

Batch Weights - SSD

$$\begin{aligned}\text{Cement Weight} &= 0.108 \times 3.14 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3 \\ &= 571 \text{ lbs. per cubic yard}\end{aligned}$$

$$\begin{aligned}\text{Basic Water} &= 0.146 \times 1.00 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3 \\ &= 246 \text{ lbs. per cubic yard}\end{aligned}$$

$$\begin{aligned}\text{Fine Agg.} &= 0.309 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3 \\ &= 1380 \text{ lbs. per cubic yard}\end{aligned}$$

$$\begin{aligned}\text{Coarse Agg.} &= 0.377 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3 \\ &= 1683 \text{ lbs. per cubic yard}\end{aligned}$$

Calculate the Batch Weights for the Materials

M-3 Mix

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC3802	0.149	3.14	
Fine Aggregate	A06502	0.287	2.65	
Coarse Aggregate	A17012	0.351	2.68	
Water	City	0.153	1.00	
Air		0.060	0	

Calculate the Batch Weights for the Materials

C-4WR Mix

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC0108	0.112	2.97	
Fine Aggregate	A17514	0.338	2.65	
Coarse Aggregate	A21516	0.339	2.69	
Water	City	0.151	1.00	
Air		0.060	0	

Calculate the Batch Weights for the Materials

C-4WR Mix

You will need to look up the specific gravities.

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC3702	0.112		
Fine Aggregate	A22520	0.338		
Coarse Aggregate	A22012	0.339		
Water	City	0.151		
Air		0.060		

Calculate the Batch Weights for the Materials

C-3WR

You will need to look up the absolute volumes

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC0209		3.11	
Fine Aggregate	A24512		2.66	
Coarse Aggregate	A22012		2.66	
Water	City		1.0	
Air				

Mineral Admixture Substitution

The two mineral admixtures that are common in Iowa are Fly Ash (predominately Class C) and Ground Granulated Blast Furnace Slag (GGBFS). The mineral admixtures are replaced by weight, not volume on a pound for pound basis. Fly Ash is replaced at a maximum of 20% and GGBFS at a maximum of 35%. The total maximum replacement = FA replacement + GGBFS replacement. The total maximum mineral admixture substitution rate is 50% for structures and 50% for paving. For more information on when mineral admixtures may be substituted, refer to Article 2301.01 – Paving, Article 2403.03 – Structural, and Article 2412.02 – New Decks.

Batch weights are calculated using mineral admixtures by multiplying the weight of the cement by the percent of replacement for each mineral admixture. The mineral admixture(s) is then subtracted from the cement, which gives the corrected cement total. When replacing cement with mineral admixtures, the absolute volume of the cement will be different. Therefore, absolute volumes must be adjusted for the entire mix. Examples of replacement and readjusting the mix are shown in the following examples.

Example 2 - Fly ash substitution - C-3WR mix

20% fly ash substitution. Assume 2.59 Sp. G. for fly ash

571 lbs. per cubic yard X 0.20 = 114 lbs. fly ash

571 – 114 = 457 lbs cement

Abs. Vol. cement = $457 \text{ lbs} \div 3.14 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.086

Abs. Vol. fly ash = $114 \text{ lbs} \div 2.59 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.026

Weight Water = $0.430 \times 571 \text{ lbs.}$
= 246 lbs per cubic yard

Abs. Vol. Water = $246 \div 1.00 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.146

Abs. Vol. Air = 0.060

Abs. Vol. (subtotal) = $0.086 + 0.026 + 0.146 + 0.060$
= 0.318

(1-subtotal) = $1 - 0.318$
= 0.682

%Coarse = 0.55×0.682
= 0.375

%Fine = 0.45×0.686
= 0.307

Weight Fine Agg. = $0.307 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3$
= 1371 lbs per cubic yard

Weight Coarse Agg. = $0.375 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3$
= 1674 lbs per cubic yard

Check to make sure Absolute Volumes = 1.00

Cement	0.086
Fly Ash	0.026
Water	0.146
Air	0.060
Coarse	0.375
Fine	0.307
<hr/> Total	1.00

Example 3 - Fly ash and GGBFS substitution - C-3WR mix

20% fly ash substitution. Assume 2.59 Sp. G. for fly ash
30% GGBFS substitution. Assume 2.88 Sp. G. for GGBFS

571 lbs. per cubic yard X 0.20 = 114 lbs. fly ash
571 lbs. per cubic yard X 0.30 = 171 lbs. GGBFS

571 – 114 – 171 = 286 lbs cement
 $((114 + 171) / 571) \times 100 = 50\%$ replacement for C-3WR-C20-S30

Abs. Vol. cement = $286 \text{ lbs} \div 3.14 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.054

Abs. Vol. fly ash = $114 \text{ lbs} \div 2.59 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.026

Abs. Vol. GGBFS = $171 \text{ lbs} \div 2.88 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.035

Weight Water = $0.430 \times 571 \text{ lbs.}$
= 246 lbs per cubic yard

Abs. Vol. Water = $246 \div 1.00 \div 62.4 \text{ lbs/ft}^3 \div 27 \text{ ft}^3/\text{yd}^3$
= 0.146

Abs. Vol. Air = 0.060

Abs. Vol. (subtotal) = $0.054 + 0.026 + 0.035 + 0.146 + .060$
= 0.321

(1-subtotal) = $1 - 0.321$
= 0.679

%Coarse = 0.55×0.679
= 0.373

%Fine = 0.45×0.683
= 0.306

Weight Fine Agg. = $0.306 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3$
= 1366 lbs per cubic yard

Weight Coarse Agg. = $0.373 \times 2.65 \times 62.4 \text{ lbs/ft}^3 \times 27 \text{ ft}^3/\text{yd}^3$
= 1665 lbs per cubic yard

Check to make sure Absolute Volumes = 1.00

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

%

Fly Ash (IM 491.17): _____

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement: _____

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Aggregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes

Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (1.00 X 62.4 X 27) = _____

Air 0.060

Subtotal = _____

1.000 - Subtotal = _____

Total = 1.000

% FA Agg.: _____ Fine Aggregate (1.000 - Subtotal) X % In Mix = _____

% In. Agg.: _____ Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: _____ Coarse Aggregate (1.000 - Subtotal) X % In Mix = _____

Aggregate Total = _____

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Summary

Cement _____ (lbs/cy)

Fly Ash _____ (lbs/cy)

Slag _____ (lbs/cy)

Water _____ (lbs/cy)

Fine Agg. _____ (lbs/cy)

Interm. Agg. _____ (lbs/cy)

Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

%

Fly Ash (IM 491.17): _____

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement: _____

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes

Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (1.00 X 62.4 X 27) = _____

Air 0.060

Subtotal = _____

1.000 - Subtotal = _____

Total = 1.000

% FA Agg.: _____

Fine Aggregate (1.000 - Subtotal) X % In Mix = _____

% In. Agg.: _____

Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: _____

Coarse Aggregate (1.000 - Subtotal) X % In Mix = _____

Aggregate Total = _____

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Summary

Cement _____ (lbs/cy)

Fly Ash _____ (lbs/cy)

Slag _____ (lbs/cy)

Water _____ (lbs/cy)

Fine Agg. _____ (lbs/cy)

Interm. Agg. _____ (lbs/cy)

Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Calculate the Batch Weights for the Materials

This is a M-4-C10 mix. You can use Form 150 to calculate answers.
Remember to find the absolute volume of the cement and basic water in IM 529.

Materials	Source
Cement	PC0509
Fly Ash	FA041C
Fine Aggregate	A26502
Coarse Aggregate	A26004
Water	City
Air	

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____	(lbs/cy)
	Fly Ash _____	(lbs/cy)
	Slag _____	(lbs/cy)
	Water _____	(lbs/cy)
	Fine Agg. _____	(lbs/cy)
	Interm. Agg. _____	(lbs/cy)
	Coarse Agg. _____	(lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Calculate the Batch Weights for the Materials

This is a C-3WR-C20 mix. You can use Form 150 to calculate answers.
Remember to find the absolute volume of the cement and basic water in IM 529.

Materials	Source
Cement	PC0509
Fly Ash	FA009C
Fine Aggregate	A26502
Coarse Aggregate	A26004
Water	City
Air	

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Calculate the Batch Weights for the Materials

This is a C-3WR-C20S20 mix. You can use Form 150 to calculate answers. Remember to find the absolute volume of the cement and basic water in IM 529.

Materials	Source
Cement	PC0009
Fly Ash	FA009C
GGBFS	SL00A
Fine Aggregate	A19522
Coarse Aggregate	A22040
Water	City
Air	

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Chapter 6

MOISTURES

Moisture Corrections

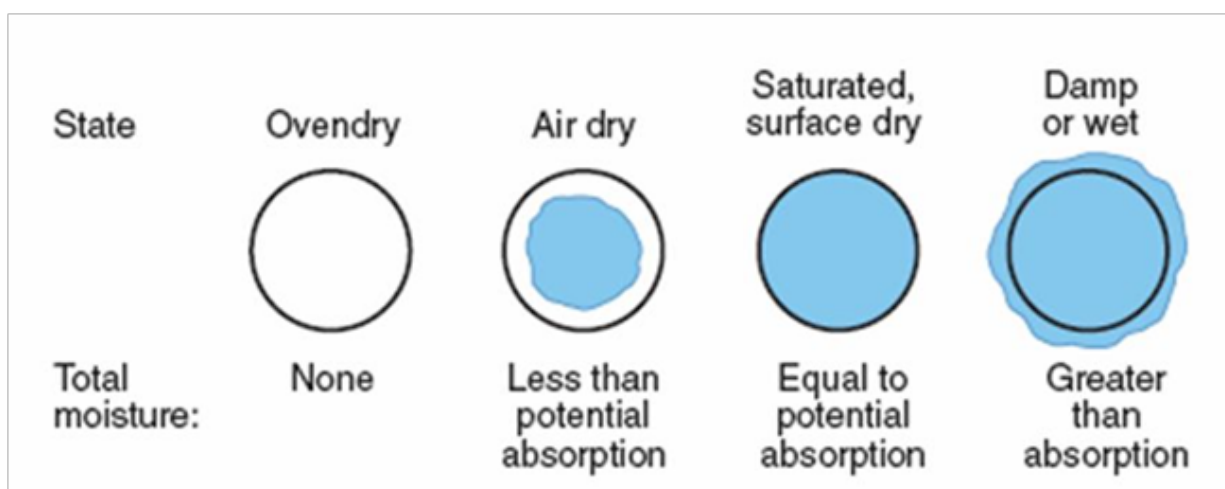
Aggregates can be in four different states. They are the following:

Oven dry – There is no moisture inside or outside of the aggregate

Air dry - The aggregate has moisture on the inside, but is not completely saturated. The aggregate could still absorb moisture.

Saturated Surface Dry – The aggregate contains all the moisture it can hold, but there is no excess moisture on the surface.

Damp or wet – The aggregate contains all the moisture it can hold and there is excess moisture on the surface.



Batch weights for concrete mixes are calculated using saturated surface dry (SSD) condition for the aggregates. Aggregates coming from the stockpiles are rarely in the SSD condition, so they are tested using the Moisture test taught in Aggregate Technician (IM 308). This will give the percentage of moisture for the aggregate. Aggregates can also be in the air dry state, which would allow them to absorb water, but this is not common. If the technician does have an aggregate with a negative moisture (absorption), they must adjust the mix for the absorption. The maximum permissible absorption is 0.5%. Since an absorption is rare, there will not be a lot of class time spent on this procedure. If the technician does run into an absorption in the field and needs assistance, they should contact their DOT PCC technician. Normally, aggregate will be in a damp/ wet condition and adjusting batches for that condition will be discussed. As was stated previously original batch weights are calculated with aggregates in SSD. Once the aggregate has been tested for moisture and the correct moisture content is calculated, the aggregate batch weights need to be adjusted. After adjusting the batch weights, the moisture in the aggregate will be used in determining the basic water and the maximum water. Moisture content in excess of 0.5% between successive batches must be prevented.

Example 1 - SSD Batch Weights

Coarse Agg. = 1665 lbs.

Fine Agg. = 1366 lbs.

Basic Water = 246 lbs

Assume: Coarse Aggregate Moisture = 0.3%

Fine Aggregate Moisture = 3.1%

Equation: Wet batch wt. = $\frac{\text{Batch wt., SSD}}{(100 - \% \text{ moisture})} \times 100$

Wet Batch wt., coarse = $\frac{1665 \text{ lbs.}}{(100 - 0.3)} \times 100 = 1670 \text{ lbs.}$

Wet Batch wt., fine = $\frac{1366 \text{ lbs.}}{(100 - 3.1)} \times 100 = 1410 \text{ lbs.}$

Adjusted Water

= Wet Batch Weight - Dry Batch Weight

Coarse - 1670 lbs. - 1665 lbs. = 5 lbs. water in aggregates

Fine - 1410 lbs. - 1366 lbs. = 44 lbs. water in aggregates

Basic Water	246
- Coarse Water	5
- Fine Water	<u>44</u>
	197 lbs.

Example 2 - SSD Batch Weights

Coarse Agg. = 1665 lbs.

Fine Agg. = 1366 lbs.

Basic Water = 246 lbs

Assume: Coarse Aggregate Moisture = 0.5%

Fine Aggregate Moisture = 3.1%

Equation: Wet batch wt. = $\frac{\text{Batch wt., SSD}}{(100 - \% \text{ moisture})} \times 100$

$$\text{Wet Batch wt., coarse} = \frac{1665 \text{ lbs.}}{(100 - 0.5)} \times 100 = 1673 \text{ lbs.}$$

$$\text{Wet Batch wt., fine} = \frac{1366 \text{ lbs.}}{(100 - 3.1)} \times 100 = 1410 \text{ lbs.}$$

Adjusted Water for Aggregate Moistures

= Wet Batch Weight - Dry Batch Weight

Coarse - 1673 lbs. - 1665 lbs. = 8 lbs. water in aggregates

Fine - 1410 lbs. - 1366 lbs. = 44 lbs. water in aggregates

Basic Water	246
- Coarse Water	8
- Fine Water	<u>44</u>
	194 lbs.

Maximum Allowed Water = $0.450 \times 571 \text{ lbs./yd}^3 = 256 \text{ lbs./yd}^3$

This equals the total water allowed including moisture in aggregates

Aggregate Moisture Corrections/Adjusted (Wet) Batch Weights

Calculate the adjusted (wet) batch weights for the following aggregate weights with the moistures given:

Fine Aggregate – 1418 pounds
Coarse Aggregate – 1560 pounds

Moistures –

1.	Fine	3.5	Fine Adjusted Batch Weight	_____
	Coarse	0.7	Coarse Adjusted Batch Weight	_____

<i>Answer</i>	<i>Fine</i>	<i>3.5</i>	<i>Fine Adjusted Batch Weight</i>	<i>__1469__</i>
	<i>Coarse</i>	<i>0.7</i>	<i>Coarse Adjusted Batch Weight</i>	<i>__1571__</i>

2.	Fine	2.9	Fine Adjusted Batch Weight	_____
	Coarse	0.6	Coarse Adjusted Batch Weight	_____

3.	Fine	2.1	Fine Adjusted Batch Weight	_____
	Coarse	0.3	Coarse Adjusted Batch Weight	_____

4.	Fine	3.9	Fine Adjusted Batch Weight	_____
	Coarse	0.9	Coarse Adjusted Batch Weight	_____

Aggregate Moisture Corrections/Adjustments

Calculate the free water for each cubic yard of concrete from the previous page:

1. Total Adjusted Batch Weights _____
Total Dry Batch Weights _____
Total Water in Aggregate _____

<i>Answer</i>	<i>Total Adjusted Batch Weights</i>	_____ 3040 _____
	<i>Total Dry Batch Weights</i>	_____ 2978 _____
	<i>Total Water in Aggregate</i>	_____ 62 _____

2. Total Adjusted Batch Weights _____
Total Dry Batch Weights _____
Total Water in Aggregate _____

3. Total Adjusted Batch Weights _____
Total Dry Batch Weights _____
Total Water in Aggregate _____

4. Total Adjusted Batch Weights _____
Total Dry Batch Weights _____
Total Water in Aggregate _____

Maximum Water Adjustments

What is the maximum water allowed that can be added at the grade for each mix after the water in the aggregate and the water added at the plant have been determined: (convert to gallons)

- 1. C-4WR-C20
205 lbs. water added at the plant
36 lbs. water in the aggregate
594 lbs. of cementitious material
Maximum water that can be added at the grade _____

*Answer C-4WR-C20
205 lbs. water added at the plant
36 lbs. water in the aggregate
594 lbs. of cementitious material
Maximum water that can be added at the grade __26 lbs.__*

- 2. M-4
220 lbs. water added at the plant
47 lbs. water in the aggregate
825 lbs. cementitious material
Maximum water that can be added at the grade _____

- 3. C-3WR
190 lbs. water added at the plant
43 lbs. water in the aggregate
565 lbs. cementitious material
Maximum water that can be added at the grade _____

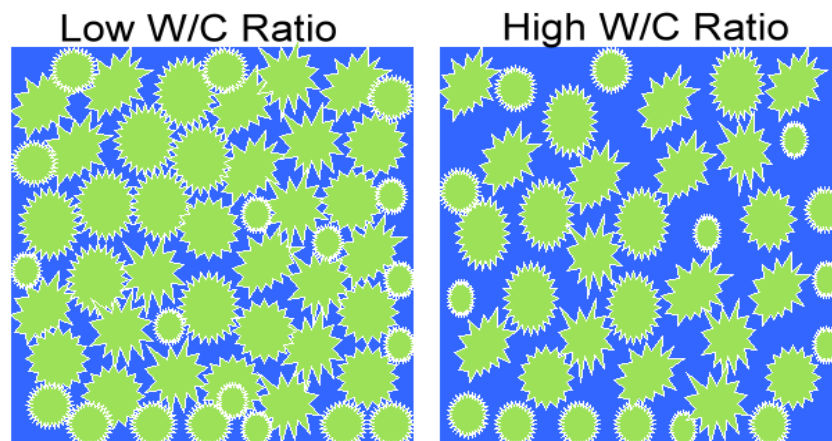
- 4. M-3-C20
225 lbs. water added at the plant
55 lbs. water in the aggregate
788 lbs. cementitious material
Maximum water that can be added at the grade _____

Water/Cement Ratio (W/C)

Water/cement ratio is the ratio of the amount of cementitious materials in concrete compared to the amount of water in the same cubic yard or batch.

- Effect of w/c on Strength and Permeability
- W/C ratio affects both strength and permeability
- A higher W/C ratio results in a lower strength and higher permeability
- As w/c ratio increases, the cement grains are pushed further apart and the needle like growths have less interconnections
- Permeability is directly related to durability since it controls the rate of moisture and contaminant intrusion
- Strength continues to develop as long as there is a supply of moisture (wet curing)
- Rule of Thumb: Adding 1 gallon of water per cubic yard increases slump ~1" and increases w/c ratio by ~0.015 (lowers strength ~250 psi and increases permeability)

When determining W/C, it is important that all cementitious materials and all water be included in the calculation. The cementitious materials include cement, fly ash (Type C) and GGBFS. The water includes water added at the plant, water in the materials, and water added at the grade. The total water is divided by the total cement to get the water/cement ratio. Remember, the Basic W/C and the Maximum W/C for all mixes are shown in IM 529. Maximum water/cement ratio should never be exceeded.



Water/Cement Ratio (W/C)

Example 1:

Water at the plant – 186 lbs.
 Water in the material – 47 lbs.
 Water added at the grade – none

Cement – 529 lbs.
 Fly Ash – 95 lbs.

Example 1			
Cementitious Material		Water	
Cement	529	Plant	186
Fly Ash	<u>95</u>	Material	<u>47</u>
	624		233
$233/624 = .373$			

Example 2:

Water at the plant – 127 lbs.
 Water in the material – 36 lbs.
 Water added at the grade – 5 gal.
 $5 \times 8.33 = 42$ lbs.
 (all units must be the same so
 the gallons need to be converted
 to pounds)

Cement – 465 lbs.
 Fly Ash – 92 lbs.
 GGBFS – 62 lbs.

Example 2			
Cementitious Material		Water	
Cement	465	Plant	127
Fly Ash	92	Material	36
GGBFS	<u>62</u>	Grade	<u>42</u>
	619		205
$205/619 = .331$			

Water/Cement Ratio (W/C)

Calculate the water/cement ratio for each of the following cubic yard batches using the batch weights given:

1. Cement 624 lbs. w/c _____
Total Water 274 lbs.

2. Cement 564 lbs. w/c _____
Fly Ash 76 lbs.
Total Water 265 lbs.

3. Cement 624 lbs. w/c _____
Water at plant 167 lbs
Water in Materials. 31 lbs.
Water added grade 54 lbs.

4. Cement 385 lbs. w/c _____
Fly Ash 72 lbs.
GGBFS 68 lbs.
Water at plant 135 lbs.
Water in materials 44 lbs.
Water added grade 60 lbs.

Chapter 7
SAMPLING & TESTING

Sampling and Testing

There are aggregate tests that need to be completed as part of the PCC production process for Quality Control, Verification, and Independent Assurance. Tests may be completed by a Level II PCC technician or an Aggregate Technician. These test methods were covered in Aggregate Technician certification class and the IM's covering the test methods may be reviewed for more detailed information.

Test Methods

IM 301 Aggregate Sampling & Sample Size

- Ensure proper samples are obtained
- Poorly obtained samples cause inaccurate test results

IM 336 Reducing Aggregate Field Samples

- Split samples
- Ensure representative samples tested

IM 302 Sieve Analysis & IM 306 Minus #200

- To determine compliance with gradation specifications with IM 209
- Gradation can affect workability, water demand, etc.
- Coarse aggregate may be tested as one sample

IM 307 Specific Gravity of Aggregates

- Ratio of materials density to water
- Used to convert volumes to equivalent weights (masses)
 - Cement 3.14 (Type I/II)
 - Water 1.00
 - Air 0
 - Aggregates IM T-203 – determine
 - Sample splitter
 - Immerse (+ #4 sieve) in water for period of not less than 15 hours

IM 308 Free Moisture and Absorption of Aggregates

- Same as IM 307 except test sample is wet as received
- Needed to determine moisture content of aggregates
- Adjust batch weights and ensure accurate w/c ratio

QUALITY CONTROL (QC)

Quality control is those actions necessary to assess production and construction processes so as to control the level of quality being produced in the end product. This concept of quality control includes sampling and testing to monitor the process. Quality control testing is performed by the Contractor when certified plant inspection is required. The Contractor's test results for aggregate moistures and gradations are considered quality control. Quality control tests are used to ensure proper material being delivered from the source and to identify problems with handling and stockpiling. Quality control testing reduces the potential for rejected materials.

VERIFICATION (V)

Verification is the sampling, testing, and the assessment of test results to determine whether or not the quality of produced material or construction process is acceptable in terms of the specifications. Verification sampling and testing is performed by the agency.

INDEPENDENT ASSURANCE (IA)

Independent assurance is the verification by a third party not directly responsible for quality control or acceptance testing. Independent assurance testing is performed by Materials. Independent assurance insures that sampling variability (the variation in sampling technique), testing variability (the lack of repeatability of test results by operators, equipment condition, calibration, and test procedure) and the differences in these variabilities between laboratories and over time do not improperly influence testing measurements. For example, the same sample tested by different laboratories should give roughly the same result.

LOT

A lot is a defined quantity of material from a single source assumed to be produced and/or placed essentially by the same controlled process.

TEST FREQUENCY

A. Paving Plants (IM 527)

- For continuous construction operation, a verification lot is defined as a week of paving. Lots less than three days of paving will be grouped with the previous or subsequent lot. A verification lot may include a minimum of three days up to eight days. Verification sampling and testing will be performed the first day of paving. Thereafter, verification sampling will be performed daily and tested once per lot. If production on a given day is less than 500 cubic yards, verification sampling may be grouped with the previous or subsequent full day of paving.
- Quality control sampling and testing shall be performed daily.
- Intermittent and low construction operation shall be grouped to establish a lot not to exceed one week. A minimum of one verification sample will be obtained and tested during the week. When intermittent production is longer than one week, sample once per week and test 20% of the samples obtained.

Quality Control Chart

Production	Specific Gravity	Moisture	Gradation	Report
Continuous	1/day first three days, 1 per 3 days thereafter	1/day >500 yd ³ 2/day >1000 yd ³	1/day > 500 yd ³	1/day
Intermittent	1/week	1/day >500 yd ³ 2/day >1000 yd ³	1/day > 500 yd ³	1/week
Low	1/week	1/week	1/week	1/week

B. Ready Mix Plants (IM 528)

- For structural concrete, a quality control lot shall consist of one week. If 50 cubic yards (40 m³) or less are produced in one calendar week, testing may be grouped with previous or subsequent lot, or 1 per two weeks. A bridge deck is considered a lot.
- For non-structural concrete items as described below, a quality control lot shall be one per month. Testing and sampling for non-structural concrete is based on that being the only concrete being produced. If structural or paving concrete is being produced, no additional gradation sampling and testing is required for non-structural concrete produced from the same plant, since the sampling and testing frequency for structural and paving concrete is greater. If multiple projects are being supplied by the plant, one representative sample for the lot covers quality control sampling and testing for all of the projects.

- Miscellaneous concrete and any concrete bid item supplied at 10 cubic yards (7.6 m³) or less for a project will be accepted without gradation testing. A gradation test for flowable mortar, revetment grout, or fabric formed revetment grout is required for the mix design only. The PCC Level II certified technician shall provide, for these bid items, materials certifications, batch tickets, and plant reports.

Quality Control Sampling, Testing, and Reporting Chart

PRODUCTION	Specific Gravity	Moisture	Gradation	Report
Structural	1 the first week, monthly thereafter or 1 every two weeks thereafter for DWU sources	2/week or 1/deck	1/deck, or 1/week. If <50 yd ³ produced in week 1/two weeks	1/lot or 1/deck
Non-Structural	1/month	1/two weeks	1/month	1/month
Miscellaneous	N/A	N/A	N/A	1/project

Specific Gravity

- It is a good idea to try to test each aggregate before the work begins.
- This gives the pycnometer weight for the moisture test
- If sample varies more that 0.02 from the T-203 Sp.Gr. or varies more that 0.02 from 1 days test to the next, contact the District Materials Lab and begin testing another sample.



Moisture

- A. Moisture shall not vary between batches by more than 0.5%
- B. Spec. 2301.02 C.1.e
 - 1. Coarse aggregate with an absorption of 0.5% or more shall be wetted and allowed to drain at least one hour before batching.
 - 2. It is recommended to soak a pile if it shows absorption.
- C. When water can be observed dripping from bins between batches, the material must not be used.
 - 1. Allow the stockpile to drain
- D. Use common sense on moisture samples. If it rains or snows, sample more often.

Gradations

- A. When certified plant inspection is required, the Contractor's test results for aggregate gradation shall be quality control. Quality control tests are used to ensure proper material being delivered from the source and to identify stockpile changes. A lot is accepted when a verification test by the agency is determined to be in compliance. The minimum frequency for quality control and verification testing shall be in accordance with IM 204.
- B. CPI -Sample and test once per day (paving) or once per week (structural).
 - 1. If a sample result is near or exceeds the specification limits, the CPI should inform the contractor and the agency so they can increase monitor frequency.
 - 2. The District Materials Engineer may investigate sampling and testing procedures.
 - 3. The producer needs to be notified if gradations continue to fail.



- C. Agency -Sample and test first day, thereafter, sample once per day and test once per week for paving, sample and test once per lot for structures.
1. In accordance with IM 205, Agency will randomly select sample location and time, witness sampling, and take immediate possession of samples.
 2. Contractor may provide assistance in obtaining samples.
 3. The agency will split the verification sample with the contractor. This allows both parties to check testing differences; however, IM 216 correlation is not required. This is a good practice.
 4. A lot is accepted when a verification test by the agency is determined to be in compliance.
 5. Retain samples until lot is accepted.



TABLE 4109.02-1: AGGREGATE GRADATION TABLE

Grad. No.	Section No.	Std. Sieve Sz. Intended Use	Percent Passing											Notes		
			1 1/2"	1.00"	3/4"	1/2"	3/8"	4	8	30	50	100	200			
1	4110 , 4125 , 4133 , 4134	PCC FA, Cover Agg.						100	90-100	70-100	10-60				0-1.5	1
2	4112	PCC Intermediate				95-100				0-10						
3	4115 (57, 2-8), 4118	PCC CA & Pipe Bedding	100	95-100		25-60			0-10	0-5					0-1.5	2, 10
4	4115 (2-8)	PCC CA	100	50-100	30-100	20-75		5-55	0-10	0-5					0-1.5	10
5	4115 (67, 2-8)	PCC CA		100	90-100			20-55	0-10	0-5					0-1.5	10
6	4115.05 (Repair & Overlay)	PCC CA			100	90-100		40-90	0-30						0-1.5	10
7	4116 (Class V)	PCC FA & CA	100						80-92	60-75	20-40					
8	4116.03 (Class V)	Fine Limestone						100	90-100						0-30	
9	2556	Grout Aggregate				100		85-100		0-10					0-1.5	
10	4119 , 4120.02 , 4120.03 (C gravel)	Granular Surface			100				50-80	25-60						3, 11
11	4119 , 4120.02 , 4120.04 , 4120.05 , 4120.07 , (A, B Cr. St.)	Granular Surface & Shoulder	100	100	95-100	70-90			30-55	15-40					6-16	4, 5, 11
12a	4121 (Cr. St.)	Granular Subbase	100			40-80				5-25					0-6	6, 11
12b	4121 (Cr. Gravel)	Granular Subbase	100			50-80				10-30			5-15		3-7	7, 11
13a	4122.02 (Cr. St.)	Macadam St. Base	3" nominal maximum size screened over 3/4" or 1.00" screen.													
13b	4122.02	Macadam Choke St.		100											6-16	11
14	4123	Modified Subbase	100		70-90					10-40					3-10	5, 7, 11
18	4117 (No. 4 Cr. Gr., Cr. St., or Nat. Sand)	Leveling Aggregate						100	95-100	50-80	0-15				0-4	11
19	4117 , 4125 (1/2" Cr. Gr. or Cr. St.)	Cover Aggregate			100	97-100		40-90	0-30	0-15					0-1.5	11
20	4125 (1/2" Scr. Gr.)	Cover Aggregate			100	95-100		40-80	0-15	0-7					0-1.5	11
21	4117 , 4125 (3/8" Cr. Gr. or Cr. St.)	Cover Aggregate				100		90-100	10-55	0-20	0-7				0-1.5	11
22	4124	Fine Slurry Mixture						100	85-100	40-95	20-60	14-35	10-25		5-25	9, 11
23	4124 (Cr. St.)	Coarse Slurry Mixture						100	70-90	40-70	19-42				5-15	11
29	4131	Porous Backfill			100	95-100		50-100	0-50	0-8						11
30	4132.02 (Cr. St.)	Special Backfill	100							10-40					0-10	5, 11, 14
31	4132.03 (Gravel)	Special Backfill		100	90-100	75-100				30-55					3-7	11
32	4133 (Sand/Gr./Cr. St.)	Granular Backfill	100% passing the 3" screen											0-10	8, 11	
35	4134 (Natural Sand/Gr.)	Floodable Backfill	100							20-90					0-4	11
36	4134 (Natural Sand)	Floodable Backfill							100						0-2	11
37	2320 (Quartzite/Granite/Slag)	Polymer-Modified Microsurfacing						100	90-100	65-90	30-50	18-30	10-21		5-15	12, 13
38	2320 (limestone/Dolomite)	Polymer-Modified Microsurfacing						100	70-90	45-70	15-35	10-25	5-20		5-15	12, 13

Notes: (Gradations No. 15, 16, 17, 24, 25, 26, 27, 28, 33, and 34 have been deleted)

1. For [Section 4110](#), when the fine aggregate is sieved through the following numbered sieves - 4, 8, 16, 30, 50, and 100 - no more than 40% shall pass one sieve and be retained on the sieve with the next higher number.
2. When used in precast and prestressed concrete bridge beams, 100% shall pass the 1.00" sieve. When used for pipe bedding ([4118](#)) the No. 200 restriction does not apply.
3. When compaction of material is a specification requirement, the minimum percent passing the No. 200 sieve is 6%.
4. See specifications for combination of gravel and limestone.
5. Unwashed air dried samples of crushed composite material shall be tested for gradation compliance except that no gradation determination will be made for material passing the No. 200 sieve.
6. The gradation requirement for the No. 8 sieve shall be 5% to 20% when recycled material is supplied.
7. For [Section 4121](#) gravel, one fractured face on 30% or more of the particles retained on the 3/8 inch sieve. For [Section 4123](#) gravel, one fractured face on 75% or more of the particles retained on the 3/8 inch sieve.
8. Crushed stone shall have 100% passing the 1½" sieve.
9. Gradation limitations for the 30, 50, and 100 sieves shall not apply when slurry mixture is applied by hand lutes, such as for slurry leveling.
10. Maximum of 2.5% passing the No. 200 sieve allowed if for crushed limestone or dolomite when documented production is 1% or less.
11. When Producer gradation test results are used for acceptance, test results representing at least 90% of the material being produced shall be within the gradation limits and the average of all gradation results shall be within the gradations limits. Stockpiled material not meeting the criteria may, at the District Materials Engineer's discretion, be resampled using [Materials I.M. 301](#) procedures. One hundred percent of the stockpile quality control and verification test results shall be within the gradation limits.
12. For Quartzite/Granite/Slag: 45% to 70% passing No. 16 Sieve; for Dolomite/Limestone: 25% to 50% passing No. 16 Sieve.
13. Percent passing shall not go from the high end to the low end of the range for any two consecutive screens.
14. If the material meets the quality requirements of [Article 4120.04](#), a maximum of 14% passing the No. 200 sieve will be allowed.

Chapter 8
CERTIFIED PLANT INSPECTION

VII. Certified Plant Inspection

IM 527 and Article 2521

A. General

- Certified Plant Inspection will be required for:
 - Primary projects
 - Interstate projects
 - State Park projects
 - Institutional projects
- The Contractor will furnish the Certified Plant Technician for the work specified.
- The Plant Technician will be responsible for:
 - Inspection of plant operation
 - Aggregate gradations
 - Identification of materials
 - Testing strength specimens
 - Maintenance of proper reports
 - Other duties as specified in IM 213
 - If test results indicate noncompliance, the Contractor is responsible for deciding corrective action, not the technician



B. Safety

Safety should be uppermost in the minds of those working in concrete plants. The technician should:

- Make certain all contractual safety requirements are met
- Encourage the elimination of hazards
- Become familiar with hazards
- Wear protective headgear when working around bins and other plant equipment
- Make sure that belt sampling locations are equipped with an On-Off switch



C. Equipment

- Bins (Article 2001.06 and IM 527)

- The contractor shall maintain any stress carrying parts of the bin frame
- Bins must be fully loaded for at least 12 hours before concrete proportioning and the amount of settling determined by the contractor



- If the settlement differential of footings exceeds 1/10 foot (30mm), the District Materials Engineer must be notified
- All other plant machinery shall meet current OSHA standards

- Proportioning Equipment (Article 2001.20 and IM 527)

- General

- Proportioning scales and meters shall be test loaded to the maximum load expected during production
- The DME or a designated staff will witness calibrations before concrete work begins
- Equipment must be examined at least at 3-hour intervals for correctness of the amount being batched and for damage to the equipment
- Scale sensitivity shall be checked at least twice a day during a normal working day
- Cement and Fly Ash Scales



- Scales must be accurate to within $\pm 0.5\%$ of the load and must operate (delivery tolerance) within $\pm 1\%$ of the required batch amount
- Cement shipment yield determinations must be made every 10,000 cubic yards (10,000 cubic meters) after the original determination made near the end of the first full day of production



- Aggregate Scales
 - Must operate within a delivery tolerance of $\pm 1\%$ of the required batch amount
- Water Measuring Device
 - Water delivered to the batch must be accurate to 2.2 pounds or $\pm 1\%$ of the amount shown by the indicator; whichever is greater
- Admixture Dispensing Equipment
 - Equipment for dispensing liquid admixtures must be accurate to $\pm 3\%$ of the quantity required
 - Operation of the dispenser must be observed for uniform delivery at least once during each 3 hours of normal operation
 - The dispensing equipment must be flushed with water at least once a day

- Mixing Equipment (Article 2001.21 and IM 527)

- Stationary Mixers
 - Mixing time shall be a minimum of 60 seconds and a maximum of 5 minutes



- Charge time plus discharge time plus minimum mixing time of 60 seconds is the minimum batch cycle time
- Mixing time must be determined and recorded at least once per day
- Truck Mixers
 - Batches must be mixed from 70-90 revolutions at mixing speed
 - Mixing time must be determined and recorded at least once daily
 - Transit mixers must carry a current certification stating that the mixer has been examined in the last 30 days

- Continuous Mixers

- Calibration performed by Contactor, witnessed by District Materials
- Once calibrated in a District, it is not required that it be recalibrated for subsequent projects within that District



- Transportation Vehicles (Article 2301.02 and IM 527)

- Stationary Mixing

- Concrete must be placed from non-agitating units within 30 minutes after discharge from mixer. If a retarding admixture is used, this time may be extended an additional 30 minutes
- Concrete must be placed from agitating units within 90 minutes after the water and cement have made contact with each other



- Truck Mixing
 - On truck-mounted transits with agitation, concrete must be placed within 90 minutes after the water and cement have made contact with each other. If no agitation is used, the time limit is 30 minutes

D. Material

- Identification
 - Aggregates
 - The plant technician shall verify that all material incorporated in the project is properly certified.
 - Certified aggregate may be incorporated on the basis of the certified truck ticket.
 - Cementitious Material (cement, fly ash, GGBFS)
 - May be incorporated into the project on the basis of the manufacturer's certification.
 - Water
 - Municipal supply systems and potable sources may be used without testing; other sources (lakes, streams, etc.) must be approved by the Central Laboratory.
 - Admixtures (Air-Entraining, Retarding and Water-Reducing Admixtures)
 - May be incorporated with no further testing if listed in MAPLE. Dosage rates are also included in MAPLE. Any admixtures suspected of being frozen and materials older than 18 months shall not be used before being tested and approved.
 - Air entraining admixtures shall be stirred, agitated, or circulated at least weekly to ensure a uniform and homogenous mixture of solids and solution.
 - Retarding, water-reducing, and high range water-reducing admixtures shall be stirred, circulated, or agitated thoroughly once a day prior to operation of the proportioning plant to maintain the solids in suspension. Each 100 gallons of solution shall be circulated a minimum of 5 minutes per day.

- Storage and Handling of Materials

- Storage and handling of all aggregates must comply with Article 2301.02. The D.M.E. authorizes and is responsible for proper changes.
- Fine aggregate must be drained at least 24 hours before being used.
- For both coarse and fine aggregate, moisture content of successive batches must not vary more than 0.5%.
- Be alert for contamination of aggregate stockpiles.
- Cementitious materials must be stored in weatherproof enclosures. If lumps develop in cement or fly ash, it must not be used until it has been reprocessed, retested and approved. Cementitious materials, which have been in storage at the project site for more than 60 days or in the producer silo for more than one year, must also be retested and approved.



VI. Concrete Plant Inspection Checklist

I.M. 527

1. The proportioning equipment must be examined at least at 3-hour intervals for correctness of the amount being delivered and for damage.
2. The scale sensitivity shall be checked at least twice during a normal working day by placing a mass equal to 1/10 percent of the batch on the fully loaded scales and observing the movement of the indicator.
3. Check scale operation to determine cement delivery tolerance conformance at least once during each day of normal operation.
4. The Standard Specification requires that the cement shipment yield determination must be made at intervals of approximately 10,000 cubic yards (10,000 cubic meters) after the original determination made near the end of the first full day of production.
5. Check scale operation to determine aggregate delivery tolerance conformance at least once during a normal working day and document.
6. If water is measured with a scale, the delivery tolerance must be determined at least once for each day of normal operation and document.
7. Admixture dispensers shall be observed for uniform delivery at least once during each 3 hours of normal operation and document.
8. Admixture dispensers must be flushed with water at least once daily.
9. Determine and record the mixing speed and the mixing time at least once daily by using the sweep hand of a watch and counting the drum revolutions in one minute.
10. Determine and record the time between batching and placement at least once during each day of normal operation.
11. Specific Gravity - One sample per day for both coarse and fine aggregates for the first three days of normal operation and one for each three days of normal operation for both coarse and fine thereafter, assuming the first three days results are consistent.
12. Moisture - A minimum of one test per each half day of operation.

13. Gradation (QC) - Obtain and test one sample per day. See Construction Department Instruction No. 3.22. Show sample number, name of sampler, and name of tester on lab work sheet.
14. If maturity not being used, one beam for each 2000 cu. yd. (1529 cubic meters) of concrete placed. Make flexural tests representing alternating 2000 cu. yd. (1529 cubic meters) placement units at 7 and 14 days.
15. At the plant, the plant inspector shall remove the specimens, clean the molds, oil and return the molds to the grade at the direction of the paving inspector. The plant inspector shall store the specimens until date of test. The storage space shall be a pit adequate for the project, and for normal projects it should be at least 4 ft. x 6 ft. x 18 in. (1.2 m x 1.8m x .46 m). The specimens shall be wet at all times. If the temperature in the sand filled pit drops below 40°F (4.4°C), remove the specimens and place them under wetted burlap in a heated enclosure or in lime saturated water. See I.M. 328. **Note:** Lime saturated water is prepared by mixing 1 ounce (30 ml) of hydrated lime with 1 gallon (4 L) of water.
16. When opening is determined by the maturity method, casting beams every 2000 cubic yards (1529 cubic meters) is not required. The plant inspector should ensure curve development is performed according to I.M. 383.
17. Other duties include:
 - Close observation of stockpiling and handling of aggregates. There must be no intermingling of aggregates and no contamination.
 - Frequent check on wet batch or dry batch truck cleanliness and degree of discharge.
 - Document all the above data in diary.
 - Make the following report daily: Plant Reports - Form #800240
 - Make the following report as prescribed: Cement Yield Report – Form #820912E
 - At the end of the project, make a copy of the plant book for the Engineer, within 10 days.
 - When required by Article 2301.07, make a copy of vibration-monitoring device records in electronic format.

Structural Plant Inspection

I.M. 528

- Equipment

- Elevated, Low-Profile, and Ground Level Bins

- Tendency for aggregates to be intermingled.
 - Intermingled or contaminated materials must not be incorporated.



- Proportioning Equipment

- District Materials Engineer approves annually.
 - Calibration Report will be posted.
 - Vibration and material accumulation cause adjustments to drift
 - Small amounts not objectionable.
 - Scales not properly sensitized require immediate action
 - Plant superintendent or authorized operator representative must make scale and equipment adjustments. Plant inspector not to participate in this activity.
 - Plant inspector independently determines if settings or if adjustments are correct and amounts of material in batch are correct.



- If material accumulation exceeds one percent of the material batch, it must be removed and readjusted to indicate a zero load within 0.5%.
 - Scale sensitivity checked at beginning of placement if intermittent or daily if continuous. 1/10 percent of batch on fully loaded scales shall exhibit visible indicator movement.
 - Strict adherence to plant inspector determine independently to maintain division of authority and to minimize erroneous operations.
 - Suitable wind protection of scales
 - Air entraining required for all structural concrete, except Class X
 - Retarding admixture may be required. Water reducer may be used at contractor's option.
 - Intermingling of admixtures together may neutralize each other. Introduce separately.
- Mixing Equipment
 - Truck mounted transit mixers
 - Stationary central mixers with in-transit agitation
 - Stationary mixers located at site
 - Concrete mobiles

Transit mixers must carry current certification signed by responsible company representative - mixer condition examined in last 30 days and free of hardened concrete. It is the responsibility of the CPI to check ready mix trucks for the monthly condition certification.



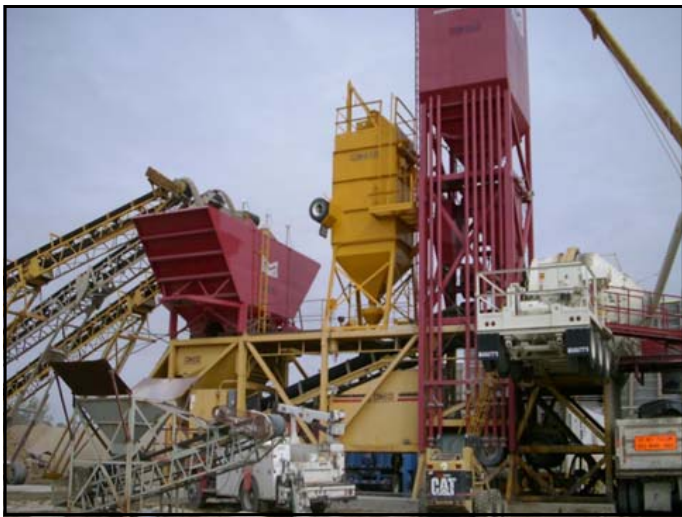
Sampling and Testing Aggregates

- Structural
 - Specific Gravity
 - 1 the first week, monthly thereafter.
 - 1 the first week, 1 every 2 weeks thereafter for DWU sources
 - Variations greater than 0.02 from T-203, inform Project Engineer and District Materials Engineer immediately.
 - Moisture
 - Two samples per week, or one per deck.
 - Gradation (QC)
 - One sample per week.
 - If less than 50 yd³/wk group with previous or subsequent week
 - One per bridge deck.
- Non-structural and miscellaneous concrete
 - ***The items of work described in IM 528 are designated as non-structural and/or miscellaneous concrete, when placed at less than 50 cubic yards (40 cubic meters) per week.***
 - When non-structural concrete is the only concrete produced for the project(s) from a given plant, quality control testing may be reduced to one specific gravity per month, one gradation per month, and one moisture every two weeks.
- Miscellaneous concrete
 - No testing is required for miscellaneous concrete.

- Water cement ratio
 - Water demand exceeds design w/c ratio and approaches maximum, notify Project Engineer and District Materials Engineer
 - Check aggregate moistures, batch weights, scales, water meter, etc.
 - Shall not exceed maximum w/c ratio
 - May increase cement content with District Materials Engineer approval

- Strength Tests - IM 316
 - Required for each day's placement of a structural unit in flexure by agency.
 - Abutment walls, pier footings, bridge end posts, and culvert curtain walls not considered critical structural units - strength testing not required.



























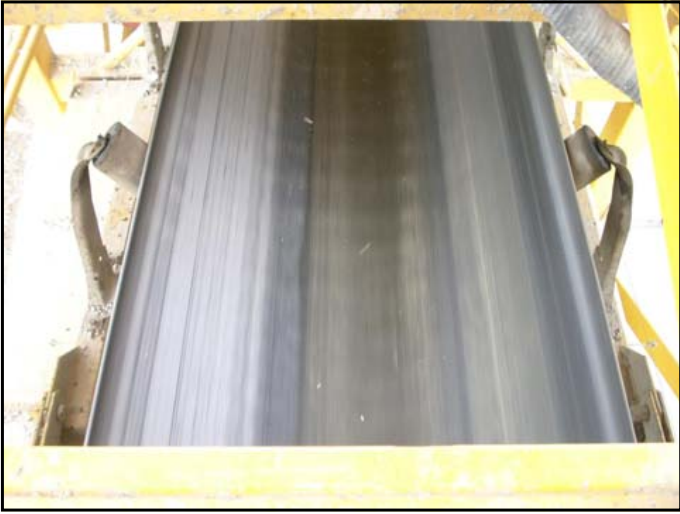






















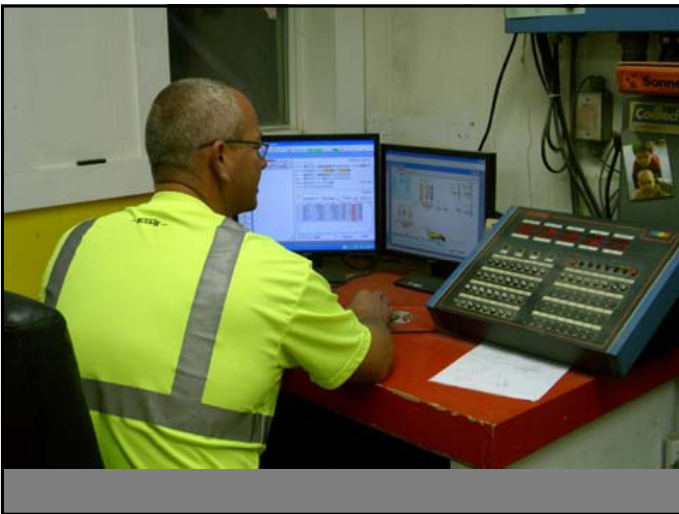












































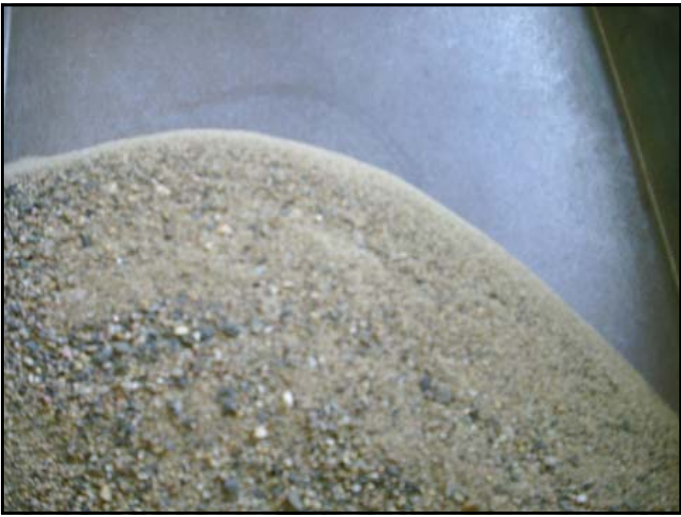










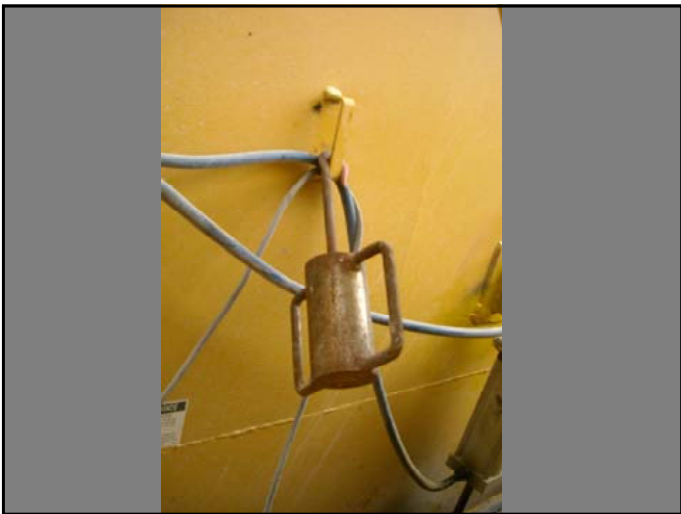










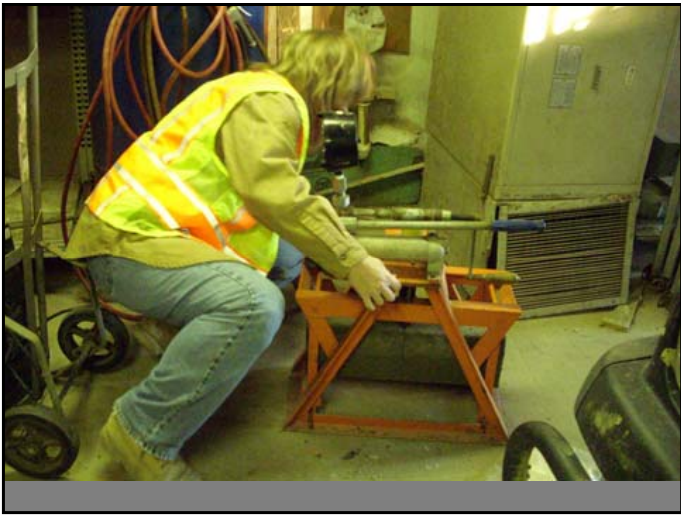






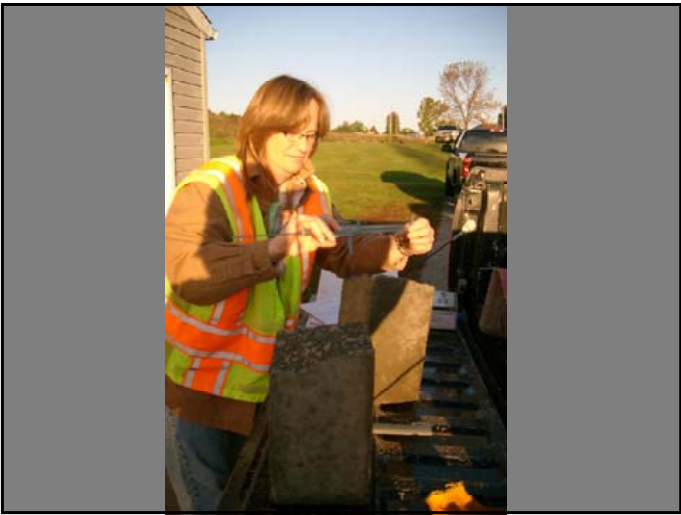


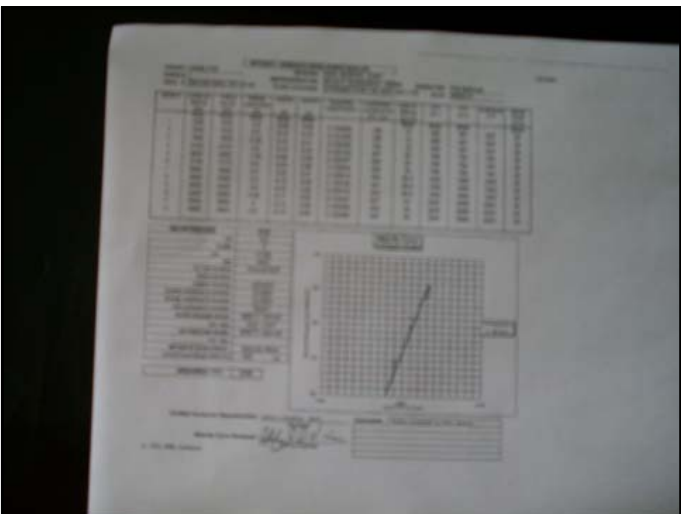












































Chapter 9

REPORTS

REPORTS

Calibration Reports

- Form 820917

Transit Mixer Condition

- Form 820907

Ready Mix Tickets

- Form 830212

Portland Cement Shipment Yield

- Every 10,000 cubic yards
- Form 820912

Paving and Structural Report

- Daily or Weekly
- Form 800240E or 800240M

Plant Report

- https://iowadot.gov/Construction_Materials/pcc/eplantreport.xlsx
- Use project Info page in the excel file

Form 830212
10-95

READY MIX CONCRETE

_____ Plant

Truck No. _____ Ticket No. _____

Date _____ Des. No. _____

Proj. No. _____

Mix No. _____ Retarder/Water Reducer? Yes No

Conc. This Truck _____ C.Y./m³

Air agent added this truck _____ oz./mL

Time Batched _____ Discharged _____

Rev. Mixed (*Plant*) _____ Grade _____

Water (*gal./L or lbs./kg This Truck*) 8.33lbs./gal.

In Aggregate	_____ gal./L	_____ lbs./kg
Added (<i>Plant</i>)	_____ gal./L	_____ lbs./kg
Subtotal	_____ gal./L	_____ lbs./kg
Added Grade	_____ gal./L	_____ lbs./kg

TOTAL WATER _____ gal./L _____ lbs./kg

Maximum Water Allowed _____ gal./L _____ lbs./cy or kg/m³

Air _____ Slump _____

Plant Insp. _____

Receiving Insp. _____



TRANSIT MIXER CONDITION CERTIFICATE

In accordance with requirements of Iowa Department of Transportation Standard Specifications Section 2001.21B this certifies the herein described transit mixer was examined on the date shown and was found to be in proper working condition, the fins and blades were not damaged or worn excessively, and the drum interior was free of hardened concrete buildup.

Unit Identification Number _____

Home Base _____

Owner _____

Mixer Manufacturer _____

Serial Number _____

MMB Rating (Mixing, Cu. Yd.) _____ Year New _____

Truck Manufacturer _____

Model _____

Year _____ Color _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

Signature _____

Date _____

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Signature _____

Date _____

Signature _____

Date _____

Signature _____

Form 830212
10-95

READY MIX CONCRETE

_____ Plant

Truck No. _____ Ticket No. _____

Date _____ Des. No. _____

Proj. No. _____

Mix No. _____ Retarder/Water Reducer? Yes No

Conc. This Truck _____ C.Y./m³

Air agent added this truck _____ oz./mL

Time Batched _____ Discharged _____

Rev. Mixed (*Plant*) _____ Grade _____

Water (*gal./L or lbs./kg This Truck*) 8.33lbs./gal.

In Aggregate	_____ gal./L	_____ lbs./kg
Added (<i>Plant</i>)	_____ gal./L	_____ lbs./kg
Subtotal	_____ gal./L	_____ lbs./kg
Added Grade	_____ gal./L	_____ lbs./kg

TOTAL WATER _____ gal./L _____ lbs./kg

Maximum Water Allowed _____ gal./L _____ lbs./cy or kg/m³

Air _____ Slump _____

Plant Insp. _____

Receiving Insp. _____

12

Form 830212
10-95

READY MIX CONCRETE

American @ Gilmore City Plant

Truck No. 5 Ticket No. 2

Date 7/17/14 Des. No. 307

Proj. No. FSSN-015-1(7)--3T-76

Mix No. C-4...-C20 Retarder/~~Water Reducer?~~ Yes No

Conc. This Truck 6 C.Y./m³

Air agent added this truck 18 oz./mL

Time Batched 7:45 AM Discharged 8:30 AM

Rev. Mixed (Plant) 70 Grade 30

Water (gal./L or lbs./kg This Truck) 8.33lbs./gal.

In Aggregate	<u>49</u>	gal./L	_____	lbs./kg
Added (Plant)	<u>134</u>	gal./L	_____	lbs./kg
Subtotal	<u>183</u>	gal./L	_____	lbs./kg
Added Grade	<u>7</u>	gal./L	_____	lbs./kg

TOTAL WATER 190 gal./L _____ lbs./kg

Maximum Water Allowed 219 gal./L _____ lbs./cy or kg/m³

Air 6.8% Slump 3"

Plant Insp. John Doe NW000

Receiving Insp. David Jones NW999

READY MIX TICKET (Form 830212)
PROBLEM

Use the following information to fill in the Ready Mix Ticket. The ticket is from Project #STP-53-4(15)—2C-53 and from Kirk's Ready Mix.

Truck #4, Ticket#2

Batched at 8:45 AM and Discharged at 9:30 AM

Mixer Revolutions – 72 at plant, 35 at grade

Air agent added this truck – 18 ounces

Percent of air – 6.8%

Slump - 2 $\frac{3}{4}$ inches

6 c. yds. C-3WR-C15S30 batched on 8/4/14

65 lbs. water per cubic yard in the aggregates

150 lbs. water per cubic yard added at the plant

19 lbs. water per cubic yard added at the grade

The amounts given are in pounds per cubic yard. The tickets want both pounds and gallons **per truck**.

Remember: Sign the first ticket and write your certification number. Initial the rest of the tickets and write your certification number.

Form 830212
10-95

READY MIX CONCRETE

_____ Plant

Truck No. _____ Ticket No. _____

Date _____ Des. No. _____

Proj. No. _____

Mix No. _____ Retarder/Water Reducer? Yes No

Conc. This Truck _____ C.Y./m³

Air agent added this truck _____ oz./mL

Time Batched _____ Discharged _____

Rev. Mixed (*Plant*) _____ Grade _____

Water (*gal./L or lbs./kg This Truck*) 8.33lbs./gal.

In Aggregate _____ gal./L _____ lbs./kg

Added (*Plant*) _____ gal./L _____ lbs./kg

Subtotal _____ gal./L _____ lbs./kg

Added Grade _____ gal./L _____ lbs./kg

TOTAL WATER _____ gal./L _____ lbs./kg

Maximum Water Allowed _____ gal./L _____ lbs./cy or kg/m³

Air _____ Slump _____

Plant Insp. _____

Receiving Insp. _____

READY MIX TICKET (Form 830212)
PROBLEM

Use the following information to fill in the Ready Mix Ticket. The ticket is from Project #STP-53-4(15)—2C-53 and from Kirk's Ready Mix.

Truck #8, Ticket #4

Batched at 10:15 AM and Discharged at 11:05 AM

Mixer Revolutions – 70 at plant, 33 at grade

Air agent added this truck – 27 ounces

Percent of air - 7.2%

Slump – 3 inches

9 c. yds. C-4-C15 batched on 8/5/10

64 lbs. of water per cubic yard in the aggregates

183 lbs. water per cubic yard added at the plant

25 lbs. water per cubic yard added at the grade

The amounts given are in pounds per cubic yard. The tickets want both pounds and gallons **per truck**.

Remember: Sign the first ticket and write your certification number. Initial the rest of the tickets and write your certification number.

Form 830212
10-95

READY MIX CONCRETE

_____ Plant

Truck No. _____ Ticket No. _____

Date _____ Des. No. _____

Proj. No. _____

Mix No. _____ Retarder/Water Reducer? Yes No

Conc. This Truck _____ C.Y./m³

Air agent added this truck _____ oz./mL

Time Batched _____ Discharged _____

Rev. Mixed (*Plant*) _____ Grade _____

Water (*gal./L or lbs./kg This Truck*) 8.33lbs./gal.

In Aggregate _____ gal./L _____ lbs./kg

Added (*Plant*) _____ gal./L _____ lbs./kg

Subtotal _____ gal./L _____ lbs./kg

Added Grade _____ gal./L _____ lbs./kg

TOTAL WATER _____ gal./L _____ lbs./kg

Maximum Water Allowed _____ gal./L _____ lbs./cy or kg/m³

Air _____ Slump _____

Plant Insp. _____

Receiving Insp. _____

Cement Yield Problem #1

Calculate the cement yield given the following

- 4096 lb. cement in scale hopper from last cement yield check.
- 4872 cubic yards at 623 lb./c. yd.
- 615 cubic yards at 604 lb./c. yd.
- 66 cubic yards at 823 lb./c. yd.
- 3000 lb. left in scale hopper

Total weight billed is 3,333,333 lb. (1666.67 Ton)

Cement Yield Problem #2

Calculate the cement yield given the following

- 2600 lb. cement left in scale hopper from last yield check
- 1480 cubic yards at 492 lb./c. yd.
- 500 cubic yards at 571 lb./c. yd.
- 3000 lb. cement left in hopper this check
- Total billed weight is 512.05 Ton
- Show your work in Tons (convert lb. to ton)

1. PLANT PAGE – FORM #240

Plant Reports are to be recorded in the computer program or on hand completed forms, both provided by the Iowa Department of Transportation. A copy of the completed PCC Plant Page shall be faxed or delivered to the District Materials Engineer on the next working day, within four hours after start-up of the plant. The CPI shall keep a copy of the PCC Plant Page and send the original to the Project Engineer. Copies of the files containing the project information are to be available to the engineer upon request until the project is final.

A separate report is to be made for each day concrete is placed. These reports are to be consecutively numbered for each project. A sample copy and the instructions on completing this report are in **Appendix A**.

When computer forms are used, the following equipment is necessary.

2. PERSONAL COMPUTER

The personal computer shall be capable of running Iowa DOT Programs. The printer shall be capable of producing quality hard copies. That is, original printed output, which is clearly readable and remains readable after being faxed and/or copied.

Example: (Paving) 16 days of 10.5-inch slip form paving - report 1 through 16.
(Ready Mix) 8 weeks of concrete on Des. 1290 - report 1 through 8.

Date This Report

Enter the date the concrete is placed for each day of paving. Enter the last day of the workweek for structures (normally the Saturday date).

Date of Last Report

Self-explanatory.

Design No.

Enter the design number of the structure where the concrete is being placed on each project. Leave this space blank on paving projects.

Check Mix (Central or Ready)

Place an "X" in the appropriate box provided indicating how the concrete is being produced.

Check Usage (Paving, Structural, Incidental, Patching)

Place an "X" in the appropriate box provided to indicate the type of work where the concrete is used.

Date (Mo./Day)

This column is only used for Ready Mix concrete applications. Enter the month and the date for each day of production during the week.

Example: 5/24, 7/01, 12/03, etc.

Mix Number

Enter the mix number being used that is listed in the proportion tables of [IM 529](#).

Location- Station (Beg. /End/Dir)

Enter the beginning and ending station for concrete placed daily by mix. Enter the direction (N, S, E, W) for divided sections or B for 2-lane sections. For structural concrete enter the unit placed (Example: pier, cap, footing, deck). Enter item placed for other work. (Example: sidewalk, drive) The grade inspector will provide the location or item placed to the plant inspector.

Batched

Enter the total cu. yds. batched for each mix for a paving plant. Enter the total cu. yds. batched for each unit poured for structures.

% Of Est. Used

Enter the percent of estimated concrete used. The grade inspector will provide the % of estimate used ((cubic yards used / cubic yards estimated) X100) to the plant inspector

Fine, Intermediate & Coarse Aggregate (Moisture)

Enter the percent moisture once in the morning and once in the afternoon for paving projects. Enter the percent moisture for each unit poured on structures.

Fine, Intermediate & Coarse Aggregate (T203 sp gr)

Enter the specific gravity for each aggregate listed in the [T203](#) source tables.

Fine, Intermediate & Coarse Aggregate (Dry Wt.)

Enter the weight of each aggregate calculated by absolute volumes.

Actual Quantities Used Per cu. yds. (Pounds)

- Cement** Enter the pounds of cement calculated by absolute volumes.
Fly Ash Enter the pounds of fly ash calculated by absolute volumes.
GGBFS Enter the pounds of GGBFS calculated by absolute volumes.
Fine Enter the actual pounds of fine aggregate adjusted by moisture content.
Inter. Enter the actual pounds of intermediate aggregate adjusted by moisture content.
Coarse Enter the actual pounds of coarse aggregate adjusted by moisture content.
In Agg. Enter the calculated difference between the actual weights and the dry weights of all aggregates.
Plant Enter the average pounds of water added at the plant for each cu. yd., including ice
Grade Enter the average pounds of water added on the grade (if permitted by specification).

Avg. W/C Ratio

Enter the ratio of total water, including water in the aggregates and water added on the grade, in one cu. yd. divided by the total sum of cement, fly ash, and ggbfs in one cu. yd., report to three decimal places.

CPI Gradations

This section of the report is for reporting the Certified Plant Inspector gradation test results for the coarse and fine aggregates being used in the mix.

Batched (Today or Week)

Place an "X" under the Today column if the report is being submitted daily (paving).
Place an "X" under the Week column if the report is being submitted weekly (structures).

Concrete Batched

Enter the total cu. yd. of concrete batched under the appropriate column. Paving plant totals are normally under the Today column; structural concrete totals are normally under the Week column.

To Date Total

Enter the running total for both concrete and cement.

Air Entraining (Air Ent.)

Enter the brand name or source, average rate per cu. yd., and lot number.

Water Reducer (Wat. Red.)

Enter the brand name or source, average dosage rate, and lot number.

Retarder

Enter the brand name or source, average dosage rate, and lot number.

Calcium Chloride (Cal. Chlor.)

Enter the brand name or source, average dosage rate, and lot number only when added at the plant site.

Superplasticizer (Superplas.)

Enter the brand name or source, average dosage rate, and lot number.

Concrete Treatment

Place an "X" directly behind Ice, Heated Water, or Heated Materials, if one or more are used. If ice is used to cool the mix, enter the pounds of ice per cu. yd. Include weight of ice with plant water.

Cement

Enter the cement type, specific gravity, and source. See [IM 401](#) for the actual source name.

Fly Ash

Enter the type and specific gravity and source. See [IM 491.17](#) for the actual source name.

Example: Chillicothe and ISG Headwaters are not source names.
Ottumwa is the source name.

Rock

Enter the [T203](#) A number, and gradation number.

GGBFS

Enter the grade, specific gravity, and source. See [IM 491.14](#) for the actual source name.

Sand

Enter the [T203](#) A number, and gradation number.

Intermediate

Enter the [T203](#) A number.

Remarks

Enter delays, which may take place. Enter description of noncomplying test results.

CPI

Enter the Certified Plant Inspector name and certification number.

Monitor

Enter the plant monitor name and certification number.

If using the computer spreadsheet, most of this information will be entered on the Project Information and Mix Information sheets and automatically transferred to the Report. For QMC and BR mixes, the combined gradation will be calculated from aggregate percentages entered in the Mix Information Station From and To, Totals to Date Cement and Concrete, and Remarks will be entered directly on the Report.

The next page is an example of a completed Paving Plant Report.

800246 computer v16.1 PCC Plant Report

Location: From To

Date of Placement: Mix 1 8/6/2013, Mix 2 8/6/2013, Mix 3, Mix 4, Mix 5

Project No.: STP-64(12)28-68
Plant Name: KR - Hwy 218 & F62
Contractor: Knife River
Subcontractor: Sunny
Weather: Sunny
Maturity #: _____
Maturity Mix ID: _____
Curve Strength: _____
Curve Type: _____

Report No.: 004
Date This Report: 9/17/2014
Date Of Last Report: _____
Structures Des. No.: _____
Curve / Validation Date: _____
Curve Expiration Date: _____
TTF: _____

Plant Type (x): Central X, Ready
Placement Type: Paving, Continuous
E-Units Report: (Daily) X, (Weekly), (Monthly), (Project)

Max On Grade W/C Ratio: _____

Mix	Batched yd3	% Of Est. Used	Fine Aggregate		Intermediate Aggregate		Coarse Aggregate		Actual Quantities Used - lbs/yd3				Avg w/c Ratio	Max w/c Ratio			
			Moist. (%)	T-203 Wt. lbs	Moist. (%)	T-203 Wt. lbs	Moist. (%)	T-203 Wt. lbs	Cement	Fly Ash	GBBFS	Fine			Inter.	Coarse	Water
1	1,256.00	0.0	3.1	2.65	1,380	0.7	2.63	1670	446	111	1424	1682	56	175.0	0.0	0.415	0.450
2	1,384.00	0.0	2.8	2.65	1,380	0.5	2.63	1670	446	111	1420	1678	48	190.0	0.0	0.428	0.450
3																	
4																	
5																	

Sample Date: _____

Conc. Treatment: Ice, Heated Water, Heated Materials, Liquid Nitrogen

CarbonCure: _____

Sample Date: _____

Sample Date: _____

Adjusted % Passing Calculated Combined Gradation

Target	1 1/2"	1"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200	#400	#600	#800	#1000	

Certified RM: _____
Remarks: _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

Location

Date of Placement:

Mix 1	From	To
Mix 2		
Mix 3		
Mix 4		
Mix 5		

Project No.: _____ Contract ID: _____ Report No.: _____

Plant Name: _____ County: _____ Date This Report: _____

Contractor: _____ Temp. Min: _____°F Date Of Last Report: _____

SubContractor: _____ Temp. Max: _____°F Structures Des. No.: _____

Weather: _____ Maturity Mix ID: _____ Curve / Validation date: _____

Maturity Used?: _____ TTF: _____ Curve #: _____

Check Mix (x)

Central Ready	Check One (x)
	Paving
	Structure
	Non-structural
	Miscellaneous

SEND (Daily) (Weekly) (Monthly) (Project)

Max On Grade W/C Ratio:

Mix	Batched yd3	Fine Aggregate		Intermediate Aggregate		Coarse Aggregate		Actual Quantities Used -			Ibs/yd3	Avg w/c Ratio	Max w/c Ratio
		% Of Est. Used	Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Cement	Fly Ash				GGBFS	Fine	Inter.	Coarse
1													
2													
3													
4													
5													

Coarse

48.0	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
								0-2.5	Y/N
									Y
									Y
									Y

Conc. Treatment	(X)	Ibs/yd3
Ice		
Heated Water		
Heated Materials		

Intermediate

12.0	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
									Y
									Y
									Y

Air Entraining: _____
 Water Reducer (Normal): _____
 Retarder: _____
 Calcium Chloride: _____
 Superplasticizer: _____

Fine

40.0	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Comply
										Y/N
										Y
										Y
										Y

Adjusted % Passing Calculated Combined Gradation

Target	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	CW Zone

Type	Sp. Gr.	Source

Cement: _____
 Fly Ash: _____
 GGBFS: _____

Coarse	Intermediate	Fine

Certified RM The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks

C.P.I. #1: _____
 C.P.I. #2: _____
 Monitor #1: _____
 Monitor #2: _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

Plant Type (X)	Central	Ready	Report No.:	004
Placement Type	Paving	Continuous	Date This Report:	9/17/2014
E - Units	Report	(Daily)	Date Of Last Report:	
	X		Structures Des. No.:	
			Curve / Validation Date:	
			Curve Expiration Date:	
			Contract ID:	67592
			Plant Name:	KR - Hwy 218 & F62
			County:	68-Louisiana
			Temp. Min:	69 °F
			Temp. Max:	87 °F
			Maturity Mix ID:	
			Curve Strength:	
			Weather:	Sunny
			Maturity?:	
			Curve #:	
			SubContractor:	
			Contractor:	Knife River
			Project No.:	STP-64(12)28-58
			Plant Name:	KR - Hwy 218 & F62
			County:	68-Louisiana
			Temp. Min:	69 °F
			Temp. Max:	87 °F
			Maturity Mix ID:	
			Curve Strength:	
			Weather:	Sunny
			Maturity?:	
			Curve #:	
			SubContractor:	
			Contractor:	Knife River

Mix	Batched		% Of Est. Used		Waste		Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used - lbs/yd3					Avg w/c Ratio	Max w/c Ratio
	yd3	1,256.00	1,384.00	0.0	0.0	0.0	T-203 Moist. (%)	T-203 Wt. SSD lbs	T-203 Sp. G.	T-203 Wt. SSD lbs	T-203 Moist. (%)	T-203 Wt. SSD lbs	T-203 Sp. G.	Cement	Fly Ash	GBBFS	Fine	Inter.	Coarse	Water Plant			Grade
1							3.1	1,384	2.65	1,384	0.7	2.63	1679	446	111	1428	1428	1691	56	175.0	0.0	0.415
2							2.8	1,384	2.65	1,384	0.5	2.63	1679	446	111	1424	1424	1687	48	190.0	0.0	0.428
3																						
4																						
5																						

Sample Date:	Coarse	1 1/2"					1"					3/4"					3/8"					Comply
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	Comply

Sample Date:	Intermediate	1 1/2"					1"					3/4"					3/8"					Comply
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	Comply

Sample Date:	Fine	1 1/2"					1"					3/4"					3/8"					Comply
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	
		100	95-100	90-100	85-100	80-100	95-100	90-100	85-100	80-100	75-100	70-100	65-100	60-100	55-100	50-100	45-100	40-100	35-100	30-100	25-100	Comply

Target	Adjusted % Passing Calculated Combined Gradation														
	1 1/2"	1"	3/4"	3/8"	#4	#8	#16	#30	#50	#75	#100	#150	#200	#250	#300
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30

Certified RM: The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks:

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

C.P.I. #1: _____

C.P.I. #2: _____

Monitor #1: _____

Monitor #2: _____

Date of Placement		From		To		Location		Plant Type (X)		Placement Type		E - Units	
Mix 1	8/6/2013	100	95-100	1"	3/4"	1/2"	3/8"	1"	3/4"	1/2"	3/8"	1"	3/4"
Mix 2	8/6/2013												
Mix 3													
Mix 4													
Mix 5													

Project No.: STP-64(12)28-58
 Plant Name: KR - Hwy 218 & F62
 Contractor: Knife River
 SubContractor:
 Weather: Sunny
 Maturity?:
 Curve #:
 Curve Type:

Contract ID: 67592
 County: 68-Louisia
 Temp. Min: 69 °F
 Temp. Max: 87 °F
 Maturity Mix ID:
 Curve Strength:

Report No.: 004
 Date This Report: 9/17/2014
 Date Of Last Report:
 Structures Des. No.:
 Curve / Validation Date:
 Curve Expiration Date:
 TTF:

Plant Type (X)
 Central
 Ready
 Paving
 Continuous
 Non-structural
 Miscellaneous

SEND Report (Daily) (Weekly) (Monthly) (Project)

Mix	Batched yd3	% Of Est. Used	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used - lbs/yd3			Avg w/c Ratio	Max w/c Ratio				
			Moist. (%)	T-203 Wt. lbs	Sp. G.	Moist. (%)	T-203 Wt. lbs	Sp. G.	Moist. (%)	T-203 Wt. lbs	Sp. G.	Cement	Fly Ash	GBBFS			Fine	Inter.	Coarse	In Agg.	Plant	Grade
1	C-3WR-C20	1,256.00	3.3															175.0		
2	C-3WR-C20	1,384.00	3.0															190.0		0.0
3																				0.0
4																				0.0
5																				0.0

Sample Date:	Coarse			Intermediate			Fine			Batched Total To Date	Waste To Date
	1 1/2"	1"	3/4"	1/2"	3/8"	3/4"	1/2"	3/8"	3/4"		
	100	95-100	25-60	25-60	0-10	0-10	0-10	0-5	0-2.5	Y/N	0.00

Concrete: yd3 2640.00
 Cement: tons 588.72

Sample Date:	Intermediate			Fine			Adjusted % Passing Calculated Combined Gradation
	1 1/2"	1"	3/4"	1/2"	3/8"	3/4"	
	100	95-100	25-60	25-60	0-10	0-10	0-1.5

Sample Date:	Intermediate			Fine			Adjusted % Passing Calculated Combined Gradation
	1 1/2"	1"	3/4"	1/2"	3/8"	3/4"	
	100	95-100	25-60	25-60	0-10	0-10	0-1.5

Sample Date:	Intermediate			Fine			Adjusted % Passing Calculated Combined Gradation
	1 1/2"	1"	3/4"	1/2"	3/8"	3/4"		1/2"
	100	95-100	25-60	25-60	0-10	0-10	0-1.5

The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks

C.P.I. #1: _____
 C.P.I. #2: _____
 Monitor #1: _____
 Monitor #2: _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Date of Placement		From		To		Location		Plant Type (x)		Placement Type		E-Units Report	
Mix 1	8/6/2013							Central	X	Paving	Continuous	Daily	X
Mix 2	8/6/2013							Ready			Non-structural	(Weekly)	
Mix 3											Miscellaneous	(Monthly)	
Mix 4												(Project)	
Mix 5													

Project No.: FM-91(15)-66-91
 Plant Name: Warren_R63
 Contractor: Knife River
 Subcontractor:
 Weather: Sunny/Cool
 Maturity?:
 Curve #:

Report No.: 009
 Date This Report: 8/6/2013
 Date Of Last Report:
 Structures Des. No.:
 Curve / Validation Date:
 Curve Expiration Date:

Contract ID: 73912
 County: 91-Warren
 Temp. Min: 40 °F
 Temp. Max: 65 °F
 Maturity Mix ID:
 Curve Strength:
 Curve Type:

Max On Grade W/C Ratio:

Mix	Batched yd3	% Of Est. Used	Waste yd3	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used - lbs/yd3			Avg w/c Ratio	Max w/c Ratio			
				Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Cement	Fly Ash	GBBFS			Fine	Inter.	Coarse	In Agg.	Plant	Grade
1	C-3WR	1,011.50	3.3	3.0	3.0	3.0	0.5	0.3										175.0		0.450
2	M-4	79.00																245.0		0.400
3																				
4																				
5																				

Sample Date:	Coarse	Intermediate	Fine	Batched	Check One (X)	Daily	Total	Waste
	1 1/2" 100	1 1/2" 25-60	3/8" 0-10	3/8" 0-10	X			
	3/4" 95-100	1/2" 25-60	3/8" 0-10	3/8" 0-10				
	3/4" 100	1/2" 25-60	3/8" 0-10	3/8" 0-10				

Conc. Treatment (X) lbs/yd3
 Ice
 Heated Water
 Heated Materials
 Liquid Nitrogen
 Cement: tons
 Concrete: yd3

Sample Date:	Intermediate	Fine	Adjusted % Passing Calculated Combined Gradation
	1 1/2" 100	3/8" 100	1 1/2" 100
	3/4" 95-100	3/8" 100	3/8" 100
	3/4" 100	3/8" 100	3/8" 100

Sample Date:	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200	CW
	100	100	100	100	100	100	100	100	100	100	Within Target
											Zone

Sample Date:	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
	100	100	100	100	100	100	100	100	100	100

CarbonCure: _____
 Air Entraining: Sika Air-Sika
 Normal Water Reducer: Plastocrete 161-Sika
 Mid-Range Water Reducer: _____
 High-Range Water Reducer: _____
 Retarder: _____
 Special Performance Admixture: _____
 Concrete Fibers: _____

Cement: IL
 Fly Ash: PC0009-Ash Grove - Louisville-IL
 GGBFS: _____

Coarse: A22010-OSTERDOCK
 Intermediate: _____
 Fine: A06502-VINTON-MILROY

Type Sp. Gr. Source
 Grad. No. 3
 T-203 A # & Source
 A06502-VINTON-MILROY 1

Certified RM The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks: _____
 Distribution: _____ DME _____ Proj. Eng. _____ Plant _____
 C.P.I. #1: _____
 C.P.I. #2: _____
 Monitor #1: _____
 Monitor #2: _____

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Location

Date of Placement	From	To	Project No.:	STP-99(19)30-85
Mix 1	9/30/15		Plant Name:	Manatt's Paving - Nevada
Mix 2	9/30/15		Contractor:	Manatt's
Mix 3			SubContractor:	
Mix 4			Weather:	Warm/Dry
Mix 5				

Contract ID:	Story	Report No.:	4
County:	72	Date This Report:	10/01/15
Temp. Min:	85 °F	Date Of Last Report:	09/30/15
Temp. Max:	85 °F	Structures Des. No.:	

Check Mix (x)	Check One (x)	E - Units
Central	Paving	SEND
Ready	Structure	(Daily)
	Non-structural	(Weekly)
	Miscellaneous	(Monthly)
		(Project)

Mix	Batched yd3	Fine Aggregate		Intermediate Aggregate		Coarse Aggregate			Actual Quantities Used - lbs/yd3				Avg w/c Ratio	Max w/c Ratio							
		% Of Est. Used	T-203 Moist. (%)	T-203 Wt. lbs	T-203 Sp. G.	T-203 Moist. (%)	T-203 Wt. lbs	T-203 Sp. G.	Cement	Fly Ash	GGBFS	Fine			Inter.	Coarse	In Agg.	Plant	Water	Grade	
1	975.00	2.9	0.3		0.3										225.0		0.443				
2	128.00	2.9	0.3		0.3										238.0		0.347		0.400		
3																					
4																					
5																					

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100	70-100	25-60		0-10	0-5	0-2.5	Y/N

Intermediate	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
									NA
									NA
									NA

Fine	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Comply
	100	90-100	70-100	10-60				0-1.5		Y/N

Adjusted % Passing Calculated Combined Gradation												
Target	1 1/2"	1"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200	CW Zone

Remarks	

Batched	Today	Week	Total
Check One (X)	X		
Concrete:	1,103.00	0.00	
Cement:	308.23		

Brand / Source	Rate	Lot Number
Darex II AEA	5.0 oz./yd.	622208
Air Entraining:		
Water Reducer:		
Retarder:		
Calcium Chloride:		
Superplasticizer:		

Type	Sp. Gr.	Source
I/II	3.11	PC0509
C	2.48	FA003F

Source	T-203 A #	Grad. No.
	A18528	3
Coarse:		
Intermediate:		
Fine:	A07512	1

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

C.P.I.: _____ Monitor: _____

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ % Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____ Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____ Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____ Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____
Max w/c _____ Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary

Cement _____ (lbs/cy)
Fly Ash _____ (lbs/cy)
Slag _____ (lbs/cy)
Water _____ (lbs/cy)
Fine Agg. _____ (lbs/cy)
Interm. Agg. _____ (lbs/cy)
Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes

Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (1.00 X 62.4 X 27) = _____

Air **0.060**

Subtotal = _____

1.000 - Subtotal = _____

Total = **1.000**

% FA Agg.: _____ Fine Aggregate (1.000 - Subtotal) X % In Mix = _____

% In. Agg.: _____ Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: _____ Coarse Aggregate (1.000 - Subtotal) X % In Mix = _____

Aggregate Total = _____

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Summary

Cement _____ (lbs/cy)

Fly Ash _____ (lbs/cy)

Slag _____ (lbs/cy)

Water _____ (lbs/cy)

Fine Agg. _____ (lbs/cy)

Interm. Agg. _____ (lbs/cy)

Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Location

Date of Placement	From	To
Mix 1	8/6/2013	
Mix 2		
Mix 3		
Mix 4		
Mix 5		

Project No.: FM-6(222)147--33-54
 Plant Name: Shipley-Keota
 Contractor: Shipley Construction
 SubContractor:
 Weather: Overcast/warm
 Maturity?: _____
 Curve #: _____

Contract ID: 56743
 County: 54-Keokuk
 Temp. Min: 68 °F
 Temp. Max: 87 °F
 Maturity Mix ID: _____
 Curve Strength: _____
 Curve Type: _____

Report No.: 005
 Date This Report: 7/16/2014
 Date Of Last Report:
 Structures Des. No.:
 Curve / Validation Date:
 Curve Expiration Date:
 TTF: _____

Plant Type (x)	Placement Type		SEND Report
	Central	Paving		(Daily)
Ready		Continuous	X
		Non-structural	(Weekly)
		Miscellaneous	(Monthly)
			(Project)

Max On Grade W/C Ratio:

Mix	Batched yd3	% Of Est. Used	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used - lbs/yd3			Avg w/c Ratio	Max w/c Ratio	
			Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Moist. (%)	T-203 Sp. G.	Wt. SSD lbs	Cement	Fly Ash	GGBFS	Fine	Inter.	Coarse			Water Plant	Grade
C-3WR-C20	1,256.00	3.8													151.0	26.0	0.450
1																	
2																	
3																	
4																	
5																	

Sample Date: _____

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

Concure Cure: _____

Conc. Treatment	(X)	lbs/yd3	Comply
Ice			Y/N
Heated Water			Y/N
Heated Materials			Y/N
Liquid Nitrogen			Y/N

Cement: _____

Check One (X)	Daily	Total To Date	Waste
X	X		

Cement: _____

Check One (X)	Daily	Total To Date	Waste
X	X		

Sample Date: _____

Intermediate	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Comply
													Y/N

Sample Date: _____

Fine	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Comply
										Y/N

Sample Date: _____

Adjusted % Passing Calculated Combined Gradation	1 1/2"	1"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200	Within Target	CW Zone

Sample Date: _____

Brand / Source	Rate	Lot Number
Sika AEA-14-Sika	5.0 oz/yd	77AA4356
Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

CarbonCure:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Normal Water Reducer:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Mid-Range Water Reducer:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

High-Range Water Reducer:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Retarder:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Special Performance Admixture:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Concrete Fibers:	Brand / Source	Rate	Lot Number
	Sika AEA-14-Sika	5.0 oz/yd	77AA4356
	Eucon WR-75-Euclid	3.0 oz./100lbs	ME88934C

Sample Date: _____

Type	Sp. Gr.	Source
III		PC3402-St Marys - Charlevoix-II
C		FA010C-Muscantine Power & Water

Sample Date: _____

Coarse	Intermediate	Fine	Grad. No.
A23004-BEHR	T-203 A # & Source		3

Sample Date: _____

Intermediate	Fine	Grad. No.
A05506-EXIRA		1

Sample Date: _____

C.P.I. #1:	C.P.I. #2:	Monitor #1:	Monitor #2:

Sample Date: _____

Within Target	CW Zone

Certified RM _____

Remarks _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

%

Fly Ash (IM 491.17): _____

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement: _____

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Distribution: ___ Materials, ___ DME, ___ Proj. Engr., ___ Contractor

Chapter 10

SOLUTIONS

Solution for Page 5-4

Calculate the Batch Weights for the Materials

M-3 Mix

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC3802	0.149	3.14	788
Fine Aggregate	A06502	0.287	2.65	1281
Coarse Aggregate	A17012	0.351	2.68	1585
Water	City	0.153	1.00	258
Air		0.060	0	

Solution for Page 5-5

Calculate the Batch Weights for the Materials

C-4WR Mix

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement (IS)	PC0108	0.112	2.97	560
Fine Aggregate	A17514	0.338	2.65	1509
Coarse Aggregate	A21516	0.339	2.69	1536
Water	City	0.151	1.00	254
Air		0.060	0	

Solution for Page 5-6

Calculate the Batch Weights for the Materials

C-4WR Mix

You will need to look up the specific gravities.

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC3702	0.112	3.14	593
Fine Aggregate	A22520	0.338	2.65	1509
Coarse Aggregate	A22012	0.339	2.66	1519
Water	City	0.151	1.00	254
Air		0.060		

Solution for Page 5-7

Calculate the Batch Weights for the Materials

C-3WR

You will need to look up the absolute volumes

Materials	Source	Absolute Volume	Specific Gravity	Batch Weight
Cement	PC0209	0.108	3.11	566
Fine Aggregate	A24512	0.309	2.66	1385
Coarse Aggregate	A22012	0.377	2.66	1690
Water	City	0.146	1.0	246
Air				

Solution for Page 5-16

Calculate the Batch Weights for the Materials

This is a M4-C10 mix. You can use Form 150 to calculate answers.
Remember to find the absolute volume of the cement and basic water in IM 529.

Materials	Source
Cement	PC0509
Fly Ash	FA000C
Fine Aggregate	A26502
Coarse Aggregate	A26004
Water	City
Air	

Solution for Page 5-17

4/3/2023

**Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE**

Form E820150
E - Units

Project No.: _____ County : 91-Warren

Mix No.: M-4-C10 Abs Vol. Cement: 0.1560 Type: IL

Cement (IM 401): 817 lbs Source: PC0509-Continental - Daver Sp. Gr.: 3.11

Fly Ash (IM 491.17): 10 % 82 lbs Source: FA041C-Prairie Creek Gene Sp. Gr.: 2.80

Slag (IM 491.14): _____ % 0 lbs Source: _____ Sp. Gr.: _____

CarbonCure: 0 % 0 lbs Cement Reduction

Adjusted Cement: 735 lbs

Total Cementitious 817 lbs Total % Replacement = 19

IM T203 Fine Aggregate Source: A26502-ELDON-FRANKLIN Sp. Gr.: 2.67

IM T203 Intern. Aggregate Source: _____ Sp. Gr.: _____

IM T203 Coarse Agregate Source: A26004-LEWIS Sp. Gr.: 2.60

Basic w/c 0.328 Water lbs/cy = Basic w/c X (Total Cementitious) = 268

Max w/c 0.400 Max. Water lbs/cy = Max w/c X (Total Cementitious) = 327

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.140</u>
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.017</u>
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.159</u>
	Air			<u>0.060</u>
		Subtotal	=	<u>0.376</u>
		1.000 - Subtotal	=	<u>0.624</u>
		Total	=	<u>1.000</u>

% FA Agg.: <u>50</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.312</u>
% In. Agg.: _____	Intern. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: <u>50</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.312</u>
	Aggregate Total	=	<u>0.624</u>

Aggregate Weights	Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1404</u>
	Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>0</u>
	Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1367</u>

Summary	Cement <u>735</u> lbs/cy
	Fly Ash <u>82</u> lbs/cy
	Slag <u>0</u> lbs/cy
	Water <u>268</u> lbs/cy
	Fine Agg. <u>1404</u> lbs/cy
	Intern. Agg. <u>0</u> lbs/cy
	Coarse Agg. <u>1367</u> lbs/cy

Plant Name & Location:
CPI:
Cert #:

Air Entrainment: <u>Sika Air-Sika</u>	Rate: <u>6.0 oz/yd</u>
Normal Water Reducer: <u>Plastocrete 161-Sika</u>	Rate: <u>2 oz./100lbs</u>
Mid-Range Water Reducer:	Rate: _____
High-Range Water Reducer:	Rate: _____
Retarder:	Rate: _____
Special Performance Admixture:	Rate: _____
Fibers:	Rate: _____
CarbonCure:	Rate: _____

Distribution: ___ DME, ___ Proj. Engr., ___ Contractor

Solution for Page 5-18

Calculate the Batch Weights for the Materials

Materials	Source
Cement	PC0509
Fly Ash	FA009C
Fine Aggregate	A26502
Coarse Aggregate	A26004
Water	City
Air	

Solution for Page 5-19

4/3/2023

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Form E820150
E - Units

Project No.: _____

County : 91-Warren

Mix No.: C-3WR-C20 Abs Vol. Cement: 0.1080 Type: IL

Cement (IM 401): 566 lbs Source: PC0509-Continental - Dave Sp. Gr.: 3.11

%

Fly Ash (IM 491.17): 20 113 Source: FA009C-Louisa Generating Sp. Gr.: 2.69

%

Slag (IM 491.14): 0 Source: _____ Sp. Gr.: _____

%

CarbonCure: 0 0 Cement Reduction

Adjusted Cement: 453 lbs

Total Cementitious 566 lbs Total % Replacement = 28

IM T203 Fine Aggregate Source: A26502-ELDON-FRANKLIN Sp. Gr.: 2.67

IM T203 Interm. Aggregate Source: _____ Sp. Gr.: _____

IM T203 Coarse Agregate Source: A26004-LEWIS Sp. Gr.: 2.60

Basic w/c 0.430 Water lbs/cy = Basic w/c X (Total Cementitious) = 243

Max w/c 0.450 Max. Water lbs/cy = Max w/c X (Total Cementitious) = 255

Absolute Volumes Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.086

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.024

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.144

Air 0.060

Subtotal = 0.314

1.000 - Subtotal = 0.686

Total = 1.000

% FA Agg.: 45 Fine Aggregate (1.000 - Subtotal) X % In Mix = 0.309

% In. Agg.: _____ Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: 55 Coarse Aggregate (1.000 - Subtotal) X % In Mix = 0.377

Aggregate Total = 0.686

Aggregate Weights Fine: Abs Vol. X Sp. Gr. X 62.4 X 27 = 1390

Intermediate: Abs Vol. X Sp. Gr. X 62.4 X 27 = 0

Coarse: Abs Vol. X Sp. Gr. X 62.4 X 27 = 1651

Summary

Cement 453 lbs/cy

Fly Ash 113 lbs/cy

Slag 0 lbs/cy

Water 243 lbs/cy

Fine Agg. 1390 lbs/cy

Interm. Agg. 0 lbs/cy

Coarse Agg. 1651 lbs/cy

Plant Name & Location:

CPI:

Cert #:

Air Entrainment: Sika Air-Sika Rate: 6.0 oz/yd

Normal Water Reducer: Plastocrete 161-Sika Rate: 2 oz./100lbs

Mid-Range Water Reducer: Rate: _____

High-Range Water Reducer: Rate: _____

Retarder: Rate: _____

Special Performance Admixture: Rate: _____

Fibers: Rate: _____

CarbonCure: oz/cy: _____

Distribution: ___ DME, ___ Proj. Engr., ___ Contractor

Solution for Page 5-20

Calculate the Batch Weights for the Materials

This is a C-3WR-C20S20 mix. You can use Form 150 to calculate answers. Remember to find the absolute volume of the cement and basic water in IM 529.

Materials	Source
Cement	PC0009
Fly Ash	FA009C
GGBFS	SL00A
Fine Aggregate	A19522
Coarse Aggregate	A22040
Water	City
Air	

Solution for Page 5-21

4/3/2023

**Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE**

Form E820150
E - Units

Project No.: _____ County: 91-Warren

Mix No.: C-3WR-C20S20 Abs Vol. Cement: 0.1080 Type: IL

Cement (IM 401):	<u>566</u>	lbs	Source: <u>PC0009-Ash Grove - Louisv</u>	Sp. Gr.: <u>3.11</u>
	%			
Fly Ash (IM 491.17):	<u>20</u>	<u>113</u>	Source: <u>FA009C-Louisa Generating</u>	Sp. Gr.: <u>2.69</u>
	%			
Slag (IM 491.14):	<u>20</u>	<u>113</u>	Source: <u>SL00A-Skyway Cement</u>	Sp. Gr.: <u>2.87</u>
	%			
CarbonCure:	<u>0</u>	<u>0</u>	Cement Reduction	

Adjusted Cement: 340 lbs

Total Cementitious 566 lbs Total % Replacement = 46

IM T203	Fine Aggregate Source:	<u>A19522-BUCKY'S</u>	Sp. Gr.: <u>2.65</u>
IM T203	Interm. Aggregate Source:	_____	Sp. Gr.: _____
IM T203	Coarse Aggregate Source:	<u>A22040-HARTMAN</u>	Sp. Gr.: <u>2.68</u>

Basic w/c	<u>0.430</u>	Water	lbs/cy	= Basic w/c X (Total Cementitious)	= <u>243</u>
Max w/c	<u>0.450</u>	Max. Water	lbs/cy	= Max w/c X (Total Cementitious)	= <u>255</u>

Absolute Volumes

Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.065</u>
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.025</u>
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.023</u>
Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.144</u>
Air			<u>0.060</u>
	Subtotal	=	<u>0.317</u>
	1.000 - Subtotal	=	<u>0.683</u>
	Total	=	<u>1.000</u>

% FA Agg.: <u>45</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.307</u>
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: <u>55</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.376</u>
	Aggregate Total	=	<u>0.683</u>

Aggregate Weights

Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1371</u>
Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>0</u>
Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1698</u>

Summary

	Cement <u>340</u> lbs/cy
	Fly Ash <u>113</u> lbs/cy
	Slag <u>113</u> lbs/cy
	Water <u>243</u> lbs/cy
	Fine Agg. <u>1371</u> lbs/cy
	Interm. Agg. <u>0</u> lbs/cy
	Coarse Agg. <u>1698</u> lbs/cy

Plant Name & Location: _____
CPI: _____
Cert #: _____

Solution for Page 6-4

Aggregate Moisture Corrections/Adjusted (Wet) Batch Weights

Calculate the adjusted (wet) batch weights for the following aggregate weights with the moistures given:

Fine Aggregate – 1418 pounds
Coarse Aggregate – 1560 pounds

Moistures –

1.	Fine	3.5	Fine Adjusted Batch Weight	__1469__
	Coarse	0.7	Coarse Adjusted Batch Weight	__1571__
2.	Fine	2.9	Fine Adjusted Batch Weight	__1460__
	Coarse	0.6	Coarse Adjusted Batch Weight	__1569__
3.	Fine	2.1	Fine Adjusted Batch Weight	__1448__
	Coarse	0.3	Coarse Adjusted Batch Weight	__1565__
4.	Fine	3.9	Fine Adjusted Batch Weight	__1476__
	Coarse	0.9	Coarse Adjusted Batch Weight	__1574__

Solution for Page 6-5

Aggregate Moisture Corrections/Adjustments

Calculate the free water for each cubic yard of concrete from the previous page:

1.	Total Adjusted Batch Weights	_____3040_____
	Total Dry Batch Weights	_____2978_____
	Total Water in Aggregate	_____62_____

2.	Total Adjusted Batch Weights	_____3029_____
	Total Dry Batch Weights	_____2978_____
	Total Water in Aggregate	_____51_____

3.	Total Adjusted Batch Weights	_____3013_____
	Total Dry Batch Weights	_____2978_____
	Total Water in Aggregate	_____35_____

4.	Total Adjusted Batch Weights	_____3050_____
	Total Dry Batch Weights	_____2978_____
	Total Water in Aggregate	_____72_____

Solution for Page 6-6

Maximum Water Adjustments

What is the maximum water allowed that can be added at the grade for each mix after the water in the aggregate and the water added at the plant have been determined: (convert to gallons)

1. C-4WR-C20
205 lbs. water added at the
plant 36 lbs. water in the
aggregate 594 lbs. of
cementitious material
Maximum water that can be added at the grade 26 lbs

2. M-4
220 lbs. water added at the
plant 47 lbs. water in the
aggregate 825 lbs.
cementitious material
Maximum water that can be added at the grade 63 lbs.

3. C-3WR
190 lbs. water added at the
plant 43 lbs. water in the
aggregate 565 lbs.
cementitious material
Maximum water that can be added at the grade 21 lbs.

4. M-3-C20
225 lbs. water added at the
plant 55 lbs. water in the
aggregate 788 lbs.
cementitious material
Maximum water that can be added at the grade 35 lbs.

Solution for Page 6-9

Water/Cement Ratio (W/C)

Calculate the water/cement ratio for each of the following cubic yard batches using the batch weights given:

- | | | | | |
|----|---------------------|----------|-----|-----------|
| 1. | Cement | 624 lbs. | w/c | __0.439__ |
| | Total Water | 274 lbs. | | |
| 2. | Cement | 564 lbs. | w/c | __0.414__ |
| | Fly Ash | 76 lbs. | | |
| | Total Water | 265 lbs. | | |
| 3. | Cement | 624 lbs. | w/c | __0.404__ |
| | Water at plant | 167 lbs | | |
| | Water in Materials. | 31 lbs. | | |
| | Water added grade | 54 lbs. | | |
| 4. | Cement | 385 lbs. | w/c | __0.455__ |
| | Fly Ash | 72 lbs. | | |
| | GGBFS | 68 lbs. | | |
| | Water at plant | 135 lbs. | | |
| | Water in materials | 44 lbs. | | |
| | Water added grade | 60 lbs. | | |

Solution for Page 9-9

Reissued April 20, 2010
Supersedes April 20, 2004

Matls. IM 527
Appendix C

Form 830212
10-95

READY MIX CONCRETE

Kirk's Ready Mix Plant _____
Truck No. 4 Ticket No. 2
Date 8/4/14 Des. No. _____
Proj. No. STP-53-4(15)--2C-53
Mix No. C-3WR-C15-530 Retarder/Water Reducer? Yes No
Conc. This Truck 6 C.Y./m³ _____
Air agent added this truck 18 oz./mL _____
Time Batched 8:45 AM Discharged 9:30 AM
Rev. Mixed (Plant) 72 Grade 35

Water (gal./L or lbs./kg This Truck) 8.33lbs./gal.

In Aggregate	<u>47</u>	gal./L	_____	lbs./kg
Added (Plant)	<u>108</u>	gal./L	_____	lbs./kg
Subtotal	<u>155</u>	gal./L	_____	lbs./kg
Added Grade	<u>14</u>	gal./L	_____	lbs./kg

TOTAL WATER 169 gal./L _____ lbs./kg

Maximum Water Allowed 185 gal./L _____ lbs./cy or kg/m³

Air 6.8 Slump 2 3/4"

Plant Insp. John Doe NW0000

Receiving Insp. David Jones NW9999

Solution for Page 9-11

April 20, 2004
Supersedes April 20, 2003

Matls. IM 527
Appendix C

Form 830212
10-95

READY MIX CONCRETE

Kirk's Ready Mix Plant _____
Truck No. 8 Ticket No. 4
Date 8/5/14 Des. No. _____
Proj. No. STP-53-4(15)--2C-53
Mix No. 9 Retarder/Water Reducer? Yes No
Conc. This Truck 9 C.Y./m³ _____
Air agent added this truck 27 oz./mL _____
Time Batched 10:15 AM Discharged 11:05 AM
Rev. Mixed (Plant) 70 Grade 33

Water (gal./L or lbs./kg This Truck) 8.33lbs./gal.

In Aggregate	<u>69</u>	gal./L	_____	lbs./kg
Added (Plant)	<u>198</u>	gal./L	_____	lbs./kg
Subtotal	<u>267</u>	gal./L	_____	lbs./kg
Added Grade	<u>27</u>	gal./L	_____	lbs./kg

TOTAL WATER 294 gal./L _____ lbs./kg

Maximum Water Allowed 329 gal./L _____ lbs./cy or kg/m³

Air 7.2 Slump 3

Plant Insp. John Doe NW000

Receiving Insp. David Jones NW999

Solution for Page 9-15

$$4872 \times 623 = 3,035,256 \text{ lb} \div 2000 = \mathbf{1517.63}$$

$$615 \times 604 = 371,460 \text{ lb} \div 2000 = \mathbf{185.73}$$

$$66 \times 823 = 54,318 \text{ lb} \div 2000 = \mathbf{27.16}$$

$$\mathbf{\text{Total} = 3,461,034 \text{ lb} \div 2000 = 1730.52}$$

$$\text{Left in scale hopper: } 3000 \text{ lb} \div 2000 = \mathbf{1.50}$$

$$\text{Left from last check: } 4096 \text{ lb} \div 2000 = \mathbf{2.05}$$

$$1730.52 + 1.50 - 2.05 = \mathbf{1729.97}$$

$$\mathbf{\text{Total billed} = 3,333,333 \div 2000 = 1666.67}$$

$$(1729.97 \div 1666.67) \times 100 = \mathbf{103.8 \%}$$

Remember:

1. Cement shipment yield determination must be made every 10,000 yd³ after the original determination has been made near the end of the first full day of production.
2. Cement yield cannot be under 99% or above 101.0%
3. Check your calculation, records, and equipment.

Solution for Page 9-17

$$1480 \text{ yd.}^3 \times 492 \text{ lb./yd.}^3 = 728,160 \text{ lb.} \div 2000 \text{ lb./ton} = \mathbf{364.08 \text{ ton}}$$

$$500 \text{ yd.}^3 \times 571 \text{ lb./yd.}^3 = 285,500 \text{ lb.} \div 2000 \text{ lb./ton} = \mathbf{142.75 \text{ ton}}$$

Total batched 506.83 ton

Left in scale

$$\text{Last check } 2600 \div 2000 = \mathbf{1.30 \text{ ton}}$$

$$\text{This check } 3000 \div 2000 = \mathbf{1.5 \text{ ton}}$$

$$\text{Total billed: } 1,024,100 \div 2000 = \mathbf{512.05 \text{ ton}}$$

$$\frac{\text{Total Cement + Left in Scale - Left in Scale}}{\text{Batched This Check From Last Check}} \times 100 = \text{Cement Yield}$$
$$\frac{\text{Total Cement Billed}}{\text{Total Cement Billed}}$$

$$\frac{506.83 + 1.50 - 1.30}{512.05} \times 100 = \text{Cement Yield}$$

$$\frac{507.03}{512.05} \times 100 = \mathbf{99.0\%}$$

Solution for Page 9-27

Location

Date of Placement	From	To
Mix 1	8/6/2013	
Mix 2	8/6/2013	
Mix 3		
Mix 4		
Mix 5		

Project No.: STP-64(12)28-58
 Plant Name: KR - Hwy 218 & F62
 Contractor: Knife River
 SubContractor:
 Weather: Sunny
 Maturity?:
 Curve #: _____

Report No.: 004
 Date This Report: 9/17/2014
 Date Of Last Report:
 Structures Des. No.:
 Curve / Validation Date:
 Curve Expiration Date:
 TTF:

Plant Type (X)	Placement Type	SEND
Central X	Paving	Report (Daily)
Ready	Continuous	X (Weekly)
	Non-structural	(Monthly)
	Miscellaneous	(Project)

Max On Grade W/C Ratio:

Mix	Batched yd3	% Of Est. Used	Waste yd3	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used -			Avg w/c Ratio	Max w/c Ratio	
				T-203 Sp. G.	Moist. (%)	Wt. SSD lbs	T-203 Sp. G.	Moist. (%)	Wt. SSD lbs	Cement	Fly Ash	GGBFS	Fine	Inter.	Coarse			In Agg.	Plant	Grade
1	1,256.00	0.0	0.00	3.3	2.65	1,384	0.5	2.63	1,679	446	111	1431	1687	56	175.0	0.0	0.414	0.450
2	1,384.00	0.0	0.00	3.0	2.65	1,384	0.3	2.63	1,679	446	111	1427	1684	48	190.0	0.0	0.427	0.450
3																		
4																		
5																		

Sample Date:	Coarse			Intermediate			Fine		
	1 1/2"	1"	3/4"	1 1/2"	1"	3/8"	1 1/2"	1"	3/4"
	100	95-100	1/2"	25-60	3/8"	3/8"	1/2"	1/2"	1/2"

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

Check One (X)	Daily	Total	Waste	To Date
Concrete: yd3	2640.00			
Cement: tons	588.72			

Sample Date:	Intermediate			Fine		
	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"
	100	90-100	70-100	100	90-100	70-100

CarbonCure:	Brand / Source	Rate	Lot Number
	Daravair-1000-GCP	5.0 oz/yd	233998
	Eucon WR-75-Euclid	3 oz./100lbs	557882

Sample Date:	Adjusted % Passing Calculated Combined Gradation		
	1 1/2"	1"	3/8"
	100	90-100	70-100

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

Target	Adjusted % Passing Calculated Combined Gradation						
	1 1/2"	1"	3/4"	3/8"	#4	#16	#30
	100	90-100	70-100	10-60	100	90-100	70-100

Type	Sp. Gr.	Source
IP(25)	2.99	PC0008-Ash Grove - Louisville-IP(25)
C	2.62	FA004C-Council Bluffs Unit #3

Certified RM The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks

C.P.I. #1:
 C.P.I. #2:
 Monitor #1:
 Monitor #2:

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

Solution for Page 9-29

4/3/2023

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Form E820150
E - Units

Project No.: STP-64(12)28-58 County : 58-Louisa

Mix No.: C-3WR-C20 Abs Vol. Cement: 0.1080 Type: IP(25)

Cement (IM 401):	<u>557</u>	lbs	Source: <u>PC0008-Ash Grove - Louisv</u>	Sp. Gr.:	<u>2.99</u>
	%				
Fly Ash (IM 491.17):	<u>20</u>	<u>111</u>	Source: <u>FA004C-Council Bluffs Unit</u>	Sp. Gr.:	<u>2.62</u>
	%				
Slag (IM 491.14):	<u>0</u>	<u>0</u>	Source: _____	Sp. Gr.:	_____
	%				
CarbonCure:	<u>0</u>	<u>0</u>	Cement Reduction		

Adjusted Cement: 446 lbs
Total Cementitious 557 lbs Total % Replacement = 40

IM T203	Fine Aggregate Source:	<u>A06502-VINTON-MILROY</u>	Sp. Gr.:	<u>2.65</u>
IM T203	Interm. Aggregate Source:	_____	Sp. Gr.:	_____
IM T203	Coarse Agregate Source:	<u>A10030-SOUTH AURORA</u>	Sp. Gr.:	<u>2.63</u>

Basic w/c	<u>0.420</u>	Water	lbs/cy	= Basic w/c X (Total Cementitious)	=	<u>234</u>
Max w/c	<u>0.450</u>	Max. Water	lbs/cy	= Max w/c X (Total Cementitious)	=	<u>251</u>

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.087</u>
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.025</u>
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.139</u>
	Air			<u>0.060</u>
	Subtotal		=	<u>0.311</u>
	1.000 - Subtotal		=	<u>0.689</u>
	Total		=	<u>1.000</u>

% FA Agg.:	<u>45</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.310</u>
% In. Agg.:	_____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.:	<u>55</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.379</u>
		Aggregate Total	=	<u>0.689</u>

Aggregate Weights	Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1384</u>
	Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>0</u>
	Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1679</u>

Summary	Cement	<u>446</u> lbs/cy
	Fly Ash	<u>111</u> lbs/cy
	Slag	<u>0</u> lbs/cy
	Water	<u>234</u> lbs/cy
	Fine Agg.	<u>1384</u> lbs/cy
	Interm. Agg.	<u>0</u> lbs/cy
	Coarse Agg.	<u>1679</u> lbs/cy

Plant Name & Location: KR - Hwy 218 &F62
CPI:
Cert #:

Air Entrainment:	<u>Daravair 1000-GCP</u>	Rate:	<u>5.0 oz/yd</u>
Normal Water Reducer:	<u>Eucon WR-75-Euclid</u>	Rate:	<u>3 oz./100lbs</u>
Mid-Range Water Reducer:		Rate:	
High-Range Water Reducer:		Rate:	
Retarder:		Rate:	
Special Performance Admixture:		Rate:	
Fibers:		Rate:	
CarbonCure:		oz/cy:	

Distribution: ___ DME, ___ Proj. Engr., ___ Contractor

Solution for Page 9-31

900240 computer v16.1 PCC Plant Report

Project No.: FM-91(15)-66-91 Contract ID: 73912 Report No.: 009

Plant Name: Warren_R63 County: 91-Warren Date This Report: 8/6/2013

Contractor: Knife River Temp. Min: 40 °F Date Of Last Report: 8/6/2013

Subcontractor: Weather: Sunny/Cool Maturity Mix ID: Maturity?: Curve #: Curve Strength: Structures Des. No.: Curves / Validation Date: Max On Grade W/C Ratio:

Plant Type (x) Placement Type SEND
 Central X Paving Continuous (Daily)
 Ready Non-structural (Weekly)
 Miscellaneous (Monthly)
 (Project)

Mix	Batched yd3	% Of Est. Used	Fine Aggregate		Intermediate Aggregate		Coarse Aggregate		Actual Quantities Used - lbs/yd3					Avg w/c Ratio	Max w/c Ratio	
			Moist. (%)	Wt. SSD lbs	Moist. (%)	Wt. SSD lbs	Moist. (%)	Wt. SSD lbs	Cement	Fly Ash	GGBFS	Fine	Inter.			Coarse	In Agg.	Plant	Grade
1	M-4	1,011.50	3.3	2.65	1,393	0.5	2.67	1408	817	1441	1415	55	175.0	0.0	0.281	0.400
2	M-4	79.00	3.0	2.65	1,393	0.3	2.67	1408	817	1436	1412	47	245.0	0.0	0.358	0.400
3																
4																
5																

Sample Date: _____

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

Concrete: yd3 1090.50 Cement: tons 445.47

Sample Date: _____

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

CarbonCure: _____

Air Entraining: Sika Air-Sika Brand / Source Rate Lot Number
 6.0 oz/yd J60038M
 Normal Water Reducer: Plastocrete 161-Sika 2 oz./100lbs J60011F
 Mid-Range Water Reducer: _____
 High-Range Water Reducer: _____
 Retarder: _____
 Special Performance Admixturer: _____
 Concrete Fibers: _____

Sample Date: _____

Conc. Treatment	(X)	lbs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

CarbonCure: _____

Air Entraining: Sika Air-Sika Brand / Source Rate Lot Number
 6.0 oz/yd J60038M
 Normal Water Reducer: Plastocrete 161-Sika 2 oz./100lbs J60011F
 Mid-Range Water Reducer: _____
 High-Range Water Reducer: _____
 Retarder: _____
 Special Performance Admixturer: _____
 Concrete Fibers: _____

Target	Adjusted % Passing Calculated Combined Gradation												
	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	CW Target Zone

Certified RM _____

Remarks _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

C.P.I. #1: _____
 C.P.I. #2: _____
 Monitor #1: _____
 Monitor #2: _____

Solution for Page 9-33

4/3/2023	Iowa Department Of Transportation Office Of Materials PORTLAND CEMENT CONCRETE	Form EB20150 E - Units
Project No.: <u>FM-91(15)--66-91</u>		County: <u>91-Warren</u>
Mix No.: <u>C-3WR</u>	Abs Vol. Cement: <u>0.1080</u>	Type: <u>IL</u>
Cement (IM 401): <u>566</u> lbs	Source: <u>PC0009-Ash Grove - Louisv</u>	Sp. Gr.: <u>3.11</u>
%		
Fly Ash (IM 491.17): <u>0</u>	Source: _____	Sp. Gr.: _____
%		
Slag (IM 491.14): <u>0</u>	Source: _____	Sp. Gr.: _____
%		
CarbonCure: <u>0</u> <u>0</u> Cement Reduction		
Adjusted Cement: <u>566</u> lbs		
Total Cementitious <u>566</u> lbs	Total % Replacement = <u>10</u>	
IM T203 Fine Aggregate Source: <u>A06502-VINTON-MILROY</u>	Sp. Gr.: <u>2.65</u>	
IM T203 Interm. Aggregate Source: _____	Sp. Gr.: _____	
IM T203 Coarse Agregate Source: <u>A22010-OSTERDOCK</u>	Sp. Gr.: <u>2.67</u>	
Basic w/c <u>0.430</u> Water lbs/cy = Basic w/c X (Total Cementitious) = <u>243</u>		
Max w/c <u>0.450</u> Max. Water lbs/cy = Max w/c X (Total Cementitious) = <u>255</u>		
Absolute Volumes		
Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	<u>0.108</u>
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	
Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	<u>0.144</u>
Air		<u>0.060</u>
	Subtotal	= <u>0.312</u>
	1.000 - Subtotal	= <u>0.688</u>
	Total	= <u>1.000</u>
% FA Agg.: <u>45</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	= <u>0.310</u>
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	= _____
% CA Agg.: <u>55</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	= <u>0.378</u>
	Aggregate Total	= <u>0.688</u>
Aggregate Weights		
Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	= <u>1384</u>
Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	= <u>0</u>
Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	= <u>1700</u>
Summary		
	Cement <u>566</u> lbs/cy	
	Fly Ash <u>0</u> lbs/cy	
	Slag <u>0</u> lbs/cy	
	Water <u>243</u> lbs/cy	
	Fine Agg. <u>1384</u> lbs/cy	
	Interm. Agg. <u>0</u> lbs/cy	
	Coarse Agg. <u>1700</u> lbs/cy	
Plant Name & Location: <u>Warren_R63</u>		
CPI: _____		
Cert #: _____		
	Air Entrainment: <u>Sika Air-Sika</u>	Rate: <u>6.0 oz/yd</u>
	Normal Water Reducer: <u>Plastocrete 161-Sika</u>	Rate: <u>2 oz./100lbs</u>
	Mid-Range Water Reducer:	Rate:
	High-Range Water Reducer:	Rate:
	Retarder:	Rate:
	Special Performance Admixture:	Rate:
	Fibers:	Rate:
	CarbonCure:	oz/cy:
Distribution: <u>DME</u> Proj. Engr., _____ Contractor		

Solution for Page 9-35

4/3/2023	Iowa Department Of Transportation Office Of Materials PORTLAND CEMENT CONCRETE	Form EB20150 E - Units
Project No.: <u>FM-91(15)--66-91</u>		County: <u>91-Warren</u>
Mix No.: <u>M-4</u>	Abs Vol. Cement: <u>0.1560</u>	Type: <u>IL</u>
Cement (IM 401): <u>817</u> lbs	Source: <u>PC0009-Ash Grove - Louisv</u>	Sp. Gr.: <u>3.11</u>
%		
Fly Ash (IM 491.17): <u>0</u>	Source: _____	Sp. Gr.: _____
%		
Slag (IM 491.14): <u>0</u>	Source: _____	Sp. Gr.: _____
%		
CarbonCure: <u>0</u> <u>0</u> Cement Reduction		
Adjusted Cement: <u>817</u> lbs		
Total Cementitious <u>817</u> lbs	Total % Replacement = <u>10</u>	
IM T203 Fine Aggregate Source: <u>A06502-VINTON-MILROY</u>	Sp. Gr.: <u>2.65</u>	
IM T203 Interm. Aggregate Source: _____	Sp. Gr.: _____	
IM T203 Coarse Agregate Source: <u>A22010-OSTERDOCK</u>	Sp. Gr.: <u>2.67</u>	
Basic w/c <u>0.328</u> Water lbs/cy = Basic w/c X (Total Cementitious) = <u>268</u>		
Max w/c <u>0.400</u> Max. Water lbs/cy = Max w/c X (Total Cementitious) = <u>327</u>		
Absolute Volumes		
Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	<u>0.156</u>
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	_____
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	_____
Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	<u>0.159</u>
Air		<u>0.060</u>
	Subtotal =	<u>0.375</u>
	1.000 - Subtotal =	<u>0.625</u>
	Total =	<u>1.000</u>
% FA Agg.: <u>50</u> Fine Aggregate (1.000 - Subtotal) X % In Mix = <u>0.312</u>		
% In. Agg.: _____ Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____		
% CA Agg.: <u>50</u> Coarse Aggregate (1.000 - Subtotal) X % In Mix = <u>0.313</u>		
	Aggregate Total =	<u>0.625</u>
Aggregate Weights		
Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27 =	<u>1393</u>
Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27 =	<u>0</u>
Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27 =	<u>1408</u>
Summary		
	Cement <u>817</u> lbs/cy	
	Fly Ash <u>0</u> lbs/cy	
	Slag <u>0</u> lbs/cy	
	Water <u>268</u> lbs/cy	
	Fine Agg. <u>1393</u> lbs/cy	
	Interm. Agg. <u>0</u> lbs/cy	
	Coarse Agg. <u>1408</u> lbs/cy	
Plant Name & Location: <u>Warren_R63</u>		
CPI: _____		
Cert #: _____		
	Air Entrainment: <u>Sika Air-Sika</u> Rate: <u>6.0 oz/yd</u>	
	Normal Water Reducer: <u>Plastocrete 161-Sika</u> Rate: <u>2 oz./100lbs</u>	
	Mid-Range Water Reducer: _____ Rate: _____	
	High-Range Water Reducer: _____ Rate: _____	
	Retarder: _____ Rate: _____	
	Special Performance Admixture: _____ Rate: _____	
	Fibers: _____ Rate: _____	
	CarbonCure: _____ oz/cy	
Distribution: <u>DME</u> Proj. Engr.: _____ Contractor _____		

Solution for Page 9-37

800240 computer VER 1-06

Location

Date of Placement	From	To
Mix 1	9/30/15	
Mix 2	9/30/15	
Mix 3		
Mix 4		
Mix 5		

PCC Plant Report

Project No.: STP-99(19)30-85
 Plant Name: Manatt's Paving - Nevada
 Contractor: Manatt's
 SubContractor:
 Weather: Warm/Dry

Contract ID:
 County: Story
 Temp. Min: 72 °F
 Temp. Max: 85 °F
 Report No.: 4
 Date This Report: 10/01/15
 Date Of Last Report: 09/30/15
 Structures Des. No:

Check Mix (X)	Check One (X)	E - Units
Central X	Paving X	SEND
Ready	Structure	(Daily)
	Non-structural	(Weekly)
	Miscellaneous	(Monthly)
		(Project)

Mix	Batched yd3	% Of Est. Used	Fine Aggregate		Intermediate Aggregate		Coarse Aggregate		Actual Quantities Used -					Avg w/c Ratio	Max w/c Ratio		
			T-203 Sp. G.	Moist. (%)	T-203 Sp. G.	Moist. (%)	T-203 Sp. G.	Moist. (%)	Cement	Fly Ash	GGBFS	Fine	Inter.			Coarse	In Agg.	Plant	Water Grade
C-4-C15	975.00	2.9	2.65	1,473	0.3	2.68	1,490	0.3	2.68	1,490	93	1,517	1,494	48	225.0	0.443	0.488
M-4	128.00	2.9	2.65	1,393	0.3	2.68	1,413	0.3	2.68	1,413	817	1,435	1,417	46	238.0	0.347	0.400

Conc. Treatment (X)	lbs/yd3
Ice	
Heated Water	
Heated Materials	

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-50		0-10	0-5	0-2.5	Y/N

Intermediate	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
									NA
									NA
									NA

Fine	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Comply
	100	90-100	70-100		10-60		0-1.5	Y/N		Y/N

Target	Adjusted % Passing Calculated Combined Gradation												
	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	CW
													Within Target Zone

Remarks	

Brand / Source	Rate	Lot Number
Darex II AEA	5.0 oz./yd.	622208
Air Entraining:		
Water Reducer:		
Retarder:		
Calcium Chloride:		
Superplasticizer:		

Type	Sp. Gr.	Source
I/II	3.11	PC0509
C	2.48	FA003F
3		

Source	T-203 A #	Grad. No.
	A18528	3
Coarse:		
Intermediate:		
Fine:	A07512	1

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____
 C.P.I.: _____
 Monitor: _____

Solution for Page 9-39

Rev 02/01

**Iowa Department of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE**

Form E820150
E - Units

Project No.: STP-99(19)30-85

County : Story

Mix No.: C-4-C15 Abs Vol. Cement: 0.118 Type: I/II

Cement (IM 401): 618 lbs Source: PC0509 Sp. Gr.: 3.11

Fly Ash (IM 491.17): 15 93 Source: FA003F Sp. Gr.: 2.48

Slag (IM 491.14): 0 Source: Sp. Gr.:

Adjusted Cement: 525 lbs

Total Cementitious 618 lbs Total % Replacement = 15

IM T203 Fine Aggregate Source: Sp. Gr.: 2.65

IM T203 Interm. Aggregate Source: Sp. Gr.:

IM T203 Coarse Agregate Source: Sp. Gr.: 2.68

Basic w/c 0.430 Water lbs/cy = Basic w/c X (Total Cementitious) = 266

Max w/c 0.488 Max. Water lbs/cy = Max w/c X (Total Cementitious) = 302

Absolute Volumes Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.100

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.022

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) =

Water (lbs/cy) / (Sp. Gr. X 62.4 X 27) = 0.158

Air 0.060

Subtotal = 0.340

1.000 - Subtotal = 0.660

Total = 1.000

% FA Agg.: 50 Fine Aggregate (1.000 - Subtotal) X % In Mix = 0.330

% In. Agg.: Interm. Aggregate (1.000 - Subtotal) X % In Mix =

% CA Agg.: 50 Coarse Aggregate (1.000 - Subtotal) X % In Mix = 0.330

Aggregate Total = 0.660

Aggregate Weights Fine: Abs Vol. X Sp. Gr. X 62.4 X 27 = 1473

Intermediate: Abs Vol. X Sp. Gr. X 62.4 X 27 =

Coarse: Abs Vol. X Sp. Gr. X 62.4 X 27 = 1490

Summary Cement 525 lbs/cy
 Fly Ash 93 lbs/cy
 Slag 0 lbs/cy
 Water 266 lbs/cy
 Fine Agg. 1473 lbs/cy
 Interm. Agg. lbs/cy
 Coarse Agg. 1490 lbs/cy

Distribution: DME, Proj. Engr., Contractor

Solution for Page 9-41

Rev 02/01

**Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE**

Form E820150
E - Units

Project No.: STP-99(19)30-85 County : Story

Mix No.:	<u>M-4</u>	Abs Vol. Cement:	<u>0.156</u>	Type:	<u>I/II</u>
Cement (IM 401):	<u>817</u> %	lbs	Source:	<u>PC0509</u>	Sp. Gr.: <u>3.11</u>
Fly Ash (IM 491.17):		<u>0</u>	Source:		Sp. Gr.: _____
Slag (IM 491.14):		<u>0</u>	Source:		Sp. Gr.: _____
Adjusted Cement:		<u>817</u>	lbs		
Total Cementitious		<u>817</u>	lbs	Total % Replacement = <u>0</u>	

IM T203	Fine Aggregate Source:	_____	Sp. Gr.:	<u>2.65</u>
IM T203	Interm. Aggregate Source:	_____	Sp. Gr.:	_____
IM T203	Coarse Agregate Source:	_____	Sp. Gr.:	<u>2.68</u>

Basic w/c	<u>0.328</u>	Water	lbs/cy	= Basic w/c X (Total Cementitious)	<u>= 268</u>
Max w/c	<u>0.400</u>	Max. Water	lbs/cy	= Max w/c X (Total Cementitious)	<u>= 327</u>

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.156</u>
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.159</u>
	Air			<u>0.060</u>
		Subtotal	=	<u>0.375</u>
		1.000 - Subtotal	=	<u>0.625</u>
		Total	=	<u>1.000</u>

% FA Agg.:	<u>50</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.312</u>
% In. Agg.:	_____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.:	<u>50</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.313</u>
		Aggregate Total	=	<u>0.625</u>

Aggregate Weights	Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1393</u>
	Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	_____
	Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1413</u>

Summary	Cement <u>817</u> lbs/cy
	Fly Ash <u>0</u> lbs/cy
	Slag <u>0</u> lbs/cy
	Water <u>268</u> lbs/cy
	Fine Agg. <u>1393</u> lbs/cy
	Interm. Agg. _____ lbs/cy
	Coarse Agg. <u>1413</u> lbs/cy

Distribution: ___ DME, ___ Proj. Engr., ___ Contractor

Solution for Page 9-43

Date of Placement		From		To		Location		Plant Type (X)		Placement Type		E-Units Report	
Mix 1	8/6/2013							Central	X	Paving	Continuous	(Daily)	X
Mix 2								Ready			Non-structural	(Weekly)	
Mix 3											Miscellaneous	(Monthly)	
Mix 4												(Project)	
Mix 5													

Report No.: 005
 Date This Report: 7/16/2014
 Date Of Last Report: _____
 Structures Des. No.: _____
 Curve / Validation Date: _____
 Curve Expiration Date: _____
 TTF: _____

Contract ID: 56743
 County: 54-Keokuk
 Temp. Min: 68 °F
 Temp. Max: 87 °F
 Maturity Mix ID: _____
 Curve Strength: _____
 Curve Type: _____

Project No.: FM-6(222)147--33-54
 Plant Name: Shipley-Keota
 Contractor: Shipley Construction
 SubContractor: _____
 Weather: Overcast/warm
 Maturity?: _____ Curve #: _____

Mix	Batched yd3	% Of Est. Used	Waste yd3	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used - lbs/yd3			Avg w/c Ratio	Max w/c Ratio	
				T-203 Moist (%)	T-203 Sp. G.	T-203 Wt. lbs	T-203 Moist (%)	T-203 Sp. G.	T-203 Wt. lbs	Cement	Fly Ash	GGBFS	Fine	Inter.	Coarse			In Agg.	Plant	Grade
1	1,256.00	0.0	0.00	3.8	2.66	1,385	0.7	2.61	1,662	457	114	1440	1674	66	151.0	26.0	0.426	0.450
2																		
3																		
4																		
5																		

Sample Date:	Coarse			Intermediate			Fine			Conc. Treatment	(X)	lbs/yd3	Comment (oz/cy)	%
	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"					
	100	95-100	25-50	3/8"	0-10	0-5	3/8"	0-10	0-5	3/8"	0-2.5	Y/N		

Sample Date:	Coarse			Intermediate			Fine			Check One (X)	Daily	Total To Date	Waste To Date
	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"				
	100	95-100	25-50	3/8"	0-10	0-5	3/8"	0-10	0-5	3/8"	X		

Sample Date:	Coarse			Intermediate			Fine			Type	Sp. Gr.	Source
	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"	1 1/2"	1"	3/4"			
	100	95-100	25-50	3/8"	0-10	0-5	3/8"	0-10	0-5	II	3.14	PC3402-St Marys - Charlevoix-II
										C	2.76	FA010C-Muscantine Power & Water

Target	Adjusted % Passing Calculated Combined Gradation									Coarse: A23004-BEHR	Intermediate: _____	Fine: A05506-EXIRA
	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30				#50	#100	#200

CarbonCure: _____
 Air Entraining: Sika AEA-14-Sika 5.0 oz/yd 77AA4356
 Normal Water Reducer: Euton WR-75-Euclid 3 oz./100lbs ME88934C
 Mid-Range Water Reducer: _____
 High-Range Water Reducer: _____
 Retarder: _____
 Special Performance Admixturer: _____
 Concrete Fibers: _____

Cement: _____
 Fly Ash: _____
 GGBFS: _____

Grad. No. 3
 Grad. No. 1

C.P.I. #1: _____
 C.P.I. #2: _____
 Monitor #1: _____
 Monitor #2: _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

Certified RM The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications

Remarks: _____

Solution for Page 9-45

4/3/2023

**Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE**

Form E820150
E - Units

Project No.: FM-6(222)147--33-54 County : 54-Keokuk

Mix No.: C-3WR-C20 Abs Vol. Cement: 0.1080 Type: II

Cement (IM 401):	<u>571</u>	lbs	Source: <u>PC3402-St Marys - Charlev</u>	Sp. Gr.:	<u>3.14</u>
	%				
Fly Ash (IM 491.17):	<u>20</u>	114	Source: <u>FA010C-Muscatine Power 8</u>	Sp. Gr.:	<u>2.76</u>
	%				
Slag (IM 491.14):	<u>0</u>	0	Source: _____	Sp. Gr.:	_____
	%				
CarbonCure:	<u>0</u>	0	Cement Reduction		

Adjusted Cement: 457 lbs
 Total Cementitious 571 lbs Total % Replacement = 20

IM T203	Fine Aggregate Source:	<u>A05506-EXIRA</u>	Sp. Gr.:	<u>2.66</u>
IM T203	Interm. Aggregate Source:	_____	Sp. Gr.:	_____
IM T203	Coarse Agregate Source:	<u>A23004-BEHR</u>	Sp. Gr.:	<u>2.61</u>

Basic w/c	<u>0.420</u>	Water	lbs/cy	= Basic w/c X (Total Cementitious)	=	<u>240</u>
Max w/c	<u>0.450</u>	Max. Water	lbs/cy	= Max w/c X (Total Cementitious)	=	<u>257</u>

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.086</u>
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.025</u>
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	<u>0.142</u>
	Air			<u>0.060</u>
		Subtotal	=	<u>0.313</u>
		1.000 - Subtotal	=	<u>0.687</u>
		Total	=	<u>1.000</u>

% FA Agg.:	<u>45</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.309</u>
% In. Agg.:	_____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.:	<u>55</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	<u>0.378</u>
		Aggregate Total	=	<u>0.687</u>

Aggregate Weights	Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1385</u>
	Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>0</u>
	Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27	=	<u>1662</u>

Summary	Cement <u>457</u> lbs/cy
	Fly Ash <u>114</u> lbs/cy
	Slag <u>0</u> lbs/cy
	Water <u>240</u> lbs/cy
	Fine Agg. <u>1385</u> lbs/cy
	Interm. Agg. <u>0</u> lbs/cy
	Coarse Agg. <u>1662</u> lbs/cy

Plant Name & Location: Shiplee-Keota
 CPI:
 Cert #:

Air Entrainment: <u>Sika AEA-14-Sika</u>	Rate: <u>5.0 oz/yd</u>
Normal Water Reducer: <u>Eucon WR-75-Euclid</u>	Rate: <u>3 oz./100lbs</u>
Mid-Range Water Reducer:	Rate:
High-Range Water Reducer:	Rate:
Retarder:	Rate:
Special Performance Admixture:	Rate:
Fibers:	Rate:
CarbonCure:	oz/cy:

Distribution: ___ DME, ___ Proj. Engr., ___ Contractor

Chapter 11
IM 213 CERTIFICATION

TRAINING

The Iowa DOT will provide the training necessary to become certified. Producers/Contractors are encouraged to conduct their own pretraining program. A complete listing of training opportunities is available at the Technical Training & Certification Program website, <https://iowadot.gov/training/technical-training-and-certification-program>.

CERTIFICATION REQUIREMENTS

1. A candidate must attend Iowa DOT course instruction and pass the examination(s) for all levels of certification prepared and presented by the Program Director or someone designated by the Program Director. If the new candidate fails the examination, they will have one opportunity to retake the examination. The retake must be completed within six months of the original exam. If they fail the retake of the examination, they will need to attend the training again before taking the examination the third time. If an individual is recertifying they will have only one opportunity to take the examination. If they fail the examination they must take the applicable training before retaking the examination.
2. All prerequisites shall be met before the applicant may attend the next level of training for the certification desired. A listing of certification levels and prerequisites is located in [Appendix A](#).
3. Once the candidate has met all the criteria and has received certification, it is recommended the Certified Technician work under the supervision of an experienced technician until they become efficient in the inspection and testing methods they will be performing.

An individual requesting to become certified as a Precast/Prestress Concrete Technician is required to obtain forty hours of experience assisting in quality control inspection at an approved plant before certification will be issued. The experience must be documented and shall be approved by the District Materials Engineer. This experience must be completed within two years from the date the individual attended the training.

4. Registered Professional Engineers, engineering graduates, and geology graduates from accredited institutions will be exempt from the training requirement in the areas they have had instruction. It is, however, strongly recommended that they attend the certification classes. In order to obtain certification for any technical level, these persons must pass all applicable written examinations for the level of certification they wish to obtain. If the written examination attempt does not meet the required score, the candidate must take the certification class before another attempt can be made. All certificates issued in accordance with these requirements will be subject to the same regulations concerning expiration, recertification, etc., as applies to certificates obtained via training and examinations.
5. Technicians will be issued certifications by reciprocity when the following criteria are met:
 - a. The applicant must be certified in another state or certification program determined equivalent by the Program Director or someone designated by the Program Director, in each level of certification they are requesting.
 - b. The applicant must pass an examination for each level of certification desired, which will be administered by the Iowa Department of Transportation. Failure of the examination shall require the applicant to take the full certification class before they can retake the exam.

-
- c. The applicant must follow the prerequisite requirements of the Technical Training & Certification Program.

Reciprocity requests should be made through the Technical Training and Certification office in Ames. Copies of all the applicant's certifications will be required.

CERTIFICATION

Upon successfully completing the requirements for certification, the Program Director will issue a pocket certification card. The certification is not transferable. A certification earned in a training season shall be valid until March 31st of the fifth succeeding training season. A training season is defined as October 1st, XXXX to September 30th, XXXX+1.

CERTIFICATION IDENTIFICATION

The certification card will identify the certificate holder, their certification number, the level(s) of certification, and the expiration date of each level.

RENEWAL OF CERTIFICATION

A certification shall be valid through March 31st of the fifth succeeding training season. If the individual has not renewed their certification by the certification expiration date, they are automatically decertified.

All certified technicians will be required to pass an examination before recertification will be issued. Failure of the examination shall require the applicant to retake the full certification class and pass the examination. If the individual does not take the examination within one year after their certification(s) expire-they must retake the full certification class and pass the examination.

If an applicant becomes decertified in any level of certification and that certification is a prerequisite for other levels of certification the applicant will also be decertified in those related levels of certification until the prerequisite certification has once again been obtained.

The certificate holder shall be responsible for applying for certification renewal and for maintaining a current address on file.

PROVISIONAL CERTIFICATION

Provisional certification will be allowed through a special request to the TTCP Director. The request can be mailed or emailed to the TTCP Director and must include the need for a provisional certification, such as, company technician quit and they need to replace, an unforeseen workload, etc. Provisional certifications will only be granted to contractors. If the request is granted the following requirements will apply.

1. The provisional certification applicant must work under the direct supervision of a certified technician until such time that the applicant is competent in the required skills of the certification and has taken the written exam. The applicant must also take the web based review offered by the TTCP in the area they are seeking provisional certification.
2. The applicant must take and pass the written exam for the provisional certification they are requesting. There will be a testing fee in the amount of the TTCP recertification fee due at the time of the exam. CIT funds may not be used for provisional certification testing. The exams will be offered at the District Materials offices or the TTCP office in Ames.
3. The technician must demonstrate proficiency to an Iowa DOT certified technician at the first available opportunity.

-
4. After the provisional certification applicant has successfully completed the steps in 1 and 2, they will become provisionally certified until the end of the calendar year in which they obtained certification.
 5. If the provisional certified technician wishes to keep their certification they must attend the full class at the full class cost for the certification during the training season immediately following their provisional certification.
 6. A provisional certification is not intended to be an annual request. The provisional certification will only be allowed for one construction season. Repeated requests for provisional certifications for the technician will be denied.
 7. Any prerequisites for the certification must be met prior to number 2 above.
 8. HMA Basic Tester is a new certification that may only be used as a provisional certification. This certification follows all the requirements previously listed and the technician will be required to take Level I HMA at the first available opportunity after the provisional expires.
 9. Provisional Certification will be offered for:
 - a. Aggregate Sampler
 - b. Aggregate Technician
 - c. Level I PCC
 - d. HMA Sampler
 - e. HMA Basic Tester

UNSATISFACTORY PERFORMANCE NOTICE

A certified technician failing to perform the required specified duties or inadequately performing these duties, will receive an Unsatisfactory Notice ([Materials IM 213, Appendix B](#)). The notice will be from the District Materials Engineer in the District where the failure occurred. This notice and all supporting documentation will be placed in the technician's record with the Iowa Department of Transportation's Technical Training & Certification Program (TTCP). The notice will remain in their file for five years. The notice may be removed prior to the five years upon the recommendation of the District Materials Engineer.

SUSPENSION

A technician receiving two Unsatisfactory Work Performance Notices for work performed under a specific certification will be given a three-month suspension of the applicable certification. Suspended technicians shall not perform any duties governed by the suspended certification, including any duties which require the suspended certification as a prerequisite.

Technicians are eligible to be reinstated after the three-month suspension and successful completion of the applicable recertification test(s).

Technicians are subject to decertification when they receive a third Unsatisfactory Performance Notice.

The suspension will be effective on the date the Program Director issues the suspension.

DECERTIFICATION

Certified Technicians will be decertified for any of the following reasons:

Certifications will be revoked for the following reasons:

1. Failure of the certificate holder to renew the certificate prior to regular expiration as described above.

-
2. Use of false or fraudulent information to secure or renew a certificate.
 3. Use of false or fraudulent documentation by the certificate holder.
 4. Use of misleading, deceptive, untrue or fraudulent representations by the certificate holder.
 5. Cheating on certification exams or performance evaluations. This includes removing, or attempts to remove, exam questions, answers, or other exam materials from the testing location.
 6. Receipt of 3 Unsatisfactory Performance notifications, as stated above under suspension.

The Program Director, or designee, will notify an individual in writing of the intent to suspend or revoke the individual's certification(s). Notice will also be sent to the technician's last known employer. For DOT employees, notice will also be sent to their immediate supervisor.

An individual's certifications will be suspended during the appeal process, and the individual can't perform any duties governed by the certification during this time, until the first day following the end of the appeal process described below.

Technicians that are decertified shall not perform any duties requiring certification.

APPEALS & REINSTATEMENT REQUESTS

An individual has 10 business days to respond to the revocation notice. If the individual fails to respond with an appeal within 10 days of receipt of the original revocation notice, the suspension or revocation becomes effective on the 10th day.

Appeal step 1: First step appeals will be heard by the program director and a representative panel. The individual will have an opportunity to present information to support their continued certification to the panel. The Program Director and representative panel will then render a written decision, taking into account the technician's actions or omissions, the existence of past infractions, and any mitigating factors. This step 1 appeal will become final if further action is not taken as described in appeal step 2 and the suspension or revocation will become effective on the day the decision is issued by the panel.

Appeal step 2: If the individual is not satisfied with the decision of the Program Director and representative panel, the individual shall, within 10 days of receipt of the written decision, submit a request for further review to the Program Director. This appeals request will be considered by the entire Certification Board. The decision of the Certification Board will be the final decision on behalf of Technical Training & Certification Program.

Any violation will remain on the violator's record for five years, at which time the violation will be removed from their record.

A technician may request reinstatement after one year of being decertified unless the Program Director authorized a shorter period of time, which shall not be less than three months. If a reinstatement is authorized, the individual must attend and successfully complete the applicable certification courses.

FUNCTIONS & RESPONSIBILITIES

A certificate holder at each production site, project site, proportioning plant, or laboratory will perform duties. The certified technician shall perform quality control testing in accordance with specified frequencies and submit designated reports and records.

The specification requirement for materials testing by a certified technician does not change the supplier's responsibilities to furnish materials compliant with the specification requirements.

The District Materials Engineer and/or Project Engineer will be responsible for monitoring the sampling, testing, production inspection activities and quality control performed by the contractor. A monitor shall have satisfactorily completed the training and be certified for the level of technician they are monitoring.

The District Materials Engineer and/or Project Engineer will have authority and responsibility to question and, where necessary, require changes in operations and quality control to ensure specification requirements are met.

QUALITY CONTROL, TESTING, & DOCUMENTATION

The QC Technician shall be present whenever construction work related to production activity, such as stockpiling or other preparatory work, requires record development and/or documentation is in progress. The QC Technician's presence is normally required on a continuing basis beginning one or more days before plant operation begins and ending after plant shut down at the completion of the project. The work shall be performed in a timely manner and at the established frequencies.

The QC Technician's presence is not normally required during temporary plant shut downs caused by conditions, such as material shortages, equipment failures, or inclement weather.

All quality control activities and records shall be available and open for observation and review by representatives of the contracting authority.

Reports, records, and diaries developed during progress of construction activities will be filed as directed by the Contracting Authority and will become the property of the Contracting Authority.

Quality control activities, testing, and records will be monitored regularly by Contracting Authority representatives. The Project Engineer or District Materials Engineer will assign personnel for this function.

Monitor activities will be reported and filed at prescribed intervals with the Project Engineer, District Materials Engineer, producer, contractor, and the contractor's designated producer.

At no time will the monitor inspector issue directions to the contractor, or to the QC Technician. However, the monitor inspector will have the authority and responsibility to question, and where necessary, reject any operation or completed product, which is not in compliance with contract requirements.

ACCEPTANCE

Completed work will be accepted on the basis of specification compliance documented by acceptance test records, and monitor inspection records. Specification noncompliance will require corrective action by the producer, contractor, or by the contractor's designated producer, and review of events and results associated with noncompliance by the Project Engineer.

CERTIFICATION LEVELS

CERTIFICATION LEVEL	TITLE	PRE-REQUISITES
AGGREGATE		
Aggregate Sampler	Certified Sampling Technician	None
Aggregate Technician	Certified Aggregate Technician	None
EROSION CONTROL		
Erosion Control	Erosion Control Technician	None
HOT MIX ASPHALT		
HMA Sampler	HMA Sampler	None
Level I HMA	HMA Technician	Aggregate Technician
Level II HMA	HMA Mix Design Technician	Level I HMA
PORTLAND CEMENT CONCRETE		
Level I PCC**	PCC Testing Technician	None
Level II PCC	PCC Plant Technician	Agg. Technician & Level I PCC
Level III PCC	PCC Mix Design Technician	Level II PCC
**American Concrete Institute (ACI) Grade I certification will be acceptable as a portion of the Level I PCC training.		
PRESTRESS		
Prestress	Prestress Technician	Level I PCC or ACI Grade I If the technician will be performing gradations, they will need to be Aggregate Technician certified.
RIDE QUALITY		
Ride Quality	Ride Quality Technician	None
SOILS		
Soils	Soils Technician	None

UNSATISFACTORY PERFORMANCE NOTICE

Issued To: _____

Date: _____

This notice is to inform you that your performance as a Certified Inspector/Technician was unsatisfactory for the reason(s) listed below.

This notice and all supporting documentation will be placed in your record with the Iowa Department of Transportation's Technical Training & Certification Program (TTCP).

The goal of the Technical Training and Certification Program (TTCP) is to work with contractors, producers, cities, counties, and consultants to continually improve the quality of Iowa's construction projects. We hope you will work with us to achieve this goal.

Unsatisfactory Performance:

District Materials Engineer

cc: Program Director –Construction and Materials Engineer, Ames
TTCP Coordinator
Resident Construction Engineer

CERTIFIED TECHNICIANS QUALIFICATIONS

Tests and Procedures the Certified Technician is qualified to perform for each level of certification.

AGGREGATE SAMPLER

- [IM 204](#) - Inspection of Construction Project Sampling & Testing (when material is incorporated)
- [IM 209, App. C](#) - Aggregate Specification Limits & Sampling & Testing Guide (when material is produced)
- [IM 301](#) - Aggregate Sampling Methods
- [IM 336](#) – Methods of Reducing Aggregate Field Samples to Test Samples

AGGREGATE TECHNICIAN

- [IM 204](#) - Inspection of Construction Project Sampling & Testing (when material is incorporated)
- [IM 209, App. C](#) - Aggregate Specification Limits & Sampling & Testing Guide (when material is produced)
- [IM 210](#) – Production of Certified Aggregate From Reclaimed Roadways
- [IM 216](#) - Guidelines for Verifying Certified Testing Results
- [IM 301](#) - Aggregate Sampling Methods
- [IM 302](#) - Sieve Analysis of Aggregates
- [IM 306](#) - Determining the Amount of Material Finer Than #200 (75µm) Sieve in Aggregate
- [IM 307](#) - Determining Specific Gravity of Aggregate
- [IM 308](#) - Determining Free Moisture & Absorption of Aggregate
- [IM 336](#) - Methods of Reducing Aggregate Field Samples to Test Samples
- [IM 344](#) - Determining the Amount of Shale in Fine Aggregate
- [IM 345](#) - Determining the Amount of Shale in Coarse Aggregate
- [IM 368](#) – Determining the Amount of Clay Lumps & Friable Particles in Coarse Aggregate
- [IM 409](#) – Source Approvals for Aggregate

HMA BASIC TESTER (This is for Provisional Certification Only)

- [IM 321](#) - Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
- [IM 322](#) - Method of Sampling Uncompacted Hot Mix Asphalt
- [IM 323](#) - Method of Sampling Asphaltic Materials
- [IM 325G](#) - Method of Test for Determining the Density of Hot Mix Asphalt (HMA) Using the Superpave Gyratory Compactor (SGC)
- [IM 350](#) - Maximum Specific Gravity of Hot Mix Asphalt (HMA) Mixtures
- [IM 357](#) - Preparation of Hot Mix Asphalt (HMA) Mix Samples for Test Specimens
- All forms must be signed by an HMA I or HMA II certified technician

HMA SAMPLER

- [IM 320](#) – Method of Sampling Compacted Asphalt Mixtures
 - [IM 321](#) – Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
 - [IM 322](#) - Method of Sampling Uncompacted Hot Mix Asphalt
-

- [IM 323](#) - Method of Sampling Asphaltic Materials

LEVEL I HMA

- [IM 204](#) - Inspection of Construction Project Sampling & Testing
- [IM 208](#) - Materials Laboratory Qualification Program
- [IM 216](#) - Guidelines for Verifying Certified Testing Results
- [IM 320](#) - Method of Sampling Compacted Asphalt Mixtures
- [IM 321](#) - Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
- [IM 322](#) - Method of Sampling Uncompacted Hot Mix Asphalt
- [IM 323](#) - Method of Sampling Asphaltic Materials
- [IM 325G](#) - Method of Test for Determining the Density of Hot Mix Asphalt (HMA) Using the Superpave Gyratory Compactor (SGC)
- [IM 337](#) - Determining Thickness of Completed Courses of Base, Subbase, & Hot Mix Asphalt
- [IM 350](#) - Maximum Specific Gravity of Hot Mix Asphalt (HMA) Mixtures
- [IM 357](#) - Preparation of Hot Mix Asphalt (HMA) Mix Samples for Test Specimens
- [IM 501](#) - Asphaltic Terminology, Equations & Example Calculations
- [IM 508](#) - Hot Mix Asphalt (HMA) Plant Inspection
- [IM 509](#) - Tank Measurement & Asphalt Cement Content Determination
- [IM 511](#) - Control of Hot Mix Asphalt (HMA) Mixtures

LEVEL II HMA

- [IM 380](#) - Vacuum-Saturated Specific Gravity & Absorption of Combined or Individual Aggregate Sources
- [IM 510](#) - Method of Design of Hot Mix Asphalt (HMA) Mixes
- AASHTO T176 - Plastic Fines in Graded Aggregate & Soils by use of Sand Equivalent Test
- AASHTO T304 - Uncompacted Void Content of Fine Aggregate
- ASTM D 4791 - Flat Particles, Elongated Particles, or Flat & Elongated Particles in Coarse Aggregate
- AASHTO T283 Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage

LEVEL I PCC

- [IM 204](#) - Inspection of Construction Project Sampling & Testing
 - [IM 208](#) - Materials Laboratory Qualification Program
 - [IM 216](#) - Guidelines for Verifying Certified Testing Results
 - [IM 315](#) - Method of Protecting, Curing, Making & Testing Concrete Cylinders
 - [IM 316](#) - Flexural Strength of Concrete
 - [IM 317](#) - Slump of Hydraulic Cement Concrete
 - [IM 318](#) - Air Content of Freshly-Mixed Concrete by Pressure
 - [IM 327](#) - Sampling Freshly-Mixed Concrete
 - [IM 328](#) - Making, Protecting, and Curing Concrete Flexural Specimens
 - [IM 340](#) - Weight Per Cubic Foot, Yield, & Air Content (Gravimetric) of Concrete
 - [IM 347](#) - Measuring Length of Drilled Concrete Cores
 - [IM 383](#) - Testing the Strength of PCC Using the Maturity Method
 - [IM 385](#) - Temperature of Freshly-Mixed Concrete
-

- [IM 525](#) - Designing Flowable Mortar
- AASHTO T97 - Third Point Loading

LEVEL II PCC

- [IM 527](#) - Paving Plant Inspection
- [IM 528](#) - Structural Concrete Plant Inspection
- [IM 529](#) - PC Concrete Proportions

LEVEL III PCC

- [IM 530](#) - Quality Management & Acceptance of PC Concrete Pavement
- [IM 531](#) - Test Method for Combining Aggregate Gradations
- [IM 532](#) - Aggregate Proportioning Guide for Portland Cement Concrete Pavement

PRESTRESS

- [IM 570](#) - Precast & Prestressed Concrete Bridge Units

RIDE QUALITY

- [IM 341](#) - Determining Pavement & Bridge Ride Quality

SOILS

- [IM 309](#) – Determining Standard Proctor Moisture Density Relationship of Soils
- [IM 312](#) – Sampling of Soils for Construction Project
- [IM 335](#) – Determining Moisture Content of Soils
- ASTM D-2937 – Field density by drive-cylinder method

AGGREGATE SAMPLING TECHNICIAN DUTIES

Duties of the Aggregate Sampling Technician are detailed in [IM 209](#) and the [IM 300](#) Series and consist of, but are not limited to the following:

A. Sampling

1. Obtain representative samples by approved method(s).
2. Sample at required frequencies.
3. Identify samples with pertinent information such as:
 - a. Type of material
 - b. Intended use
 - c. Production beds working depth
 - d. Sampling method
4. Reduce samples by approved method(s).

AGGREGATE TECHNICIAN DUTIES

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A. Sampling

1. Obtain representative samples by approved method(s).
2. Sample at required frequencies.
3. Identify samples with pertinent information such as:
 - a. Type of material
 - b. Intended use
 - c. Production beds working depth
 - d. Sampling method
4. Reduce samples by approved method(s).

B. Gradation Testing

1. Follow appropriate testing methods.
2. Maintain current applicable specifications.
3. Post test results within 24 hours of sampling.

C. Other Testing as required (specific gravity, moisture, deleterious material, etc.)

1. Follow appropriate testing methods.
2. Maintain current applicable specifications.
3. Complete required reports.

D. Sampling & Testing Equipment

1. Clean and check testing sieves for defects.
2. Assure scale accuracy.
3. Maintain sampling and testing equipment.

E. Communication

1. Notify the District Materials office for production start-up or changes.
2. Relay test results to appropriate production or supervisory personnel.
3. Report failing test results immediately to appropriate personnel (including District Materials office) and assure remedial actions are taken.

F. General

1. Monitor stockpiling procedures to avoid contamination and excess segregation.
2. Assure proper identification of stockpiles.
3. Assure specification requirements for intended use are met before shipment.
4. Assure sampling locations are safe.
5. Assure proper bedding planes or production depths are maintained.

G. Documentation

1. Report all production test results of certified aggregates on Form #821278 and distribute as required.
2. Assure "plant production log" is maintained.

EROSION CONTROL TECHNICIAN DUTIES

Duties of the Erosion Control Technician consist of, but are not limited to the following:

- A. Carefully review and be familiar with the details in the contract documents.
- B. Assign erosion and sediment control monitoring responsibilities to Erosion & Sediment Control (ESC) Basics trained field staff.
- C. Review copies of storm water inspection reports.
- D. Provide input on initial Erosion Control Implementation Plan (ECIP) submittal and ECIP updates.
- E. Provide onsite reviews when requested by Contracting Authority or Contractor field staff.

HOT MIX ASPHALT (HMA) SAMPLING TECHNICIAN INSPECTION DUTIES

Duties of the Hot Mix Asphalt Sampling Technician consist of, but are not limited to the following:

A. Plant Sampling. ([Article 2303.04](#), [IM 204](#) & [511](#))

1. Obtain asphalt binder samples as directed by Contracting Authority personnel per [IM 323](#) and [IM 204](#).

B. Field Sampling ([Article 2303.04](#), [IM 204](#) & [511](#))

1. Obtain uncompacted mix random samples as directed by Contracting Authority personnel, and identify time, station, lift and side.
2. Obtain compacted mix core random samples as directed by Contracting Authority personnel.

HOT MIX ASPHALT (HMA) TECHNICIAN INSPECTION DUTIES

The following is a list of the duties that must be performed by the Certified Level I HMA Technicians doing quality control work for the Contractor on all projects where the Quality Management-Asphalt (QM-A) specification applies. The Quality Control Technician shall have no other duties while performing certified inspection duties.

These duties consist of, but are not limited to, the following:

A. Aggregate Stockpiles.

1. Assure proper stockpiling of aggregate deliveries. (stockpile build & additions) ([IM 508](#))
 - a. Prevent intermingling of aggregates.
 - b. Check for and prevent contamination.
 - c. Prevent segregation.
 - d. Check for oversize material.
2. Document certified aggregate deliveries. (each delivery) ([IM 508](#)). When the aggregate supplier can provide a summary document of all deliveries, do not enter into Plant Book.
 - a. Obtain truck tickets.
 - b. Check for proper certification.
 - c. Check for proper approved source.
 - d. Enter deliveries in Plant Book Program when other documentation cannot be provided, Aggregate Certification page.
3. Observe loader operation. (daily) ([IM 508](#))
 - a. Check for proper stockpile to bin match-up.
 - b. Check that loader does not get stockpile base material in load.
 - c. Check that loader does not intermingle aggregate by overloading bins.

B. Asphalt Binder Delivery. (each delivery) ([IM 508](#) & [509](#))

1. Check that material is pumped into correct tank.
2. Document Deliveries.
 - a. Obtain truck tickets.
 - b. Check for proper approved source.
 - c. Check for proper certification.
 - d. Check for proper grade.
 - e. Check for addition of liquid anti-strip if required.
 - f. Check if weight per gallon or specific gravity has changed.
 - g. Enter deliveries into Plant Report Program.

C. Plant Operations. (daily)

1. Prepare Plant Report Program for daily entries. ([IM 511](#))
 - a. Enter Date.
 - b. Enter Report Number.
 - c. Enter expected tonnage for the day.
 - d. Enter any proportion or target changes that apply.
2. Aggregate Delivery System. ([IM 508](#))
 - a. Check for proper cold feed gate settings.
 - b. Check for proper cold feed belt speed settings.
 - c. Check for proper moisture setting (drum plants).
 - d. Monitor RAP proportions.
3. Mixing System. ([Article 2303.03](#), [IM 508](#))
 - a. Check for proper asphalt binder delivery setting.
 - b. Check for proper interlock operation.
 - c. Monitor coating of aggregates.
 - d. Monitor mixing time (batch plants).
4. Loading System. ([Article 2303.03](#) & [2001.01](#), [IM 508](#))
 - a. Check hopper/silo gates for proper open/close
 - b. Check trucks for proper loading and possible segregation.
 - c. Check trucks for diesel fuel contamination in box and remove contaminated trucks from service (5 hrs with box raised).
5. Asphalt Binder Quantity Determination.
 - a. Obtain totalizer printout readings and periodically check against tank stick readings.
 - b. If using batch count for quantity, obtain printouts of each batch and add up the asphalt binder used for total quantity.

D. Plant Operations. (2 hour intervals) ([IM 508](#))

1. Temperatures.
 - a. Monitor and record mix temperature at discharge into truck box.
 - b. Monitor and record asphalt binder temperature.
 - c. Monitor and record air temperature.
 2. Observe plant operation for any irregularities.
-

E. Weighing Equipment.

1. Proportioning scales (batch plants). (min. 1/day) ([Articles 2001.07](#) & [2001.20](#))
([IM 508](#))
 - a. Perform sensitivity checks of scales.
 - b. Check for interference at scale pivot points.
2. Pay Quantity Scales. (min. 1/day) ([Articles 2001.07](#) & [2001.20](#), [IM 508](#))
 - a. Regularly perform check weighing comparisons with a certified scale as necessary. (min. 1st day and one additional if >5000 tons, and as directed by Engineer)
 - b. Perform sensitivity checks of scales.
 - c. Check for interference at scale pivot points.
 - d. Perform verification weighing (truck platform scales).
3. Weigh Belts. (daily)
 - a. Check weigh belt for excess clinging fines that effects speed reading.
 - b. Check weigh belt for interference at bridge pivot points.
 - c. Check for proper span setting.
4. Enter scale checks in Plant Report Program. (daily)

F. Plant Sampling. (daily) ([Article 2303.04](#), [IM 204](#) & [511](#))

1. Obtain cold-feed gradation samples as directed by Contracting Authority personnel per [IM 301](#) and [IM 204](#).
2. Obtain asphalt binder samples as directed by Contracting Authority personnel per [IM 323](#) and [IM 204](#).
3. Obtain cold-feed moisture samples at a minimum of every ½ day (drum mix plants).

G. Field Sampling (if not performed by others). (daily) ([Article 2303.04](#), [IM 204](#) & [511](#))

1. Obtain uncompacted mix random samples as directed by Contracting Authority personnel, and identify time, station, lift and side.
2. Obtain compacted mix core random samples as directed by Contracting Authority personnel.

H. Testing. (daily) ([Article 2303.04](#), [IM 204](#) & [511](#))

1. Field cores.
 - a. Provide properly calibrated equipment for Contracting Authority technician's use.
 - b. Obtain and record core location station and offset information.
-

- c. Obtain copy of core thickness measurements from Contracting Authority Technician.
- d. Obtain copy of core weights from Contracting Authority technician.
- e. Record weights and thickness in Plant Report Program.

2. Uncompacted mix.

- a. Properly store Contracting Authority secured portion of paired sample.
- b. Split Contractor half of paired sample into test portions as per [IM 357](#).
- c. Perform gyratory compaction as per [IM 325G](#).
- d. Perform bulk specific gravity test of laboratory-compacted specimen as per [IM 321](#).
- e. Perform maximum specific gravity test as per [IM 350](#).
- f. Enter test data into Plant Report Program.
- g. Submit secured samples to DOT District Lab.

3. Aggregate.

- a. Split one sample each day as directed by Contracting Authority personnel and provide half for testing by Contracting Authority.
- b. Perform gradation analysis as per [IM 302](#) and enter weights into Plant Report Program.
- c. Perform moisture tests and produce results upon request.

4. Testing Lab Qualification. (as needed) ([IM 208](#) & [511](#))

- a. Record all HMA sample validations with DOT on form [235](#).
- b. Document corrective actions taken when not correlating.
- c. Document all test equipment calibrations.
- d. Update IM's, test procedures and specs as required.

I. Documentation. (daily) ([Article 2303.04](#), [IM 204](#), [511](#) & [508](#))

The Plant Report, Chart, Plant Book, and other HMA worksheets are available on the following website: https://iowadot.gov/construction_materials/Hot-mix-asphalt-HMA

1. Prepare computerized Daily Plant Report.

- a. Check that all data is correct.
- b. Check that all data is complete.
- c. Compute tons of mix used to date.
- d. Enter mix adjustment data on report.
- e. Check for spec compliance.
- f. Immediately report non-complying results.
- g. Obtain and record mat temperatures and stationing.
- h. Provide electronic daily Plant Report to DME.

2. Maintain a daily diary of work activity in Plant Report Program.

- a. Record weather conditions.

- b. Record daily high and low temperatures.
 - c. Record sunrise and sunset times.
 - d. Record any interruptions to plant production.
 - e. Record any other significant events.
 3. Import daily data into charting program.
 4. Enter tack shipment quantities in Plant Report Program.
 5. Total all truck tickets delivered to project and deduct any waste to determine HMA pay quantity.
 6. Complete Daily Check List
 - J. Miscellaneous. (daily) ([IM 208](#) & [511](#))
 1. Clean lab.
 2. Back-up computer files.
 3. Dispose of samples as directed by District Lab.
 4. Clean and maintain lab equipment.
 - K. Independent Assurance Duties. (Every 3 months) ([IM 205](#) & [216](#))
 1. Pick up HMA and aggregate proficiency sample from District Lab.
 2. Test aggregate proficiency sample for gradation per [IM 302](#).
 3. Test HMA proficiency sample per [IM 357](#), [325G](#), [321](#) & [350](#).
 4. Report test results on proficiency samples to Construction Materials Bureau per [IM 205](#).
 - L. Project Duties. (1/project) ([IM 508](#) & [511](#))
 1. Be in possession of appropriate mix design.
 2. Be present during plant calibration.
 3. Observe scale calibrations.
 4. Perform plant site and set-up inspection and fill out Plant Site Inspection List.
 5. Set up Plant Report Program and enter all project information to create Project Master files at beginning of project.
-

6. Check that release agents used in truck boxes are on the approved list in [MAPLE](#).
7. Copy all computer files and provide to the Contracting Authority at completion of project.
8. Copy all paperwork and control charts and provide to the Contracting Authority at completion of project.

**PORTLAND CEMENT CONCRETE (PCC) TECHNICIAN DUTIES
PAVING & STRUCTURAL CONCRETE**

The Quality Control Technician shall have no other duties while performing certified inspection duties. Refer to IM 528 for exceptions. The District Materials Engineer may approve all quality control activities be performed by a single certified technician for low production situations.

Many of the duties of the PCC Level II Technician are detailed in [IM 527](#) (Paving) and [IM 528](#) (Structural) and consist of, but are not limited to the following:

A. Stockpiles

1. Assure proper stockpiling procedures.
2. Prevent intermingling of aggregates.
3. Prevent contamination.
4. Prevent segregation.

B. Plant Facilities

1. Assure safe sampling locations.
2. Check for equipment compliance.
3. Assure proper laboratory location and facilities.

C. Calibration

1. Be present during calibration (paving).
2. Check plant calibration (structural).
3. Assure proper batch weights.

D. Cement (Fly Ash) & Aggregate Delivery

1. Check for proper sources and certification.
2. Document quantities delivered.
3. Monitor condition of shipments.

E. Plant Sampling

1. Check aggregate gradations by obtaining, splitting, and testing samples.

2. Check aggregate moistures and specific gravity.

F. Proportion Control

1. Check scale weights and operation.
2. Check admixture dispensers.
3. Check mixing time and revolutions.
4. Check cement yield. (Paving plant only, unless over 10,000 cu. yds.)

G. Concrete Tests

1. Cure flexural test specimens.
2. Test flexural specimens (Contract agency will perform test in structural plant).
3. Conduct maturity testing.

H. Test Equipment

1. Clean and maintain scales, screens, pycnometers and beam molds, and laboratory facility.

I. Documentation

1. Prepare daily plant reports (paving), weekly plant reports (structures).
2. Document all checks and test results in the field book.
3. Maintain daily diary of work activity.

PRESTRESS TECHNICIAN DUTIES

Duties of the Prestress Technician are detailed in [IM 570](#) and consist of, but are not limited to the following:

A. Pre-pour

1. Identify and document materials requiring outside fabrication inspection.
2. Identify potential fabrication or production problems and notify Iowa DOT inspectors.
3. Verify that all materials incorporated meet the requirements of the contract documents.
4. Review concrete placement documents for strand locations.
5. Check tension calculations.
6. Measure elongation and gauge pressure during tensioning.
7. Check hold down and insert locations.
8. Check stress distributions.
9. Check steel reinforcement and placement.
10. Check strand position.
11. Check condition of pallet.
 - a. Level
 - b. Holes
 - c. Gaps
 - d. Other deformities
12. Determine moisture of aggregates.
13. Check form condition and placement.
 - a. Oil
 - b. Line alignment level
 - c. Tightness

B. Concrete Placement

1. Check on use of an approved mix design and batching operations (sequence).
2. Assure appropriate placement and proper vibration techniques.
3. Measure and record concrete temperature.
4. Assure test cylinders are properly made.
5. Assure appropriate finish.
6. Assure appropriate curing operations.

C. Post-pour

1. Check temperature and record during curing process.
2. Assure concrete strength has been met prior to releasing the line.
3. Assure proper detensioning procedure.
4. Check unit for defects and obtain approval for repairs.
5. Identify and store cylinders with the respective units.
6. Check beam ends for fabrication in accordance with the plans.
7. Assure exterior sides of fascia beams are grouted.
8. Inspect after patching and desired surfacing.
9. Measure and record overall dimensions of beam.
10. Measure and record camber at release and compare to design camber.
11. Check and/or measure and record lateral sweep before shipping.
12. Assure proper cylinder cure.

RIDE QUALITY TECHNICIAN DUTIES

Duties of the Ride Quality Technician are detailed in [IM 341](#) and consist of, but are not limited to the following:

- A. Test pavement and bridge surfaces for ride quality.
- B. Evaluate the test data.
 - 1. Identify bumps and dips.
 - 2. Summarize the roughness into segments and sections.
 - 3. Identify the segments for incentive, disincentive, or grind.
 - 4. Retest and evaluate bumps, dips, and must grid segments for specification compliance.
- C. Documentation
 - 1. Document the evaluation on a test report. A copy is sent to the Project Engineer, District Materials Engineer, and Central Materials.
 - 2. Notify the Project Engineer if the daily average profile index exceeds the specification tolerance.
 - 3. Submit the profilograms to the Project Engineer for all areas tested.

SOILS TECHNICIAN DUTIES

A certified Soils Technician is required for all projects with Compaction with Moisture Control, Compaction with Moisture and Density Control, or Special Compaction of Subgrade (including for Recreation Trails). Refer to contract documents for Contractor QC testing requirements. Duties of the Soils Technician consist of, but are not limited to the following:

- A. Sampling: Obtain samples at required frequencies per [IM 204](#).
- B. Proctor Testing
- C. Other Testing as Required
 - 1. For projects with Compaction with Moisture Control: Determine moisture content per frequencies in [IM 204](#).
 - 2. For projects with Compaction with Moisture and Density Control or Special Compaction of Subgrade: Determine moisture content and in-place density per frequencies in [IM 204](#).
- D. Sampling & Testing Equipment
 - 1. Clean and check testing sieves for defects.
 - 2. Assure scale accuracy.
 - 3. Check and maintain other testing equipment.
- E. Evaluate the test data.
 - 1. For projects with Compaction with Moisture Control: Confirm soils are being placed within required moisture content range.
 - 2. For projects with Compaction with Moisture and Density Control or Special Compaction of Subgrade: Confirm soils are being placed within required moisture content range and soil is compacted to density equal to or greater than density requirement.
- F. Documentation and Communication
 - 1. Document test data. A copy is sent to the Project Engineer.
 - 2. Relay test results to appropriate supervisory personnel.
 - 3. Notify the Project Engineer if any test results do not meet contract requirements and assure corrective actions are taken.

Chapter 12
IM 401
INSPECTION & ACCEPTANCE - CEMENT

HYDRAULIC CEMENTS

GENERAL

Portland cement shall meet the requirements of ASTM C150 for the type specified. When blended cement is to be furnished, it shall meet the requirements of ASTM C595. Cement Type I, II, III, IP, IS, IT and IL shall also meet the additional requirements outlined in [Section 4101](#) of the Standard Specifications. Approval of any type of Portland and blended cements will be based on certification by an approved source or upon source sampling and testing before being incorporated into the work. Approved cement sources and distribution terminals are listed in the Materials Approved Products Listing Enterprise (MAPLE) as [Appendixes A and B](#).

The available cement types are:

ASTM C150

- | | |
|----------|---|
| Type I | For general use. |
| Type II | For moderate sulfate resistance. C ₃ A less than 8%. |
| Type III | High early strength. Generally, a finer ground Type I cement. |

White Cement White cement sources shall meet the requirements of ASTM C150, except the maximum Fe₂O₃ shall not exceed 0.5%. Approved sources of white cement are listed in the [Appendix B](#).

ASTM C595

- | | |
|---------|---|
| Type IS | Type I Slag is a Portland cement blended, or clinker interground, up to 40% GGBFS. |
| Type IP | Type I Pozzolan is a Portland cement blended or clinker interground, up to 25% pozzolan. |
| Type IL | Type I Limestone is a Portland cement blended or clinker interground, between 5% and 15% limestone. Type IL cements are a direct replacement for Type I or Type I/II cement. Use specific gravity of 3.11 and a 10% limestone addition will be assumed. |
| Type IT | Type IT(SX)(LX) is a limestone/slag Portland cement blended or clinker interground with up to 35% slag and between 5% and 15% limestone. Type IT(SX)L(X) cements are a direct replacement for Type IS(X) cement. Type IT(PX)(LX) is a limestone/pozzolan blend with up to 25% pozzolan and between 5% and 15% limestone. Type IT(PX)L(X) cements are a direct replacement for Type IP(X) cement |

ASTM C1157

- | | |
|---------|--|
| Type GU | General use cement, similar to Type I. |
|---------|--|

Type MS Moderate sulfate resistance, similar to Type II.

Type HE High early strength, similar to Type III.

Type MH Moderate heat of hydration.

Option R designation indicates low reactivity with alkali-silica reactive aggregates. ASTM C 1157 cements with option R, typically include pozzolans or slag, are a direct replacement when Type IP or IS are required.

SOURCE APPROVAL

For consideration for approval, the manufacturer shall provide the following to the Construction and Materials Bureau:

1. A quality control program that meets the requirements of Section A.
2. A copy of the latest CCRL inspection report on quality control laboratory, including documentation of resolution of any discrepancies noted.
3. A 3-month strength uniformity report prepared in accordance with the requirements of ASTM C917, "Standard Test Method for Evaluation of Cement Strength Uniformity from a Single Source".
4. A letter indicating the type of each processing addition, and the percent range that will be used in Type I cement.

The manufacturer shall also prepare a 24-hour composite sample of cement from current production according to ASTM C183. This sample will be tested by the Central Materials Laboratory for acceptance.

Iowa may approve a source based on another state source approval, provided that state will agree to the terms specified in this IM, and the source meets [Section 4101](#) of the Iowa DOT Standard Specifications.

Mixing of cement from different sources, different plants, or of different types in one storage bin or silo will not be allowed.

When less than 5% of limestone is used, the manufacturer shall inform the Construction and Materials Bureau in writing on the amount of the addition. The manufacturer shall also supply comparative test data on chemical and physical properties of the cement with and without limestone. The amount of limestone used shall be included in the manufacturer's Mill Test Reports.

A. Quality Control Program

The control of the production from each grinding mill type shall be considered separately. The following minimum testing frequencies are presented as a general guideline:

1. One sample representing 24 hours of production to be tested for air content, false set, and soundness. Determinations of free lime may be used to alter the frequency of testing soundness.

2. One sample representing 4 hours production to be tested for time of set and fineness.
3. One sample representing 48 hours production to be tested for chemical analysis.
4. One sample representing 4 day's production to be tested for 3- and 7-day compressive strength.

The sampling, tests and testing frequencies required may vary from the above guidelines depending of the particular production problems of the plant. In all cases, the quality control procedure used shall be submitted in writing to the District Materials Engineer for approval.

Sampling, handling and testing of cement samples shall follow ASTM C183.

The plant sample test records shall be available for study by Highway Division personnel for at least seven years after the cement represented has been produced.

B. Quality Control Laboratory

The Portland cement plant is required to have a control laboratory compliant with ASTM C1222, Standard Practice for Evaluation of laboratories Testing Hydraulic Cement. The control laboratory shall be AASHTO accredited. This laboratory will perform testing on the applicable types of cement meeting ASTM C150 and C595. Any major difference on test results between the control laboratory and the Highway Division Ames Laboratory shall be resolved quickly. Continued unresolved differences in test results will be considered a basis for discontinuing control laboratory approval.

SOURCE APPROVED BY OTHER STATES

Iowa DOT will accept cements and cement blends approved or certified by other state transportation agencies, providing that state agrees to the following terms and that source meets [Article 4101](#) of Standards Specifications. Sources tested by NTPEP may also be used for approval.

1. The host state agency will require the cement plant within its boundaries to have a laboratory compliant with ASTM C1222, Standard Practice for Evaluation of Laboratories Testing Hydraulic Cement. This laboratory shall be AASHTO accredited and will perform testing on the applicable types of cement produced (ASTM C 150/AASHTO M 85, C595/AASHTO M 240, C 1157) and shipped for state agencies consumption. Agency laboratories used for verification testing must meet the same criteria.
2. The host state agency will require the cement plant within its boundaries to have a printed, agency acceptable quality control/quality assurance plan for the production of cements used by state agencies. The plan must include commitments to comply with ASTM C1222 and ASTM C183, Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement. The host state agency will verify compliance with the quality control plan.
3. The host state agency will require the cement producer to maintain and provide, for each lot (silo) of cement shipped, a compilation of Mill Test Reports in an electronic form (Excel spread

sheet). The applicable data will be provided to the host state agency at least semiannually.

4. The host state agency will require the cement producer to submit split samples of a regular Portland cement (ASTM C150/AASHTO M85) and a blended cement (ASTM C595/AASHTO M240) or performance specification cement (ASTM C1157) if produced, semiannually for verification testing.
5. The host state agency will require the cement producer to submit reports for ASTM C917, Standard Test Method for Evaluation of Cement Strength Uniformity From a Single Source, for both a regular Portland cement and a blended cement, if produced, at least semiannually.
6. The host state agency will require the cement producer to maintain production and quality control/quality assurance records for at least seven years and make those records available if requested.
7. The host state agency will review submittals from the cement producer along with agency test results. If deficiencies are discovered, the state agency will monitor corrective actions taken by the producer until the deficiencies are corrected. The reciprocal agreement state agency will be notified of the deficiencies and of each occurrence.
8. Any test results or submittals collected by the host state agency may be made available to the reciprocal agreement state agency upon request.
9. All cement plant information and data is confidential within the limits of a public agency and is for state agencies information and inspection only.
10. Quality assurance test results of field samples, performed by a reciprocal state, shall be reported to the host state agency when non-compliance occurs. The reciprocal state agency will deal directly with the cement producer. The host state agency will take action as described in Item 7. The host state agency shall notify all reciprocal agreement state agencies when non-compliance occurs.
11. Cement tests or requirements beyond the standards stated above may be provided to reciprocal state agencies by agreement between the host state and reciprocal state agencies.

CONTINUED SOURCE APPROVAL

A. DOT Sampling and Testing

After initial approval, random samples will be taken and tested at a minimum rate of one sample semiannually. The samples may be taken at the source or at the distribution terminal if the source is outside the district's normal area of travel.

A split-sample will be obtained from the plant of a Regular Supplier twice a year, preferably in January and July. The sample will be split and tested for complete chemical and physical properties by supplier's control laboratory and the Highway Division Ames Laboratory, respectively. The date of the split sampling and load out silo number will be identified on the sample identification report for later comparison.

Verification samples will be secured at the project site just before incorporation into the work. Test results, which do not comply with the specifications, may be considered sufficient cause to rescind approval to furnish cement. Construction that contains cement represented by verification samples showing deficient test results will be subject to the requirements of [Article 1105.04](#) of the Standard Specifications.

B. Mill Test Reports

Mill Test Reports covering cement to be certified shall be submitted to the Cement and Concrete Engineer at the Central Laboratory at Ames, and if requested, to the District Materials Engineer who monitors the plant. An electronic form (~~Excel spreadsheet~~) is acceptable.

The plant of a regular supplier is required to submit reports for ASTM C917, Standard Test method for Evaluation of Cement Strength Uniformity at least annually.

PROJECT DOCUMENTATION

All approved cements shipped for intended use in Iowa shall be clearly identified. The producer of approved cement shall furnish for the project records, two invoices or bill of lading copies, which bear the following certification statement.

CERTIFICATION STATEMENT

The material herein described has been sampled and tested as prescribed by the Highway Division of the Iowa Department of Transportation and complies with the applicable specification requirements for type _____ cement.

Bin No. _____
Date _____

The bills of lading or invoices shall include project number, if available, source name, source location, source code, type, and quantity in the shipments. For blended cements (Types IT, IL, IP and IS), the above type designation shall include the suffix (X), where (X) equals the targeted percentage of limestone, slag or pozzolan in the product.

In the case of truck shipments, these copies of the bill of lading or invoice shall accompany each load, and shall be retained at the project or ready mixed concrete plant for the project engineer records. In the case of rail shipments, these copies shall be mailed to the project or ready mix plant.



Materials Approved Products List

401aa - Appendix A - Portland Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Ash Grove III - Chanute (Code PC0103)	02/17/2015	Ash Grove Cement Company	PORTLAND CEMENT	401	Chanute, KS	Ash Grove Cement	Chanute, KS; Des Moines, IA	3.15
Ash Grove III - Louisville (Code PC0003)	02/17/2015	Ash Grove Cement Company	PORTLAND CEMENT	401	Louisville, NE	Ash Grove Cement Company	Louisville, NE; Des Moines, IA	3.15
Ash Grove IL(11) - Chanute (Code PC0109)	04/05/2023	Ash Grove Cement Company	PORTLAND CEMENT	401	Chanute, KS	Ash Grove Cement Company	Chanute, KS; Des Moines, IA	3.11
Ash Grove IL(11) - Louisville (Code PC0009)	08/02/2022	Ash Grove Cement Company	PORTLAND CEMENT	401	Louisville, NE	Ash Grove Cement Company	Louisville, NE; Des Moines, IA	3.11
Ash Grove IP(25) - Chanute (Code PC0108)	04/24/2014	Ash Grove Cement Company	PORTLAND CEMENT	401	Chanute, KS	Ash Grove Cement Company	Chanute, KS; Des Moines, IA	2.97
Ash Grove IP(25) - Louisville (Code PC0008)	04/24/2014	Ash Grove Cement Company	PORTLAND CEMENT	401	Louisville, NE	Ash Grove Cement Company	Louisville, NE; Des Moines, IA	2.99
Ash Grove IP(30) - Louisville (Code PC0018)	08/19/2022	Ash Grove Cement Company	PORTLAND CEMENT	401	Louisville, NE	Ash Grove Cement Company	Louisville, NE; Des Moines, IA	2.90
Buzzi I/II - Cape Girardeau (Code PC1502)	04/24/2014	Buzzi Unicem USA	PORTLAND CEMENT	401	Cape Girardeau, MO	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.14
Buzzi I/II - Festus (Code PC3002)	04/24/2014	Buzzi Unicem USA	PORTLAND CEMENT	401	Festus, MO	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.14
Buzzi I - Pryor (Code PC1401)	04/24/2014	Buzzi Unicem USA	PORTLAND CEMENT	401	Pryor, OK	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.14
Buzzi IL(10) - Cape Girardeau (Code PC1509)	11/12/2021	Buzzi Unicem USA	PORTLAND CEMENT	401	Cape Girardeau, MO	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.11
Buzzi IL(10) - Festus (Code PC3009)	11/19/2021	Buzzi Unicem USA	PORTLAND CEMENT	401	Festus, MO	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.11
Buzzi IL(10) - Pryor (Code PC1409)	11/19/2021	Buzzi Unicem USA	PORTLAND CEMENT	401	Pryor, OK	Buzzi Unicem USA	Bonner Springs, KS; Festus, MO; Rock Island, IL	3.11
Central Plains III - Sugar Creek (Code PC0703)	06/11/2021	Central Plains Cement Company	PORTLAND CEMENT	401	Sugar Creek	Central Plains Cement Company	Sugar Creek, MO; Omaha, NE	3.15



Materials Approved Products List

401aa - Appendix A - Portland Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Central Plains IL(12) - Sugar Creek (Code PC0709)	06/11/2021	Central Plains Cement Company	PORTLAND CEMENT	401	Sugar Creek, MO	Central Plains Cement	Sugar Creek, MO; Omaha, NE	3.11
Central Plains IT(S20) (L10) - Sugar Creek (Code PC0706)	04/17/2024	Central Plains Cement Company	PORTLAND CEMENT	401	Sugar Creek, MO	Central Plains Cement Company	Sugar Creek, MO; Omaha, NE	3.07
Central Plains IT(S25) (L9) - Sugar Creek (Code PC2816)	04/17/2024	Central Plains Cement Company	PORTLAND CEMENT	401	Sugar Creek, MO	Central Plains Cement Company	Sugar Creek, MO, Omaha, NE	3.07
Central Plains IT(S38) (L7) - Sugar Creek (Code PC2806)	01/11/2023	Central Plains Cement Company	PORTLAND CEMENT	401	Sugar Creek, MO	Central Plains Cement Company	Sugar Creek, MO, Omaha, NE	3.05
Continental III - Hannibal (Code PC0203)	02/17/2015	Continental Cement Company, LLC	PORTLAND CEMENT	401	Hannibal, MO	Continental Cement Company	Hannibal, MO; West Des Moines, IA; St. Paul, MN; Minneapolis, MN; LaCrosse, WI	3.15
Continental IL(10) - Davenport (Code PC0509)	11/17/2020	Continental Cement Company, LLC	PORTLAND CEMENT	401	Buffalo, IA	Continental Cement Company	Hannibal, MO; West Des Moines, IA; St. Paul, MN; Minneapolis, MN; LaCrosse, WI	3.11
Continental IL(10) - Hannibal (Code PC0209)	05/21/2021	Continental Cement Company, LLC	PORTLAND CEMENT	401	Hannibal, MO	Continental Cement Company	Hannibal, MO; West Des Moines, IA; St. Paul, MN; Minneapolis, MN; LaCrosse, WI	3.11
GCC I/II - Pueblo (Code PC2902)	01/02/2019	GCC USA	PORTLAND CEMENT	401	Pueblo, CO	GCC USA	Sioux Falls, SD; Hawarden, IA	3.14
GCC I/II - Rapid City (Code PC1002)	05/06/2014	GCC USA	PORTLAND CEMENT	401	Rapid City, SD	GCC USA - Rapid City Terminal	Sioux Falls, SD; Hawarden, IA	3.14
GCC I/II - Samalayuca (Code PC3602)	09/04/2019	GCC USA	PORTLAND CEMENT	401	Samalayuca, Mexico		Sioux Falls, SD; Hawarden, IA	3.14
GCC III - Rapid City (Code PC1003)	09/02/2015	GCC USA	PORTLAND CEMENT	401	Rapid City, SD	GCC USA	Sioux Falls, SD; Hawarden, IA	3.15



Materials Approved Products List

401aa - Appendix A - Portland Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
GCC III - Samalayuca (Code PC3603)	09/25/2019	GCC USA	PORTLAND CEMENT	401	Samalayuca, Mexico		Sioux Falls, SD; Hawarden, IA	3.15
GCC IL(10) - Pueblo (Code PC2909)	02/16/2022	GCC USA	PORTLAND CEMENT	401	Pueblo, CO	GCC, USA	Sioux Falls, SD; Hawarden, IA	3.11
GCC IL(10) - Rapid City (Code PC1009)	02/24/2022	GCC USA	PORTLAND CEMENT	401	Rapid City, SD	GCC, USA	Sioux Falls, SD; Hawarden, IA	3.11
GCC IP(25) - Rapid City (Code PC1008)	05/06/2014	GCC USA	PORTLAND CEMENT	401	Rapid City, SD	GCC USA - Rapid City Terminal	Sioux Falls, SD; Hawarden, IA	3.05
Heidelberg III - Mason City (Code PC0403)	10/03/2024	Heidelberg Materials	PORTLAND CEMENT	401	Mason City, IA	Heidelberg Materials	Mason City, IA	3.15
Heidelberg IL(10) - Mason City (Code PC0409)	10/03/2024	Heidelberg Materials	PORTLAND CEMENT	401	Mason City, IA	Heidelberg Materials	Mason City, IA	3.11
Holcim IP(25) - Florence (Code PC2008)	03/24/2022	Holcim (US) Inc.	PORTLAND CEMENT	401	Portland/Florence, CO	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	3.01
Holcim IL(10) - Ada (Code PC1909)	10/11/2023	Holcim (US) Inc.	PORTLAND CEMENT	401	Ada, OK	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	3.11



Materials Approved Products List

401aa - Appendix A - Portland Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Holcim IL(10) - Alpena (Code PC1809)	03/24/2022	Holcim (US) Inc.	PORTLAND CEMENT	401	Alpena, MI	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	3.11
Holcim IL(10) - Joppa (Code PC1309)	10/11/2023	Holcim (US) Inc.	PORTLAND CEMENT	401	Grand Chain, IL	Holcim	Mason City, IA; Des Moines, IA; Cedar Rapids, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA	3.11
Holcim IL(10) - ST. Genevieve (Code PC3209)	01/29/2024	Holcim (US) Inc.	PORTLAND CEMENT	401	Ste. Genevieve, MO	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	3.11
Holcim IT(P25)(L6) - St. Genevieve (Code PC3206)	02/13/2024	Holcim (US) Inc.	PORTLAND CEMENT	401	St. Genevieve, MO/Fremont, NE	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	2.85



Materials Approved Products List

401aa - Appendix A - Portland Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Holcim IT(S30)(P10) - St Genevieve (Code PC3216)	02/13/2024	Holcim (US) Inc.	PORTLAND CEMENT	401	St. Genevieve, MO/Fremont, NE	Holcim	Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA; LaCrosse, WI; Kansas City, MO; St. Louis, MO	2.96
Illinois I/II (Code PC3302)	09/07/2023	Illinois Cement Company	PORTLAND CEMENT	401	LaSalle, IL	Illinois Cement Company	LaSalle, IL	3.14
Kosmos Cement IL(10) (Code PC3909)	06/07/2024	Kosmos Cement Company	PORTLAND CEMENT	401	Louisville, KY	Central Plains/Eagle Materials	Sugar Creek, MO, Omaha, NE	3.11
Monarch I/II - Humboldt (Code PC0802)	04/24/2014	The Monarch Cement Company	PORTLAND CEMENT	401	Humboldt, KS	The Monarch Cement Company	West Des Moines, IA	3.14
Monarch III - Humboldt (Code PC0803)	02/17/2015	The Monarch Cement Company	PORTLAND CEMENT	401	Humboldt, KS	The Monarch Cement Company	West Des Moines, IA	3.15
Monarch IL(12) - Humboldt (Code PC0809)	02/24/2022	The Monarch Cement Company	PORTLAND CEMENT	401	Humboldt, KS	The Monarch Cement Company	West Des Moines, IA	3.11
Ozinga CarbonSense IS (20) (Code PC3807)	06/27/2024	Ozinga Cement	PORTLAND CEMENT	401	Chicago, IL	Ozinga Cement	South Chicago Terminal	3.12
Ozinga I/II - Long Son Cement (Code PC3802)	05/13/2024	Ozinga Cement	PORTLAND CEMENT	401	Thanh Hoa Province, Vietnam	Ozinga Cement	Chicago, IL	3.14
Ozinga I/II - Song Lam JSC (Code PC3702)	11/13/2023	Ozinga Cement	PORTLAND CEMENT	401	Nghe An Province, Vietnam	Ozinga Cement	Chicago, IL	3.14
St Marys II - Ontario (Code PC1702)	04/24/2014	St Marys Cement Group	PORTLAND CEMENT	401	St. Mary's, Ontario	St Marys Cement Group		3.14
St Marys II LA - Charlevoix (Code PC3402)	04/24/2014	St Marys Cement Group	PORTLAND CEMENT	401	Charlevoix, MI	St Marys Cement Group		3.14



Materials Approved Products List

401ab - Appendix B - White Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Heidelberg White Cimsa I	10/03/2024	Heidelberg Materials	PORTLAND CEMENT	401	Cimsa, Turkey	Heidelberg Materials	Plainfield, IL; Burnsville, MN	3.15
Heidelberg White York I	10/03/2024	Heidelberg Materials	PORTLAND CEMENT	401	York, PA	Heidelberg Materials	Plainfield, IL	3.15

Chapter 13
IM 403
INSPECTION & ACCEPTANCE - AD MIX.

CHEMICAL ADMIXTURES FOR CONCRETE

GENERAL

Air entraining admixtures shall meet the requirements of AASHTO M154. Water reducing and retarding, water-reducing, high range water reducing, and non-chloride accelerating admixtures shall meet the requirements of AASHTO M194. All chemical admixtures used for Portland Cement Concrete shall meet the requirements outlined in [Section 4103](#) and other applicable Iowa Department of Transportation Standard Specifications. Approved brands of chemical admixtures for concrete are listed in the Materials Approved Products Listing Enterprise ([MAPLE](#)) as Appendixes A, B, C, D, E, F, G and H for different types of applications.

For all types of admixtures, the source, brand name, and lot/batch number must be identifiable by description on the invoice, bill of lading or delivery ticket. The manufacturer and supplier shall maintain a record of each shipment, which identifies source, the brand, lot/batch number and certified test data for each shipment. This data shall be made available to the contracting authority when requested.

The end user (concrete supplier) shall keep records of deliveries available for inspection for a minimum of 3 years after delivery.

MANUFACTURER, BRAND NAME APPROVAL, USAGE GUIDELINES

To obtain approval for any admixture type, the manufacturer shall submit the following items to the Construction and Materials Bureau in Ames:

1. Product identification including brand name and product number
2. Complete manufacturer's recommendation for usage
3. A copy of Level 1 product test report for the submitted admixture from the National Transportation Product Evaluation Program (NTPEP). The test result reported will be evaluated for compliance with appropriate AASHTO specification. The NTPEP report is not required for admixtures for prestressed and precast concrete listed in the [Appendix F](#).
4. A current Materials Safety Data Sheet (MSDS)
5. A one-quart (one-liter) representative sample may be required upon request

Specific requirements for each type of admixture are as follows:

A. Air Entraining Admixtures

Air entraining admixtures shall meet the requirements of Iowa Department of Transportation Standard Specifications [Section 4103](#) and AASHTO M154.

Approved brands of air entraining admixtures are listed in the [Appendix A](#) of this IM.

B. Retarding, and Water-Reducing & Retarding Admixtures for Bridge Deck and Drilled Shaft Concrete Requiring Extended Working Time

Retarding, and water-reducing & retarding admixtures shall meet the requirements of AASHTO M194, Type B or Type D. These admixtures can be used for water reduction, retardation, or water reduction and retardation for bridge deck and drilled shaft concrete when extended

working time is required.

Approved brands of retarding, and water-reducing & retarding admixtures for bridge deck and drilled shaft concrete requiring extended working time are listed in the [Appendix B](#) of this IM. The [Appendix B](#) also contains a guideline for dosage rates and working time limits based on an estimated maximum temperature of the concrete during placement at the point of discharge. Working time limits have been determined by AASHTO T197 using 200 psi (1.38 MPa) penetration resistance and shall be provided by manufacturer. In addition to the AASHTO M194 requirements, a minimum working time of 4.5 hours is required for the Type I/II cement mix using the maximum normal recommended dosage of an admixture and tested at the normal temperature (between 70°F and 75°F).

Retarding admixtures from Appendix B also act as water reducers. At higher dosages of retarding admixtures may necessitate a dosage reduction or elimination of water reducers from [Appendix C](#). Water reducers from [Appendix C](#) can also aid with air entrainment. Check with the admixture supplier for recommendations.

C. Water-Reducing Admixtures

Water-reducing admixtures shall meet the requirements of AASHTO M194, Type A.

Approved brands of water-reducing admixtures with their proper dosage rates are listed in the [Appendix C](#) of this IM.

Mid-range water reducers used for bridge overlay concrete (Class HPC-O Mixture), without retarding admixtures, are noted in the [Appendix C](#). In addition to the AASHTO M194 requirements, the use of these admixtures shall provide a maximum water content of 90% of the control at a normal dosage, and shall not result in a less initial set time as compared to the control. The intent of these mid-range water reducers is to achieve a workable, dense, low water to cementitious material ratio concrete for bridge overlay as described in [Article 2413.02](#) of Standard Specifications. All other mid-range water reducers shall be used in conjunction with a retarder for the HPC-O mixtures.

A combination of a water-reducing admixture and a retarding admixture may be used to aid in air entrainment and slump retention. A water-reducing admixture may be used in any mix design, even if it is not designated by the mix number.

D. High Range Water-Reducing Admixtures

High range water-reducing admixtures shall meet the requirements of AASHTO M194, Type F.

Approved brands of high range water-reducing admixtures with their recommended dosage rates are listed in the [Appendix D](#) of this IM. As indicated, some of these high range water reducers listed can be used to cast self-consolidated concrete. If needed, a viscosity-modified admixture produced by the same manufacturer is allowed to cast self-consolidated concrete.

E. Non-Chloride Accelerating Admixtures

Non-chloride accelerating admixtures shall meet the requirements of AASHTO M194, Type C or E. Total chloride content, which may come from some indirect sources, shall not exceed 0.1% in

the admixtures.

Approved brands of non-Chloride accelerating admixtures with their recommended dosage rates are listed in the [Appendix E](#) of this IM.

F. Admixtures for Prestressed & Precast Concrete

In addition to the admixtures listed in other Appendixes of this IM, the admixtures listed in the [Appendix F](#) can also be used in prestressed and precast concrete. Benefits of those admixtures in the [Appendix F](#) include increasing production rate, improvement of visual appeal, greater strength, more durable, better compactability, and extension of life of molds and machines parts for dry-cast concrete. In order to get an admixture approval, its producer shall prove that the use of the admixture will not reduce strength of concrete, and provide evidence of the above-mentioned benefits.

G. Retarding, Water-Reducing & Retarding Admixtures for Concrete with Normal Working Times

Retarding, water-reducing and retarding admixtures shall meet the requirements of AASHTO M194, Type B or Type D. These admixtures can be used for water reduction, retardation, or water reduction and retardation for concrete.

When use as a retarder is specified or authorized by the engineer, the contractor shall be responsible for its use and application of the proper dosage rate. It may also be necessary to adjust the quantity of air entraining agent. When fly ash is used in the concrete, the dosage rate shall be applied to both the cement and fly ash combined.

Mixed-to-placed time period may be extended as per Iowa DOT Standard Specifications [Section 2301.02.C.4](#). For patching with extended haul time, rate may be reduced to half dosage.

Approved brands of water-reducing and retarding admixtures with their recommended dosage rates are listed in the Appendix G of this IM.

H. Special Performance Admixtures

Special performance admixtures shall meet the requirements of AASHTO M194, Type S. These admixtures will provide a desired performance characteristic(s) other than reducing water content, or changing the time of setting of concrete, or both, without any adverse effects on fresh, hardened and durability properties of concrete as specified, excluding admixtures that are used primarily in the manufacture of dry-cast concrete products. Special performance admixtures with their recommended dosage rates are listed in the [Appendix H](#) of this IM.

CarbonCure or carbon dioxide are considered a special performance admixture. Carbon dioxide shall be added to the mix using the manufacturers delivery system. The delivery system shall be provided and calibrated by manufacturers and integrated into the PCC plant batching system. Use of carbon dioxide addition without Portland cement reduction requires no approval. Use of carbon dioxide addition with up to a 3 percent Portland cement reduction is allowed, provided the producer has completed the approval process in Appendix I of this IM. Portland cement reductions and mix proportions shall be completed as shown in IM 529.

I. Flowable Fill Admixtures

Flowable fill admixtures are used to develop high volume of stable air (>20%) for use in foamed cellular concrete and alternate mix designs in accordance with [Section 2506](#). Flowable fill admixtures are listed in the Appendix I of this IM.

A hydration stabilizer/controller will be evaluated for approval as a retarder (Type B) or a water reducing & retarding admixture (Type D), and listed and identified in the [Appendix B](#) or the [Appendix G](#) after approved.

If alternative requirements specified in AASHTO M194 are met, an admixture may be provisionally approved based on six-month test results. Producer shall submit one-year test results for final approval as soon as they become available. The failure or delay in submitting one-year results may lead to revoking of provisional approval.

FOR MANUFACTURER

At the beginning of each calendar year, the manufacturer shall submit an annual certification statement to the Construction and Materials Bureau. If the admixture to be supplied during that year is identical with the formulation previously tested and approved, then the manufacturer shall complete the quality control limits in the certification statement.

FOR DISTRIBUTOR

At the beginning of each calendar year, The distributor shall certify that admixtures to be supplied are not altered and will be distributed as received from the manufacturer.

Approval of admixtures may be withdrawn because of deficient test results; product changes made after original approval, or unsatisfactory field performance.

AGITATION OF ADMIXTURES

Air entraining admixtures shall be stirred, agitated, or circulated at least weekly, or as recommended by manufacturer, to ensure a uniform and homogeneous mixture of solids and solution. It is the admixture supplier's responsibility to the contractor to provide a quality product. Therefore the admixture suppliers shall be responsible for the system used to maintain the quality product described above.

Retarding, water-reducing, and high range water-reducing admixtures shall be stirred, circulated, or agitated thoroughly once a day prior to operation of the proportioning plant to maintain the solids in suspension. The agitating shall be done in such a way that the solution in the holding or storage tank is circulated for a minimum of five minutes each day per 100 gallons (380 liters) of solution or any fraction thereof. Use of a timer on the pump is recommended to prevent excessive heat from the pump. 5 minutes is adequate for smaller tanks to a maximum of 15 minutes for larger tanks. A circulating pump with a 250-watt (1/3 hp) pump motor and a 1-inch (25 mm) inside diameter hose will be considered as a minimum requirement. The engineer shall approve the method of agitation.

NOTE: Introducing air into a tank will not be acceptable.

MONITOR SAMPLING & TESTING, AND REJECTION OF MATERIAL

District Materials Inspector shall check approved brand and lot number of admixture prior to use.

Monitor samples will be obtained and sent to Central Materials for testing. Minimum sampling frequency shall be according to [IM 204](#). The sample size shall be one 1 pint (0.5 liter).

Admixtures that exceed the manufacturer's recommended shelf life will be sampled and tested prior to use. If retesting complies, the admixture will be allowed to use for another six months. Manufacturers shall be responsible to their customers to know if their product's effectiveness diminishes during storage.

Samples will be tested for variation from the manufacturer target for solids, specific gravity and chloride content if needed.

If the test result of a monitor sample is outside the quality control limits specified by AASHTO M154 or M194 and provided by the manufacturer, all material in the storage tank shall be rejected. The admixture company is not allowed to mix new replacement material with the non-compliance material. The admixture manufacturer is responsible for the condition of storage tanks and should determine if the tanks should be cleaned to prevent cross contamination and further product failures.



Materials Approved Products List

403aa - Appendix A - Air Admixtures

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Air Plus	04/24/2014	Fritz-Pak Corporation	ADMIXTURES, AIR ENTRAINING	403	Dallas, TX	Fritz-Pak Corporation		
Airalon 3000	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Airalon 7000	03/21/2019	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403		GCP Applied Technologies		
Chryso Air 260	03/02/2017	CHRYSO Inc	ADMIXTURES, AIR ENTRAINING	403	Rockwall, TX	Chryso, Inc.		
ConAir 260	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, AIR ENTRAINING	403	Pioneer, OH	Premiere Concrete Admixtures™		
ConAir X	03/05/2018	Premiere Concrete Admixtures	ADMIXTURES, AIR ENTRAINING	403		Premiere Concrete Admixtures		
DSA 110	02/04/2021	DarCole Products, Inc	ADMIXTURES, AIR ENTRAINING	403		Darcole Products, Inc.		
Daravair 1000	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Daravair 1400	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Daravair AT 30	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Daravair AT 60	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Daravair M	06/26/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Darex II AEA	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		
Eucon AEA-92	04/24/2014	Euclid Chemical Company	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	
Eucon AEA-92S	04/24/2014	Euclid Chemical Company	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	
Eucon Air MAC12	06/01/2017	Euclid Chemical Company	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	
Eucon Air MAC6	06/01/2017	Euclid Chemical Company	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	

Materials Approved Products List

403aa - Appendix A - Air Admixtures

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Eucon Air Mix	04/24/2014	Euclid Chemical Company	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	
Mapeair SA	06/28/2023	Mapei Corporation	ADMIXTURES, AIR ENTRAINING	403	Eagan, MN	Mapei Corporation		
Mapeair SA-50	06/28/2023	Mapei Corporation	ADMIXTURES, AIR ENTRAINING	403	Eagan, MN	Mapei Corporation		
Mapeair VR	06/28/2023	Mapei Corporation	ADMIXTURES, AIR ENTRAINING	403	Eagan, MN	Mapei Corporation		
MasterAir AE 200	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Master Builders Solutions US LLC		
MasterAir AE 400	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Master Builders Solutions US LLC		
MasterAir AE 90	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Master Builders Solutions US LLC		
MasterAir VR 10	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, AIR ENTRAINING	403	Cleveland, OH	Master Builders Solutions US LLC		
Miracon 2315	04/24/2014	Miracon Technologies	ADMIXTURES, AIR ENTRAINING	403	Richardson, TX	Miracon™ Technologies		
Polychem SA-14	04/17/2024	Mapei Corporation	ADMIXTURES, AIR ENTRAINING	403	Eagan, MN	Mapei Corporation		
RAE-260	05/15/2017	RussTech, Inc.	ADMIXTURES, AIR ENTRAINING	403		RussTech Inc.		
RSA-10	04/24/2014	RussTech, Inc.	ADMIXTURES, AIR ENTRAINING	403	Louisville, KY	RussTech, Inc.		
Sika AEA-14	04/24/2014	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation (Construction)		
Sika AER C	07/30/2020	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation		
Sika Air	04/24/2014	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation (Construction)		
Sika Air-260	04/24/2014	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation (Construction)		
Sika Air-360	04/24/2014	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation (Construction)		



Materials Approved Products List

403aa - Appendix A - Air Admixtures

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
SikaControl AIR-160	11/14/2018	Sika Corporation	ADMIXTURES, AIR ENTRAINING	403	Ottawa, IL	Sika Corporation		
Stable Air	04/24/2014	CCT	ADMIXTURES, AIR ENTRAINING	403	Irvine, CA	Cellular Concrete Technologies LLC		
Super Air Plus	04/24/2014	Fritz-Pak Corporation	ADMIXTURES, AIR ENTRAINING	403	Dallas, TX	Fritz-Pak Corporation		
Terapave AEA	04/24/2014	GCP Applied Technologies	ADMIXTURES, AIR ENTRAINING	403	Boston, MA	GCP Applied Technologies		

**APPROVED SOURCES
RETARDING & WATER REDUCING & RETARDING ADMIXTURES
EXTENDED WORKING TIME IS REQUIRED for BRIDGE DECK (2412) &
DRILLED SHAFT CONCRETE (2433)**

Dosage is in fluid ounces per 100 lbs of cement, fly ash, and ggbsfs.

Check percent of air as retarding admixtures may tend to increase air contents

Approximate working time limits for various cements with -NO RETARDER

Mix Temp at point of discharge	Dosage	Type III or IL No fly ash	Type III or IL With fly ash	Type IS, IP With fly ash or Ternary
°F	fl. oz./cwt	hours	hours	hours
55	0	3.8	4.8	5.8
65	0	3.1	3.8	4.6
75	0	2.5	3.0	3.5
85	0	2.2	2.5	2.7
95	0	1.9	1.9	1.9

Ternary mixes utilize cement, fly ash, and slag.

COMPANY:	BASF Corporation		BRAND:		MasterSet Delvo
	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash		
Mix Temp at point of discharge	fl. oz./cwt	hours	hours	hours	Type IS, IP With fly ash or Ternary
°F					hours
65	2	4.4	5.4	6.4	
	3	4.9	5.9	6.9	
	4	5.4	6.4	7.4	
	5	5.9	6.9	7.9	
	6	6.4	7.4	8.4	
	7	7.4	8.4	9.4	
	8	8.4	9.4	10.4	
	9	9.4	10.4		
75	2	3.3	4.3	5.3	
	3	3.8	4.8	5.8	
	4	4.3	5.3	6.3	
	5	4.8	5.8	6.8	
	6	5.3	6.3	7.3	
	7	5.8	6.8	7.8	
	8	6.8	7.8	8.8	
	9	7.8	8.8		
85	3	3.0	4.0	5.0	
	4	3.5	4.5	5.5	
	5	4.0	5.0	6.0	
	6	4.5	5.5	6.5	
	7	5.0	6.0	7.0	
	8	5.5	6.5	7.5	
	9	6.5	7.5	8.5	
	10	7.5	8.5		
95	4	2.7	2.7	2.7	
	5	3.2	3.2	3.2	
	6	3.7	3.7	3.7	
	7	4.2	4.2	4.2	
	8	4.7	4.7	4.7	
	9	5.2	5.2	5.2	
	10	6.2	6.2	6.2	
	11	7.2	7.2	7.2	

COMPANY:	BASF Corporation		BRAND:		MasterSet R 100
	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash		
Mix Temp at point of discharge	fl. oz./cwt	hours	hours	hours	Type IS, IP With fly ash or Ternary
°F					hours
55	2				
	3				
	4				
	5				
	3	9.0	9.7	10.5	
	4				
	5				
	6				
65	3	6.1	6.6	7.1	
	4	7.8	8.3	8.8	
	5	9.2	9.7	10.2	
	6				
	7				
	3	5.2	5.5	5.7	
	4	6.7	7.0	7.2	
	5	8.1	8.4	8.6	
85	6				
	7				
	3	4.5	4.5	4.5	
	4	6.0	6.0	6.0	
	5	7.4	7.4	7.4	
	6				
	7				
	8				
95	3	4.5	4.5	4.5	
	4	6.0	6.0	6.0	
	5	7.4	7.4	7.4	
	6				
	7				
	8				
	9				
	10				

COMPANY: BASF Corporation		BRAND: MasterSet R 300	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz./cwt	hours	hours
55	2	4.5	5.5
	3	5.3	6.3
	4	6.8	7.8
	5		
	6		
65	3	4.6	5.3
	4	5.5	6.2
	5	6.8	7.5
	6		
	7		
75	3	4.7	5.2
	4	6.0	6.5
	5	7.2	7.7
	6		
	7		
85	3	4.6	4.9
	4	5.3	5.6
	5	6.4	6.7
	6		
	7		
95	3	4.1	4.1
	4	4.7	4.7
	5	5.6	5.6
	6	6.6	6.6

COMPANY:		Euclid Chemical Company		Eucon Retarder 100	
Mix Temp at point of discharge	Dosage	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type IS, IP
°F	fl. oz./cwt	No fly ash	With fly ash	With fly ash	With fly ash or Ternary
		hours	hours	hours	hours
55	2				
	3	9.6	10.6	11.6	
	4	10.4	11.4	12.4	
	5	12.3	13.3	15.3	
	3	8.2	8.9	9.7	
65	4	10.0	10.7	11.5	
	5	11.7	12.4	13.2	
	6	12.9	13.6	14.4	
	3	7.5	8.0	8.5	
	4	9.9	10.4	10.9	
	5	11.9	12.4	12.9	
75	6	12.5	13.0	13.5	
	7				
	3	6.8	7.1	7.3	
	4	9.6	9.9	10.1	
85	5	11.9	12.2	12.4	
	6	11.9	12.2	12.4	
	7				
	3	6.8	6.8	6.8	
95	4	9.9	9.9	9.9	
	5	11.8	11.8	11.8	
	6	11.8	11.8	11.8	
	7				
	8				

COMPANY:		Euclid Chemical Company		BRAND:		Eucon Stasis	
Mix Temp at point of discharge	Dosage	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type IS, IP	Type IS, IP	Type IS, IP
°F	fl. oz./cwt	No fly ash	With fly ash	With fly ash	With fly ash or Ternary	With fly ash or Ternary	With fly ash or Ternary
		hours	hours	hours	hours	hours	hours
55	2						
	3	7.5	8.5	9.5			
	4	9.5	10.5	11.5			
	2	5.0	5.5	6.0			
65	3	6.0	6.5	7.0			
	4	7.0	7.5	8.0			
	5	8.5	9.0	9.5			
	3	4.0	4.5	5.0			
	4	4.5	5.0	5.5			
75	5	5.5	6.0	6.5			
	6	6.5	7.0	7.5			
	7	7.5	8.0	8.5			
	4	4.5	4.7	5.0			
85	5	5.0	5.2	5.5			
	6	5.5	5.7	6.0			
	7	6.5	6.7	7.0			
	8	7.5	7.7	8.0			
95	4	4.0	4.0	4.0			
	5	5.0	5.0	5.0			
	6	5.5	5.5	5.5			
	7	6.0	6.0	6.0			
	8	7.0	7.0	7.0			

COMPANY:	Euclid Chemical Company		Eucon WR-91	
	Dosage	Type I/II or IL No fly ash	BRAND:	Type IS, IP With fly ash or Ternary
Mix Temp at point of discharge	fl. oz./cwt	hours	hours	hours
55	2	4.8	5.8	6.8
	3	5.8	6.8	7.8
	4	7.8	8.8	9.8
	5	9.8	10.8	11.8
	6	11.8	12.8	13.8
65	3	4.6	5.3	6.1
	4	5.6	6.3	7.1
	5	7.1	7.8	8.6
	6	8.6	9.3	10.1
	4	4.0	4.5	5.0
	5	4.5	5.0	5.5
75	6	5.5	6.0	6.5
	7	6.5	7.0	7.5
	8	7.5	8.0	8.5
	4	3.7	4.0	4.2
	5	4.2	4.5	4.7
	6	4.7	5.0	5.2
	7	5.7	6.0	6.2
85	8	6.7	7.0	7.2
	5	3.9	3.9	3.9
	6	4.4	4.4	4.4
	7	4.9	4.9	4.9
	8	5.4	5.4	5.4
	4	3.7	4.0	4.2
	5	4.2	4.5	4.7
	6	4.7	5.0	5.2
95	7	5.7	6.0	6.2
	8	6.7	7.0	7.2
	5	3.9	3.9	3.9
	6	4.4	4.4	4.4
	7	4.9	4.9	4.9
	8	5.4	5.4	5.4
	4	3.7	4.0	4.2
	5	4.2	4.5	4.7
	6	4.7	5.0	5.2

COMPANY:	Euclid Chemical Company		BRAND:		Eucon DS	
	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash	Type IS, IP With fly ash or Ternary		
Mix Temp at point of discharge	fl. oz./cwt	hours	hours	hours		
65	2	1.5	2.5	2.5		
	3	2.0	3.0	3.0		
	4	2.5	3.5	4.0		
	5	3.0	4.0	4.5		
	6	4.0	5.0	5.5		
	7	5.0	6.0	6.5		
	8	6.0	7.0	7.5		
	2	1.0	1.5	1.5		
75	3	1.5	2.0	2.5		
	4	2.0	3.0	3.5		
	5	2.5	3.5	4.0		
	6	3.5	4.5	5.0		
	7	4.5	5.5	6.0		
	8	5.5	6.5	7.0		
	3	1.0	1.5	1.5		
	4	1.5	2.0	2.5		
85	5	2.0	3.0	3.5		
	6	2.5	3.5	4.0		
	7	3.5	4.5	5.0		
	8	4.5	5.5	6.0		
	3	1.0	1.5	1.5		
	4	1.5	2.0	2.5		
	5	2.0	3.0	3.5		
	6	2.5	3.5	4.0		
	7	3.5	4.5	5.0		
95	8	4.5	5.5	6.0		
	9	5.5	6.5	7.0		
	4	1.0	1.5	1.5		
	5	1.5	2.0	2.5		
	6	2.0	3.0	3.5		
	7	2.5	3.5	4.0		
	8	3.5	4.5	5.0		
	9	4.5	5.5	6.0		
	10	5.5	6.5	7.0		
	4	1.0	1.5	1.5		

COMPANY:		GCP Applied Technologies		BRAND:		Daratard 17	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash	Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz/cwt	hours	hours	°F	fl. oz/cwt	hours	hours
65	3			65	3	5.4	6.5
	4				4	6.0	7.0
	5				5	6.8	7.8
	6				6	7.4	8.9
75	3	4.3	4.7	75	3	4.8	5.8
	4	6.6	7.1		4	5.5	6.5
	5	7.6	8.1		5	6.3	7.3
	6				6	7.6	8.6
85	3	4.3	4.6	85	3	4.4	5.4
	4	5.2	5.5		4	4.7	5.7
	5	6.5	6.8		5	5.3	6.3
	6				6	6.0	7.0
95	3	3.9	3.9	95	3		
	4	4.4	4.4		4	2.8	3.8
	5	5.7	5.7		5	3.0	4.0
	6				6	3.7	4.7
	7				4.5	5.5	

COMPANY :		GCP Applied Technologies		BRAND:		RECOVER	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash	Mix Temp at point of discharge	Dosage	Type IS, IP With fly ash or Ternary	hours
°F	fl. oz/cwt	hours	hours	°F	fl. oz/cwt	hours	hours
65	3	5.4	6.5	65	3	7.5	7.5
	4	6.0	7.0		4	8.0	8.0
	5	6.8	7.8		5	8.8	8.8
	6	7.4	8.9		6	9.8	9.8
75	3	4.8	5.8	75	3	6.8	6.8
	4	5.5	6.5		4	7.5	7.5
	5	6.3	7.3		5	8.3	8.3
	6	7.6	8.6		6	9.6	9.6
85	3	4.4	5.4	85	3	6.4	6.4
	4	4.7	5.7		4	6.7	6.7
	5	5.3	6.3		5	7.3	7.3
	6	6.0	7.0		6	8.0	8.0
95	3	2.8	3.8	95	3	4.8	4.8
	4	3.0	4.0		4	5.0	5.0
	5	3.7	4.7		5	5.7	5.7
	6	4.5	5.5		6	6.5	6.5

COMPANY:	GCP Applied Technologies		BRAND:		Zyla 640
	Mix Temp at point of discharge	Type III or IL	Type III or IL	Type IS, IP	
°F	Dosage	No fly ash	With fly ash	With fly ash or Ternary	hours
	fl. oz./cwt	hours	hours	hours	hours
50	2	9.2	10.2	10.7	10.7
	3	9.5	10.5	11.0	11.0
	4	10.2	11.2	11.7	11.7
	5	11.0	12.0	12.5	12.5
	6	11.5	12.5	13.0	13.0
	7	12.5	13.5	14.0	14.0
	7	7.0	8.0	8.5	8.5
60	3	7.2	8.2	8.7	8.7
	4	7.6	8.6	9.1	9.1
	5	8.2	9.2	9.7	9.7
	6	8.7	9.7	10.2	10.2
	7	9.3	10.3	10.8	10.8
	2	4.5	5.5	6.0	6.0
	3	4.8	5.8	6.3	6.3
70	4	5.1	6.1	6.6	6.6
	5	5.5	6.5	7.0	7.0
	6	5.8	6.8	7.3	7.3
	7	6.2	7.2	7.7	7.7
	2	3.4	4.4	4.9	4.9
	3	3.5	4.5	5.0	5.0
	4	3.7	4.7	5.2	5.2
80	5	3.9	4.9	5.4	5.4
	6	4.3	5.3	5.8	5.8
	7	4.6	5.6	6.1	6.1
	2	2.2	3.2	3.7	3.7
	3	2.5	3.5	4.0	4.0
	4	2.7	3.7	4.2	4.2
	5	2.8	3.8	4.3	4.3
90	6	3.0	4.0	4.5	4.5
	7	3.1	4.1	4.6	4.6

COMPANY:		Mapei Corporation		Mapeplast 400 NC	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash	Type IS, IP With fly ash or Ternary	BRAND:
°F	fl. oz./cwt	hours	hours	hours	
55	3	4.2	4.8	5.0	
	5	4.8	5.5	5.8	
	7	7.0	8.1	8.4	
	9	10.0	11.5	12.0	
65	3	3.9	4.5	4.7	
	5	4.7	5.4	5.6	
	7	6.9	7.9	8.3	
	9	9.7	11.2	11.6	
75	3	3.7	4.3	4.4	
	5	4.6	5.3	5.5	
	7	6.8	7.8	8.2	
	9	9.4	10.8	11.3	
85	3	3.1	3.6	3.7	
	5	4.5	5.1	5.3	
	7	6.3	7.2	7.6	
	9	9.0	10.4	10.8	

COMPANY :		Mapei Corporation		Mapeplast R	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash	Type IS, IP With fly ash or Ternary	BRAND:
°F	fl. oz./cwt	hours	hours	hours	
55	2	4.7	5.7	6.7	
	3	6.5	7.5	8.5	
	4	8.2	9.2	10.2	
	5	9.0	10.0	11.0	
	6	11.0	12.0	13.0	
65	2	4.5	5.2	6.0	
	3	6.0	6.7	7.5	
	4	7.5	8.2	9.0	
	5	8.3	9.0	9.8	
	6	9.8	10.5	11.3	
75	2	4.3	4.8	5.3	
	3	5.5	6.0	6.5	
	4	6.8	7.3	7.8	
	5	7.8	8.3	8.8	
	6	8.8	9.3	9.8	
85	2	4.0	4.3	4.5	
	3	5.0	5.3	5.5	
	4	6.0	6.3	6.5	
	5	7.3	7.6	7.8	
	6	8.5	8.8	9.0	

COMPANY: Mapei Corporation		BRAND: Mapecrete Resolve	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz./cwt	hours	hours
55	2	3.5	4.0
	4	4.8	5.5
	6	5.9	6.8
	8	7.3	8.4
	10	8.1	9.3
	12	9.6	11.0
65	2	3.4	3.9
	4	4.5	5.2
	6	5.7	6.6
	8	7.1	8.2
	10	7.8	9.0
	12	9.3	10.7
75	2	3.2	3.7
	4	4.2	4.8
	6	5.4	6.2
	8	6.9	7.9
	10	7.6	8.7
	12	9.1	10.5
85	2	3.1	3.6
	4	3.9	4.5
	6	5.2	6.0
	8	6.7	7.7
	10	7.4	8.5
	12	8.9	10.2
		Type IS, IP With fly ash or Ternary	hours
			4.2
			5.8
			7.1
			8.8
			9.7
			11.5
			4.1
			5.4
			6.8
			8.5
			9.4
			11.2
			3.8
			5.0
			6.5
			8.3
			9.1
			10.9
			3.7
			4.7
			6.2
			8.0
			8.9
			10.7

COMPANY: Sika Corporation		Sika Corporation		BRAND:		Plastiment	
Mix Temp at point of discharge	Dosage	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type IS, IP	
°F	fl. oz./cwt	No fly ash	With fly ash	With fly ash	With fly ash	With fly ash	hours
55	2						
	3						
	4						
	5						
65	3	5.1	5.8			6.6	
	4	7.1	7.8			8.7	
	5	11.4	12.0			13.0	
	6	20.2	20.8			19.0	
	3	3.6	4.0			4.2	
	4	4.7	5.1			5.4	
75	5	6.9	7.4			7.8	
	6	10.9	11.4			12.1	
	7	18.9	19.3			20.5	
	3	3.0	3.3			3.1	
	4	3.6	3.9			3.8	
85	5	4.9	5.1			5.1	
	6	6.9	7.1			7.2	
	7	10.2	10.5			10.3	
	3	2.2	2.2			2.2	
95	4	2.7	2.7			2.7	
	5	3.5	3.5			3.5	
	6	4.9	4.9			4.9	
	7	7.4	7.4			7.4	
	8	12.1	12.1			12.1	

COMPANY: Sika Corporation		Sika Corporation		BRAND:		Plastiment XR	
Mix Temp at point of discharge	Dosage	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type I/II or IL	Type IS, IP	
°F	fl. oz./cwt	No fly ash	With fly ash	With fly ash	With fly ash	With fly ash	hours
55	2	5.2	6.2			7.2	
	3	6.1	7.1			8.1	
	4	7.2	8.1			9.1	
	5	8.5	9.5			10.4	
65	2	4.5	5.3			6.1	
	3	5.5	6.2			7.0	
	4	6.6	7.4			8.1	
	5	7.9	8.6			9.3	
75	2	3.6	4.1			4.6	
	3	4.5	5.0			5.5	
	4	5.5	6.0			6.5	
	5	6.6	7.1			7.7	
85	3	4.1	4.6			5.1	
	4	5.1	5.4			5.7	
	5	6.0	6.3			6.5	
	4	3.8	3.9			4.0	
	5	4.8	4.9			5.0	
95	6	5.7	5.8			5.9	

COMPANY: Sika Corporation		BRAND: Plastocrete 10N	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz./cwt	hours	hours
55	2	5.3	6.3
	3	6.2	7.2
	4	7.3	8.3
	5	8.6	9.6
	6	10.6	10.6
65	2	4.6	5.3
	3	5.7	6.4
	4	6.8	7.5
	5	8.0	8.7
	6	9.5	9.5
75	2	3.6	4.1
	3	4.7	5.2
	4	5.7	6.2
	5	6.8	7.2
	6	7.9	8.4
85	3	3.7	4.0
	4	4.6	4.9
	5	5.5	5.8
	6	6.6	6.9
	7	7.1	7.1
95	4	3.6	3.6
	5	4.5	4.5
	6	5.4	5.4
	7	6.0	6.0
	8	6.0	6.0

COMPANY: Sika Corporation		BRAND: SikaTard 440	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz./cwt	hours	hours
65	2	4.3	5.9
	3	5.5	7.1
	4	7.2	8.8
	5	8.3	9.9
	6	10.5	12.1
	7	12.3	13.9
	8	13.0	14.6
	8	15.8	15.8
75	2	3.5	4.9
	3	4.4	5.8
	4	5.4	6.2
	5	6.6	8.0
	6	8.0	9.4
	7	9.6	10.0
	8	10.4	11.8
	8	12.7	12.7
	3	3.1	4.3
	4	3.6	4.8
85	5	4.2	5.4
	6	4.9	6.1
	7	5.7	6.9
	8	6.6	7.8
	9	7.6	8.8
	4	2.7	3.7
	5	3.3	4.3
	6	4.0	5.0
	7	4.8	5.8
	8	5.7	6.7
95	9	6.7	7.7
	10	7.8	8.8
	4	2.7	3.7
	5	3.3	4.3
	6	4.0	5.0
	7	4.8	5.8
	8	5.7	6.7
	9	6.7	7.7
	10	7.8	8.8
	10	9.1	9.1

COMPANY: Premiere		BRAND: ProLong L	
Mix Temp at point of discharge	Dosage	Type I/II or IL No fly ash	Type I/II or IL With fly ash
°F	fl. oz./cwt	hours	hours
65	2	4.0	5.0
	3	5.0	6.0
	4	5.5	6.5
	5	6.5	7.5
	6	8.0	9.0
	7	9.0	10.0
	8	10.5	11.5
	10		12.0
75	2	3.5	4.5
	3	4.0	5.0
	4	4.5	5.5
	5	5.5	6.5
	6	6.5	7.5
	7	8.0	9.0
	8	9.0	10.0
	10		10.5
85	3	3.0	4.0
	4	3.5	4.5
	5	4.5	5.5
	6	5.5	6.5
	7	7.0	8.0
	8	8.0	9.0
	9	10.0	11.0
	10		11.5
95	4	2.5	3.5
	5	3.5	4.5
	6	4.5	5.5
	7	6.0	7.0
	8	7.0	8.0
	9	9.0	10.0
	10		10.5
	10		11.0



Materials Approved Products List

403ab - Appendix B - Retarders Bridge Deck

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Daratard 17	04/12/2019	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403		GCP Applied Technologies		Extended Time-See File
Eucon Retarder 100	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH; Albertville, MN; Marengo, IA	Euclid Chemical Company		Extended Time-See File
Eucon Stasis	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403		Euclid Chemical Company		Extended Time-See File
Eucon WR-91	04/12/2019	Euclid Chemical Company	ADMIXTURES, RETARDING EXTENDED SET	403	Cleveland, OH; Albertville, MN; Marengo, IA	Euclid Chemical Company		Extended Time-See File
Mapecrete Resolve	01/19/2024	Mapei Corporation	ADMIXTURES, RETARDING EXTENDED SET	403		Mapei Corporation		2 fl oz./100 lbs
Mapeplast 400 NC	06/28/2023	Mapei Corporation	ADMIXTURES, RETARDING EXTENDED SET	403		Mapei Corporation		Extended Time-See File
Mapetard R	04/06/2023	Mapei Corporation	ADMIXTURES, RETARDING EXTENDED SET	403		Mapei Corporation		Extended Time-See File
MasterSet Delvo	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING EXTENDED SET	403		Master Builders Solutions US LLC		Extended Time-See File
MasterSet R 100	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING EXTENDED SET	403		Master Builders Solutions US LLC		Extended Time-See File
MasterSet R 300	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING EXTENDED SET	403		Master Builders Solutions US LLC		Extended Time-See File
Polychem Renu	10/16/2020	Mapei Corporation	ADMIXTURES, RETARDING EXTENDED SET	403		Mapei Corporation		Extended Time-See File
ProLong L	10/05/2023	Premiere Concrete Admixtures	ADMIXTURES, RETARDING EXTENDED SET	403		Premiere Concrete Admixtures		2.0 fl oz./100 lbs



Materials Approved Products List

403ab - Appendix B - Retarders Bridge Deck

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
RECOVER	04/12/2019	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403		GCP Applied Technologies		Extended Time-See File
Sika Plastiment	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	Ottawa, IL	Sika Corporation (Construction)		Extended Time-See File
Sika Plastiment XR	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	Ottawa, IL	Sika Corporation (Construction)		Extended Time-See File
Sika Plastocrete-10N	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	Ottawa, IL	Sika Corporation		Extended Time-See File
SikaTard 440	04/12/2019	Sika Corporation	ADMIXTURES, RETARDING EXTENDED SET	403	Ottawa, IL	Sika Corporation (Construction)		Extended Time-See File
Zyla 640	03/14/2024	GCP Applied Technologies	ADMIXTURES, RETARDING EXTENDED SET	403		GCP Applied Technologies		



Materials Approved Products List

403ac - Appendix C - Water Reducers

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
ADVA 140M	01/22/2021	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.0 oz per 100 lbs
ADVA 140M	06/23/2021	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		6 fl. oz. per 100 lbs
ADVA Cast 575	05/10/2022	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		2.0 fl. oz./100 lbs
ADVA Cast 600	12/14/2021	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403				
ADVA Cast 600	08/21/2023	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403				
Accelguard G3	09/14/2017	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	16.0 fl. oz./100 lb
Chryso Fluid Optima 256	03/02/2017	CHRYSO Inc	ADMIXTURES, NORMAL WATER REDUCING	403		Chryso, Inc.		2.0 fl. oz./100 lb
Chryso Fluid Optima 256	03/02/2017	CHRYSO Inc	ADMIXTURES, MID-RANGE WATER REDUCING	403		Chryso, Inc.		5.0 fl. oz./100 lbs
Chryso Optima 249	01/16/2024	CHRYSO Inc	ADMIXTURES, NORMAL WATER REDUCING	403		Chryso Inc.		2.5 fl oz./100 lbs
Clarena MC 2000	05/03/2017	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		6.0 fl. oz./100 lb



Materials Approved Products List

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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Concera CP1124	07/27/2018	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		7.0 fl. oz./100 lb
Concera SA8080	08/23/2019	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		2.5 fl. oz./100 lb
DNL 485	02/04/2021	DarCole Products, Inc	ADMIXTURES, NORMAL WATER REDUCING	403		Darcole Products, Inc.		5 oz per 100 lbs
DNL 785	02/04/2021	DarCole Products, Inc	ADMIXTURES, NORMAL WATER REDUCING	403		Darcole Products, Inc.		7 oz per 100 lbs
Daracem 65	07/02/2014	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		3.0 fl. oz./100 lb
Dynamon 850	01/18/2024	Mapei Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403		Mapei Corporation		4.5 fl oz./100 lbs
Dynamon 850	04/06/2023	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		2.5 fl. oz. / 100 lbs
Dynamon NRG 1092	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		3.0 fl. oz./100 lb
Dynamon NRG 546	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		3 oz./100 lbs
Dynamon SX	10/16/2020	Mapei Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403		Mapei Corporation		4.0 fl. oz./100 lb
Dynamon SX	01/18/2024	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		2 fl oz./100 lbs



Materials Approved Products List

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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Elara SP200	12/22/2021	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403				
Eucon MR	07/02/2014	Euclid Chemical Company	ADMIXTURES, MID-RANGE WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	6.0 fl. oz./100 lb
Eucon MRX	07/02/2014	Euclid Chemical Company	ADMIXTURES, MID-RANGE WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	5.0 fl. oz./100 lbs
Eucon MRX	04/24/2014	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	3.0 fl. oz./100
Eucon SE	05/22/2018	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	2.5 fl. oz./100 lb
Eucon WR	04/24/2014	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	3.0 fl. oz./100 lb
Eucon WR-75	04/24/2014	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	3.0 fl. oz./100 lb
Eucon WR-91	04/24/2014	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	3.0 fl. oz./100 lb
Eucon X-15	05/19/2023	Euclid Chemical Company	ADMIXTURES, MID-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company		14.0 fl oz./100 lbs
Eucon X-15	05/19/2023	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company		6.0 fl oz./100 lbs



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Extendflo X90	05/15/2017	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RussTech Inc. & Mapei Corporation		3.0 fl. oz./100 lbs
FinishEase-NC	06/08/2015	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RuthTech Inc.		3.0 fl. oz./100 lb
FinishEase-NC	07/02/2014	RussTech, Inc.	ADMIXTURES, MID-RANGE WATER REDUCING	403		RussTech, Inc.		6.0 fl. oz./100 lb
LC-400P	04/24/2014	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RussTech, Inc.		3.0 fl. oz./100 lb
MIRA 110	09/02/2015	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		6.0 fl. oz./100 lb
MIRA 62	05/03/2021	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.5 fl. oz. per 100 lbs
MIRA 62	07/02/2014	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz./100 lb
MIRA 95	02/12/2015	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.0 fl. oz./100 lb.
MIRA 95	02/12/2015	GCP Applied Technologies	ADMIXTURES, MID-RANGE WATER REDUCING	403		GCP Applied Technologies		5.0 fl. oz./100 lb.
Mapeifluid N200	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		4 fl. oz./100 lbs



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Mapeplast 400 NC	06/28/2023	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		3.0 fl. oz./100 lb
Mapeplast KB 1200	06/26/2023	Mapei Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403		Mapei Corporation		6.0 fl. oz./100 lbs
Mapeplast KB 1200	06/26/2023	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		3.0 fl. oz./100 lb
Mapeplast MR 107	10/16/2020	Mapei Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403		Mapei Corporation		5 oz./100 lbs
Mapeplast MR 107	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		4 oz./100 lbs
Mapeplast N	03/11/2021	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		2 fl. oz. / 100 lbs
Mapeplast Paver Plus	06/28/2023	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		3.0 fl. oz./100 lb
Master X-Seed 66	09/28/2023	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions, Inc.		
MasterEase 5000	04/22/2024	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Master Builders Solutions, Inc.		2.5 fl oz./100 lbs
MasterGlenium 1466	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		4.0 fl. oz./100 lb
MasterGlenium 3030	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		2.0 fl. oz./100 lb



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
MasterGlenium 3030	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		4 fl. oz./100 lbs
MasterGlenium 7920	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		2.0 fl. oz./100 lbs
MasterGlenium 7500	11/08/2023	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions, Inc.		4.0 fl. oz./100 lbs
MasterPolyheed 1020	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPolyheed 1025	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPolyheed 1720	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPolyheed 1725	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPolyheed 900	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPolyheed 900	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		7.0 fl. oz./100 lb



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
MasterPolyheed 997	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, MID-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		6.0 fl. oz/100 lb
MasterPolyheed 997	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC	Type A, Water Reducing	3.0 fl. oz/100 lb
MasterPozzololith 200	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		3.0 fl. oz/100 lb
MasterPozzololith 322	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		3.0 fl. oz/100 lb
MasterPozzololith 700	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		3.0 fl. oz/100 lb
MasterPozzololith 80	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NORMAL WATER REDUCING	403		Master Builders Solutions US LLC		4.0 fl. oz/100 lb
Melchem 38	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		2.6 oz/100 lbs
OptiFlo 500	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, NORMAL WATER REDUCING	403		Premiere Concrete Admixtures™		2.0 fl. oz/100 lb
OptiFlo 700	03/05/2018	Premiere Concrete Admixtures	ADMIXTURES, NORMAL WATER REDUCING	403		Premiere Concrete Admixtures		3.0 fl. oz./100 lb
OptiFlo MR	02/25/2022	Premiere Concrete Admixtures	ADMIXTURES, NORMAL WATER REDUCING	403				
OptiFlo MR	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, MID-RANGE WATER REDUCING	403		Premiere Concrete Admixtures™		7.0 fl. oz/100 lb



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Optifo 700	02/11/2022	Premiere Concrete Admixtures	ADMIXTURES, MID-RANGE WATER REDUCING	403				
Plastol 6420	06/01/2017	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH		Albertville, MN; Marengo, IA	2.5 fl. oz./100 lb
Plastol 6420	06/01/2017	Euclid Chemical Company	ADMIXTURES, MID-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	4.0 fl. oz./100 lb
Plastol 6425	03/14/2023	Euclid Chemical Company	ADMIXTURES, NORMAL WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company		4.0 fl. oz./100 lbs
Polychem 3000	10/16/2020	Mapei Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403		Mapei Corporation		4.0 fl. oz./100 lb
Polychem 3000	10/16/2020	Mapei Corporation	ADMIXTURES, NORMAL WATER REDUCING	403		Mapei Corporation		2.0 fl. oz./100 lb
Sika Plastocrete-10N	07/30/2020	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		2.0 fl. oz./100 lb
Sika Plastocrete-161	07/30/2020	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation		2.0 fl. oz./100 lb
Sika Plastocrete-250	07/30/2020	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation		2.0 fl. oz./100 lb
Sika ViscoFlow-2020	08/14/2017	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		6.0 fl. oz./100 lb



Materials Approved Products List

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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Sika ViscoFlow-2020	08/14/2017	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation		3.0 fl. oz./100 lb
Sika Viscocrete-1000	09/18/2023	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sika Viscocrete-1100	09/18/2023	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation		2.3 fl oz./100 lbs
Sikament 686	04/24/2014	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		4.0 fl. oz./100 lb
Sikament AFM	07/02/2014	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sikament-475	08/19/2016	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		5.0 fl. oz./100 lb
Sikament-475	08/19/2016	Sika Corporation	ADMIXTURES, NORMAL WATER REDUCING	403	Ottawa, IL	Sika Corporation		3.0 fl. oz./100 lb
Sikaplast 200	07/02/2014	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		4.0 fl. oz./100 lb
Sikaplast 300GP	07/02/2014	Sika Corporation	ADMIXTURES, MID-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		4.0 fl. oz./100 lb
Superflo 2000 RM	05/15/2017	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RussTech Inc.		2.0 fl. oz./100 lbs



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Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Superflo 2000 SCC	05/15/2017	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RussTech Inc.		1.0 fl. oz/100 lbs
Superflo 2040 RM	05/15/2017	RussTech, Inc.	ADMIXTURES, NORMAL WATER REDUCING	403		RussTech Inc.		1.0 fl. oz/100 lbs
WRDA 82	04/24/2014	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.0 fl. oz/100 lb
ZYLA 620	05/01/2014	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.0 fl. oz/100 lb
ZYLA 630	11/02/2015	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb
ZYLA 640	03/10/2015	GCP Applied Technologies	ADMIXTURES, NORMAL WATER REDUCING	403		GCP Applied Technologies		3.0 fl. oz/100 lbs



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
ADVA 140M	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		10.0 fl. oz/100 lb
ADVA 190	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		5.0 fl. oz/100 lb.
ADVA 195	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb.
ADVA 198	02/12/2015	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb.
ADVA 405	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		13.0 fl. oz/100 lb
ADVA Cast 555	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		10.0 fl. oz/100 lb
ADVA Cast 575	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb
ADVA Cast 585	11/07/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb
ADVA Cast 600	08/21/2023	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.0 fl. oz/100 lb



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403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
ADVA ITM750	11/14/2018	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		4.5 fl. oz./100 lb
Adva Cast 593	01/07/2022	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403				
Chryso Fluid Optima 256	03/02/2017	CHRYSO Inc	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Chryso, Inc.		9.0 fl. oz./100 lb
Chryso Optima 249	01/16/2024	CHRYSO Inc	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Chryso Inc.		4.5 fl oz./100 lbs
Clarena MC 2000	05/03/2017	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		10.0 fl. oz./100 lb
Concerta SA8080	06/20/2018	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		11 fl oz./100 lb.
Daracem 19	04/24/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		12.0 fl. oz./100 lb
Dynamon 850	04/06/2023	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		7 fl. oz. /100 lbs
Dynamon NRG 1092	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		4.5 fl. oz./100 lb



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Dynamon NRG 546	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		5.5 oz./100 lbs
Dynamon SX	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		8.0 fl. oz./100 lb
Dynamon SX 37	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		4 oz. / 100 lbs
Eucon 1037	04/24/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical /Brett Admixtures	Albertville, MN; Marengo, IA	10.0 fl. oz./100 lb
Eucon 37	04/24/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical/Brett Admixtures	Albertville, MN; Marengo, IA	10.0 fl. oz./100 lb
Eucon MRX	05/06/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical/Brett Admixtures	Albertville, MN; Marengo, IA	8.0 fl. oz./100 lb
MIRA 110	09/02/2015	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		10.0 fl. oz./100 lb
MIRA 62	05/06/2014	GCP Applied Technologies	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		GCP Applied Technologies		9.0 fl. oz./100 lb
Mapecrete Resolve	01/19/2024	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		4 fl oz./100 lbs



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Mapefluid N200	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		8.5 oz/100 lbs
MasterGlenium 1466	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		4.0 fl. oz./100 lb
MasterGlenium 3030	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		9.0 fl. oz./100 lb
MasterGlenium 3400	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		4.0 fl. oz/100 lb
MasterGlenium 7500	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		6.0 fl. oz/100 lb
MasterGlenium 7700	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		5.0 fl. oz/100 lb
MasterGlenium 7920	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		4.0 fl. oz/100 lbs
MasterRheobuild 1000	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Master Builders Solutions US LLC		10.0 fl. oz/100 lb
Melchem 38	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		6.5 oz/100 lbs



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Plastol 341	04/24/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	4.0 fl. oz./100 lb
Plastol 341-S	04/24/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	4.0 fl. oz./100 lb
Plastol 5000	04/24/2014	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	5.0 fl. oz./100 lb
Plastol 6400	06/01/2017	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	4.0 fl. oz./100 lb
Plastol 6420	06/01/2017	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	7.0 fl. oz./100 lb
Plastol 6425	03/14/2023	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical Company		9.0 fl oz./100 lbs
Plastol Ultra 209	01/23/2017	Euclid Chemical Company	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Cleveland, OH	Euclid Chemical Copany	Albertville, MN; Marengo, IA	3.0 fl. oz./100 lb
Polychem 3000	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		9.0 fl. oz./100 lb
Polychem SPC	10/16/2020	Mapei Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Mapei Corporation		9.0 fl. oz./100 lb



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Sika ViscoCrete 1000	05/06/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		10.0 fl. oz./100 lb
Sika ViscoCrete 2100	04/24/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sika ViscoCrete 2110	04/24/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sika ViscoCrete 4100	04/24/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sika ViscoCrete 6100	04/24/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		5.0 fl. oz./100 lb
Sika Viscocrete-1100	09/18/2023	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		4.5 fl oz./100 lbs
Sikament 686	05/06/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		6.0 fl. oz./100 lb
Sikament AFM	05/06/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		9.0 fl. oz./100 lb
Sikament SPMN	04/24/2014	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation (Construction)		15.0 fl. oz./100 lb



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Sikament-475	08/19/2016	Sika Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403	Ottawa, IL	Sika Corporation		7.0 fl. oz./100 lb
Supercizer 5	04/24/2014	Fritz-Pak Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Fritz-Pak Corporation		5.0 oz/100 lb
Supercizer 7	04/24/2014	Fritz-Pak Corporation	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Fritz-Pak Corporation		6.0 oz/100 lb
Superflo 2000 RM	05/15/2017	RussTech, Inc.	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		RussTech Inc.		9.0 fl. oz/100 lbs
Superflo 2000 SCC	04/24/2014	RussTech, Inc.	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		RussTech, Inc.		9.0 fl. oz/100 lb
Superflo 2040 RM	05/15/2017	RussTech, Inc.	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		RussTech Inc.		5.0 fl. oz/100 lbs
Superflo DSF 1443	02/04/2021	DarCole Products, Inc	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Darcole Products, Inc.		4.5 oz per 100 lbs
UltraFlo 2000	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Premiere Concrete Admixtures		8.0 fl. oz./100 lb
UltraFlo 5600	03/05/2018	Premiere Concrete Admixtures	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Premiere Concrete Admixtures		9.0 fl. oz./100 lb



Materials Approved Products List

403ad - Appendix D - High Range WR

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
UltraFlo DP	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, HIGH-RANGE WATER REDUCING	403		Premiere Concrete Admixtures™		6.0 fl. oz/100 lb



Materials Approved Products List

403ae - Appendix E - Non CL Accelerators

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Accelguard 80	05/21/2021	Euclid Chemical Company	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Euclid Chemical Company		18 oz per 100 lbs
Accelguard G3	09/14/2017	Euclid Chemical Company	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	16.0 fl. oz/100 lb
Accelguard NCA	04/24/2014	Euclid Chemical Company	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Cleveland, OH	Brett Admixtures	Albertville, MN; Marengo, IA	12.0 fl. oz/100 lb
DCI	05/07/2014	GCP Applied Technologies	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		GCP Applied Technologies		2.0-6.0 gal./cubic yard of concrete
DNS 166	02/04/2021	DarCole Products, Inc	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Darcole Products, Inc.		18 oz per 100 lbs
DWR 385	02/04/2021	DarCole Products, Inc	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Darcole Products, Inc.		5 oz per 100 lbs
DarNset 130	03/19/2024	DarCole Products, Inc	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Darcole Products, Inc.		18 fl oz./100 lbs
Daraset 400	04/24/2014	GCP Applied Technologies	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		GCP Applied Technologies		10.0 fl. oz/100 lb
Fritz-Pak NCA	10/25/2022	Fritz-Pak Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Fritz-Pak Corporation		1 lb per 100 lbs cement
LCNC-166	05/15/2017	RussTech, Inc.	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		RussTech Inc.		15.0 fl. oz/100 lbs
Mapefast Super Set	06/28/2023	Mapei Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Mapei Corporation		8.0 fl. oz/100 lb



Materials Approved Products List

403ae - Appendix E - Non CL Accelerators

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Mapefast Super Set Plus	04/05/2023	Mapei Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Mapei Corporation		20.0 fl. oz/100 lb
Mapeshield CI 300	06/28/2023	Mapei Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403				
MasterLife CI 30	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Master Builders Solutions US LLC		1.0-6.0 gal./cubic yard of concrete
MasterSet AC 534	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Master Builders Solutions US LLC		10.0 fl. oz/100 lb
MasterSet FP 20	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Master Builders Solutions US LLC		5.0 fl. oz/100 lb
NitroCast NC	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		Premiere Concrete Admixtures™		10.0 fl. oz/100 lb
Plastocrete 161FL	01/12/2021	Sika Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Ottawa, IL	Sika Corporation		25 oz. per 100 lbs
Polarset	04/24/2014	GCP Applied Technologies	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403		GCP Applied Technologies		8.0 fl. oz/100 lb
Sika CNI	01/12/2021	Sika Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Ottawa, IL	Sika Corporation		65 oz. per 100 lbs
Sika Rapid-1	04/24/2014	Sika Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Ottawa, IL	Sika Corporation (Construction)		8.0 fl. oz/100 lb
SikaSet NC	04/24/2014	Sika Corporation	ADMIXTURES, NON-CHLORIDE ACCELERATOR	403	Ottawa, IL	Sika Corporation (Construction)		10.0 fl. oz/100 lb



Materials Approved Products List

403af - Appendix F - Precast Admixtures

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
CBP 2	10/14/2015	GCP Applied Technologies	ADMIXTURES, PRE CAST-DRY CAST	403		GCP Applied Technologies		4.0 fl. oz/100 lb
Daravair M	04/24/2014	GCP Applied Technologies	ADMIXTURES, PRE CAST-DRY CAST	403		GCP Applied Technologies		0.3 fl. oz/100 lb
Eucon For-Cast N	04/24/2014	Euclid Chemical Company	ADMIXTURES, PRE CAST-DRY CAST	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	2.0 fl. oz/100 lb
Eucon For-Cast S	04/24/2014	Euclid Chemical Company	ADMIXTURES, PRE CAST-DRY CAST	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	2.0 fl. oz/100 lb
Master X-Seed 66	12/04/2023	Master Builders Solutions US LLC	ADMIXTURES, PRE CAST-DRY CAST	403		Master Builders Solutions, Inc.		
MasterCast 730S	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, PRE CAST-DRY CAST	403		Master Builders Solutions US LLC		2.0 fl. oz/100 lb
MasterCast 750HS	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, PRE CAST-DRY CAST	403		Master Builders Solutions US LLC		2.0 fl. oz/100 lb
MasterPel 240	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, PRE CAST-DRY CAST	403		Master Builders Solutions US LLC		2.0 fl. oz/100 lb
Quantec PL-490	04/24/2014	GCP Applied Technologies	ADMIXTURES, PRE CAST-DRY CAST	403		GCP Applied Technologies		2.0 fl. oz/100 lb
Sika Stabilizer-4 R	07/30/2020	Sika Corporation	ADMIXTURES, PRE CAST-DRY CAST	403	Ottawa, IL	Sika Corporation		3.0 fl. oz/100 lb
SikaMix HC-300	10/13/2016	Sika Corporation	ADMIXTURES, PRE CAST-DRY CAST	403	Ottawa, IL	Sika Corporation		3.0 fl. oz/100 lb
Sikamix PL-100	02/10/2015	Sika Corporation	ADMIXTURES, PRE CAST-DRY CAST	403	Ottawa, IL	Sika Corporation		2.0 fl. oz/100 lb



Materials Approved Products List

403af - Appendix F - Precast Admixtures

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Sikamix PL-200	01/27/2020	Sika Corporation	ADMIXTURES, PRE CAST-DRY CAST	403		Sika Corporation		3.0 fl. oz/100 lb
V-Mar F100	04/24/2014	GCP Applied Technologies	ADMIXTURES, PRE CAST-DRY CAST	403		GCP Applied Technologies		5.0 fl. oz/100 lb



Materials Approved Products List

403ag - Appendix G - WR Retarding

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
DHS	03/19/2024	DarCole Products, Inc	ADMIXTURES, RETARDING	403		Darcole Products, Inc.		4 fl oz./100 lbs
DWR 385R	03/19/2024	DarCole Products, Inc	ADMIXTURES, RETARDING	403		Darcole Products, Inc.		4 fl oz./100 lbs
Daratard 17	05/07/2014	GCP Applied Technologies	ADMIXTURES, RETARDING	403		GCP Applied Technologies		2.0 fl. oz./100 lb
Eucon DS	03/24/2023	Euclid Chemical Company	ADMIXTURES, RETARDING	403	Cleveland, OH	Euclid Chemical Company		4.0 oz. per 100 lbs
Eucon Retarder 100	05/07/2014	Euclid Chemical Company	ADMIXTURES, RETARDING	403	Cleveland, OH	Euclid Chemical/Brett Admixtures	Albertville, MN; Marengo, IA	2.0 fl. oz./100 lb
Eucon SE	07/30/2018	Euclid Chemical Company	ADMIXTURES, RETARDING	403	Cleveland, OH	Euclid Chemical Company	Albertville, MN; Marengo, IA	4.5 fl. oz./100 lb
Eucon Stasis	06/01/2017	Euclid Chemical Company	ADMIXTURES, RETARDING	403	Cleveland, OH	Euclid Chemical	Albertville, MN; Marengo, IA	5.0 fl. oz./100 lb
Eucon WR-91	05/07/2014	Euclid Chemical Company	ADMIXTURES, RETARDING	403	Cleveland, OH	Euclid Chemical/Brett Admixtures	Albertville, MN; Marengo, IA	4.0 fl. oz./100 lb
LC-400P	05/15/2017	RussTech, Inc.	ADMIXTURES, RETARDING	403		RussTech, Inc.		6.0 fl. oz./100 lbs
LC-400R	05/07/2014	RussTech, Inc.	ADMIXTURES, RETARDING	403		RussTech, Inc		3.0 fl. oz./100 lb
Mapecrete Resolve	01/19/2024	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		2 fl oz./100 lbs
Mapeplast 400 NC	06/28/2023	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		6.0 fl. oz./100 lb



Materials Approved Products List

403ag - Appendix G - WR Retarding

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Mapeplast N	03/11/2021	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		5.5 oz per 100 lbs
Mapetard Plus	10/26/2020	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		2.5 fl. oz. / 100 lbs
Mapetard R	04/06/2023	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		2.0 fl. oz./100 lb
MasterPozzolith 200	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		3.0 fl. oz./100 lbs
MasterPozzolith 322	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPozzolith 700	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		5.0 fl. oz./100 lb
MasterPozzolith 80	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		6.0 fl. oz./100 lb
MasterSet Delvo	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		2 oz. per 100 lbs (See Manuf. Recommendation)
MasterSet Delvo ESC	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		See manufacturer recommendation
MasterSet R 100	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		2.0 fl. oz./100 lb



Materials Approved Products List

403ag - Appendix G - WR Retarding

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
MasterSet R 300	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, RETARDING	403		Master Builders Solutions US LLC		3.0 fl. oz./100 lb
Mini Delayed Set	10/25/2022	Fritz-Pak Corporation	ADMIXTURES, RETARDING	403		Fritz-Pak Corporation		1 bag (8 oz.) per cubic yard for 1 hr. delay
OptiFlo 500	12/01/2016	Premiere Concrete Admixtures	ADMIXTURES, RETARDING	403		Premiere Concrete Admixtures		4.0 fl. oz./100 lb
Polychem Renu	10/16/2020	Mapei Corporation	ADMIXTURES, RETARDING	403		Mapei Corporation		2 oz. per 100 lbs (See Manuf. Recommendation)
ProLong L	03/05/2018	Premiere Concrete Admixtures	ADMIXTURES, RETARDING	403		Premiere Concrete Admixtures		2 oz. per 100 lbs (See Manuf. Recommendation)
RENU	05/15/2017	RussTech, Inc.	ADMIXTURES, RETARDING	403		RussTech Inc.		6.0 fl. oz./100 lbs
Recover	05/07/2014	GCP Applied Technologies	ADMIXTURES, RETARDING	403		GCP Applied Technologies		2 oz. per 100 lbs
Sika Plastiment	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL	Sika Corporation		2.0 fl. oz./100 lb
Sika Plastiment XR	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL	Sika Corporation		3.0 fl. oz./100 lb



Materials Approved Products List

403ag - Appendix G - WR Retarding

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Sika Plastocrete-10N	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL	Sika Corporation		3.5 fl. oz./100 lb
Sika Plastocrete-161	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL	Sika Corporation		4.0 fl. oz./100 lb
Sika Plastocrete-250	07/30/2020	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL	Sika Corporation		6.0 fl. oz./100 lb
Sikatard 440	05/07/2014	Sika Corporation	ADMIXTURES, RETARDING	403	Ottawa, IL			2.0 fl. oz./100 lb
Standard Delayed Set	05/07/2014	Fritz-Pak Corporation	ADMIXTURES, RETARDING	403		Fritz-Pak Concrete Admixtures		1.0 oz./100 lbs
V-Mar VSC 500	05/07/2014	GCP Applied Technologies	ADMIXTURES, RETARDING	403		GCP Applied Technologies		7.0 fl. oz./100 lb
WRDA with Hycol	05/07/2014	GCP Applied Technologies	ADMIXTURES, RETARDING	403		GCP Applied Technologies		5.0 fl. oz./100 lb
Zyla 640	08/22/2023	GCP Applied Technologies	ADMIXTURES, RETARDING	403				3 fl oz./100 lbs
Zyla R	05/12/2020	GCP Applied Technologies	ADMIXTURES, RETARDING	403		GCP Applied Technologies		4.0 fl. oz./100 lbs



Materials Approved Products List

403ah - Appendix H - Special Performance

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
ADVA ITM750	11/14/2018	GCP Applied Technologies	ADMIXTURES, SPECIAL PERFORMANCE	403		GCP Applied Technologies		0.3 fl. oz/100 lb
CSxtreme	03/05/2021	Concrete Moisture Solutions, Inc.	ADMIXTURES, SPECIAL PERFORMANCE	403		Concrete Moisture Solutions/Barrier One Admixtures		14 oz per 100 lbs
CarbonCure	04/14/2021	CarbonCure Technologies, Inc.	ADMIXTURES, SPECIAL PERFORMANCE	403				
CarbonJect	10/11/2023	CRH	ADMIXTURES, SPECIAL PERFORMANCE	403		CRH		
DG-F	01/20/2023	Mapei Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Mapei Corporation		See Manufacturers Recommendations
E5 Internal Cure	11/10/2023	Specification Products	ADMIXTURES, SPECIAL PERFORMANCE	403		Specification Products		See Manufacturers Recommendations
E5 Liquid Fly Ash	11/10/2023	Specification Products	ADMIXTURES, SPECIAL PERFORMANCE	403		Specification Products		See Manufacturers Recommendations
Eucon AWA-P20	07/08/2021	Euclid Chemical Company	ADMIXTURES, SPECIAL PERFORMANCE	403		Euclid Chemical Company		8 fl. oz. / 100 lbs



Materials Approved Products List

403ah - Appendix H - Special Performance

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Hycrete X1002	04/28/2023	Hycrete	ADMIXTURES, SPECIAL PERFORMANCE	403		Hycrete		Manufacturers Recommendations
Mapecrete V3K	10/16/2020	Mapei Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Mapei Corp.		See Manufacturer's Recommendation
Mapecrete VMA	06/28/2023	Mapei Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Mapei Corp.		2.0 fl oz./100 lbs
Master X-Seed 44	11/02/2022	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions		15 oz./100lbs.
Master X-Seed 55	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions US LLC		7.5 fl oz./100 lbs
Master X-Seed 66	12/04/2023	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions, Inc.		
MasterMatrix VMA 358	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions US LLC		4.5 fl oz./100 lbs
MasterMatrix VMA 362	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions US LLC		4.0 fl oz./100 lbs
MasterPel 240	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions US LLC		2.0 fl. oz./100 lb
MasterSure Z-60	10/12/2020	Master Builders Solutions US LLC	ADMIXTURES, SPECIAL PERFORMANCE	403		Master Builders Solutions US LLC		5.0 fl oz./100 lbs



Materials Approved Products List

403ah - Appendix H - Special Performance

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
Penetron Admix SB	02/13/2023	Penetron USA, Inc.	ADMIXTURES, SPECIAL PERFORMANCE	403		Penetron USA, Inc.		1% weight of cement
Sika WT-240 P	11/12/2019	Sika Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403				Contact manufacturer
SikaControl NS	12/20/2018	Sika Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Sika Corporation		3.0% of cement by weight
SikaControl SC	10/06/2020	Sika Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Sika Corporation		3.5% of cement by weight
Slick-Pak	08/10/2018	Fritz-Pak Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Fritz-Pak Corporation		See Manufacturer's Recommendation
Slick-Pak II	08/10/2018	Fritz-Pak Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Fritz-Pak Corporation		1.5 oz./cubic yard of concrete or grout
Stabilizer-4R	01/22/2018	Sika Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403	Ottawa, IL	Sika Corporation		2.0 fl. oz./100 lb
Super Slump Buster	08/10/2018	Fritz-Pak Corporation	ADMIXTURES, SPECIAL PERFORMANCE	403		Fritz-Pak Corporation		See Manufacturer's Recommendation



Materials Approved Products List

403ah - Appendix H - Special Performance

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Dosage
V-Mar 3	04/20/2018	GCP Applied Technologies	ADMIXTURES, SPECIAL PERFORMANCE	403		GCP Applied Technologies		8.0 fl oz./100 lbs
V-Mar F100	01/10/2020	GCP Applied Technologies	ADMIXTURES, SPECIAL PERFORMANCE	403		GCP Applied Technologies		6.0 fl oz./100 lbs
VMA-758	12/08/2021	RussTech, Inc.	ADMIXTURES, SPECIAL PERFORMANCE	403				
Visctrol	02/06/2019	Euclid Chemical Company	ADMIXTURES, SPECIAL PERFORMANCE	403		Euclid Chemical Company		

Chapter 14
IM 491.14
INSPECTION & ACCEPTANCE - SLAG

**INSPECTION & ACCEPTANCE
GROUND GRANULATED BLAST FURNACE SLAG (GGBFS)**

GENERAL

Acceptance of Ground Granulated Blast Furnace Slag (GGBFS), or slag cement, the glassy, granular material produced when molten blast furnace slag is rapidly chilled, will be on the basis of approved sources and upon satisfactory test results on samples obtained at the project site. Approved manufacturers and brands of slag cement (GGBFS) are listed in the Materials Approved Products Listing Enterprise ([MAPLE](#)).

Approval is based upon slag produced when the blast furnace is utilizing specific processes. Any change in the processes will void any source approval and require that a new approval be sought.

SOURCE APPROVAL

Approval of a slag cement (GGBFS) source is based on the requirement of ASTM C989.

A source may furnish Ground Granulated Blast Furnace Slag cement on the basis of certification provided:

- A. The quality-monitoring program meets the minimum sampling and testing frequencies established in ASTM C-989. At least one sample for each 30 consecutive days shall be tested by the producer for conformance to Iowa Department of Transportation Specifications. The test reports for all monitor samples shall be submitted to the Iowa Department of Transportation, Office of Materials, within 45 days of the sampling date.

The Quality Control Laboratory will be considered approved if it is properly equipped and staffed to perform the tests required for an accepted Quality Control Program. Continued approval of the control laboratory will depend on the comparison of its test results with the Iowa Department of Transportation Central Materials Laboratory. If major differences are found, an attempt to resolve them shall be made as quickly as possible. Continued unresolved differences in test results will be considered a basis for discontinuing control laboratory approval.

- B. The Ground Granulated Blast Furnace Slag cement has shown conformance to the applicable specifications for a continuous period of at least six months.
- C. Each shipment of Ground Granulated Blast Furnace Slag cement is properly certified.

The supplier of certified Ground Granulated Blast Furnace Slag cement shall furnish, for the project records, two invoices or bill of lading copies, which bear the following certification statement:

Certification Statement

The material herein described has been sampled and tested as prescribed by the Highway Division of the Iowa Department of Transportation and complies with the

applicable specification requirements for Ground Granulated Blast Furnace Slag.

Date _____

The bills of lading or invoices shall include project number, if available, source name, source location, source code, grade, and quantity of the shipments.

These copies of bill of lading or invoice shall accompany each load, and shall be retained at the project or ready mix plant for the Project Engineer record. The truck tanker shall have a copy of the invoice or bill of lading attached directly to the tanker portion of the truck. When the tanker unloads the contents at the project site, the unloading time and material final destination (storage "pig" number) shall be marked on this copy and left with the invoice or bill of lading copies.

In the case of more than one project being supplied by a ready mix plant, the plant shall furnish the Project Engineer, for each project, either a copy of each bill of lading or invoice, or a listing of the bills of lading or invoices representing the ground granulated blast furnace slag incorporated in the project. This listing shall bear the signature of a responsible supplier representative.

The source, car or truck number, ticket number, grade, and quantity of each shipment of ground granulated blast furnace slag used on a project shall be recorded on Form #830211, Form #830224, or other applicable form.

- D. Monitor samples secured and tested by the Iowa Department of Transportation indicate compliance with current specifications. The District Materials Engineer will obtain annual samples.



Materials Approved Products List

491.14aa - Appendix A - Slag Cement

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Carbon Smart Grade 100 (Code SL05A)	09/14/2020	Ozinga Cement	SLAG CEMENT	491.14	Anshan City, Liaoning, China	Ozinga Cement		2.95
Heidelberg Speed Plant (Code SL06A)	05/08/2024	Heidelberg Materials	SLAG CEMENT	491.14	Speed, IN	Heidelberg Materials		2.87
NewCem (Code SL02A)	03/24/2022	Holcim (US) Inc.	SLAG CEMENT	491.14	Chicago	Holcim	Davenport, IA (Continental Terminal); Omaha, NE	2.93
Skyway Cement (Code SL00A)	04/24/2014	Skyway Cement Company	SLAG CEMENT	491.14	Chicago (Skyway), IL	Skyway Cement Co/Central Plains Cement Co		2.87

Chapter 15
IM 491.17
INSPECTION & ACCEPTANCE - FLY ASH

FLY ASH

GENERAL

Acceptance of fly ash or natural pozzolan will be on the basis of approved sources and upon satisfactory test results on samples obtained at the project site. Test results of fly ash or natural pozzolan shall meet the requirements of ASTM C 618, C 1697 and the Specifications of the Iowa Department of Transportation. Approval will require identification of the specific sources of the coal from which the ash is derived.

Approval is based upon fly ash produced when the power plant is utilizing specific materials, equipment, and processes. Any change in materials, equipment, and processes will void any source approval and require that a new approval be sought. Approved fly ash sources are listed in the Materials Approved Products Listing Enterprise ([MAPLE](#)).

Fly ash produced immediately prior to shut down and after start up may be quite different from the fly ash normally obtained. The fly ash can be affected to the point that it does not meet specifications. Monitor samples or verification samples tested by the Iowa Department of Transportation not meeting specifications will void the source approval.

Fly ash used for soil stabilization shall meet the requirements of [Article 4108.01, E](#) of the Specifications. Acceptance will be on the basis of satisfactory test results.

SOURCE APPROVAL

A. Certified Source

Approved certified sources of fly ash or natural pozzolan are listed in the [Appendix A](#) of this IM. A source may furnish fly ash or natural pozzolan on the basis of certification provided:

1. The quality-monitoring program meets the minimum sampling and testing frequencies established in ASTM C 311. The tonnage units expressed therein are interpreted to refer to as-marketed material. The producer shall test at least one sample for each consecutive 30 days, for the months of March through October for conformance to Iowa Department of Transportation specifications. The test reports for all monitor samples shall be submitted to the Iowa Department of Transportation within 45 days of the sampling date.

In addition to the test frequencies established in ASTM C 311, daily control tests shall be made to establish the uniformity of the fly ash or natural pozzolan being produced. Specific tests shall be agreed to by the engineer and may vary from source to source. As a minimum, the loss on ignition and percent retained on the No. 325 mesh sieve shall be determined.

Sample test records and shipment reports shall be available for inspection by Iowa Department of Transportation personnel for at least three years after the fly ash or natural pozzolan has been tested.

The Quality Control Laboratory will be considered approved if it is properly equipped and

staffed to perform the tests required for an accepted Quality Control Program. Continued approval of the control laboratory will depend on the comparison of its test results with the Iowa Department of Transportation Central Laboratory. If major differences are found, an attempt to resolve them shall be made as quickly as possible. Continued unresolved differences in test results will be considered a basis for discontinuing control laboratory approval.

2. The fly ash shall comply with ASTM C 618 or C 1697, either Class F or Class C, except the value of total equivalent alkalies (expressed as Na_2O_e) shall not exceed 3.80%.
3. Natural pozzolans shall comply with ASTM C 618. In addition, manufacturer shall submit to the Construction and Materials Bureau, test results of two Iowa DOT Concrete Mix Designation C-3WR-C20, or C-4WR-C20, concrete mixtures, one as a control and one with the natural pozzolan at a replacement rate recommended by the manufacturer. The coarse aggregate used shall be an Iowa DOT approved limestone or dolomite. Fly ash, sand, air entraining agent and chemical admixtures used shall also be from Iowa DOT approval lists. The air content shall be in the range of 5.5% and 7.0%.

The tests and approval requirements are listed below:

- ASTM C39, Compressive Strength at 7, 28, and 56 Days: 90% or better of control.
 - ASTM C78 or C293, Flexural Strength, at 28 Days: 95% or better of control
 - ASTM C157, Concrete Shrinkage up to 56 Days: 95% or better of control or 56-day shrinkage less than 0.040%.
 - ASTM C666, Freeze-Thaw Resistance up to 300 Cycles: 95% or better of control or a durability factor greater than 90%.
 - ASTM C1202, Rapid Chloride Permeability, 50% or lower of control.
4. The fly ash or natural pozzolan has shown conformance to the applicable specifications for a continuous period of at least the last six months.
 5. Each shipment of fly ash or natural pozzolan is properly certified.

The supplier of certified fly ash or natural pozzolan shall furnish for the project records two invoices or bill of lading copies that bear the following certification:

Certification Statement

The material herein described has been sampled and tested as prescribed by the Highway Division of the Iowa Department of Transportation and complies with the applicable specification requirements for Class _____ fly ash/pozzolan.

Date _____

The bills of lading or invoices shall include project number, if available, name of marketing company, source name, source location, source code, class, and quantity in the shipment.

These copies of the bill of lading or invoice shall accompany each load and shall be

retained at the project or ready mix plant for the Project Engineer records.

The truck tanker shall have a copy of the invoice or bill of lading attached directly to the tanker portion of the truck. When the tanker unloads the contents at the project site, the unloading time and material final destination (storage "pig" number) shall be marked on this copy and left with the invoice or bill of lading copies.

In the case of more than one project being supplied by a ready mix plant, the plant shall furnish the Project Engineer, for each project, either a copy of each bill of lading or invoice, or a listing of the bills of lading or invoices representing the fly ash or natural pozzolan incorporated in the project. This listing shall bear the signature of a responsible supplier representative.

The source, car or truck number, ticket number, ash type, and quantity of each shipment of fly ash or natural pozzolan used on a project shall be recorded on Form #830211, or Form #830224, whichever is applicable.

6. At least one monitor sample shall be secured annually from power plant sites, located in Iowa or within 50 miles from Iowa borders, and be tested by the Iowa Department of Transportation. The test results of monitor samples shall be in compliance with current specifications.
7. Blending and Co-Mingling of Fly Ash

Each approved fly ash source shall be stored separately. Unless approved by the Construction and Materials Bureau, mixing of fly ashes from different sources, different generating plants/units, or different classes into one storage bin or silo will not be allowed. Blending or co-mingling of fly ashes may be allowed under the following circumstances.

- a. Two approved fly ashes may be blended according to ASTM C 1697. Individual fly ash constituents are not required to conform to ASTM C 618, as long as the blended product meets ASTM C 618 for the predominant constituent. The finished blended product will be approved by the Construction and Materials Bureau as a new source prior to use. The finished blended product shall be stored separately and be inspected and tested according to ASTM C 311. Manufacturer is required to conform that the amount of pozzolan in the finished blended product shall not vary from the target value by more than ± 5 percentage points, with a 99 % probability of compliance.
- b. When the same coal stockpile, the same brand and model of generating equipment, the same process of operation, and the same brand and model of fly ash collection equipment are used; fly ashes from different units at a generating plant may be considered for approval as a single blend and stored in a silo. To apply for the approval, the producer or marketer shall provide the composite sample test data (composite samples should represent 3200 ton increments of fly ash collection or the month whichever comes first) from the separate units for the previous 12 months. The Construction and Materials Bureau will conduct a statistical t-test to compare major physical and chemical properties of the two fly ash sources. If the t-test results show the test data means to be equal at a significance level of 0.05, the blending process may be

allowed. Annual analysis may be required for continued approval. Blending will only be allowed within the storage silo.

At ready mixed concrete plants and paving batch plants, a fly ash storage bin shall be emptied, as far as practical, prior to refilling from a different source.

B. Sources for Pavement Undersealing and Jacking

1. Class C Fly ash listed in the [Appendix A](#) may be used for pavement undersealing and jacking, provided that it meets the setting time criterion given below.
2. A mixture of 3 parts fly ash and 1 part Portland cement shall have an initial setting time between 30 minutes and 3.0 hours. Initial set is defined as 100-psi resistance when measured in accordance with ASTM C 403.

PROJECT ASSURANCE SAMPLING

Required verification samples will be secured at the project site just before incorporation into the work. Test results, which do not comply with the specifications, may be considered sufficient cause to rescind approval to furnish fly ash or natural pozzolan on certification basis. Construction, which contains fly ash or natural pozzolan represented by verification samples, which show deficient test results, will be subject to the requirements of [Article 1105.04](#) of the Standard Specifications.

Depending upon certain chemical characteristics, fly ash is marketed as either Class F or Class C ash, or Class N for natural pozzolans, per ASTM C 618 or C 1697. The identification submitted with the verification samples sent to the Central Laboratory should include the normal descriptive information as well as the source of the ash, the marketer and the class of the ash.

Precautionary measures shall be taken to prevent cement contamination of fly ash or natural pozzolan samples obtained at the proportioning plants. The samples shall be taken preferably as follows:

1. Directly from the delivery transport vehicles
2. Drop a sufficient amount of material in a clean container or a clean end loader bucket and obtain a representative sample.

UNIFORMITY CHECK AND DENSITY UPDATE

For checking the AASHTO M 295 uniformity requirement, the average density for a source will be computed based on the values tested and reported by the Central Materials Laboratory. The value of average density will be updated if it is more than 0.10 gram/cm³ different than the current value listed in the [Appendix A](#). The density update will generally be done in the October IM revision unless a change in fly ash operation or coal source occurs.



Materials Approved Products List

491.17aa - Appendix A - Fly Ash

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
CarbonSense C Ash (Code FA223C)	04/08/2022	Ozinga Cement	FLY ASH	491.17	Joppa, IL	Ozinga Cement		2.79
CarbonSense CWLP F Ash (Code FA055F)	04/08/2022	Ozinga Cement	FLY ASH	491.17	Springfield, IL	Ozinga Cement		2.46
CarbonSense F Ash (Code FA323F)	04/08/2022	Ozinga Cement	FLY ASH	491.17	Mokena, IL	Ozinga Cement		2.60
Clay Boswell Generating Station, Unit 3 (Code FA039C)	04/05/2016	National Minerals Corporation	FLY ASH	491.17	Cohasset, MN	National Minerals Corporation		2.61
Coal Creek Micron 3 (Code FA003F)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Bismark, ND	EM Resources LLC		2.63
Coal Creek Power Plant (Code FA003F)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Bismark, ND	EM Resources LLC		2.48
Columbia Generating Station #1, #2 or Combined (Code FA001C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Portage, WI	Holcim		2.75
Council Bluffs Unit #3 (Code FA004C)	01/17/2023	National Minerals Corporation	FLY ASH	491.17	Council Bluffs, IA	EM Resources LLC		2.62
Cumberland Power Station (Code FA058F)	11/14/2022	EM Resources LLC	FLY ASH	491.17	Cumberland City, TN	EM Resources, LLC		2.50
Duck Creek Power Station (Code FA050C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Canton, IL	EM Resources LLC		2.71
Durapoz F (Code FA043F)	09/17/2014	Ash Grove Cement Company	FLY ASH	491.17	Chanute, KS	Ash Grove Cement Co.		2.55
Dynegy Newton Power Station (Code FA044C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Newton, IL	EM Resources LLC		2.66
Edgewater Unit #5 Generating Station (Code FA020C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Sheboygan, WI	Holcim		2.78
Edwards Power Station, Unit #2 (Code FA249C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Bartonville, IL	EM Resources LLC		2.71
Edwards Power Station, Unit #3 (Code FA349C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Bartonville, IL	EM Resources LLC		2.72



Materials Approved Products List

491.17aa - Appendix A - Fly Ash

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Elim Road Generating Station Unit #1 (Code FA137F)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oak Creek, WI	Holcim		2.68
Elim Road Generating Station Unit #1, Unit 2 or Combined (Code FA037C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oak Creek, WI	Holcim		2.70
Elim Road Generating Station Unit #2 (Code FA237F)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oak Creek, WI	Holcim		2.67
Genoa Power Station #3, Dairyland (Code FA034C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Genoa, WI	EM Resources LLC and Croell Redi-Mix	Croell Storage Facilities in Lansing and in Lawler.	2.70
Gerald Gentleman Station, Unit #1 (Code FA028C)	04/24/2014	Nebraska Ash	FLY ASH	491.17	Sutherland, NE	Nebraska Ash		2.67
Iatan Generating Station, Unit #1 (Code FA007C)	07/02/2024	EM Resources LLC	FLY ASH	491.17	Weston, MO	EM Resources LLC	West Des Moines (Continental Terminal)	2.78
Iatan Generating Station, Unit #2 (Code FA005C)	07/02/2024	EM Resources LLC	FLY ASH	491.17	Weston, MO	EM Resources LLC	West Des Moines (Continental Terminal)	2.68
J.P. Madgett Station, Dairyland, Poz AC (Code FA032C)	07/24/2024	Croell, Inc.	FLY ASH	491.17	Alma, WI	Croell, Inc.		2.70
Jeffrey Energy Center (Code FA056C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	St. Marys, KS	EM Resources LLC		2.90
Joliet Generating Station (Code FA017F)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Joliet, IL	Holcim		2.54
La Cygne Station Power Plant, Unit #2 (Code FA035C)	07/02/2024	EM Resources LLC	FLY ASH	491.17	La Cygne, KS	EM Resources LLC		2.64
Labadie Power Plant Labadie (Code FA022C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Labadie, MO	EM Resources LLC		2.73



Materials Approved Products List

491.17aa - Appendix A - Fly Ash

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Lawrence Power Plant (Code FA061C)	06/13/2024	EM Resources LLC	FLY ASH	491.17	Lawrence, KS	EM Resources LLC		2.67
Leland Olds Station, Unit 1 (Code FA053C)	06/08/2022	Holcim (US) Inc.	FLY ASH	491.17	Stanton, ND	Holcim & Innovative Consulting ND LLC		2.78
Limestone Plant (Code FA059C)	09/29/2023	EM Resources LLC	FLY ASH	491.17	Jewett, TX	EM Resources LLC		2.69
Louisa Generating Station (Code FA009C)	01/17/2023	National Minerals Corporation	FLY ASH	491.17	Grandview, IA	EM Resources LLC	Croell-Cedar Bluff	2.69
M.L. Kapp Generating Station (Code FA018C)	04/24/2014	National Minerals Corporation	FLY ASH	491.17	Clinton, IA			2.73
Montrose Station Power Plant, Unit #3 (Code FA036C)	04/24/2014	Kansas City Fly Ash, LLC	FLY ASH	491.17	Clinton, MO	Kansas City Fly Ash, LLC		2.67
Muscatine Power & Water (Code FA010C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Muscatine, IA	Holcim		2.76
Muskogee Generating Station (Code FA042C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Muskogee, OK	Holcim		2.69
Nebraska City Station (Code FA011C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Nebraska City, NE	EM Resources LLC		2.73
North Omaha Generating Station (Code FA012C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Omaha, NE	EM Resources LLC		2.68
North Shore Station (Code FA051C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oak Creek, WI	Holcim		2.70
Northeastern Generating Station (Code FA033C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oolagah, OK	Holcim		2.68
Oak Creek Power Station (Code FA045C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Oak Creek, WI	Holcim		2.70
Oak Grove Pozzolan (Code FA060F)	09/29/2023	EM Resources LLC	FLY ASH	491.17	Franklin, TX	EM Resources LLC		2.42
Ottumwa Generating Station (Code FA013C)	04/24/2014	National Minerals Corporation	FLY ASH	491.17	Chillicothe, IA	National Minerals Corporation	RGI Storage, Des Moines	2.75
P2P PSGC/Louisa Blend (Code FA054F)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Marissa, IL and Grandview, IA	EM Resources LLC	Eldridge, IA	2.46



Materials Approved Products List

491.17aa - Appendix A - Fly Ash

Brand Name	Approved	Company Name	Material Item	IM	Plant Location	Marketer	Terminal/Supplier	Specific Gravity
Petersburg Generating Station, Unit #3 (Code FA038F)	05/06/2014	Charah, Inc	FLY ASH	491.17	Petersburg, IN	Charah, Inc		2.52
Platte Generating Station (Code FA057C)	10/12/2020	Nebraska Ash	FLY ASH	491.17	Grand Island, NE	Nebraska Ash		2.59
Port Neal Power Plant #3, #4 or Combined (Code FA015C)	01/17/2023	National Minerals Corporation	FLY ASH	491.17	Sioux City, IA	EM Resources LLC		2.66
Prairie State Generating Station (Code FA046F)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Marissa, IL	EM Resources LLC	Eldridge, IA	2.42
Prairie Creek Generating Station, Unit #3 (Code FA041C)	11/14/2018	National Minerals Corporation	FLY ASH	491.17	Cedar Rapids, IA	National Minerals Corporation		2.80
Rush Island Power Plant (Code FA027C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Festus, MO	EM Resources LLC	Croell- Cedar Bluff	2.69
Thomas Hill Energy Center (Code FA025C)	11/12/2021	Charah, Inc	FLY ASH	491.17	Thomas Hill, MO	Charah, Inc.		2.70
Weston Generating Station (Code FA026C)	03/24/2022	Holcim (US) Inc.	FLY ASH	491.17	Rothschild, WI	Holcim		2.64
Whelan Hastings Generation Plant, Unit 2 (Code FA052C)	07/21/2022	EM Resources LLC	FLY ASH	491.17	Hastings, NE	EM Resources LLC		2.64

Chapter 16
IM 527
PAVING PLANT INSPECTION

PAVING PLANT INSPECTION

GENERAL

The following instruction is to be used when inspecting the operation of a PC Concrete paving plant.

Materials and proportions must be controlled in accordance with the specifications and the following detailed instructions.

The plant inspector will normally be assigned the following duties:

1. Inspection or monitoring of proportioning and plant operation
2. Gradation determination of the aggregates used
3. Identification and tabulation of materials received and used
4. Protection, curing, and testing of the strength specimens, and care of the specimen forms
5. Maintenance of a daily diary and preparation of the Daily Plant and Strength Reports

Certified Plant Inspectors will assume a number of duties, as specified in [IM 213](#).

The contract documents provide for the class of concrete to be used in a given project. Standard and slip form are the two types of pavements specified. All classes of concrete contain entrained air to improve durability. Unit absolute volume proportions for the four classes of concrete and the various mix numbers are provided in [IM 529](#). The class of concrete is designated in the contract documents and the Contractor may use any of the numbered mixes designated in the respective class of concrete. The gradation of the coarse aggregate must comply with the requirements of the mix number chosen.

The Engineer will see that the inspector is provided with proper equipment for carrying on the work, except the Certified Plant Inspectors will provide their own equipment. Furnished equipment will be provided upon request from the Ames Laboratory and the Inventory Management storerooms. Requests for equipment or supplies to be checked out must be made on Iowa Department of Transportation Stock Issue Form #133005.

The following statement shall apply to all phases of equipment and material testing and/or examinations:

Tests and/or examinations must be made at least as frequently as described herein or in other applicable memorandums. All test and examination results are to be recorded in the Plant Inspector Field Book. All field books and records shall become the property of the Contracting Authorities at the completion of the project.

If a test result on a project verification sample indicates specification noncompliance, appropriate action in accordance with the applicable specifications, instructional memorandums, and resident engineer instructions shall be taken. (See [IM 204](#)) Normally, the Contracting Authority will issue

a Form #830246, Noncompliance Notice.

If a test result on a project quality control sample indicates specification noncompliance, the Contractor must take corrective action. It must be noted that the Contractor is responsible for deciding what corrective action must be taken, for directing that it be taken and for the results. The inspector must not in any way assume responsibility for the corrective action or its results.

It is the inspector's responsibility, based on prescribed tests and examinations, to monitor the progress of the work, to make available to the Contractor the results of tests and examinations on a continuing basis and to inform the Engineer and Contractor when tests show noncompliance. The Contractor is responsible for furnishing compliant material and finished work.

A checklist of the detailed plant inspection duties is included as part of these instructions. Refer to this checklist before the work begins, and periodically thereafter, to be certain that all the required tests and inspection procedures are being included in the routine activities.

SAFETY

Safety should be uppermost in the minds of those working in a concrete plant. In the past there have been injuries and even deaths because proper attention was not given to safety details. Certain requirements have been made a part of the contract documents as safety measures. It is not possible, however, to remove all unsafe conditions from a paving plant situation.

The plant inspector must make certain all contractual requirements are met, including those related to safety. The inspector should encourage the elimination of hazards not specifically covered by the specifications. Some hazards will be impractical to remove. The inspector should be familiar with these hazards and thus be better able to protect against them. Protective headgear should be worn when working around bins and other plant equipment.

Safety considerations mandate that stopped belt sampling locations must be equipped with an on-off switch near and in plain view of the sampling point. This switch must have sole control of the sampling belt when the switch is in the off position.

EQUIPMENT

1. BINS

The following requirements shall apply to bins used in connection with the production and delivery of materials and to bins used in connection with the proportioning of materials for mixtures. Standard Specifications in [Article 2001.06](#) authorize the Engineer to examine the bin each time it is erected for use.

The Contractor shall maintain any stress-carrying parts of the bin frame, which support the load in proper working condition. No stress-carrying member shall be absent while the bin is in use. All members must be straight and full-size. If any member has become bent or deformed, it shall be straightened by methods, which will not injure the material, or a new member must replace it. Piles of aggregate shall be kept from introducing stresses into the bin legs caused by lateral pressure against the legs. If all footings under one bin settle uniformly after the bin has been loaded, the settlement is not considered a problem. However, if the settlement differential of the footings under one bin exceeds 1/10 foot, the District Materials Engineer must be informed.

The Contractor shall periodically observe the bin for settlement after the bin has been loaded. Before concrete proportioning at a new plant installation, the bins should have been fully loaded for at least 12 hours and the amount of settlement determined by the contractor. Checks of settlement by the contractor shall be furnished to the Engineer. If a scale is affected by the above unequal settlement, its operation must also be re-evaluated.

All conveyers and other plant machinery shall meet current OSHA Standards. The Contractor shall be responsible for complying with these requirements for both design and erection. The Contractor shall furnish a certification or design calculations to the Engineer to confirm compliance, if requested to do so.

2. PROPORTIONING EQUIPMENT

Requirements for scales or meters for proportioning aggregates, cement, fly ash, water, or admixtures are found in [Article 2001.20](#) of the Standard Specifications. These essential requirements are in addition to the safety requirements referred to in Section 1 above for bins.

When a proportioning plant has been moved and set up, it is essential that the proportioning scales are test loaded and the proportioning meters are tested for specification compliance.

Proportioning scales and meters shall be test loaded to the maximum load expected during production. Proportioning during production shall not exceed the maximum load tested during calibration.

It is the duty of the District Materials Engineer or designated staff to witness calibration of all proportioning and plant equipment before concrete work begins. The plant inspector is encouraged to be present while the scales and other equipment are being tested and evaluated.

When it has been determined that all proportioning devices and plant equipment comply with the specification requirements, a Plant Calibration Report, Form #820917, will be prepared by the contractor's representative and signed by the District Materials Engineer, or representative, as a witness to the calibration. This report authorizes the use of the plant to which it applies, and the materials and proportions listed thereof. It is to remain at the plant in the inspector's files during progress of the work. A sample copy of Form #820917 is shown later in [Appendix C](#) and a calibration checklist is shown in [Appendix D](#). The plant inspector must be familiar with all features of the plant operation before the work begins. While the inspector must not personally make any of the plant manipulations or adjustments, understanding the basic machinery operation and being able to recognize the significance of a malfunction is important.

For ready mix plants, the District Materials Engineer may allow plant scales and water metering devices to be calibrated and sealed by a licensed commercial scale service. The District Materials Engineer will be given the opportunity to witness the annual calibration. A copy of the certification and calibration shall be provided to the engineer during laboratory inspection.

The proportioning equipment must be examined at least at **3-hour intervals** for correctness of the **amount being batched** and for damage of the equipment. Special attention must be

given to the empty balance and the position of the poises for beam and dial scales. The normal plant operation causes vibration, which tends to change these adjustments.

Accumulation of material clinging to the inside of the hopper can also cause these adjustments to drift. Small amounts of material accumulation clinging to the inside of the hopper are not considered objectionable. If the amount exceeds one percent of the material batch mass, however, it must be removed and the indicator on the empty hopper readjusted to indicate a zero load within $\pm 0.5\%$ (See [Article 2001.20](#)). The **scale sensitivity** shall be checked **at least twice during a normal working day** by placing a mass equal to 1/10 percent of the batch on the fully loaded scales and observing the movement of the indicator. A properly sensitive scale will exhibit a visible indicator movement when so tested. If no indicator movement is visible and immediate corrective action by the Contractor does not yield successful results, the District Materials Engineer must be informed.

The following procedure is required for setting or adjusting the various items of proportioning equipment in order that they will deliver the proper amount of material to the batch:

1. The plant superintendent or other authorized contractor representative must make all necessary scale and equipment settings and/or adjustments. The plant inspector is specifically directed not to participate in this activity.
2. Before the plant operation begins or resumes, the plant inspector will independently determine that the settings and/or adjustments are accurate and that the masses of material being delivered to the batch are correct. Errors must be corrected immediately.

Strict adherence to the above procedure is necessary to maintain a proper division of authority and responsibility between the Contractor and the Contracting Authority and to minimize the possibility of operating with erroneous proportions.

Suitable wind protection on all sides of the scales is required by the specification. This protection, if not provided by the plant design, can be fabricated from burlap, Masonite, plywood or other suitable material and should provide adequate room for the scale operator to work unobstructed. The District Materials Engineer may waive wind protection when non-suspended load cells are used and proven to be unaffected by wind.

- a. **CEMENT & FLY ASH SCALES.** Cement and fly ash scales at the contractor proportioning plant are usually required to be automatic. (See [Article 2001.20](#) and [2301.02, C](#)) The scales must be **accurate** to within **plus or minus 0.5%** of the load and must operate (**delivery tolerance**) within **plus or minus 1%** of the required batch. If all cementitious materials are weighed on the same scale, delivery tolerance shall be within **plus or minus 1%** for the cement and the total cementitious for the batch.

The scale accuracy is determined prior to the beginning of concrete work by the District Materials Engineer or representative and in most cases will need no further attention.

The delivery tolerance, however, can be determined only when the automatic device is in operation. A number of suitable procedures for determining delivery tolerance have been devised. While one procedure may not be suitable for all scale installations, the following is suggested, because it can be applied to the majority of the cement proportioning equipment used. Modifications of the procedure are permitted providing the delivery

tolerance is determined.

- 1) With the hopper loaded to the correct amount for one batch, the addition of material to the hopper equal to one percent of the correct batch must cause the "over" limit switch to function and prevent automatic discharging of the batch.
- 2) With the hopper loaded to the correct amount for one batch, the removal of material from the hopper equal to one percent of the correct batch must cause the "under" limit switch to function and prevent automatic discharging of the batch.

Check scale operations to determine **delivery tolerance** conformance at least **once** during **each day** of normal operation.

Minor adjustments of numerous phases of the automatic batching cycle are normally required on a continuing basis because of changing weather and material conditions. The inspector must become intimately familiar with the automatic scale operation to be able to recognize when these minor adjustments are needed. As a general rule, if the operator has to manually adjust the amount of material in the hopper or charge or discharge manually more often than once in each ten batches the automatic measuring device needs repair, adjustment, or servicing. A 24-hour grace period is provided during which manual operation is permissible. Specific approval of the engineer is required for continued manual operation beyond the 24-hour grace period. The engineer's approval should be based on a consideration of the following:

- Immediate steps were taken to repair the automatic malfunction.
- If repair within the 24-hour period is not possible and beyond the control of the Contractor and the malfunction could not reasonably have been anticipated.
- Manual measuring is within the accuracy required for automatic scales.
- It would be to the advantage of the contracting authority for the paving operation to continue.

Manual measuring of cement shall be under the constant surveillance of the inspector. The empty scales must be tare-balanced after discharging each batch and before charging another.

Cement Yield Check

The Standard Specification requires that the cement shipment yield determination must be made at intervals of approximately 10,000 cubic yards after the original determination made near the end of the first full day of production. When a permanent, commercial-ready mix plant is dedicated to furnishing greater than 10,000 cubic yards of continuous concrete production, cement yield determinations are required. When a permanent, commercial-ready mix plant furnishes greater than 10,000 cubic yards on an intermittent basis, cement yield determinations shall be at the option of the District Materials Engineer. If fly ash is batched on the same scale as cement, no yield determination is needed for the fly ash.

The purpose of the cement yield test is to compare the amount of cement, which is measured, on the contractor's batch scales with the amount, which is measured on the scales at the cement manufacturing plant. The assumption is made that the mass shown by the manufacturer (billed amount) is correct.

The cement storage bin or bins must be empty and free of cement before the test is started. In the event a bin is partially filled with cement left over from a previous project, it should be used and the bin completely empty before the yield determination is started. The removal of all cement from the bins provides the necessary starting point in addition to assurance that cement lumps and foreign debris have been eliminated.

Make the first cement yield near the end of the first full day of production, being sure each cement car or truck is completely empty after unloading into the storage bin.

At the end of the test the storage bin must be completely empty again. Estimating the amount of cement in a storage bin is not suitable and by doing so the test result is virtually meaningless.

A careful record must be made of the total batches used and from this figure calculate the total cement batched. Also calculate the yield expressed as a percent of the billed total.

If the yield percent is less than 99.0, or greater than 101.0, refer to the section entitled, General, in this IM for special action required. If the results of the first test are within the above limits no special action is necessary. Follow the same procedure for following yield tests, except extend the test over about 10,000 cubic yards intervals of work. For the longer interval tests, the amount of cement in a bin at the beginning and ending can be estimated without introducing appreciable error. Report each cement yield test performed on Form #820912, Portland Cement Shipment Yield Report. (See sample Yield Report in [Appendix C](#)).

- b. **AGGREGATE SCALES.** Aggregate scales may be operated either manually or automatically and must operate within a **delivery tolerance** of plus or minus **one percent** of the required batch amount. If the scales are operated automatically, the delivery tolerance can be determined in the same manner described in 2a, Cement Scales. If it is operated manually note the location of the balance indicator or dial indicator when a one percent over and under load is added to and subtracted from the correct amount in the hopper. Aggregate delivered to the batch must be within the above limits. Check scale operation to determine **delivery tolerance** conformance at least **once during a normal working day**.

For small loads, 3 cubic yards or less, the scale gradations may be larger than the delivery tolerance for the batch. A delivery tolerance of plus or minus **two percent** of the required batch amount may be used.

- c. **WATER MEASURING DEVICE.** Scales or volume meters are permissible for measuring water. Scales may be operated manually or automatically. Regardless of the type of measuring equipment used, the amount of water delivered to the batch must be **accurate to 2.2 lbs.** or within plus or minus **one percent** of the amount shown by the indicator whichever is greater. If water is measured with a scale, the **delivery**

tolerance must be determined at least **once for each day** of normal operation as described in 2b, Aggregate Scales. If a volume meter is used, the delivery tolerance need not be determined other than during the original calibration or at such time that a water-measuring problem is indicated. Volume meter shall be tested by weight during calibration at ambient temperature (40 - 90°F). Testing a water meter is the duty of the District Materials Engineer or his/her representative.

- d. **ADMIXTURE DISPENSING EQUIPMENT.** Admixtures (air or water reducing) may be proportioned manually or by automatic equipment. If they are proportioned manually, the method and procedure must be approved by the engineer and should be performed by a person having no other duties. If they are proportioned automatically, the dispensers must be equipped with a transparent chamber that will permit visual observation of the admixtures as they are introduced into the batch. The visual inspecting chamber requirement may be waived in lieu of admixture dispensing systems utilizing positive electronic flow metering and computer-controlled delivery that prevents improper admixture incorporation into the mix. Equipment for dispensing liquid admixtures shall be accurate within plus or minus 3.0 percent of the quantity required. The operation of the dispenser when operated either manually or automatically must be observed for uniform **delivery** at least **once during each 3 hours** of normal operation. The dispensing equipment must be flushed with water at least once daily to minimize the possibility of material accumulation that will impair the equipment performance. The use of malfunctioning dispenser equipment will be discontinued immediately upon detection of the malfunction and its use must not be resumed until the malfunction has been eliminated. If a problem with the air agent dispenser develops, the first indication of it will likely appear as a problem controlling the air content in the plastic concrete. The air content may be variable from one batch to another, or it may be uncontrollable in either the high or low range. If immediate corrective action does not yield satisfactory results the engineer in charge and/or the District Materials Engineer must be informed. Concrete work must not be permitted to continue if air test results show specification non-compliance. There are no such indicators in plastic concrete for water-reducing admixtures. Therefore, as mentioned above, the dispenser operation must be observed regularly.

3. MIXING EQUIPMENT

Central mixer is the most popular, and is the type normally used when high production is desired, ready-mix trucks are used for limited amounts of pavement, and mobile mixers are typically used in bridge deck overlays.

Mixing equipment for paving projects will be one of the following types as described in [Article 2001.21](#):

- a. **CENTRAL MIXERS.** For central mixers, the maximum batch size and the mixing speed recommended by the manufacturer are shown on the Mixer Manufacturer Bureau (MMB) rating plate that is attached to the mixer. The batch size shall not exceed that recommended on the MMB plate and the rotational speed of the mixer drum shall be at least equal to that shown on the MMB plate. After all materials are in the mixer, the mixing time shall be a minimum of 60 seconds and a maximum of 5 minutes.

The following is the recommended method for determining mixing time:

There are three parts of the batch cycle: the charging of the drum, the mixing, and the discharge. In order to check the mixing time; first determine the time required to add all ingredients to the mixing drum. Then determine the time to discharge, from the time the first concrete falls out of the drum into the delivery vehicle until the drum is back into the mixing position and material begins to be charged into the drum. The charge time plus discharge time plus a minimum mixing time of 60 seconds is the minimum batch cycle time.

The mixing time must be determined and recorded at least once per day by the Certified Plant Inspector. By timing the batch cycle and subtracting the charge time and discharge time, the mixing time can be determined. Determining the average cycle times over a number of batches where the batching operation is running uninterrupted is preferable. The total batch cycle time, as well as the time needed for charging and discharging, should also be recorded initially for a given batch size. This enables mixing time to be determined through timing of the total batch cycle.

The batch cycle time may change if the size of the batch changes. The size of the batch should be noted if changes in the cycle time are found.

The monitor inspector should check the mixing time when visits are made to the project. The monitor should then compare the determined mixing time to those recorded by the Certified Plant Inspector. The contractor is required to furnish individual batch tickets or a daily summary of the materials in each batch and the time the batching begins or in the case of batch tickets, the time of discharge of each batch.

If the mixing time is less than 60 seconds, an immediate correction must be made.

- b. **READY MIX.** The maximum size of the batch and the mixing speed recommended by the manufacturer for ready mix trucks shall be shown on a plate attached to the mixer. The Truck Mixer Manufacturer's Bureau (TMMB) may issue the plate; if not, an independent, recognized laboratory, shall determine compliance as defined in [Article 4103.01](#), and complete test results may be required. The batch size must not exceed that shown on the plate and the mixing speed must be in the range shown. Determine and record the mixing speed for each mixer at least once daily. The batch must be mixed from 70 to 90 revolutions at mixing speed unless otherwise directed by the engineer. All mixers must be equipped with a revolution counter. If the counter is one that counts revolutions only when the drum is turning at mixing speed, mixing may be permitted while the truck is in transit. If the counter is a simple re-settable counter, which counts all revolutions regardless of the drum speed, mixing must be accomplished at a location where it can be observed by the inspector. It is permissible for the mixing to be done either at the plant or the project site. A clear understanding must exist between the plant and grade inspectors as to where the mixing will be done.

Ready mix trucks must carry, in the vehicle; a current certification signed by a responsible company representative stating that the mixer condition has been examined during the previous 30 days and is free of hardened concrete and is in proper working condition. Mixers not carrying the required certification must not be used.

4. TRANSPORTATION VEHICLES

-
- a. **CENTRAL MIXING.** When the concrete is centrally mixed it may be transported in either agitating or non-agitating hauling units. If non-agitating units are used, the fresh concrete must be placed on the grade within 30 minutes after it has been discharged from the mixer. If agitating units are used, the fresh concrete must be placed on the grade within 90 minutes after the water and cement have made contact with each other (See [Article 2301.02, C.](#)).

When approved by the engineer, an approved retarding admixture may be used at the rate prescribed in IM 403, and the mixed-to-placed time period, for concrete transported without agitation, may be extended an additional 30 minutes.

- b. **READY MIX.** When the concrete is mixed in ready mix trucks and agitated thereafter, the fresh concrete must be placed on the grade within 90 minutes after the water and cement have made contact with each other. If continuous agitation is not used, the time limit is 30 minutes (See [Article 2301.02, C.](#)). When Class M mix is used for pavement patching, ready mix concrete must be delivered and placed within 60 minutes without retarder, or 90 minutes when retarder is used. Concrete must be placed within 30 minutes after calcium chloride is added. (See [Articles 2529.02, B](#) and [2530.02, B.](#)) Concrete, which has been mixed, agitated, or held in excess of the above time limits, must not be used.

Determine and record the cement to **water contact time** at least **once during each day** of normal operation.

MATERIAL

1. IDENTIFICATION

Arriving shipments of material must be examined for damage and contamination. Before material is incorporated into the project, the inspector must be assured that approval reports for the material have been received or will be received shortly.

For shipments of cement and fly ash the inspector shall examine the invoice or bill of lading that is attached to the tanker when shipments arrive. When nighttime delivery occurs, the inspector shall examine the invoice or bill of lading before production begins on the next working day. The inspector must be ensured the proper material is placed in the proper storage unit.

An orderly record showing when the shipment arrived, the amount and identification of material involved and the laboratory report number, invoice number, ticket number, on which the material has been approved is necessary for documenting that material used has been tested and approved. Telephone conversations regarding material approval must also be summarized in this record. Keep a similar record for aggregates, and admixtures.

A file of proportioned aggregate tickets, cementitious materials delivery tickets, and admixture delivery tickets will be maintained by the plant inspector and copies made for the Engineer at the end of the project.

The inspector will not permit any material to be used or stored with accepted material until the inspector is satisfied the material is acceptable.

- a. **AGGREGATES.** Certified aggregate may be incorporated into a project on the basis of the certified truck ticket. When the material represented is non-proportioned aggregate the project number must show on the truck ticket and a copy furnished for project inspection personnel. When the material represented is proportioned aggregate, the project number is preferred when practical as in the case when shipping to a paving plant site and not required when impractical as in the case when shipping into warehouse stock at a ready-mix plant. The plant inspector shall verify that all material incorporated in the project is properly certified and document this verification and quantity on each of the appropriate daily or periodic construction reports. No other project documentation for the incorporated aggregate is required (See [IM 209](#)).
- b. **CEMENTITIOUS MATERIAL.** Cement, fly ash, and Ground, Granulated, Blast Furnace Slag (GGBFS) may be incorporated into the project on the basis of the manufacturer certification. (See [IM 401](#), [491.17](#), and [491.14](#).)
- c. **WATER.** Water secured from streams, lakes, and other non-potable sources will be tested and approved by the Central Laboratory before it is used. Water from municipal supply systems and other potable sources may be used without testing provided the source is documented.
- d. **ADMIXTURES.** Admixtures may be incorporated into the project without further sampling and testing if they are listed in [IM 403](#).
- e. Approved brands of water reducing admixtures, retarding admixtures, and dosage rates are in [IM 403](#). Any admixtures suspected of being frozen or materials exceeding manufacturer's shelf life shall not be used before being tested and approved. These admixtures shall be agitated in accordance with [IM 403](#) to maintain the solids in suspension.

NOTE: A stream of air bubbles during agitation will not be acceptable. Proper storage of the admixtures during the winter months is recommended to avoid freezing of the material.

2. STORAGE & HANDLING OF MATERIALS

The contractor shall notify the Engineer of the stockpiling procedures to be used and of the date when stockpiling will begin. This shall be done ahead of commencement of stockpiling in order to allow discussion of procedures and inspection of the stockpile sites and dumping areas. District Materials personnel may also be a part of this review and inspection.

The storage and handling of all aggregates must comply with [Article 2301.02.C](#) If alternate methods are used as permitted and the required sampling and testing indicates non-specification aggregate gradation, the District Materials Engineer must be informed immediately. The responsibility of and the authorization for proper changes, if necessary, lies with the District Materials Engineer. It is important that the moisture content of the aggregates be uniform. Fine aggregate must be drained at least 24 hours before it is placed in the batch. For both coarse and fine aggregate, moisture content of successive batches must not vary more than 0.5 percent, or this will be considered non-compliant. In such a case, the engineer and the contractor must be immediately informed. The problem must be corrected within a reasonable amount of time, generally one day. The work must not be permitted to progress

when such a problem is not corrected. Unless aggregates are stored on platforms or other smooth hard surfaces some material in the bottom of the pile will be unfit for use because of contamination by the underlying soil. (See [Article 2301.02, C](#))

Aggregates may become contaminated or degraded from a number of sources. Examples of these are foreign material from the pit or quarry, foreign material in the rail cars or other hauling units, boards or bags used to plug holes in rail cars, and degradation from handling or prolonged storage. When aggregates are being taken from the lower portion of the pile, particularly when the work is approaching completion and the stockpiles are small, the inspector must be continually alert and forbid the use of contaminated aggregates. The inspector must understand that all of the above sources and numerous others can furnish objectionable contaminants. If contamination does occur, the aggregates affected must not be used.

Cement, fly ash, and GGBFS must be stored in weatherproof enclosures, which will protect against dampness. If lumps develop in the cement or fly ash it must not be used until it has been reprocessed, re-tested and approved as provided in [Articles 4101](#) and [4108](#). Cement, fly ash, and GGBFS, which has been in storage more than 60 days at the project site or in the producer silo for more than a year must also be re-tested and approved.

SAMPLING & TESTING

1. AGGREGATES

The explanation below describes the sampling and testing required for proper plant inspection. [IM 204](#) describes the minimum sampling and testing frequencies required for the inspection of construction projects.

- a. SAMPLES. Aggregate samples are necessary to determine moisture content, specific gravity, and gradation. Care must be taken to ensure that the samples are representative of the materials being used. Secure fine and coarse aggregate samples as prescribed in [IM 301](#).

The Contractor is required to furnish, at the proportioning plant site, facilities for collecting representative samples of the coarse aggregate from a ribbon or stream. Refer to [Article 2001.20](#). Do not attempt to secure samples in dangerous locations. Under no circumstance should samples be secured from a partially opened clam bucket or from the discharge end of a belt where proper walkways and stairs do not exist. Refer to [Article 2001.06](#).

Secure and test aggregate samples at least as frequently as described in [IM 204](#).

- b. GRADATION. Determine the fine and coarse aggregate sieve analysis in accordance with IMs [302](#) and [306](#). These Instructional Memorandums prescribe the test sample size and the procedures for fine and coarse aggregate sieve analysis and for determining the amount of material finer than the No. 200 sieve. Sample calculations are included.

[Article 4109](#) of the Standard Specifications allows an increase of the minus No. 200 material from 1.5% to 2.5% for certain aggregate types. Determination to allow this increase shall be made by consultation with the District Materials Engineer.

For projects requiring certified plant inspection, the certified inspector results shall be quality control tests. Quality control testing is performed to ensure the proper material is being delivered to the plant from the source and identify stockpile changes. Verification sampling and testing will be performed by the Engineer at the frequency described below. [IM 205](#) describes the agency responsibility to randomly select sample location and time, and witness sampling with the contractor providing assistance in obtaining the samples.

Quality Control Sampling, Testing, and Reporting

Production	Specific Gravity	Moisture	Gradation	Report
Continuous	1/day 1 st 3 days, 1 per 3 days thereafter	1/day >500 yd ³ 2/day >1000 yd ³	1/day >500 yd ³	1/day
Intermittent	1/week	1/day >500 yd ³ 2/day >1000 yd ³	1/day >500 yd ³	1/week
Low	1/ week	1/ week	1/ week	1/ week

As a general rule, for each day production greater than 500 cubic yards, one gradation and one moisture shall be sampled and tested. If production is greater than 1000 cubic yards for the day, one additional moisture test shall be performed.

Continuous operation is defined as production greater than 500 cubic yards per day, for three or more days in a week. Quality control sampling and testing shall be performed daily. If production is less than 500 cubic yards for a day, sampling and testing may be grouped with a previous or subsequent day.

Intermittent operation is defined as a week of paving with two days or less of production greater than 500 cubic yards. A minimum of one quality control sample shall be obtained and tested on each day of production greater than 500 cubic yards.

Low construction operation is defined as a week of paving with production less than 500 cubic yards per day. A minimum of one quality control sample shall be obtained and tested during the week.

When a quality control gradation test does not comply with the gradation requirements of [Article 4109](#), the certified plant inspector shall contact the Engineer. After corrections have been made, the Engineer will obtain and test another verification sample.

Verification Sampling and Testing

Production	Gradation Sampling	Gradation Testing
Continuous	1/day >500 yd ³	1 st day, then 1/ week
Intermittent and Low	1/ week	1 st week, then 20%

For continuous construction operation, a verification lot is defined as a week of paving. Lots less than three days of paving will be grouped with the previous or subsequent lot. A verification lot may include a minimum of three days up to eight days. Verification sampling and testing will be performed the first day of paving. Thereafter, verification sampling will be performed daily and tested once per lot. If production on a given day is less than 500 cubic yards, verification sampling may be grouped with the previous or subsequent full day of paving.

Intermittent and low construction operation shall be grouped to establish a lot not to exceed one week. A minimum of one verification sample will be obtained and tested during the week. When intermittent production is longer than one week, sample once per week and test 20% of the samples obtained.

A lot is accepted when a verification test result by the Contracting Authority is determined to be in compliance. The Engineer will retain the samples until the lot is accepted. The Contractor may elect to run a split sample when the verification samples are obtained. The Engineer will witness the splitting and secure their portion of the sample. Since the contracting authority tests are verification, correlation with [IM 216](#) is not required but may be performed as a check of sampling and testing procedures only.

When a verification gradation test does not comply with the gradation requirements of [Article 4109](#), the Engineer will contact the contractor and the District Materials Engineer. The District Materials Engineer may investigate sampling and testing procedures, stockpiling, source material, etc. After corrections have been made, the Engineer will obtain and test another verification sample.

- c. SPECIFIC GRAVITY. Determine in accordance with [IM 307](#) and [IM 308](#). The $W-W_1$ chart, [IM T215A](#), which shows the corresponding moisture content values, is also included. It must be noted that the mass of the sample for determining both W and W_1 must be 1000 to 2000 grams respectively for the fine and coarse aggregate for the $W-W_1$ chart to be valid.

Minimum testing will be one sample per day for both coarse and fine aggregates for the first three days of normal operation and one for each three days of normal operation for both coarse and fine thereafter, assuming the first three days' results are consistent.

The specific gravity should not vary more than 0.02 from the tabular value ([T203](#)-General Aggregate Source Information) or from one day's test to the next. If the above variations are greater than 0.02, inform the Engineer and the District Materials Engineer immediately. The District Materials Engineer may adjust the specific gravity used to determine batch weights.

- d. MOISTURE. Tables [T214A](#), showing the Moisture Reciprocals (multiplication factors) that can be used for adjusting the aggregate batch amounts for the moisture content are included. The method most preferred for adjusting batch amounts is located in the Proportions section of this instruction. The District Materials Engineer may approve the use of the Chapman flask (ASTM C70) for fine aggregate moisture provided accurate specific gravity of the source is known. The District Materials Engineer may approve oven dry moisture content (AASHTO T 255) provided an accurate absorption (SSD) is determined.

Document all original test result information in the field book or other permanent records. Record the following for each test:

- All W and W_1 determinations
- The mass retained on each sieve for gradation
- All calculations for arriving at the final test result, i.e., moisture and gradation

The Specifications ([Article 2301.02, C.](#)) provide that coarse aggregate with absorption of 0.5% or more shall be wetted in the stockpile or cars, and methods of handling shall be such that change in moisture content in excess of 0.5% between successive batches must be prevented.

The use of materials that have varying amounts of moisture shall not be permitted. When the moisture content varies more than one-half percent from one batch to the next, the material must not be used unless something can be done to make the moisture uniform. It is the responsibility of the plant operator to devise remedial measures.

When the moisture content in either aggregate is high enough that water can be observed dripping from the bin between batches, or when the water will drip from the sample as described in [Article 2301.02, C.](#), the moisture cannot be measured successfully with the pycnometer nor can it be uniformly controlled. Materials with too much free water as described above must not be used until the moisture content has stabilized. It is the plant inspector's responsibility to recognize when this condition occurs and to secure the necessary corrective measures. Close communication with the grade inspector will inform the plant inspector when difficulties caused by moisture variation arise. The frequency of moisture testing may need to be increased if variations arise, such as rain events, etc.

When proportioning equipment is equipped with features, which allow instantaneous moisture content measurement of an aggregate, the following shall apply:

1. The acceptance of this system will be based on a correlation of the aggregate moisture content in a batch as determined by the proposed system and the moisture content determined by tests described in [IM 308](#). The proposed system should be able to accurately determine the moisture content within 0.5 percent when compared to a sample obtained from a point in the plant as close as possible to the point of measurement used by the proposed system.
 2. Prior to project startup, the contractor shall provide the engineer with the current calibration range data for the proposed system. The calibration range shall be used to establish the upper and lower limits of the range. After plant calibration, a check between the moisture content obtained by the system and the moisture content determined the test described in [IM 308](#) shall be made prior to production.
 3. Batch weights for the aggregates proportioned using this proposed system may be adjusted automatically on an individual batch basis. Moisture content results outside the upper and lower range limits of system shall not be used to adjust batch weights.
 4. The limit in moisture content variation between successive batches will not apply. (Ref. Standard Specification [Article 2301.02, C.](#) and [IM 527](#))
 5. Moisture contents determined by the test described in [IM 308](#) shall be performed at the frequency prescribed in [IM 204](#) to establish correlation with results from the moisture determination system as per Paragraph 1. After correlation is demonstrated, the Engineer may reduce the frequency of moisture testing ([IM 308](#)) to a minimum of once per week for verification of the system.
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6. The proposed system will provide a batch-by-batch record of the material weights, percent of moisture of the aggregates, time, date, batch number, truck number, mix type, water in aggregate, total water in batch and end tares for all scales and meters. This may be in the form of a printed summary report or as a ticket to be sent to the project, provided the ticket includes the required information as shown on Form #830212 and described in [IM 527](#).

2. STRENGTH

Test specimens shall be cast, cured, and tested as per the appropriate IM (i.e., [IM 315](#), [IM 316](#), and [IM 328](#)).

PROPORTIONS

The following procedure is required for determining basic proportions of dry materials in order that the proportions used in the work are correct:

1. The Contractor representative must make the calculations necessary to determine the quantities of dry ingredients and water necessary to comply with the mix proportions specified.
2. Before the plant operation begins or resumes the plant inspector (if certified plant inspection does not apply) or the monitor inspector will independently determine the batch quantities and cross check them with those made by the contractor representative.
3. Batching operations shall not commence until both independent determinations have been made and documented in the field records.

The proportions in the Standard Specifications are stated in terms of absolute volume per unit volume of freshly mixed concrete. Refer to [IM 529](#). To obtain the weight of aggregate or cement per batch, the specified absolute volume per unit volume must be multiplied by the number of cubic feet of concrete per batch, and this product multiplied by the mass of saturated surface dry aggregate or dry cement per cubic foot. The weight per cubic foot of aggregate will be determined using the aggregate specific gravities shown in Table [T203](#), General Aggregate Source Information.

[Table T203](#) is revised annually, and care must be taken to use the table, which is current. Follow the same procedure for determining the cement batch weight. However, the specific gravity for Type I/II Portland Cement is constant for all brands at 3.14.

The following is an example of a basic mix without fly ash.

Determine the mass of the cement and aggregate batch for a C-3 mix using crushed stone from Wendling Quarries, Inc. Montour Quarry, and sand from Manatt's Flint pit.

abs. vol. x cubic feet/cubic yard x sp.gr. x lbs. of water/cubic foot = lbs./cubic yard

Cement - specific gravity 3.14

Specified unit absolute volume, From [IM 529](#), 0.114.

$(0.114 \times 27 \times 3.14 \times 62.4) = 603 \text{ lbs.}$

Fine aggregate - specific gravity 2.65
Specified unit absolute volume, from [IM 529](#), 0.302.

$$(0.302 \times 27 \times 2.65 \times 62.4) = 1348 \text{ lbs.}$$

Coarse aggregate - specific gravity 2.63
Specified unit absolute volume, From [IM 529](#), 0.370.

$$(0.370 \times 27 \times 2.63 \times 62.4) = 1639 \text{ lbs.}$$

The above masses are for one cubic yard of concrete and would have to be multiplied times the total cubic yards being batched.

The Batch Tables contain the masses of the batch including cement predetermined for the respective mixes using the above calculation procedure. These aggregate amounts must be corrected for the amount of moisture determined by the pycnometer method. While the plant inspector is instructed to make specific gravity determinations in the field, these determinations are for the cross checking the tabular value and must not be used for batch calculations. THE SPECIFIC GRAVITY VALUES FURNISHED IN THE CURRENT TABLE [T203](#), AGGREGATE SOURCE INFORMATION, MUST BE USED FOR CALCULATING THE DRY BATCH.

1. ADJUSTMENTS FOR MINERAL ADMIXTURE SUBSTITUTION & CEMENT MODIFICATION

Fly ash or GGBFS may be substituted for cement at the contractor's option within certain restrictions. [Article 2301.02, B](#). specifies the substitution rates as they relate to time of the year.

[IM 529](#) lists each standard concrete mix. These mixes contain only cement but may be adjusted to accommodate fly ash or GGBFS substitution. Explanation of how those adjustments are to be performed is discussed later. The procedure to make necessary adjustments for increasing cement content in a mix is also explained later in the IM.

2. PROPORTIONING A MIX FOR A MINERAL ADMIXTURE SUBSTITUTION

- a. To adjust a standard mix for fly ash or GGBFS substitution, the amount of cement specified for a basic mix is multiplied by the percentage of fly ash that is to be substituted. This product will give the pounds of fly ash in the mix. To calculate the adjusted cement in the mix, subtract the fly ash or GGBFS amount from the basic cement weight. The basic water must also be adjusted. This is done by taking the design w/c, which is found in [IM 529](#), and multiplying that number by the total amount of cementitious material in the mix. The product of that calculation will be the adjusted pounds of basic water.
- b. The absolute volumes must also be adjusted for the new mix. This is done by multiplying the specific gravity of the material by the pounds of water per cubic yard times cubic feet in a cubic yard or 62.4×27 , then dividing the pounds per cubic yard by that amount. This procedure is used for the cement, fly ash, GGBFS, and water. Those absolute volumes plus the absolute volume of air, which is designated as 0.060, must be summed and subtracted from 1.000. The remaining volume is the aggregate portion of the mix.

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- c. To determine the volumes of the coarse and fine aggregate, the number from the difference above would be multiplied by the percentage of each aggregate used in the mix. The percentage would depend on the mix number being used, for example, a C-4 mix would have 50% coarse aggregate and 50% fine aggregate, a C-3 mix would have 55% coarse aggregate and 45% fine aggregate. After the absolute volumes of the fine and coarse aggregate are determined, the pounds of each shall be determined. This is done by multiplying the absolute volumes of the aggregate by the specific gravity of that aggregate and by the pounds of water in a cubic foot x cubic foot in a cubic yard.

Example A, in [Appendix B](#), shows the process of adjusting a mix for 15% fly ash usage in a C-mix using the form provided.

3. ADJUSTING BATCH WEIGHTS FOR AGGREGATE MOISTURE

The above dry aggregate batch amounts must be adjusted to account for moisture or lack of moisture in the aggregates. If additional moisture is present above the amount for the saturated and surface-dry condition (SSD), refer to [IM 308](#). The aggregate dry batch amount must be increased an amount equal to the mass of the water in the aggregate batch. If aggregates have less moisture than is present for the SSD condition, the aggregate dry batch amount must be reduced an amount equal to the mass of the water in the batch, below what is required for the SSD condition. When the latter condition occurs, the aggregate is described as having absorption. It occurs infrequently and for short duration and will generally be found during or at the end of a prolonged hot dry period in mid or late summer. The maximum permissible absorption limit is 0.5 percent. If the absorption exceeds 0.5 percent refer to the section entitled, "General" in this IM for the special action necessary.

There are two procedures that can be used for adjusting the dry aggregate batch amount to account for the free moisture in the aggregates. If a system with instantaneous moisture content measurement equipment is used to automatically adjust individual batch weights, see previous section, **Sampling & Testing/Moisture**, for instructions on an approval, use, and monitoring of the system.

The following example illustrates one of the methods used:

Assume the fine aggregate contains 3.4 percent and the coarse aggregate contains 0.7 percent of free moisture.

Fine aggregate -- 100.0 percent minus 3.4 percent = 96.6 percent
 $1348 \div 96.6 \times 100 = 1395$ lbs.

Coarse aggregate -- 100.0 percent minus .7 percent = 99.3 percent
 $1639 \div 99.3 \times 100 = 1651$ lbs.

To determine the free water in the aggregates, subtract the dry aggregate quantity from the adjusted dry aggregate weight for both aggregates and add the two differences.

1395 lbs. - 1348 lbs. = 47 lbs.
1651 lbs. - 1639 lbs. = 12 lbs.

47 lbs. + 12 lbs. = 59 lbs. of free moisture in one cubic yard of concrete.

The less preferred method is to use the moisture reciprocal tables [T214A](#) in which the correction factors are for 3.4 and 0.7, 1.0351967 and 1.0070493 respectively. Multiply the dry aggregate batch weight determined previously by the respective moisture reciprocal correction factor.

Fine aggregate 1348 lbs. \times 1.0351967 = 1395 lbs.

Coarse aggregate 1639 lbs. \times 1.0070493 = 1651 lbs.

These adjusted quantities are for one cubic yard and would have to be multiplied times the total cubic yards being batched. To determine the free water in the aggregates, subtract the dry aggregate weight from the adjusted dry aggregate amount for both aggregates and add the two differences as you did above in the example.

Add the total free water in the aggregates to the water proportioned into the mixer to determine the total water for mixing. Determine and record also at the same time the adjusted dry aggregate batch amounts, the water in the materials, the water proportioned and the total water available in the batch for mixing.

Record in the plant field book all weight determinations and calculations and sign each day's entry.

Check the aggregate scale settings, also at three-hour minimum intervals, as indicated by the adjusted dry aggregate batch weights. Refer to the section entitled Equipment, in this IM, for the procedure to follow when scale adjustments are required.

The water demand of a particular mix is dependent upon the materials used in the mix. For this reason, the water batch weight is determined by trial when the mixing begins. The water batch weight is controlled indirectly by the slump requirements.

Many central mixing plants have equipment for introducing additional water into the mixer after the batch has been in the mixer and has been mixed. The additional water is added manually through a system, which is independent from the main water proportioning system. The auxiliary water meter must be read at the same interval as the moisture determinations and scale adjustments are made. The total water through the auxiliary system is reduced to the pounds per batch basis by dividing by the number of batches produced during the three-hour interval and the per batch amount must be included in the total mixing water recorded per batch.

The plant inspector must keep a record in the plant field book of the total mixing water used, including the water in the aggregates, for at least each three (3) hours of normal operation to determine that the maximum permissible water content is not exceeded and to determine the batch volume. When ready mix trucks are used, water added on the grade must also be reported to the plant inspector.

Whenever the water demand, to achieve the desired workability, exceeds the design water/cement ratio and approaches the maximum water allowed, the Engineer and the District Materials Engineer Office should be notified. At the same time, aggregate moisture contents, batch weights, cement scales, water meter, etc., should all be immediately checked. In no

circumstance should the maximum water/cement ratio be knowingly exceeded.

If, after the District Materials Engineer investigation and evaluation, additional workability above that which is attainable with the maximum permissible water content is desired, the cement content may be increased in accordance with [Article 2301.02, B](#). This should be done only with the approval of the District Materials Engineer or his/her representative. The District Materials Engineer will provide the revised and adjusted mix proportions for these situations.

If the batch yield variation is less than 98 percent or greater than 102 percent for the water content being used, refer to Specification [Article 2301.02, B](#) for the special action necessary. The District Materials Engineer may allow adjustments in the proportions after checking moisture contents of the material and the operation of the batching equipment.

Mixes using fly ash as a substitution for cement are permitted as a contractor option, as allowed in the specifications.

REPORTS & REPORTING

1. PLANT PAGE – FORM #240

Plant reports are to be recorded in the computer program or on hand completed forms, both provided by the Iowa Department of Transportation. A copy of the completed PCC Plant Page shall be faxed or delivered to the District Materials Engineer and Project Engineer on the next working day, within four hours after start-up of the plant. Use electronic mail as the method of delivery unless otherwise approved by the Engineer. The CPI shall keep a copy of the PCC Plant Page and send the original to the Engineer. Copies of the files containing the project information are to be available to the engineer upon request until the project is final. The plant book shall be available for audit checks by the Engineer.

A separate report is to be made for each day concrete is placed. These reports are to be consecutively numbered for each project. A sample copy and the instructions on completing this report are in [Appendix A](#).

2. PERSONAL COMPUTER

The personal computer shall be capable of running Microsoft Excel 365 or newer version to use Iowa DOT Programs. The printer shall be capable of producing quality hard copies. That is, original printed output, which is clearly readable and remains readable after being faxed and/or copied.

3. READY MIXED CONCRETE, TRUCK TICKET FORM - FORM #830212

When concrete source for a paving project is a commercial ready-mix plant, each truckload of concrete must be identified by Form #830212 or acceptable computer-generated plant ticket. For continuous mainline paving, Form 830212 shall be filled out completely for the first truck. Tickets for subsequent trucks need only to have the Truck No., Ticket No., Conc. This Truck, Time Batched, Water Subtotal, and Maximum Water Allowed portion filled out. When any change in the moisture content, plant adjustments in mixing water, or any other changes to the batching or materials in the concrete are made, a complete ticket must be filled out for the first load that includes the changes. The Engineer and District Materials

Engineer will approve any variations to accepting the truck ticket form or computer-generated form.

The plant inspector must fill in the information pertaining to the plant, and the grade inspector must collect and record the information pertaining to the grade, assemble the tickets by day and store with the other project records. These completed tickets will contain primary information and must not be lost or destroyed. A sample is shown in [Appendix C](#).

4. PORTLAND CEMENT SHIPMENT YIELD REPORT - FORM #820912

The cement shipment yield test is described in section 2a, Cement Scales. Report the cement yield results on Form #820912. A sample copy of Form #820912 is included in [Appendix C](#).

5. PORTLAND CEMENT CONCRETE BATCH PROPORTIONS - FORM #820150

Submit the batch proportions report #820150 to the Engineer or Doc Express for review. For standard mix designs, do not delay work if not submitted prior to placement.

IMs & SPECIFICATIONS

A list of the IMs and Specifications used in PCC Plant Inspection are located at the end of this IM.

CONCRETE PLANT INSPECTION CHECKLIST

- A. The proportioning equipment must be examined at least at 3-hour intervals for correctness of the amount being delivered and for damage.
 - B. The scale sensitivity shall be checked at least twice during a normal working day by placing a mass equal to 1/10 percent of the batch on the fully loaded scales and observing the movement of the indicator.
 - C. Check scale operation to determine cement delivery tolerance conformance at least once during each day of normal operation.
 - D. The Standard Specification requires that the cement shipment yield determination must be made at intervals of approximately 10,000 cubic yards after the original determination made near the end of the first full day of production.
 - E. Check scale operation to determine aggregate delivery tolerance conformance at least once during a normal working day and document.
 - F. If water is measured with a scale, the delivery tolerance must be determined at least once for each day of normal operation and document.
 - G. Admixture dispensers shall be observed for uniform delivery at least once during each 3 hours of normal operation and document.
 - H. Admixture dispensers must be flushed with water at least once daily.
 - I. Determine and record the mixing speed and the mixing time at least once daily by using the sweep hand of a watch and counting the drum revolutions in one minute.
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- J. Determine and record the time between batching and placement at least once during each day of normal operation.
- K. Specific gravity - One sample per day for both coarse and fine aggregates for the first three days of normal operation and one for each three days of normal operation for both coarse and fine thereafter, assuming the first three days results are consistent.
- L. Moisture - A minimum of one test per each day of operation greater than 500 cubic yards. Two per day, if production is greater than 1000 cubic yards.
- M. Gradation - Obtain and test one sample per day. Show sample number, name of sampler, and name of tester on lab work sheet.
- N. If opening not determined by maturity method, cast one beam for each 2000 cu. yd. of concrete placed. Make flexural tests representing alternating 2000 cu. yd. placement units at 7 and 14 days.
- O. At the plant, the plant inspector shall remove the specimens, clean the molds, oil, and return the molds to the grade at the direction of the paving inspector. The plant inspector shall store the specimens until date of test. The storage space shall be a pit adequate for the project, and for normal projects it should be at least 4 ft. x 6 ft. x 18 in. The specimens shall be wet at all times. If the temperature in the sand filled pit drops below 40°F, remove the specimens, and place them under wetted burlap in a heated enclosure or in lime-saturated water. See [IM 328](#). **NOTE:** Lime-saturated water is prepared by mixing 0.4 ounces of hydrated lime with 1 gallon of water.
- P. When opening is determined by the maturity method, casting beams every 2000 cubic yards is not required. The plant inspector should ensure curve development is performed according to [IM 383](#).
- Q. Other duties include:
- Close observation of stockpiling and handling of aggregates. There must be no intermingling of aggregates and no contamination.
 - Frequent check on wet batch or dry batch truck cleanliness and degree of discharge.
 - Document all the above data in diary.
 - Make the following report daily: Plant Reports - Form #800240
 - Make the following report as prescribed: Cement Yield Report - Form #820912E
 - At the end of the project, make a copy of the plant book for the Engineer, within ten days.
 - When required by [Article 2301.03](#), make a copy of vibration-monitoring device records in electronic format.

IMs/SPECIFICATIONS USED IN PCC PLANT INSPECTION BY VOLUME

Volume II IMs:

IM 527	Paving Plant Inspection
IM 528	Structural Concrete Plant Inspection
IM 529	Portland Cement (PC) Concrete Proportions
IM 401	Hydraulic Cements
IM 403	Chemical Admixtures for Concrete
IM 491.14	Ground Granulated Blast Furnace Slag (GGBFS)
IM 491.17	Fly Ash
IM 203	Consultation Provided by Materials Personnel on Construction Projects
IM 204	Inspection of Construction Project Sampling & Testing
IM 213	Technical Training & Certification Program
IM 216	Guidelines for Validating Testing Results
IM 301	Aggregate Sampling & Minimum Size of Samples for Sieve Analysis
IM 302	Sieve Analysis of Aggregate
IM 306	Determining Amount of Material Finer than the No. 200 Sieve in Aggregate
IM 307	Determining Specific Gravity of Aggregate
IM 308	Determining Free Moisture & Absorption of Aggregates
IM 316	Flexural Strength of Concrete
IM 317	Slump of Hydraulic Cement Concrete
IM 318	Air Content of Freshly Mixed Concrete by Pressure
IM 327	Sampling Freshly Mixed Concrete
IM 328	Making, Protecting & Curing Concrete Flexural Strength Field Specimens
IM 383	Estimate of Portland Cement Concrete Strength by Maturity Method

Volume IV IMs:

IM 209	Certified Aggregates & Approved Producer Program
IM 409	Source Approvals for Aggregates
IM T203	General Aggregate Source Information

Specifications:

2301	Portland Cement Concrete Pavement
2403	Structural Concrete
4100	General Provisions
2001	General Equipment Requirements

Supplemental or Developmental Specification that was in effect at the time of the project letting.

INSTRUCTIONS FOR COMPLETION OF PCC PAVING & STRUCTURAL REPORTS

The new reporting process does not include Mobile Mixer information. Use the following forms and reports when using a Mobile Mixer:

Form E 115	Air & Slump Record
Form E 120	Mobile Mixer Data Record
Report #820180	Gradation Test
Report #821297	Nuclear Density of Plastic PC Concrete
Report #820020	Mobile Mixer Calibration

Project No.

Enter the project number listed on the plans.

Plant Name

Enter the name of the ready-mix plant and location for structural concrete. Enter the approximate location of a paving plant set up by a contractor.

Example: Croell - Waverly (Ready Mix)
2 miles NW of Waverly (Paving Plant)

Contractor/Sub

A group of people or a company must perform the work being done, either a prime or sub contractor. Enter the name of the contractor performing the work. If it is a subcontractor, list this after the contractor's name.

Weather

Enter a brief description of the actual weather conditions at the paving plant. Weather conditions are not required for structural concrete (Ready Mix).

Contract ID

Enter the nine-digit contract number listed at the top of a contract. This is not the five-digit accounting ID number listed with the project number.

County

Enter the county listed on the project plans.

Temperatures, Min. & Max.

An air temperature shall be recorded early in the morning for the minimum and around mid-afternoon for the maximum. Take the temperatures in a shaded area, otherwise they are meaningless. Temperatures are not required for structural concrete, except bridge decks.

Report No.

Start with the number 1 at the beginning of work for each project. The ending report number shall coincide with the last day each item is completed for paving and the last week for structural. Do not restart the report sequence if the project carries over to the next year.

Example: (Paving) 16 days of 10.5-inch slip form paving - report 1 through 16.
(Ready Mix) 8 weeks of concrete on Des. 1290 - report 1 through 8.

Date This Report

Enter the date the concrete is placed for each day of paving. Enter the last day of the workweek for structures (normally the Saturday date).

Date of Last Report

Self-explanatory.

Design No.

Enter the design number of the structure where the concrete is being placed on each project. Leave this space blank on paving projects.

Check Mix (Central or Ready)

Place an "X" in the appropriate box provided indicating how the concrete is being produced.

Check Usage (Paving, Structural, Incidental, Patching)

Place an "X" in the appropriate box provided to indicate the type of work where the concrete is used.

Date (Mo./Day)

This column is only used for Ready Mix concrete applications. Enter the month and the date for each day of production during the week.

Example: 5/24, 7/01, 12/03, etc.

Mix Number

Enter the mix number being used that is listed in the proportion tables of [IM 529](#).

Location- Station (Beg. /End/Dir)

Enter the beginning and ending station for concrete placed daily by mix. Enter the direction (N, S, E, W) for divided sections or B for 2-lane sections. For structural concrete enter the unit placed (Example: pier, cap, footing, deck). Enter item placed for other work. (Example: sidewalk, drive) The grade inspector will provide the location or item placed to the plant inspector.

Batched

Enter the total cu. yds. batched for each mix for a paving plant. Enter the total cu. yds. batched for each unit poured for structures.

% Of Est. Used

Enter the percent of estimated concrete used. The grade inspector will provide the % of estimate used ((cubic yards used / cubic yards estimated) X100) to the plant inspector

Fine, Intermediate & Coarse Aggregate (Moisture)

Enter the percent moisture once in the morning and once in the afternoon for paving projects. Enter the percent moisture for each unit poured on structures.

Fine, Intermediate & Coarse Aggregate (T203 sp gr)

Enter the specific gravity for each aggregate listed in the [T203](#) source tables.

Fine, Intermediate & Coarse Aggregate (Dry Wt.)

Enter the weight of each aggregate calculated by absolute volumes.

Actual Quantities Used Per cu. yds. (Pounds)

- Cement** Enter the pounds of cement calculated by absolute volumes.
- Fly Ash** Enter the pounds of fly ash calculated by absolute volumes.
- GGBFS** Enter the pounds of GGBFS calculated by absolute volumes.
- Fine** Enter the actual pounds of fine aggregate adjusted by moisture content.
- Inter.** Enter the actual pounds of intermediate aggregate adjusted by moisture content.
- Coarse** Enter the actual pounds of coarse aggregate adjusted by moisture content.
- In Agg.** Enter the calculated difference between the actual weights and the dry weights of all aggregates.
- Plant** Enter the average pounds of water added at the plant for each cu. yd., including ice
- Grade** Enter the average pounds of water added on the grade (if permitted by specification).

Avg. W/C Ratio

Enter the ratio of total water, including water in the aggregates and water added on the grade, in one cu. yd. divided by the total sum of cement, fly ash, and ggbfs in one cu. yd., report to three decimal places.

CPI Gradations

This section of the report is for reporting the Certified Plant Inspector gradation test results for the coarse and fine aggregates being used in the mix.

Batched (Today or Week)

Place an "X" under the Today column if the report is being submitted daily (paving).
Place an "X" under the Week column if the report is being submitted weekly (structures).

Concrete Batched

Enter the total cu. yd. of concrete batched under the appropriate column. Paving plant totals are normally under the Today column; structural concrete totals are normally under the Week column.

To Date Total

Enter the running total for both concrete and cement.

Air Entraining (Air Ent.)

Enter the brand name or source, average rate per cu. yd., and lot number.

Water Reducer (Wat. Red.)

Enter the brand name or source, average dosage rate, and lot number.

Retarder

Enter the brand name or source, average dosage rate, and lot number.

Calcium Chloride (Cal. Chlor.)

Enter the brand name or source, average dosage rate, and lot number only when added at the plant site.

Superplasticizer (Superplas.)

Enter the brand name or source, average dosage rate, and lot number.

Concrete Treatment

Place an "X" directly behind Ice, Heated Water, or Heated Materials, if one or more are used. If ice is used to cool the mix, enter the pounds of ice per cu. yd. Include weight of ice with plant water.

Cement

Enter the cement type, specific gravity, and source. See [IM 401](#) for the actual source name.

Fly Ash

Enter the type and specific gravity and source. See [IM 491.17](#) for the actual source name.

Example: Chillicothe and ISG Headwaters are not source names.
Ottumwa is the source name.

Rock

Enter the [T203](#) A number, and gradation number.

GGBFS

Enter the grade, specific gravity, and source. See [IM 491.14](#) for the actual source name.

Sand

Enter the [T203](#) A number, and gradation number.

Intermediate

Enter the [T203](#) A number.

Remarks

Enter delays, which may take place. Enter description of noncomplying test results.

CPI

Enter the Certified Plant Inspector name and certification number.

Monitor

Enter the plant monitor name and certification number.

If using the computer spreadsheet, most of this information will be entered on the Project Information and Mix Information sheets and automatically transferred to the Report. For QMC and BR mixes, the combined gradation will be calculated from aggregate percentages entered in the Mix Information Station From and To, Totals to Date Cement and Concrete, and Remarks will be entered directly on the Report.

The next page is an example of a completed Paving Plant Report.

PCC Plant Report

v10.1

Date of Placement	From	To	Location	Project No.:	STP-64(12)28-58
Mix 1	8/6/2013			Contract ID:	67592
Mix 2	8/6/2013			Plant Name:	KR - Hwy 218 & F62
Mix 3				County:	95-Louisiana
Mix 4				Temp. Min:	69 °F
Mix 5				Temp. Max:	87 °F

Contractor: Knife River
SubContractor: Sunny
Weather: Sunny
Maturity Mix ID: _____
Maturity?: _____ Curve #: _____

Report No.: 004
Date of Last Report: 9/17/2014
Structures Des. No.: _____
Curve / Validation Date: _____
Curve Expiration Date: _____
TTF: _____

Max On Grade W/C Ratio: _____

Mix	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used -			Water			Avg w/c Ratio	Max w/c Ratio		
	Moist. (%)	T-203 Wt. lbs	Sp. G.	Moist. (%)	T-203 Wt. lbs	Sp. G.	Moist. (%)	T-203 Wt. lbs	Sp. G.	Cement	Fly Ash	GBBFS	Fine	Inter.	Coarse			In Agg.	Plant	Grade
1	3.1	1,380	2.65	0.7	1,380	2.63	1670	2.63	1670	446	111	1424	1424		1682	56	175.0	0.0	0.415
2	2.8	1,380	2.65	0.5	1,380	2.63	1670	2.63	1670	446	111	1420	1420		1678	48	190.0	0.0	0.428
3																			
4																			
5																			

Sample Date:	Coarse	Intermediate	Fine
	1 1/2" 1" 3/4" 1/2" 3/8" 100 95-100	1 1/2" 3/4" 1/2" 3/8" 0-10 0-5	1 1/2" 3/8" #4 #8 #16 #30 #50 #100 #200 #400 #800 #1600 #3200
	Comply Y/N	Comply Y/N	Comply Y/N

Carbon Cure: _____
Air Entraining: Daravair 1000-GCP
Normal Water Reducer: Eucon WR-75-Euclid
Mid-Range Water Reducer: _____
High-Range Water Reducer: _____
Retarder: _____
Special Performance Admixturer: _____
Concrete Fibers: _____

Conc. Treatment	(X)	Ibs/yd3
Ice		
Heated Water		
Heated Materials		
Liquid Nitrogen		

Concrete: 2640.00 yd3
Cement: 588.72 tons

Check One (X)	Daily	Total	Waste	Waste To Date
	X			

Brand / Source	Rate	Lot Number
Daravair 1000-GCP	5.0 oz/yd	233998
Eucon WR-75-Euclid	3 oz./100lbs	557882

Type	Sp. Gr.	Source
IS(25)	3.06	PC0707-Central Plains - EaglePave-IS(25)
C	2.82	FA004C-Council Bluffs Unit #3

Coarse	Intermediate	Fine
A10030-SOUTH AURORA	T-203 A # & Source	A06502-VINTON-MILROY
Grad. No. 3		1

Adjusted % Passing Calculated Combined Gradation	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
Target	100	100	100	100	100	100	100	100	100	100
Actual										

Certified RM
Remarks: _____
C.P.I. #1: _____
C.P.I. #2: _____
Monitor #1: _____
Monitor #2: _____

Distribution: _____ DME _____ Proj. Eng. _____ Plant _____

EXAMPLE A

4/3/2023		Iowa Department Of Transportation Office Of Materials PORTLAND CEMENT CONCRETE			Form EB20150 E - Units	
Project No.: <u>FM-91(15)--66-91</u>		County: <u>91-Warren</u>				
Mix No.: <u>C-3WR-C20S20</u>		Abs Vol. Cement: <u>0.1080</u>		Type: <u>IL</u>		
Cement (IM 401):	<u>566</u> lbs	Source: <u>PC0009-Ash Grove - Louisv</u>		Sp. Gr.: <u>3.11</u>		
	%					
Fly Ash (IM 491.17):	<u>20</u> <input type="text" value="113"/>	Source: <u>FA004C-Council Bluffs Unit</u>		Sp. Gr.: <u>2.62</u>		
	%					
Slag (IM 491.14):	<u>20</u> <input type="text" value="113"/>	Source: <u>SL02A-NewCem</u>		Sp. Gr.: <u>2.93</u>		
	%					
CarbonCure:	<u>0</u> <input type="text" value="0"/>	Cement Reduction				
Adjusted Cement: <u>340</u> lbs						
Total Cementitious <u>566</u> lbs		Total % Replacement = <u>46</u>				
IM T203	Fine Aggregate Source:	<u>A06502-VINTON-MILROY</u>			Sp. Gr.: <u>2.65</u>	
IM T203	Interm. Aggregate Source:				Sp. Gr.: <u></u>	
IM T203	Coarse Aggregate Source:	<u>A22010-OSTERDOCK</u>			Sp. Gr.: <u>2.67</u>	
Basic w/c	<u>0.430</u>	Water	lbs/cy	= Basic w/c X (Total Cementitious)	= <u>243</u>	
Max w/c	<u>0.450</u>	Max. Water	lbs/cy	= Max w/c X (Total Cementitious)	= <u>255</u>	
Absolute Volumes						
	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)		= <u>0.065</u>		
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)		= <u>0.026</u>		
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)		= <u>0.023</u>		
	Water	(lbs/cy) / (Sp. Gr. X 62.4 X 27)		= <u>0.144</u>		
	Air			<u>0.060</u>		
		Subtotal		= <u>0.318</u>		
		1.000 - Subtotal		= <u>0.682</u>		
		Total		= <u>1.000</u>		
% FA Agg.:	<u>45</u>	Fine Aggregate (1.000 - Subtotal) X % In Mix		= <u>0.307</u>		
% In. Agg.:	<u></u>	Interm. Aggregate (1.000 - Subtotal) X % In Mix		= <u></u>		
% CA Agg.:	<u>55</u>	Coarse Aggregate (1.000 - Subtotal) X % In Mix		= <u>0.375</u>		
		Aggregate Total		= <u>0.682</u>		
Aggregate Weights						
	Fine:	Abs Vol. X Sp. Gr. X 62.4 X 27		= <u>1371</u>		
	Intermediate:	Abs Vol. X Sp. Gr. X 62.4 X 27		= <u>0</u>		
	Coarse:	Abs Vol. X Sp. Gr. X 62.4 X 27		= <u>1687</u>		
Summary						
		Cement <u>340</u> lbs/cy				
		Fly Ash <u>113</u> lbs/cy				
		Slag <u>113</u> lbs/cy				
		Water <u>243</u> lbs/cy				
		Fine Agg. <u>1371</u> lbs/cy				
		Interm. Agg. <u>0</u> lbs/cy				
		Coarse Agg. <u>1687</u> lbs/cy				
Plant Name & Location: <u>Warren_R63</u>		Air Entrainment: <u>Sika Air-Sika</u>		Rate: <u>6.0 oz/yd</u>		
CPI:		Normal Water Reducer: <u>Plastocrete 161-Sika</u>		Rate: <u>2 oz./100lbs</u>		
Cert #:		Mid-Range Water Reducer:		Rate:		
		High-Range Water Reducer:		Rate:		
		Retarder:		Rate:		
		Special Performance Admixture:		Rate:		
		Fibers:		Rate:		
		CarbonCure:		oz/cy:		
Distribution: <u>DME</u> , <u>Proj. Engr.</u> , <u>Contractor</u>						

Form 830212
10-95

READY MIX CONCRETE

_____ Plant

Truck No. _____ Ticket No. _____

Date _____ Des. No. _____

Proj. No. _____

Mix No. _____ Retarder/Water Reducer? Yes No

Conc. This Truck _____ C.Y./m³

Air agent added this truck _____ oz./mL

Time Batched _____ Discharged _____

Rev. Mixed (*Plant*) _____ Grade _____

Water (*gal./L or lbs./kg This Truck*) 8.33lbs./gal.

In Aggregate	_____ gal./L	_____ lbs./kg
Added (<i>Plant</i>)	_____ gal./L	_____ lbs./kg
Subtotal	_____ gal./L	_____ lbs./kg
Added Grade	_____ gal./L	_____ lbs./kg

TOTAL WATER _____ gal./L _____ lbs./kg

Maximum Water Allowed _____ gal./L _____ lbs./cy or kg/m³

Air _____ Slump _____

Plant Insp. _____

Receiving Insp. _____

Form 820912E - computer											
Portland Cement Shipment Yield Report										Report No.:	1
										Date Submitted:	01/02/04
Contract ID: 29999								Source: Ash Grove			
Project No.: FM-85(25)-55-85								Contractor: Manatt's			
County: Story				Plant Location: NW Corr E29							

Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type
06/02/03	107312	28.19	I/II	06/04/03	107352	27.86	I/II	0	0	0.00	I/II
06/02/03	107313	28.14	I/II	06/04/03	107353	27.57	I/II	0	0	0.00	I/II
06/02/03	107314	27.85	I/II	06/04/03	107354	28.14	I/II	0	0	0.00	I/II
06/02/03	107315	27.81	I/II	06/04/03	107355	27.99	I/II	0	0	0.00	I/II
06/02/03	107316	27.92	I/II	06/04/03	107356	28.10	I/II	0	0	0.00	I/II
06/02/03	107317	28.21	I/II	06/04/03	107357	27.79	I/II	0	0	0.00	I/II
06/02/03	107318	25.49	I/II	06/04/03	107358	26.99	I/II	0	0	0.00	I/II
06/02/03	107319	26.57	I/II	06/04/03	107359	27.85	I/II	0	0	0.00	I/II
06/02/03	107320	28.06	I/II	06/04/03	107360	28.00	I/II	0	0	0.00	I/II
06/02/03	107321	28.02	I/II	06/04/03	107361	27.94	I/II	0	0	0.00	I/II
06/02/03	107322	28.15	I/II	06/04/03	107362	27.30	I/II	0	0	0.00	I/II
06/03/03	107323	28.36	I/II	06/04/03	107363	28.28	I/II	0	0	0.00	I/II
06/03/03	107324	28.08	I/II	06/04/03	107364	27.90	I/II	0	0	0.00	I/II
06/03/03	107325	27.73	I/II	06/04/03	107365	28.50	I/II	0	0	0.00	I/II
06/03/03	107326	28.26	I/II	06/04/03	107366	28.00	I/II	0	0	0.00	I/II
06/03/03	107327	25.55	I/II	06/04/03	107367	27.99	I/II	0	0	0.00	I/II
06/03/03	107328	28.19	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107329	27.61	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107330	28.18	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107331	28.37	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107332	28.24	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107333	28.20	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107334	28.03	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107335	28.18	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107336	28.03	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/03/03	107337	21.00	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107338	27.78	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107339	28.15	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107340	28.25	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107341	28.32	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107342	27.89	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107343	27.96	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107344	28.50	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107345	28.28	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107346	27.27	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107347	27.91	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107348	28.34	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107349	27.88	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107350	28.34	I/II	0	0	0.00	I/II	0	0	0.00	I/II
06/04/03	107351	28.35	I/II	0	0	0.00	I/II	0	0	0.00	I/II

	Cement			Cement		
	Per CY	Batched		Batched		
Mix No.	(lbs)	(CY)	.....	(Tons)		
C-4WR-C15	503	5,782.00	.....	1,454.17		
M-4	825	168.00	.....	69.30		
C-4WR	593	147.00	.....	43.59		
0	0	0.00	.....	0.00		
0	0	0.00	.....	0.00		
Left In	This Check (+)			1.53		
Scale (Tons)	Previous Yield Check (-)			1.68		
	Total Weighed (Batch Scale)			1,566.91		
						C.P.I.:
						Signature

Distribution: DME RCE Central Materials Contractor Inspector

Form 820917
11-94



Iowa Department of Transportation

Office of Materials

PLANT CALIBRATION REPORT

- Portland Cement Paving Plant
 Ready Mix Plant
 Initial Calibration
 Check Calibration
 Change in Material Source

Shaded area to be completed for paving plants and when applicable for ready mixed concrete plants.

Contractor/Producer		County	
Plant Location		Project	
Class of Concrete		Mix No.(s)	
Design W/C Ratio(s)		Max W/C Ratio(s)	
MATERIAL	SOURCE Producer Name & Location	SPECIFIC GRAVITY	DRY BATCH MASS
Aggregate (Coarse)			
Aggregate (Fine)			
Cement			
Fly Ash			
Water			
Air Entraining Agent			
Curing Compound			
Water Reducing Agent			
Retarding Admixture			

Calibrated by: _____ Title: _____ Date: _____

Coarse Aggregate Sampling Point: _____

Remarks: _____

Note: Circulation of air entraining, water reducing, and retarding admixtures is required **prior to use**.

This above data is furnished by the Contractor/Producer as set forth in the Standard Specifications for plant operations. The Contracting Authority makes no representations as to accuracy, either express or implied, which are to be construed to relieve the contractor from the responsibility to comply with the specifications.

Witnessed _____

Title _____

Distribution: White Copy - Plant Inspector; Canary Copy - Contractor/Producer; Pink Copy - Transportation Center Materials Engineer; Goldenrod Copy - Resident Engineer
Send copy to Central Materials on city and county projects. (PCCP Only)

**PORTLAND CEMENT & READY MIX
PLANT CALIBRATION CHECKLIST**

References: [IM 527](#), [528](#) and noted Specifications

STORAGE & HANDLING OF MATERIALS

Aggregates: [2301.02](#)

- Certified compliance
- Separation of materials
- Storage area floor shall be a minimum of 18" of similar material
- Fine aggregates shall drain a minimum of 24 hours on new bridge deck floors-2412.02

Cementitious Material: [2301.02](#)

- Approved certified sources
- No intermingling of products or sources
- Stored in suitable weather proof enclosures

WATER

- Sample when required

ADMIXTURES

- Verify acceptance of lot
- Circulate 5 min. per 100 gal. of solution
- Proper storage to prevent freezing

PLANT REQUIREMENTS

Safety:

- Guards, ladders, railings and walkways
- Sampling location
- Proper template if belt sample
- Safety switches and belt lockouts in place
- Bins are structurally safe: [2001.06](#)
- Settlement of footings is uniform
- Suitable wind protection for scale operation
- Automatic interlocks for projects over 6000 sq. yds: [2001.20](#) & [2301.13](#)
- Weight indicator or digital readouts are in full view of the plant operator.

Scale Calibration: [2001.20](#)

Calibration of batch plant scales as required by the specifications is performed by incrementally loading the scales with standard test weights and partial batches through the operating range of the scales. As each increment of load is applied, the actual observed weight and the required weight are compared. The differences plus or minus, are determined and converted to percentages of the required weight. If the percentage deviations are less than the tolerance allowed by the specifications and the scales are sensitive to the test loads, the scales will be considered in calibration. If the scales do not meet the various requirements, the contractor should be notified immediately and required to make the necessary repairs or adjustments. The engineer may order recalibration if the scale equipment malfunctions, material quantities do not agree with actual material quantities, or any repairs or replacement of equipment occurs.

- Calibrate scales to include the maximum weight for projected batches
- Commercially manufactured weights that have the weight stamped on the exterior and appear to be unaltered and in good condition may be assumed to meet the requirements of ASTM E617.
- Non-commercially manufactured test weights may be used in providing accumulating weight for loading the scales, if validated against commercially manufactured test weights, or a certified scale, a minimum of once every two years. Some manufactured weights may vary and require more frequent validation.

Example: Aggregate Scale Calibration.

Aggregate Scale 1 (0.5% tolerance)			Date Calibrated:	3/9/23	Grads	20	
Weight	Material Weight	Total	Scale Reading	Error (%)	Return Reading	Return Error (%)	Compliance
2000	0	2000	2000	0.00%	0	0.00%	Yes
4000	0	4000	4000	0.00%	0	0.00%	Yes
4000	4080	8080	8060	-0.25%	4080	0.00%	Yes
4000	8080	12080	12060	-0.17%	8080	0.00%	Yes
4000	16400	20400	20380	-0.10%	16420	0.10%	Yes
4000	22320	26320	26280	-0.15%	22320	0.00%	Yes
4000	27980	31980	31940	-0.13%	27980	0.00%	Yes
						0.00%	

As a guide, a working form to help record field calibration measurements is on page 4. Certified scale company reports may be used or use District Materials Engineer Excel spreadsheets.

Water Calibration: [2001.20B](#)

- Equipment shall be such that accuracy will not be affected by variations in pressure of the water supply.
- Weighing equipment to verify water calibration shall meet specification
- Repairs or adjustments will require equipment to be recalibrated.

Equipment for Dispensing Liquid Admixtures: [2001.20C](#)

- Calibrate per Specification
- Measuring container of digital readout shall be on view of plant operator.

Truck Mixer & Agitator: [2001.21B](#)

- Meet the requirements of specification
- Truck mixer certification (Form #820907) kept in truck and is up to date.

CONCRETE PLANT CALIBRATION WORKSHEET

DATE _____ PAVING PLANT _____
 LOCATION _____ READY MIX PLANT _____

CEMENT SCALE – ACCURATE TO 0.5% OF BATCH WEIGHT

SENSITIVITY – EMPTY _____ FULL _____ LBS. @ _____ LBS.
 TOLERANCE – 0.1% OF BATCH WEIGHT OR 2 LBS., WHICHEVER IS GREATER

applied weight	scale reading	Error, %	applied weight	scale reading	Error, %

AGGREGATE SCALE – ACCURATE TO 0.5% OF BATCH WEIGHT

SENSITIVITY – EMPTY _____ FULL _____ LBS. @ _____ LBS.
 TOLERANCE – 0.1% OF BATCH WEIGHT OR 2 LBS., WHICHEVER IS GREATER

applied weight	scale reading	Error, %	applied weight	scale reading	Error, %

WATER-ACCURATE TO +/-1.0% OR 2 LBS., **ADMIXTURES**-ACCURATE TO +/-3.0%
 WHICHEVER IS GREATER OF QUANTITY REQUIRED

metered gal.	lbs.	scale reading	Error. %	area meter meas.		water reducer meter meas.		Retarder meter meas.	
				oz.	oz.	oz.	oz.	oz.	oz.

Chapter 17
IM 528
STRUCTURAL PLANT INSPECTION

READY MIX CONCRETE PLANT INSPECTION

GENERAL

Refer to [IM 527](#) (General, Safety).

The following instruction is to be used when inspecting the operation of a ready mix concrete plant typically used for structural concrete, patching, and other concrete items. Refer to IM 527 for sampling and testing for paving.

EQUIPMENT

1. ELEVATED, LOW PROFILE, AND GROUND-LEVEL BINS

Refer to [IM 527](#) (Equipment Bins) and the following:

Permanent ready mix concrete plants often have facilities for storing sizable quantities of a number of different aggregates. There is a tendency for the stockpiles to become too large for the available area and for the bins to be filled beyond their normal capacity. Aggregates thus tend to become intermingled. Aggregates may also become contaminated with foreign material from a number of sources, including the material, which underlies some stockpiles, if proper care is not taken. Materials, which have been intermingled or otherwise contaminated, must not be incorporated into the work.

2. PROPORTIONING EQUIPMENT

Requirements for scales or meters for proportioning aggregates, cement, fly ash, water or air entraining agents or other admixtures are found in [Article 2001.20](#) of the Standard Specifications, as modified by Supplemental Specifications. These requirements are in addition to Section 1 above for elevated bins.

It is the duty of the District Materials Engineer to examine and evaluate all proportioning and plant equipment annually, and maintain a current list of approved ready mix concrete plants. The Calibration Report, Form #820917, with any appropriate restrictions, conditions, comments, etc., will be posted at the plant site. (See [IM 527, Appendix C](#) for a sample copy and [Appendix D](#) for calibration checklist.) Before concrete work begins on a project, the Project Engineer must communicate with the District Office and determine that the plant to be used has received annual approval.

The PCC Level II certified technician must be familiar with all features of the plant operation before work begins. While the inspector must not personally make any of the manipulations or adjustments, an understanding of the basic machinery operation and the ability to recognize the significance of a malfunction is important.

The proportioning equipment must be examined at regular intervals during a placement for correctness of the amount being delivered and for possible damage or malfunction. Special attention must be given to the empty balance and the position of the poise weights for beam and dial scales.

The normal plant operation causes vibration, which tends to change these adjustments. Accumulation of material clinging to the inside of the hoppers can also cause these adjustments to drift. Small amounts of material accumulation clinging to the inside of a hopper are not considered objectionable. If the amount exceeds one percent of the material batch, however, it must be removed and readjusted to indicate a zero load within 0.5% ([Article 2001.20](#)).

The scale sensitivity shall be checked at least at the beginning of a placement if operations are intermittent, and at the beginning of each day if the operations are continuous in the following manner:

Place a weight equal to 1/10 percent of the batch on the fully-loaded scales while observing the movement of the indicator.

A properly sensitive scale will exhibit a visible indicator movement when tested in this manner. If no indicator movement is visible and immediate corrective action by the owner does not yield successful results, the District Materials Engineer must be informed.

Periodic observation of the measuring operation must be made to determine that the proper amounts of materials are being delivered to the concrete batch. The plant inspector must be able to recognize when the hopper is overloaded or underloaded by one percent of the batch. For a dial scale, these limits are readily recognizable on the graduated dial chart. For scales with a balance indicator, the location of the indicator hand when a one percent over and underload is applied and removed can be noted before work begins.

If an examination reveals that the scales are not properly sensitized or the proper amounts of material are not being furnished to the concrete batch, refer to [IM 527](#), General, for the necessary action.

Document all routine scale sensitivity, delivery tolerance checks and any necessary corrective action taken, in the plant inspection diary.

The following procedure is required for setting or adjusting the various items of proportioning equipment so that they will deliver the proper amount of material to the batch:

- The plant superintendent or other authorized operator representative must make all necessary scale and equipment setting and/or adjustments. The PCC Level II certified technician is specifically directed not to participate in this activity.
- Before the plant operation begins or resumes, the PCC Level II certified technician will independently determine for himself/herself that the settings and/or adjustments are correct and that the amounts of material being delivered to the batch are correct. Errors must be corrected immediately. Strict adherence to the above procedure is necessary to maintain a proper division of authority and responsibility between the contractor and the contracting authority, and to minimize the possibility of operating with erroneous proportions.

Suitable wind protection on all sides of the scales is required by the specification. This protection, if not provided by the plant design, can be fabricated from burlap, masonite, plywood or other suitable material and should provide adequate room for the scale operator to work unobstructed.

An air-entraining admixture is required for all structural concrete, except Class X, and can be proportioned either manually or automatically. Mechanical dispensers must have a transparent measuring chamber so that each batch can be observed as it is measured and dispensed. Mechanical dispensers must be cleaned daily to minimize the possibility of deposits accumulating and causing a malfunction.

The amount of air entraining admixture required is determined by the results of the pressure meter air tests run on the plastic concrete, as described in [IM 318](#). The contractor must decide the quantity to be used and the adjustments necessary, if any, after the pressure meter testing has been completed. Provision shall be made for agitation of the air-entraining agent. (See [Article 4103.01, A](#))

An admixture for set retardation may be required. The list of approved retarding admixtures, and recommended dosages, is found in [IM 403](#). An admixture for water reduction may be used at the contractor's option in mixes so designated in [IM 529](#). (See [Article 2301.02, B.](#))

See IM 527 (Materials, Admixtures), regarding dosage, handling and storage of admixtures.

Most air entraining and retarding admixtures, when intermingled with each other tend to neutralize each other and negate the effects of each. Care must therefore, be taken to introduce each admixture into the mixer separately and allow the first to become intermingled into the batch before the second is introduced. A procedure, which has been used successfully, is to introduce the air-entraining agent first along with most of the mixing water and other ingredients, and after these have become intermingled then introduce the balance of the mixing water and the retardant admixture.

3. MIXING EQUIPMENT

Mixing equipment for structural projects will be one of the following types:

- Truck-mounted transit mixers
- Stationary central mixers with in-transit agitation
- Stationary mixers located at the project site
- Concrete-Mobiles

The truck-mounted transit mixers are the most popular with stationary, central mixers increasing in popularity. Stationary site mixers are seldom used.

Refer to [IM 527](#) (Mixing Equipment) for inspection instructions relating to stationary central mixers and truck-mounted transit mixers, and [IM 534](#) for Concrete-Mobiles.

Transit mixers must carry a current certification signed by a responsible company representative stating that the mixer condition has been examined during the previous 30 days, is free of hardened concrete, and is in proper working condition. Mixers not carrying the required certification must not be used.

MATERIAL

Refer to [IM 527](#) (Material) for the necessary inspection instructions relating to material identification,

handling and storage.

OTHER ADMIXTURES (See [Article 2403.02. B. 4](#))

Certain structural placements with congested steel and narrow forms may require higher slump to place the concrete. The Engineer may approve the use of a high range water reducer with standard mixes in accordance with [IM 529](#). If a highly flowable mix is needed for the placement, the Engineer may approve the use self-consolidating concrete (SCC) in accordance with [IM 529 Appendix A](#).

Conditions on the project may require a retarding admixture due to long delivery times, etc. With the Engineer's approval, the mixed to placed time period may be extended an additional 30 minutes when using a retarding admixture at the prescribed rate in [IM 403](#). If longer times are required, the dosage rate will be based on manufacturers recommendation with Engineers approval.

BATCHING

A PCC Level II certified technician may also act as a batch person for the following items only:

- Non-structural and miscellaneous items less than 50 cubic yards per week
- Night work patching
- Two truckloads of structural concrete or less produced per day.

A PCC Level II certified technician shall perform required plant inspection duties prior to start up and a minimum of once per lot. A PCC Level II certified technician responsible for quality control shall be available by cell phone.

SAMPLING & TESTING

Quality Control

1. AGGREGATES

Refer to [IM 527](#) (Sampling & Testing) for related inspection instructions.

Personnel performing aggregate testing shall be Aggregate Level II certified. The PCC Level II certified technician may direct this person performing the testing. The minimum frequencies for testing aggregates for structural concrete are as follows:

Specific Gravity - One sample for both coarse and fine aggregate as described in the table, unless the first two tests indicate variations greater than 0.02 from the tabular value [T203](#), Aggregate Source Information, or from one test to the next. If the above variations are greater than 0.02, inform the Project Engineer and the District Materials Engineer immediately. The District Materials Engineer may adjust the specific gravity used to determine batch weights.

Moisture - One sample for each aggregate as described in the table. If a system with instantaneous moisture content measurement equipment is used to automatically adjust individual batch weights, see section titled Sampling & Testing/Moisture in [IM 527](#) for instructions on approval, use, and monitoring of the system. Frequency shall be increased if stockpile changes occur. When specific gravity is not tested, moisture content may be determined by the mass (weight) difference method ([IM 308](#) Method B).

Gradation - One sample for each aggregate per lot.

For structural concrete, a quality control lot shall consist of one week. If 50 cubic yards or less are produced in one calendar week, testing may be grouped with previous or subsequent lot, or 1 per two weeks. A bridge deck is considered a lot.

For non-structural concrete items as described below, a quality control lot shall be one per month. Testing and sampling for non-structural concrete is based on that being the only concrete being produced. If structural or paving concrete is being produced, no additional gradation sampling and testing is required for non-structural concrete produced from the same plant, since the sampling and testing frequency for structural and paving concrete is greater. If multiple projects are being supplied by the plant, one representative sample for the lot covers quality control sampling and testing for all of the projects.

Miscellaneous concrete and structural or non-structural concrete bid items supplied at 10 cubic yards or less for a project will be accepted without gradation testing. A gradation test for flowable mortar, revetment grout, or fabric formed revetment grout is required for the mix design only. The PCC Level II certified technician shall provide, for these bid items, materials certifications, batch tickets, and plant reports with the following statement on the PCC Plant report (Form 800240):

“The PCC mix contains certified materials, approved aggregates, and was produced in compliance with applicable specifications.”

For projects requiring certified plant inspection, the certified inspector will obtain and test one gradation sample per lot, unless operations are prematurely shut down.

Quality Control Sampling, Testing, and Reporting

PRODUCTION	Specific Gravity	Moisture	Gradation	Report
Structural	1/first week, monthly thereafter or 1/two weeks thereafter for DWU sources	2/week or 1/deck	1/deck, or 1/week If <50 yd ³ produced in week 1/two weeks	1/week or 1/deck
Non-Structural	1/month	1/two weeks	1/month	1/week
Miscellaneous	N/A	N/A	N/A	1/project

Verification

The engineer will perform verification sampling and testing at the minimum frequency described in the table for each aggregate. [IM 205](#) describes the agency responsibility to randomly select sample location and time, and witness sampling with the contractor providing assistance in obtaining the samples. For production of less than 50 cubic yards of structural concrete per week, verification sampling will be grouped with the previous or subsequent week, or 1 per two weeks. The engineer will split samples obtained with the plant inspector,

or observe splitting by the plant inspector, and immediately take possession of the agency sample. Report test results to producer in a timely manner.

Testing and sampling for non-structural concrete is based on that being the only concrete being produced. If structural or paving concrete is being produced, no additional gradation sampling and testing is required for non-structural concrete produced from the same plant, since the sampling and testing frequency for structural and paving concrete is greater. If multiple projects are being supplied by the plant, one representative gradation sample for the lot covers sampling and testing for all of the projects.

Verification Sampling and Testing

PRODUCTION	Gradation Sampling	Gradation Testing
Structural Concrete	1/deck, or 1/week If <50 yd ³ produced in a week 1/two weeks	First week, then 20% of samples obtained or 1/deck
Non-Structural	1/project	1/project
Miscellaneous	N/A	N/A

Non-structural and Miscellaneous Concrete

The following Items of work are designated as non-structural and miscellaneous concrete. Other items may be designated by the Engineer as non-structural or miscellaneous concrete, for gradation sampling and testing, provided they are not structurally critical items that could directly affect the safety of the travelling public.

Non-structural Concrete

Article	Work Type
2201	PCC Base
2212	Base Repair
2213	Base Widening
2405	Seal course
2415	Curtain wall
2511	Sidewalks
2511	Trails
2512	Curb & Gutter
2515	Driveways
2517	Railroad Approach Sections
2529	Patching (Full Depth), Rumble Strips
2530	Patching (Partial Depth)

Miscellaneous Concrete

Article	Work Type
2304	Detour Pavement
2416	Pipe collars

2503	Catch basins, abandonment, collars
2506	Flowable Mortar
2507	Revetment Grout or Fabric Formed Revetment Grout
2519	Fence construction
2524	Type A and B signs
2554	Thrust Blocks

Test air and slump at the minimum rate for structural concrete or at least once daily for concrete exposed to freezing and thawing.

Non Complying Gradation

When a quality control gradation test does not comply with the gradation requirements of [Article 4109](#), the certified plant inspector shall contact the Engineer. After corrections have been made, the Engineer will obtain and test another verification sample.

When a verification gradation test does not comply with the gradation requirements of [Article 4109](#), the Engineer will contact the contractor, producer and the District Materials Engineer. The District Materials Engineer may investigate sampling and testing procedures, stockpiling, source material, etc. After corrections have been made, the Engineer will obtain and test another verification sample.

Acceptance of lots will be based on complying verification test results. The engineer will retain all samples representing the lots until the lots have been accepted. Since the contracting authority tests are verification, correlation with [IM 216](#) is not required, but may be performed as a check of sampling and testing procedures.

2. WATER/CEMENT RATIO

Whenever the water demand, to achieve the desired workability, exceeds the design water/cement ratio and approaches the maximum water allowed the Project Engineer and the District Materials Engineer Office should be notified. At the same time, aggregate moisture contents, batch amounts, cement scales, water meter, etc., should all be immediately checked. In no circumstance should the maximum water/cement ratio be knowingly exceeded.

If, after the District Materials Engineer investigation and evaluation, additional workability above that which is attainable within the maximum permissible water content is desired, the cement content may be increased in accordance with [Article 2403.02, B](#). This should be done only with the approval of the District Materials Engineer or the engineer representative. The District Materials Engineer will provide the revised and adjusted mix proportions for these situations.

Also, in accordance with [Article 2403.02, B](#), the engineer may authorize the use of a water-reducing admixture to improve workability. When authorized, only the water-reducing admixtures and dosage rates, as shown in [IM 403](#) should be used.

When calcium chloride solution is added for patching M mix, water included in the calcium chloride solution should not be included in calculation of water-to-cement ratio.

3. STRENGTH TESTS

The test for Modulus of Rupture is the only strength test determined in the field. Test specimens are required for each day's placement of a structural unit in flexure.

Meet the requirements of [2403](#) for flexural beam strength. Contract requirements may also require cylinders for compressive strength.

Test the flexural specimens as prescribed in [IM 316](#), Flexural Strength of Concrete. Testing will be done by contract authority personnel. [IM 204](#) lists minimum testing requirements.

PROPORTIONS

Refer to IM 527 (Proportions)

REPORTS & REPORTING

1. PCC PLANT PAGE – FORM #240

The same form is to be used for PCC Paving and PCC Structures. Refer to [IM 527](#) for instructions on completing the form and an example form.

Structural Reports are to be recorded in the computer program provided by the Iowa Department of Transportation. A separate, consecutively numbered, report is to be made for each project as required in the Quality Control Sampling, Testing, and Reporting table. A copy of the completed PCC Plant Page shall be faxed or delivered to the District Materials Engineer and Project Engineer within four hours on the next working day after the end of the lot. Use electronic mail as the method of delivery unless otherwise approved by the Engineer. When supplying multiple projects, one quality control gradation may be reported on all test reports.

The PCC Level II certified technician shall keep a copy of the PCC Plant Page and send the original to the Project Engineer. At the end of the project, make a copy of the plant book for the Engineer, within ten days.

Report non-structural and miscellaneous concrete as required in the Quality Control Sampling, Testing, and Reporting table.

2. READY MIXED CONCRETE, TRUCK TICKET FORM – FORM #830212

Each truckload of concrete must be identified by Form #830212 or an acceptable computer-generated plant ticket. If available, computer generated batch tickets shall be used. Computer generated batch tickets shall include wet and dry batch weights and information on Form #830212. Any information unable to be printed by the computer will be written on the computer generated batch ticket. See [IM 527](#). The Engineer and District Materials Engineer will approve any variations to accepting the truck ticket form or computer generated form.

A PCC Level II certified batch person can fill out and sign the hand written truck ticket forms so the plant inspector can perform their required duties. The District Materials Engineer may approve other personnel to fill out hand written batch tickets. The PCC Level II inspector remains responsible for the batch tickets.

3. PORTLAND CEMENT CONCRETE BATCH PROPORTIONS - FORM #820150

Submit the batch proportions report #820150 to the Engineer or Doc Express for review. For standard mix designs, do not delay work if not submitted prior to placement.

Chapter 18
IM 529
PCC PROPORTIONS

PORTLAND CEMENT (PC) CONCRETE PROPORTIONS

GENERAL

Materials for pavement concrete and structural concrete shall be mixed in any one of the following proportions for the class of concrete specified. Each mixture will have specific requirements for the coarse and fine aggregates and the type of cement. Concrete mix proportions include the unit volumes of all materials.

Mix numbers designate numerous aspects of the particular mix. The following is an explanation of the various aspects of the mix number:

- The first letter designates the class of concrete as designated in the contract documents.
- In certain mix designations, the letter V or L appears after the first hyphen. This indicates either Class V or Class L aggregate is to be used. If no letter is shown, aggregate other than Class V or Class L shall be used.
- The number indicates the relationship of coarse aggregate to fine aggregate. A mix with a 4 is a 50/50 mix. The following chart shows the number within the mix number and the proportions of the aggregates for each number:

2	is composed of 40% fine and 60% coarse
3	is composed of 45% fine and 55% coarse
4	is composed of 50% fine and 50% coarse
5	is composed of 55% fine and 45% coarse
6	is composed of 60% fine and 40% coarse
7	is composed of 65% fine and 35% coarse
8	is composed of 70% fine and 30% coarse
57	is composed of 50% fine and 50% coarse
57-6	is composed of 60% fine and 40% coarse

- The letters WR indicate water reducer is used in this mixture.
- When a C or an F is shown toward the end of the mix number, fly ash is a part of the mixture and C-fly ash or an F-fly ash, respectively, is used. The percentage of fly ash being used in the mixture shall be designated at the end of the mix number.
- When used as a mineral admixture, Ground Granulated Blast Furnace Slag (GGBFS) shall be designated through the letter "S," followed by the percent substitution, and shown at the end of the mix number. This would be in the same convention used for fly ash substitution. When GGBFS is a portion of a blended cement, the cement type will be designated as IS, but special notation will not be made in the mix number.
- The following example illustrates a mix number showing a Class C concrete mixture, 50/50 aggregate proportions, using Class L aggregate, water reducer, and 35% GGBFS substitution.

Example: C - L 4 W R – S35

The following example illustrates a mix number showing a Class C concrete mixture, 50/50 aggregate proportions, using water reducer and a Class C fly ash substitution at a rate of 10%.

Example: C – 4 W R – C10

The following example illustrates a mix number showing a Class C concrete mixture, 50/50 aggregate proportions, using a water reducer, Class C fly ash substitution at 20%, and GGBFS substitution at 20%.

Example: C – 4 W R –C20-S20

The Class D mixtures and the Class V mixtures vary somewhat from the above pattern but follow the general format.

MIX REQUIREMENTS

General requirements for the mixes are:

1. Fly Ash and GGBFS used in concrete mixtures shall meet the requirements of [Section 4108](#). Fly Ashes for use in concrete mixtures shall be included on the list of approved sources (Materials [IM 491.17](#)). GGBFS for use in concrete mixtures shall be included on the list of approved sources (Materials [IM 491.14](#)).
2. A water-reducing admixture shall be used in concrete mixtures with the designation as follows: Those mixtures have mixture numbers which have the letters "WR" following a single digit number, all following the first hyphen in the mixture number. These mixtures have reduced cementitious contents to produce concrete of approximately equal strength compared with other mixtures in a particular class of concrete. A water-reducing admixture may be added to other concrete mixtures, without cement reduction, to aid in workability and air entrainment. Other admixture combinations may be approved based on manufactures recommendations.

The water-reducing admixture shall meet the requirements of [Section 4103](#) and shall be included on the list of Approved Sources of Water Reducing Admixtures ([Materials IM 403](#), [Appendix C](#)). The dosage shall be as described in [IM 403](#).

3. The total quantity of water in the concrete, including water in the aggregate, shall not exceed the maximum water to cement and fly ash ratio.
4. Type I, Type II, Type III, Type IP, and Type IS Cement shall be used as provided for in the specifications. All cement shall be from an approved source as per [IM 401](#). The cement type shall be documented on all reports pertaining to a project.
5. The fine aggregates other than Class V ([Section 4117](#)) and Class L ([Section 4111](#)) shall meet the requirements of [Section 4110](#) of the current specifications. The coarse aggregates for mixtures using aggregates, other than Class V aggregates, shall meet the requirements of [Articles 4115.01](#) through [4115.04](#) of the current specifications. The coarse aggregates for Class O or Class HPC-O concrete mixtures shall meet the requirements of [4115.05](#) of the current specifications, for overlays ([Article 2413](#)). Intermediate aggregates used for QMC, BR, or HPC-D mixes shall meet [4112](#).
6. When approved by the Engineer, combined fine and coarse aggregate may be used in combination with screened coarse aggregate to produce proportions specified for Class D and Class X concrete mixtures according to the percentage of particles passing the No. 4 sieve in the combined aggregate at the time the material is used.

7. With Engineer approval, proportions designated for mixtures A-V or C-V with and without fly ash may be substituted for Class X concrete.
8. With Engineer approval, Class M concrete may be substituted for Class A or Class C concrete.
9. Certain structural placements with congested steel and narrow forms may require higher slump to place the concrete. The Engineer may approve the use of a high range water reducer with standard mixes. When a high range water reducer is used, the allowable slump may be increased to a target range of 1 to 7 inches, with a maximum of 8 inches. If highly flowable concrete is needed for the placement, the Engineer may approve the use self-consolidating concrete (SCC) in accordance with [Appendix A](#).

A-MIX

A-Mixes are specified primarily as paving mixes. They have a lower cement content and lower ultimate strength when compared to a Class C-Mix. A-Mix may be used on lower traffic roadways or detour pavement.

C-MIX

C-Mixes are specified for use in both paving and structures. The C-WR mixes are typically used in paving and bridge decks. Class C mixes are typically used in box culverts, bridge piers, bridge abutments, and other miscellaneous placements. When Class C is specified, any mix beginning with the letter C may be utilized.

D-MIX

D-Mixes are specified for use primarily in structures. A typical use includes drilled shafts.

M-MIX

M-Mixes are designed for high early strength, suitable for many applications for which they are allowed. Calcium chloride should only be used when needed, for patching and other placements without steel reinforcement. Do not include water in calcium chloride solution when calculating water cement ratio.

O-MIX

O-Mixes are specified for low slump concrete, primarily for use in bridge deck overlays. The water-cement ratio is intended to be controlled by the slump specified elsewhere for concrete where these mixtures are used. A water-reducing agent is required for this mix, as described in [IM 403](#). O-Mixes require coarse aggregate specifically intended for repair and overlay. See [Article 4115.05](#). HPC-O is also used in bridge deck overlays. The HPC-O mix requires the use of slag or blended cements. Fly ash replacement up to a maximum of 20%. The maximum water-cement ratio is 0.42 (basic of 0.39).

X-MIX

X-Mixes are specified to be used as seal course concrete, primarily in cofferdams. No air entraining is required. No maximum water-cementitious ratio is specified. See [Article 2405.05](#) for

limits on water usage.

QMC

Contractor-designed aggregate proportioning mixes for paving. Minimum absolute volume of cement is 0.106. Basic water-cement ratio is 0.40. Maximum water-cement ratio is 0.42.

BR

BR mixes are used in slip form barrier rail in accordance with [Section 2513](#). Determine aggregate proportions based on production gradations. Unless major changes occur to aggregate gradations, utilize aggregate proportions determined and assess gradation of individual aggregates during concrete production. The minimum absolute volume of cement is 0.114. Maximum water-cement ratio is 0.45.

HPC

HPC mixes are used in bridge substructures and decks to achieve low permeability and higher compressive strength. HPC mixes require the use of slag or blended cements. Fly ash replacement up to a maximum of 20%. Maximum water-cement ratio is 0.42 (basic of 0.40) for decks and 0.45 (basic of 0.42) for substructures. Aggregate proportioning is required for HPC-D mixes with an absolute volume of cement of 0.118.

MCM

Mass Concrete Mix (MCM) mixes are used for mass concrete placements. MCM Mixes may utilize higher replacement rates of slag. Minimum absolute volume of cement is 0.106. Basic water-cement ratio is 0.40. Maximum water-cement ratio is 0.45.

CLASS V

Class V is an aggregate classification, specified in [Section 4116](#). The fine limestone aggregates in concrete mixes using Class V aggregate with/without fly ash shall meet the requirements of [Article 4116.03](#) of the current specifications. Allowable cements and substitutions shall meet the requirements of [Article 4116.05](#). This material may be used in various concrete mixes, including HPC mixes. The mixes utilizing this material will be designated with a Roman numeral V, in the Mix Number.

CLASS L

Class L is an aggregate classification, specified in [Section 4111](#). This material may be used in various concrete mixes, so designated. The mixes utilizing this material will be designated with a Roman Numeral L, in the Mix Number.

SUDAS CONCRETE MIXTURES

Class C-SUD and CV-SUD mixes are utilized on SUDAS projects where higher durability is desired to reduce joint deterioration due to deicing chemicals. These mixes are designed with a lower water to cement ratio of 0.42 maximum (basic w/c 0.40) to reduce permeability.

QMC and C-SUD mixes are designed for slipform paving with a very low w/c ratio. For handwork,

a C-3WR or C-4WR mix is recommended.

FLY ASH & GGBFS SUBSTITUTION

At Contractor option, fly ash or GGBFS may be substituted for a portion of the cement in concrete mixes, within the limitations set forth in the appropriate Article for each type of placement. [IM 527](#) gives instructions on how to determine the proper batch proportions in a mix.

When fly ash or GGBFS is substituted for the cement, the replacement shall be on a pound-for-pound basis. Tables 1, 2, and 3 define concrete mixes with no substitution. These mixes shall be used as the basis for determining the final batch proportions and shall be adjusted accordingly. The change in volume resulting from the substitution shall be determined and an adjustment in both coarse and fine aggregate proportions shall be determined in order to ensure a unit volume. The change in aggregate proportions shall be in the same ratio as that of the specific mix. In those cases where the cement content is increased, relative to the standard design mix, the mix proportions shall be adjusted and a change in the aggregate content shall be determined, as described above.

When both fly ash and GGBFS are substituted for the cement in ready-mixed concrete, the replacement shall be on a pound-for-pound basis and shall be substituted as shown in the following example.

Example: C-3WR-C20-S20

Absolute Volume Cement = 0.108

Cement = $0.108 \times 62.4 \times 27 \times 3.14 = 571$ lbs. per cubic yard

Fly ash substitution 20% = $571 \times 0.20 = 114$ lbs. per cubic yard

Slag substitution 20% = $571 \times 0.20 = 114$ lbs. per cubic yard

Type IP, Type IS, Type IL, and Type IT cements shall be considered cement with regard to substitution of fly ash. Refer to appropriate Article for limitations. A Type IS(25) cement with a 20% fly ash replacement is equivalent to a 40% weight replacement of Portland cement.

Example: C-3WR-C20 using Type IS(20) cement

Absolute Volume Cement = 0.108

Cement = $0.108 \times 62.4 \times 27 \times 3.10 = 564$ lbs. per cubic yard

Fly ash substitution 20% = $564 \times 0.20 = 113$ lbs. per cubic yard

Weight of cement = $564 - 113 = 451$ lbs. per cubic yard

Type IS(20) cement contains Portland cement and slag

$451 \times 0.80 = 361$ lbs. Portland cement

$451 \times 0.20 = 90$ lbs. slag

Total replacement of Portland cement
 $((113 + 90) / 564) \times 100 = 36\%$

Example: C-3WR-C10-S20 using Type IL cement

Absolute Volume Cement = 0.108

Cement = $0.108 \times 62.4 \times 27 \times 3.11 = 566$ lbs. per cubic yard

Fly ash substitution 10% = $566 \times 0.10 = 57$ lbs. per cubic yard

Slag substitution 20% = $566 \times 0.20 = 113$ lbs. per cubic yard

Weight of cement = $566 - 57 - 113 = 396$ lbs. per cubic yard

Type IL(10) cement contains Portland cement and inter-ground limestone

$396 \times 0.90 = 356$ lbs. Portland cement

$396 \times 0.10 = 40$ lbs. inter-ground limestone

Total replacement of Portland cement
 $((57 + 113 + 40) / 566) \times 100 = 37\%$

CARBONCURE PORTLAND CEMENT REDUCTION

Producers that are using CarbonCure or other carbon sequestration admixtures and have been approved for Portland cement reduction following the approval process in [IM 403](#) are eligible to reduce Portland cement content by up to 3 percent. The reduction is for Portland cement only and is determined after substitutions of fly ash and GGBFS have occurred. Blended cements will be considered cement when determining Portland cement reductions. The reduced Portland cement content should be used when calculating total replacement of Portland cement.

Example: C-3WR-C20 using Type IL(10) cement and CarbonCure with a 3 percent Portland cement reduction

Absolute Volume Cement = 0.108

Cement = $0.108 \times 62.4 \times 27 \times 3.11 = 566$ lbs. per cubic yard

Fly ash substitution 20% = $566 \times 0.20 = 113$ lbs. per cubic yard

Weight of cement = $566 - 113 = 453$ lbs. per cubic yard

3 percent Portland cement reduction = $0.03 \times 453 = 14$ lbs. per cubic yard

Weight of cement = $453 - 14 = 439$ lbs. per cubic yard

Type IL(10) cement contains Portland cement and inter-ground limestone

439 X 0.90 = 395 lbs. Portland cement
439 X 0.10 = 44 lbs. inter-ground limestone

Adjusted original cement weight = 566 – 14 = 552 lbs. per cubic yard

Total replacement of Portland cement
((113 + 44) / 552) X 100 = 28%

Proportion Table 1
Concrete Mixes
Using [Article 4110](#) and [4115](#) Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

A MIXES Basic w/c = 0.474 Max w/c = 0.532					
Mix No.	Cement	Water	Air	Fine	Coarse
A-2	0.101	0.150	0.060	0.276	0.413
A-3	0.104	0.155	0.060	0.306	0.375
A-4	0.108	0.161	0.060	0.335	0.336
A-5	0.111	0.165	0.060	0.365	0.299
A-6	0.115	0.171	0.060	0.392	0.262
BR MIXES Basic w/c = 0.400 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
BR	0.114	0.143	0.060	*	*
C MIXES Basic w/c = 0.430 Max w/c = 0.488					
Mix No.	Cement	Water	Air	Fine	Coarse
C-2	0.110	0.149	0.060	0.272	0.409
C-3	0.114	0.154	0.060	0.302	0.370
C-4	0.118	0.159	0.060	0.331	0.332
C-5	0.123	0.166	0.060	0.358	0.293
C-6	0.128	0.173	0.060	0.383	0.256
C-WR MIXES Basic w/c = 0.430 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
C-3WR	0.108	0.146	0.060	0.309	0.377
C-4WR	0.112	0.151	0.060	0.338	0.339
C-5WR	0.117	0.158	0.060	0.366	0.299
C-6WR	0.121	0.163	0.060	0.394	0.262
D MIXES Basic w/c = 0.423 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
D-57	0.134	0.178	0.060	0.314	0.314
D-57-6	0.134	0.178	0.060	0.377	0.251
M MIXES Basic w/c = 0.328 Max w/c = 0.400					
Mix No.	Cement	Water	Air	Fine	Coarse
M-3	0.149	0.153	0.060	0.287	0.351
M-4	0.156	0.161	0.060	0.311	0.312
M-5	0.160	0.165	0.060	0.338	0.277
O MIXES Basic w/c = 0.327 Max w/c = -----					
Mix No.	Cement	Water	Air	Fine	Coarse
O-4WR	0.156	0.160	0.060	0.312	0.312
HPC-O MIXES Basic w/c = 0.390 Max w/c = 0.420					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-O	0.134	0.164	0.060	0.321	0.321
HPC-S MIXES Basic w/c = 0.420 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-S	0.118	0.156	0.060	0.333	0.333

HPC-D MIXES Basic w/c = 0.400 Max w/c =0.435					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-D	0.118	0.148	0.060	*	*
QMC MIXES Basic w/c = 0.400 Max w/c =0.420					
Mix No.	Cement	Water	Air	Fine	Coarse
QMC	0.106	0.133	0.060	*	*
MCM MIXES Basic w/c = 0.400 Max w/c =0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
MCM	0.133	0.133	0.060	0.315	0.386
X MIXES Basic w/c = 0.423 Max w/c = -----					
Mix No.	Cement	Water	Air	Fine	Coarse
X-2	0.124	0.165	0.000	0.284	0.427
X-3	0.129	0.171	0.000	0.315	0.385
X-4	0.134	0.178	0.000	0.344	0.344

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

*These mixes require optimized aggregate proportioning in accordance with the specifications.

Proportion Table 2
Concrete Mixes
Using Class V Aggregates Combined with Limestone
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

V47B MIXES							
Mix No.	Cement	Water	Air	Class V.	Coarse Limestone	Basic w/c	Max. w/c
A-V47B	0.107	0.148	0.060	0.479	0.206	0.440	0.560
C-V47BP ¹	0.113	0.145	0.060	0.477	0.205	0.430	0.488
C-V47BS ³	0.113	0.145	0.060	0.477	0.205	0.430	0.488
M-V47B ²	0.155	0.170	0.060	0.338	0.277	0.350	0.400
V MIXES							
Mix No.	Cement	Water	Air	Class V.	Fine Limestone	Basic w/c	Max. w/c
A-V	0.135	0.188	0.060	0.586	0.031	0.444	0.467
C-V	0.135	0.188	0.060	0.586	0.031	0.444	0.467
M-V	0.160	0.196	0.060	0.555	0.029	0.390	0.420
CV-HPC MIXES							
Mix No.	Cement	Water	Air	Class V.	Coarse Limestone	Basic w/c	Max. w/c
CV-HPC-D ¹	0.123	0.147	0.060	0.368	0.302	0.400	0.435
CV-HPC-S ¹	0.123	0.155	0.060	0.364	0.298	0.420	0.450

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

¹When Type IP or IL cement is used. See Section 4116 for requirements when Type IL used.

²M-V47B mix shall use Type I/II or IL cements for patching projects.

³When Type IS or IT cement is used.

Proportion Table 3
Concrete Mixes
Using Class L Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

A-L MIXES Basic w/c = 0.474 Max w/c = 0.532

Mix No.	Cement	Water	Air	Fine	Coarse
A-L-2	0.107	0.159	0.060	0.270	0.404
A-L-3	0.111	0.165	0.060	0.299	0.365
A-L-4	0.115	0.171	0.060	0.327	0.327
A-L-5	0.118	0.176	0.060	0.355	0.291

C-L MIXES Basic w/c = 0.430 Max w/c = 0.488

Mix No.	Cement	Water	Air	Fine	Coarse
C-L-2	0.117	0.158	0.060	0.266	0.399
C-L-3	0.121	0.163	0.060	0.295	0.361
C-L-4	0.125	0.169	0.060	0.323	0.323
C-L-5	0.131	0.177	0.060	0.348	0.284

C-LWR MIXES Basic w/c = 0.430 Max w/c = 0.489

Mix No.	Cement	Water	Air	Fine	Coarse
C-L3WR	0.115	0.155	0.000	0.301	0.369
C-L4WR	0.119	0.161	0.000	0.330	0.330
C-L5WR	0.124	0.167	0.000	0.357	0.292

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

Proportion Table 4
SUDAS Concrete Mixes
Using [Article 4110](#) and [4115](#) Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

C-SUD MIXES Basic w/c = 0.400 Max w/c = 0.420

Mix No.	Cement	Water	Air	Fine	Coarse
C-SUD	0.106	0.133	0.060	*	*

Above mixture is based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#). *These mixes require optimized aggregate proportioning in accordance with the specifications.

Using Class V Aggregates ([4116](#)) Combined with Limestone
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

CV-SUD MIXES Basic w/c = 0.400 Max w/c = 0.420

Mix No.	Cement	Water	Air	Class V.	Coarse Limestone
CV-SUD	0.114	0.135	0.060	0.379	0.311

Above mixture is based on Type IP, IS, or IT cements.

Proportion Table 1
Concrete Mixes
Using [Article 4110](#) and [4115](#) Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

A MIXES Basic w/c = 0.474 Max w/c = 0.532					
Mix No.	Cement	Water	Air	Fine	Coarse
A-2	0.101	0.150	0.060	0.276	0.413
A-3	0.104	0.155	0.060	0.306	0.375
A-4	0.108	0.161	0.060	0.335	0.336
A-5	0.111	0.165	0.060	0.365	0.299
A-6	0.115	0.171	0.060	0.392	0.262
BR MIXES Basic w/c = 0.400 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
BR	0.114	0.143	0.060	*	*
C MIXES Basic w/c = 0.430 Max w/c = 0.488					
Mix No.	Cement	Water	Air	Fine	Coarse
C-2	0.110	0.149	0.060	0.272	0.409
C-3	0.114	0.154	0.060	0.302	0.370
C-4	0.118	0.159	0.060	0.331	0.332
C-5	0.123	0.166	0.060	0.358	0.293
C-6	0.128	0.173	0.060	0.383	0.256
C-WR MIXES Basic w/c = 0.430 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
C-3WR	0.108	0.146	0.060	0.309	0.377
C-4WR	0.112	0.151	0.060	0.338	0.339
C-5WR	0.117	0.158	0.060	0.366	0.299
C-6WR	0.121	0.163	0.060	0.394	0.262
D MIXES Basic w/c = 0.423 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
D-57	0.134	0.178	0.060	0.314	0.314
D-57-6	0.134	0.178	0.060	0.377	0.251
M MIXES Basic w/c = 0.328 Max w/c = 0.400					
Mix No.	Cement	Water	Air	Fine	Coarse
M-3	0.149	0.153	0.060	0.287	0.351
M-4	0.156	0.161	0.060	0.311	0.312
M-5	0.160	0.165	0.060	0.338	0.277
O MIXES Basic w/c = 0.327 Max w/c = -----					
Mix No.	Cement	Water	Air	Fine	Coarse
O-4WR	0.156	0.160	0.060	0.312	0.312
HPC-O MIXES Basic w/c = 0.390 Max w/c = 0.420					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-O	0.134	0.164	0.060	0.321	0.321
HPC-S MIXES Basic w/c = 0.420 Max w/c = 0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-S	0.118	0.156	0.060	0.333	0.333

HPC-D MIXES Basic w/c = 0.400 Max w/c =0.435					
Mix No.	Cement	Water	Air	Fine	Coarse
HPC-D	0.118	0.148	0.060	*	*
QMC MIXES Basic w/c = 0.400 Max w/c =0.420					
Mix No.	Cement	Water	Air	Fine	Coarse
QMC	0.106	0.133	0.060	*	*
MCM MIXES Basic w/c = 0.400 Max w/c =0.450					
Mix No.	Cement	Water	Air	Fine	Coarse
MCM	0.106	0.133	0.060	0.315	0.386
X MIXES Basic w/c = 0.423 Max w/c = -----					
Mix No.	Cement	Water	Air	Fine	Coarse
X-2	0.124	0.165	0.000	0.284	0.427
X-3	0.129	0.171	0.000	0.315	0.385
X-4	0.134	0.178	0.000	0.344	0.344

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

*These mixes require optimized aggregate proportioning in accordance with the specifications.

Proportion Table 2
Concrete Mixes
Using Class V Aggregates Combined with Limestone
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

V47B MIXES							
Mix No.	Cement	Water	Air	Class V.	Coarse Limestone	Basic w/c	Max. w/c
A-V47B	0.107	0.148	0.060	0.479	0.206	0.440	0.560
C-V47BP ¹	0.113	0.145	0.060	0.477	0.205	0.430	0.488
C-V47BS ³	0.113	0.145	0.060	0.477	0.205	0.430	0.488
M-V47B ²	0.155	0.170	0.060	0.338	0.277	0.350	0.400
V MIXES							
Mix No.	Cement	Water	Air	Class V.	Fine Limestone	Basic w/c	Max. w/c
A-V	0.135	0.188	0.060	0.586	0.031	0.444	0.467
C-V	0.135	0.188	0.060	0.586	0.031	0.444	0.467
M-V	0.160	0.196	0.060	0.555	0.029	0.390	0.420
CV-HPC MIXES							
Mix No.	Cement	Water	Air	Class V.	Coarse Limestone	Basic w/c	Max. w/c
CV-HPC-D ¹	0.123	0.147	0.060	0.368	0.302	0.400	0.435
CV-HPC-S ¹	0.123	0.155	0.060	0.364	0.298	0.420	0.450

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

¹When Type IP or IL cement is used. See Section 4116 for requirements when Type IL used.

²M-V47B mix shall use Type I/II or IL cements for patching projects.

³When Type IS or IT cement is used.

Proportion Table 3
Concrete Mixes
Using Class L Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

A-L MIXES Basic w/c = 0.474 Max w/c = 0.532

Mix No.	Cement	Water	Air	Fine	Coarse
A-L-2	0.107	0.159	0.060	0.270	0.404
A-L-3	0.111	0.165	0.060	0.299	0.365
A-L-4	0.115	0.171	0.060	0.327	0.327
A-L-5	0.118	0.176	0.060	0.355	0.291

C-L MIXES Basic w/c = 0.430 Max w/c = 0.488

Mix No.	Cement	Water	Air	Fine	Coarse
C-L-2	0.117	0.158	0.060	0.266	0.399
C-L-3	0.121	0.163	0.060	0.295	0.361
C-L-4	0.125	0.169	0.060	0.323	0.323
C-L-5	0.131	0.177	0.060	0.348	0.284

C-LWR MIXES Basic w/c = 0.430 Max w/c = 0.489

Mix No.	Cement	Water	Air	Fine	Coarse
C-L3WR	0.115	0.155	0.000	0.301	0.369
C-L4WR	0.119	0.161	0.000	0.330	0.330
C-L5WR	0.124	0.167	0.000	0.357	0.292

Above mixtures are based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#).

Proportion Table 4
SUDAS Concrete Mixes
Using [Article 4110](#) and [4115](#) Aggregates
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

C-SUD MIXES Basic w/c = 0.400 Max w/c = 0.420

Mix No.	Cement	Water	Air	Fine	Coarse
C-SUD	0.106	0.133	0.060	*	*

Above mixture is based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP, IS, IL, or IT) must be adjusted for cement gravities listed in [IM 401](#). *These mixes require optimized aggregate proportioning in accordance with the specifications.

Using Class V Aggregates ([4116](#)) Combined with Limestone
Basic Absolute Volumes of Materials Per Unit Volume of Concrete

CV-SUD MIXES Basic w/c = 0.400 Max w/c = 0.420

Mix No.	Cement	Water	Air	Class V.	Coarse Limestone
CV-SUD	0.114	0.135	0.060	0.379	0.311

Above mixture is based on Type IP, IS, or IT cements.

GUIDELINES FOR APPROVING AND TESTING SCC MIX DESIGNS FOR FIELD PLACED CONCRETE

Description

- A. Develop and provide self-consolidating concrete (SCC) for cast in place structural concrete. SCC is defined as a concrete mix that provides the following:
- Filling ability to flow and fill completely spaces within formwork, under its own weight.
 - Passing ability to flow through tight spaces between reinforcement without segregation or blocking.
 - Ability to resist segregation by remaining homogenous during transport and placement.
- B. Apply Sections 2403, 2412, and Division 41 of the Standard Specifications with the following modifications.

Typically aggregates are well graded with a maximum top size of $\frac{3}{4}$ " or less. Aggregate angularity and shape can affect the slump flow. Typical sand to aggregate ratio is 0.40 to 0.50. Paste volume can range from 28 to 40% depending on slump flow required. Water to cementitious ratio is typically in the 0.25 to 0.44 range.

If the producer has no previous experience with SCC, it is recommended that a technical representative of the admixture company be present during initial trial batches.

Materials

Meet the requirements of Division 41 for the appropriate materials and the following:

- Use a high range water reducer (HRWR) from Material IM 403 Appendix D.
- When a viscosity modifying admixture (VMA) is used, manufacturer shall provide documentation indicating compatibility with HRWR.
- Use maximum nominal aggregate size no larger than one third the minimum clear spacing between reinforcing steel
- Maximum w/c ratio of 0.45
- Minimum cementitious content shall be ~~624~~ 700 pounds per cubic yard
- When required to maintain plasticity during a placement, use a retarding admixture or hydration stabilizer.

Mix Design

Mix designs will be approved by the District Materials Engineer (DME). New mix designs for SCC shall be verified through trial batches. Other mix designs will be qualified by previous performance. Field validation shall be required for all new mixes.

- Work with the admixture supplier representative to develop the mix design
- Slump flow in accordance with Materials IM 389. The target slump flow value is 23.0 inches. The allowable tolerance range of the slump flow is plus or minus 3 inches. The contractor may submit a target slump flow, if placement requires different flow characteristics.

- Target Visual Stability Index (VSI) in accordance with Materials IM 389. The VSI Rating shall not exceed 1.0.
- Passing ability by J-Ring in accordance with ASTM C 1621. Calculate the difference between slump flow and J-Ring flow. The maximum allowable difference is 2 inches (50 mm).
- Static segregation using hardened cylinders in accordance with Material IM 390

Producer shall submit material sources, proportions, individual gradations of each aggregate, combined aggregate gradation, slump flow, visual stability index, air content, and compressive strength for the proposed mix design.

Trial Batch Validation

1. Allow the District Materials Engineer ample opportunity to witness the trial batching. Provide the District Materials Engineer notice and mix proportions 7 calendar days prior to this event.
2. Mix the trial batch with a minimum of 3 cubic yards at least 30 calendar days prior to planned placement. Establish the batching sequence of the materials during the trial batch.
3. Transport the concrete a distance comparable to the distance from the ready mix plant to the placement site.
4. Test concrete samples that are representative of the entire batch for air content, slump flow, visual stability index, J-Ring, density (unit weight), static segregation and temperature. Cast specimens from each sample for compressive strength tests. Modify the consolidation method of all materials test procedures, including IM 315, IM 316, IM 318, and IM 340 by placing the concrete in the molds in one layer without vibration or tamping.
5. Cast a minimum of eight 4 inch by 8 inch cylinders for testing. Trial batch concrete will be tested for strength and static segregation. All samples will be cast, cured, and handled according to Materials IM 315.
6. Strength samples will be stripped of their molds and wet cured until their break age. Strength samples will be tested according to AASHTO T 22. Three cylinders will be tested for strength at each age of 7 and 28 days. The District Materials Engineer may witness the strength testing. The samples for static segregation may be sent to the Central Materials Laboratory for sawing.
7. Submit a trial batch report to the District Materials Engineer no later than 7 calendar days after trial batching. Approval will be based on successful trial batch mixing and properties. The District Materials Engineer may waive the trial batch testing provided satisfactory mix properties have been achieved through testing of previous trial batches or production placements.

Quality Control Plan

Submit for approval a written Quality Control Plan describing the procedures to be used to control the production and placement of SCC. Submit the Quality Control Plan at least 30 calendar days before the first intended structural concrete placement. Do not place structural concrete before receiving written approval from the engineer of the Quality Control Plan and having all equipment and materials necessary to facilitate the plan on site and ready for use.

Include the following in the Quality Control Plan:

- Develop mix design that meets the design criteria for strength, flowability, passing ability, and consistency.
- Define concrete batching sequence, mixing time, and minimum revolutions to prevent cement balls and mix foaming. Include procedures for ensuring wash water is removed before batching.
- Define concrete placement pattern and methods. Include maximum horizontal flow distance from point of discharge.
- Describe additional quality control procedures at the plant to ensure consistent delivery of concrete.
- Define field procedures to accept or reject concrete during production.
- Describe procedures used when continuous placements are interrupted.
- Other information as needed.

Provide stability analysis of proposed formwork for full static pressure and proposed methods used to prevent leakage.

Placement

Deliver concrete without any interruption of flow such that a continuous placement is achieved. Deposit concrete continuously or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Do not exceed 30 minutes between placement of successive batches unless engineer has reviewed placement conditions. If a section cannot be placed continuously, provide construction joints as specified.

If deemed necessary by the Engineer, construct a mock-up of the section to verify placement procedures.

Do not re-temper SCC.

Do not vibrate SCC without permission of the Engineer. If Engineer approves vibration, maximum insertion time is 2 seconds or less. If emergency delay occurs, concrete may be rodded with a piece of lumber or conduit if the material has lost its fluidity prior to placement of additional concrete. The DME may approve other methods of consolidation, if necessary.

Validate drop distance to demonstrate that separation does not occur.

Testing

Notify the Engineer 48 hours prior to placement of production concrete. Use only approved SCC mixes for production concrete. Ensure mix has the same materials, proportions, and properties established in the trial batch.

Perform air content testing in accordance with Materials IM 318, except place SCC in one layer, without consolidation or tapping. Cast cylinders in accordance with Materials IM 315, except place SCC in one layer, without consolidation or tapping.

The Engineer will perform air content testing at sampling at testing rate described in IM 204. The contractor will perform quality control testing of slump flow in accordance with IM 389 at rate of 1/30 cubic yards. Slump flow range shall be ± 2 inches of the mix design target value. The visual stability index shall not exceed 1. If the slump flow exceeds the range up to a maximum of 28 inches, the concrete may be placed provided the visual stability index does not exceed 1. The producer will make adjustments to move the slump flow back into range.

The District Materials Engineer will obtain verification strength samples on a minimum of two random placements. Strength samples will be tested at the District Materials Laboratory according to AASHTO T 22. A set of five cylinders will be cast, cured, and handled according to Materials I.M. 315. Three cylinders will be tested for strength at 28 days. The remaining two cylinders will be checked for static segregation of hardened cylinders in accordance with Material IM 390.

Since SCC mixes are highly sensitive to moisture, the Producer should perform aggregate moistures at a minimum of once per day prior to mixing. The DME may adjust moisture testing depending on weather conditions and aggregate storage.

Chapter 19
IM 535
PCC PLANT MONITOR

PCC PLANT MONITOR

GENERAL

The following instruction is to be used when monitoring the operation of a ready mix concrete plant or a central batch plant. The plant monitor is responsible for monitoring the plant operation, quality control procedures performed by the plant inspector, and ensure that proper concrete mix is being batched and delivered.

DUTIES

The following duties are performed by the plant monitor for structural and paving concrete. If non-structural concrete is being produced during the time that structural or paving concrete is produced, no additional plant site visits are required. When non-structural concrete is the only concrete being placed, perform monitor duties at least once per project.

Duty	Task	Minimum Frequency
1. Inspect stockpiles	<ul style="list-style-type: none"> •Observe stockpiling procedures. •Check for segregation. •Check for contamination. •Check for degradation. •Check for proper storage and handling of aggregates per Article 2301.02.C.1 and IM 527. 	Observe during startup and during visits
2. Maturity Curve and Validation	<ul style="list-style-type: none"> •Witness curve development or beam break. •Verify that a valid maturity curve exists and has been signed by the DME. •Check validation in accordance with Materials IM 383. 	When available Observe each occurrence
3. Test Equipment	<ul style="list-style-type: none"> •Inspect test equipment to ensure in good working order and lab has been qualified. 	During startup and when problems arise
4. Material certifications	Check certifications for cement, fly ash, slag, aggregates, admixtures	During visits
5. Observe aggregate moisture and specific gravity testing	<ul style="list-style-type: none"> •Observe test performed in accordance with Materials IM 307 and IM 308. 	Central Batch– once during first week Ready Mix 1/ project (structural or paving)

6. Plant proportion control	<ul style="list-style-type: none"> •Observe delivery tolerance. •Observe scale sensitivity. •Observe admixture dispenser operation. •Check for proper batch proportions on computer generated or hand written batch tickets 	Central Batch– once during first week
7. Observe mix times for central batch plant	<ul style="list-style-type: none"> •Per Article 2001.21. 	During visits
8. Audit Checks and Test results in Plant Book	<ul style="list-style-type: none"> •Check for proper completion of Daily Plant Checklist and Plant Site Inspection List. •Observe record of test results for moistures and specific gravities. 	During visits
9. Audit Daily Diary	<ul style="list-style-type: none"> •Review for proper recording of events. 	During visits
10. Plant Reports	<ul style="list-style-type: none"> •Check for proper project and mix identification. •Check for dates and report number. •Review batch weights and aggregate gradations. •Check materials brands and sources. •Check for correct concrete and cement totals (daily, weekly, and to date). •Check for appropriate Plant Inspector signature or initials. •Sign report after review. •Check for hard copy or electronic backup of files 	Daily / Weekly
11. Inspect Transit Mixers	<ul style="list-style-type: none"> •Inspect for buildup in drum per Article 2001.21 B. •Inspect for fin wear or broken fins per Article 2001.21 B. •Check for current truck certification per Article 2001.21 B. 	1/Month
12. Monitor agitators & dump trucks	<ul style="list-style-type: none"> •Check for properly cleaned dump box. 	During visits
13. Inspect plant facility	<ul style="list-style-type: none"> •Observe plant calibration to assure compliance with Materials IM 527. •Check lab qualifications. •Inspect test equipment. 	Central Batch - startup Ready Mix - Yearly

SAMPLING & TESTING

AGGREGATES

Verification Gradation – One sample for each aggregate per lot in accordance with [IM 527](#) for paving or [IM 528](#) for all other concrete.

The engineer will split samples obtained with the plant inspector, or observe splitting by the plant inspector, and immediately take possession of the agency sample. Report test results to producer in a timely manner. Contracting authority tests are verification and correlation with [IM 216](#) is not required but should be performed as a check of sampling and testing procedures.

Testing and sampling for non-structural concrete is based on that being the only concrete being produced. If structural or paving concrete is being produced, no additional gradation sampling and testing is required for non-structural concrete produced from the same plant, since the sampling and testing frequency for structural and paving concrete is greater. If multiple projects are being supplied by the plant, one representative gradation sample for the lot covers sampling and testing for all of the projects.

Example 1: If a sample was obtained for a footing and the ready mix produces concrete for a sidewalk project the next week, the gradation sample for the footing can be used for the sidewalk project.

Example 2: If a sample was obtained for a paving project and the ready mix produces concrete for a patching and a bridge pier, the gradation sample for the paving can be used for all projects.

Non Complying Gradation

When a verification gradation test does not comply with the gradation requirements of [Article 4109](#), the Engineer will contact the contractor, producer and the District Materials Engineer. The Engineer will test any remaining sample to check results, test any backup samples, or obtain a resample. The District Materials Engineer may investigate sampling and testing procedures, stockpiling, source material, etc. After corrections have been made, the Engineer will obtain and test another verification sample.

Acceptance of lots will be based on complying verification test results. The engineer will retain all samples representing the lots until the lots have been accepted. Since the contracting authority tests are verification, correlation with [IM 216](#) is not required, but may be performed as a check of sampling and testing procedures.

Note: Mechanical shaking and over washing should be cautioned when testing certain softer limestone aggregates, as excessive fines will be produced. Contact the District Materials Engineer for information on proper test procedures for these sources.

REPORTS & REPORTING

Enter monitor checks on plant monitor workbook for structural or paving. Report gradations on gradation verification form 821283.

PCC PAVING - FIELD AND PLANT SAMPLING AND TESTING GUIDE
(See Specifications for Complete Details.)

Article	Work Type	Field Acceptance		Plant Acceptance		Gradation Verification
		Air & Slump (No slump for slipform paving)		Gradation QC		
2122	PCC Shoulders	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st day, then 1/day >500 yd ³ , If <500 yd ³ /day 1/wk		S/T 1st/day, S 1/day >500 yd ³ & T 1/wk, If <500 yd ³ /day S 1/wk & T 20% (4)
2301	PCC Pavement	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st day, then 1/day >500 yd ³ , If <500 yd ³ /day 1/wk		S/T 1st/day, S 1/day >500 yd ³ & T 1/wk, If <500 yd ³ /day S 1/wk & T 20% (4)
2301	PCC Pavement - QMC	1/700 yd ³ : 1/200 yd ³ RM		If >500 yd ³ /day S/T 1/1500 yd ³ , If <500 yd ³ /day S/T 1/wk		S/T 1st/day, S 1/day >500 yd ³ , Test 2/week, If <500 yd ³ /day, S/T 1 wk
2301	Bridge Approaches, Gores, tapers, radiuses	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st day, then 1/day >500 yd ³ , If <500 yd ³ /day 1/wk		n/a
2302	PCC Widening	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st day, then 1/day >500 yd ³ , If <500 yd ³ /day 1/wk		S/T 1st/day, S 1/day >500 yd ³ & T 1/wk, If <500 yd ³ /day S 1/wk & T 20% (4)
2310	PCC Overlay	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st day, then 1/day >500 yd ³ , If <500 yd ³ /day 1/wk		S/T 1st/day, S 1/day >500 yd ³ & T 1/wk, If <500 yd ³ /day S 1/wk & T 20% (4)
2310	PCC Overlay - QMC	1/700 yd ³ : 1/100 yd ³ RM		S/T 1/1500 yd ³ , If <500 yd ³ /day 1/wk		S/T 1st/day, S 1/day >500 yd ³ , Test 2/week, If <500 yd ³ /day, S/T 1 wk

(4) If less than 500 yd³ per day / intermittent construction continues for more than two weeks, obtain verification samples weekly and test 20% of the samples obtained.

PCC STRUCTURAL - FIELD AND PLANT SAMPLING AND TESTING GUIDE
(See Specifications for Complete Details.)

Article	Work Type	Field Acceptance		Plant Acceptance		Gradation Verification
		Air & Slump	Gradation QC	Gradation QC	Gradation QC	
2403	Structural Concrete	1/30 yd ³ (2)	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2405	Foundations	1/30 yd ³ (2)	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2406	Concrete Structures	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2412	Bridge Decks	1/30 yd ³ (2)	S/T 1/deck pour	S/T 1/deck pour	S/T 1/deck pour	
2413	Deck Repair	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2413	Deck Surfacing/Overlay HPC-O	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1/project	S/T 1/project	
2413	Deck Surfacing/Overlay Class O	1/100 yd ² (4)	n/a	n/a	n/a	
2414	Railings	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2415	Box, Arch Circular Culverts	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2416	Rigid Pipe Culverts	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2423	Support Structures	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2424	Shotcrete		S/T for Field Test design mix	n/a	n/a	
2433	Drilled Shaft	1/30 yd ³ (2)	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2503	Storm Sewers	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2503	intakes, utility access	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	n/a	n/a	
2501	Pile encasement	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2505	Guardrail anchorage	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	n/a	n/a	
2513	Concrete barrier	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	
2516	Walls and Steps	1/30 yd ³	S/T 1/week, if <50 yd ³ /wk S/T 1/2 weeks	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	S/T 1st/wk; S 1/wk or S 1/2 wks if <50 yd ³ /wk , T 20%	

(2) On large structural placements >350 yd³, the DME may adjust air and slump testing to 1/50 yd³ based on consistent results in the first 100 yd³ placed
(4) See [204 Appendix M](#) for overlays >300 yd².

PCC NON-STRUCTURAL & MISCELLANEOUS - FIELD AND PLANT SAMPLING AND TESTING GUIDE

(See Specifications for Complete Details.)

Article	Work Type	Field Acceptance		Plant Acceptance		Gradation Verification
		Air & Slump		Gradation QC		
NON-STRUCTURAL						
2212	Base Repair	1/30 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2201	PCC Base	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2213	Base Widening	1/700 yd ³ : 1/100 yd ³ RM		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2415	Curtain Wall	1/30 yd ³		n/a		n/a
2507	Revetment Grout	Air -1/half day		S/T for Mix Design only		n/a
	Slope Protection	Air -1/day		n/a		n/a
	Fabric Formed Revetment	Air- 1/half day		S/T for Mix Design only		n/a
2511	Sidewalks	1/100 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2511	Trails	1/100 yd ³		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2512	Curb & Gutter	1/100 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2515	Driveways	1/100 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2517	Railroad Approach Sections	1/100 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2529	Patching (Full depth), rumble strip	1/30 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
2530	Patching (Partial depth)	1/30 yd ³ (1)		S/T 1st week, S/T 1 per month (3)		S/T 1/project (3)
MISCELLANEOUS						
2304	Detour Pavement, 3 yrs or less	n/a		n/a		n/a
2405	seal course	n/a		n/a		n/a
2416	Pipe collars	n/a		n/a		n/a
2503	Catch basins, abandonment,collars	n/a		n/a		n/a
2506	Flowable Mortar	n/a		S/T for Mix Design only		n/a
2519	Fence construction	n/a		n/a		n/a
2524	Type A and B	n/a		n/a		n/a
2554	Thrust blocks	n/a		n/a		n/a

(1) If less than 20 yd³/ day, the engineer may waive air testing if inspection is not available and producer has exhibited consistency in prior placements. When inspection available on project, test minimum of 1/day for concrete exposed to freezing and thawing.

(3) Sampling and testing rate if no other concrete supplied. Use structural or paving test results to cover non-structural concrete items. Any concrete items not listed are considered miscellaneous concrete.

Chapter 20
IM T-203
AGGREGATE SOURCES

GENERAL AGGREGATE SOURCE INFORMATION

GENERAL

Only those sources which have been sampled or tested within the last ten years are listed. This listing additionally ranks sources in accordance with a frictional classification as defined herein for aggregates used in Hot Mix Asphalt (HMA) construction, durability class for coarse aggregates used in Portland Cement Concrete (PCC) construction, and Approved Fine Aggregate. Upon request, new sources or different combinations of beds within an existing source can be evaluated for classification. These rankings do not in any way waive the normal quality requirements for the particular types of aggregates indicated in contract documents.

Aggregate sources are continuously updated and the most current version of this IM can be found on the Materials Approved Product List Enterprise (MAPLE) website at <https://maple.iowadot.gov/>.

Products listed in this document may not always be available. Contact the supplier for availability.

PORTLAND CEMENT CONCRETE AGGREGATES

Aggregates shall be produced from sources approved in accordance with the requirements of Office of Materials IM 409. The engineer may approve scalping of some portion of the coarser fraction.

All aggregates produced and inspected for intended use in contracts under Iowa Department of Transportation Specifications shall be stored in identifiable stockpiles unless they are being delivered as produced.

DURABILITY CLASSIFICATION

The coarse aggregates have been divided into three classes in accordance with their durability level as determined by performance or laboratory testing.

Class 2 durability aggregates will produce no deterioration of pavements of the non-interstate segments of the road system after 15 years and only minimal deterioration in pavements after 20 years.

Class 3 durability aggregates will produce no deterioration of pavements of non-interstate segments of the road system after 20 years of age and less than 5% deterioration of the joints after 25 years.

Class 3i durability aggregates will produce no deterioration of the interstate road system after 30 years of service and less than 5% deterioration of the joints after 35 years.

NOTE: Those sources with a "B" in their durability class designation are approved for 1/2 in. Bridge Deck Overlay/Repair material.

HOT MIX ASPHALT AGGREGATES

Aggregates for HMA construction have been classified into five main functional types in accordance with their frictional characteristics. Those aggregates with the potential to develop the greatest amount of friction under traffic conditions are classified as Type 1 with the potential for friction decreasing as the type number increases. One or more friction types may be specified for use in pavement surface courses. If a type is not specified in the contract documents, Type 5 or better will be acceptable. Tentative bed limitations are shown in this publication.

The frictional classification types are listed and defined in order of descending quality as follows.

Type 1: Aggregates, which are generally, a heterogeneous combination of minerals with coarse-grained microstructure of very hard particles (generally, a Mohs hardness range of 7 to 9) bonded together by a slightly softer matrix. These aggregates are typified by those developed for and used by the grinding-wheel industry such as calcined bauxite (synthetic) and emery (natural). They are not available from Iowa sources. Due to their high cost, these aggregates would be specified only for use in extremely critical situations.

Type 2: Natural aggregates in this class are crushed quartzite and both fine and coarse-grained crushed igneous rocks. The mineral grains in these materials generally have a Mohs hardness range of 5 to 7. Synthetic aggregates in this class are some air-cooled steel furnace slags and others with similar characteristics. For asphalt mixtures, pipestone and sandstone in quartzite may not exceed 5 percent.

Type 3: Natural aggregates in this class are crushed gravels. The crushed gravels shall contain 40% or more igneous and metamorphic particles. Synthetic aggregates in this class are the expanded shales with a Los Angeles abrasion loss less than 35 percent.

Type 4: Aggregates crushed from dolomitic or limestone ledges in which 80 percent of the grains are 20 microns or larger. The mineral grains in the approved ledges for this classification generally have a Mohs hardness range of 3 to 4. For natural gravels, the Type 5 carbonate (see below) particles, as a fraction of the total material, shall not exceed the non-carbonate particles by more than 20 percent.

Type 5: Aggregates crushed from dolomitic or limestone ledges in which 20 percent or more of the grains are 30 microns or smaller.

REVETMENT CLASSIFICATIONS

Revetment or rip-rap is rock or other material used to armor bridge abutments, pilings, and rivers or shorelines against scour and water erosion. The Iowa DOT uses five Classes of Revetment based on the size of the aggregate. See the table below for nominal top size. The Engineer may approve revetment containing material larger than the nominal top size. For this product, individual beds are approved at each source based on quality and bed thickness.

Revetment Class	Nominal top size
Class A	400 pounds
Class B	650 pounds
Class C	450 pounds
Class D and Class E	250 pounds

SOURCE LISTING – Explanation

NOTE: - Number indicates additional source restrictions (see bottom of page)

Revetment class approval for size and quality of quarried stone used for river, lake bank, and water-way stabilization

Bed number shown for PCC aggregate are those on the formal source approval letter, Beds shown for HMA source are those which have prior approval for use and have the designated friction type.

Beds are also indicated for revetment (rip rap) approvals.

Source restrictions for L2 Friction HMA surface mix designs. L=limestone (<15% MgO) and D=dolomite (≥15% MgO), defines rock type.

Frictional Classification – as indicated on page 2
Hot Mix Asphalt – Type A and B

Durability Class for Portland Cement Concrete Coarse Aggregate ("B" indicates acceptability for Bridge Deck Overlay/Repair)
Fine Aggregate (X=PCC and HMA Approval, H=HMA use only)

Source Code Number (A-number) used to identify sources.
Ex. A29002: 29=County, 0=crushed stone, 02= unique source identifier
Ex. A29502: 29=County, 5=sand & gravel, 02= unique source identifier
Out of State Sources: Ex. AMN004: MN=State, 0=crushed stone, 04= unique source identifier

Specific Gravity
DWU-Determine When Used by

CODE	OPERATOR	DIST	SOURCE NAME	LOCATION	BULK SSD SpGr	DUR PCC CA	FRICT HMA A B	L2 ROCK TYPE	BEDS	REVETMENT CLASS	NOTES
29 A29002	DES MOINES L&W QUARRIES INC	DIST 5	CRUSHED STONE MEDIAPOLIS	SE 01 T071N R04W	2.65	3	4 4 4 4 5 5	L L L	15 15-18 20 3-7	A B C D E A B C D E	1
A29052	CESSFORD CONST CO		SAND AND GRAVEL SPRING GROVE	SW 36 T069 R04W	DWU 2.66	3 X	4 4				

NOTE 1: AASHTO 57 GRADATION MAXIMUM

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK			FRICT			L2 ROCK TYPE	BEDS	CLASS	REVTMENT	NOTES
				SSD SpGr	DUR CA	PCC	HMA A	B						
DIST 4 CRUSHED STONE														
1	ADAIR													
A01002	SCHILDBERG CONSTRUCTION CO	MENLO	NE 21 T77N R31W					5	5	L	15A-15C	A B C D E		
A01006	SCHILDBERG CONSTRUCTION CO	HOWE	SW 1 T76N R31W						4		14			
A01008	SCHILDBERG CONSTRUCTION CO	JEFFERSON	NE 17 T77N R31W						5		25			
									5		25B-25E	D		
									5		20			
									5		25			
											25B-25E	D		
DIST 4 CRUSHED STONE														
2	ADAMS													
A02002	SCHILDBERG CONSTRUCTION CO	MT ETNA	SW 14 T73N R34W						4		11-13	D		
A02004	SCHILDBERG CONSTRUCTION CO	CORNING	NE 08 T71N R34W						4		3-5	D		
DIST 2 CRUSHED STONE														
3	ALLAMAKEE													
A03002	BRUENING ROCK PRODUCTS INC	WEXFORD	NE 36 T98N R03W	2.70	3i				4	4	1C-6			
									4	4	1-8			
A03004	BRUENING ROCK PRODUCTS INC	LANGE	E2 17 T96N R06W	2.60	3				4	4	1B-8	A B C D E		
A03008	BRUENING ROCK PRODUCTS INC	MCCABE	NE 6 T97N R05W						4	4	2-5	A B C D E		
A03010	SKYLINE MATERIALS LTD	RUDE	SE 17 T100N R06W						4	4	1-5			
A03014	BRUENING ROCK PRODUCTS INC	HAMMEL-BOONIES	SW 2 T99N R06W	DWU	3i				4	4	2-4C	A B C D E		
A03022	SKYLINE MATERIALS LTD	LIVINGOOD	SW 7 T96N R06W						4	4	4-7			
									4	4	2-7			
A03026	BRUENING ROCK PRODUCTS INC	BYRNES	SE 25 T99N R06W								FULL FACE	A B C D E		
A03028	BRUENING ROCK PRODUCTS INC	WELPER-JOHNSON	SW 35 T99N R04W									A B C D E		
A03036	BRUENING ROCK PRODUCTS INC	SWENSON	SE 19 T96N R05W									A B C D E		
A03038	RIEHM CONSTRUCTION CO INC	RIEHM	SE 7 T100N R04W	DWU	3i				4	4	1-4	A B C D E		
A03040	BRUENING ROCK PRODUCTS INC	DEE	SE 21 T99N R04W	DWU	3i				4	4	5A-5D	A B C D E		
A03042	BARD MATERIALS	CHURCHTOWN	SW 29 T99N R04W						4	4	1-3	A B C D E		
									4	4	3			
A03046	BRUENING ROCK PRODUCTS INC	MOHS	SW 29 T96N R04W	DWU	2				5	5	1-2			
A03048	BRUENING ROCK PRODUCTS INC	POSTVILLE	SW 16 T96N R06W	2.61	3				4	4	1-4			
									4	4	6-8			
A03050	BRUENING ROCK PRODUCTS INC	GREEN	NW 16 T96N R06W	2.63	3				4	4	2-5			
									4	4	2-3A			
A03052	BRUENING ROCK PRODUCTS INC	ROSSVILLE	NE 35 T97N R05W						4	4	1-3	A B C D E		
A03054	BRUENING ROCK PRODUCTS INC	WEST RIDGE	NE 8 T98N R06W						4	4	1-5	A B C D E		
A03058	BRUENING ROCK PRODUCTS INC	ELON	SW 33 T98N R04W									A B C D E		
A03064	RAINBOW QUARRY LLC	RAINBOW	SE 26 T97N R05W								FULL FACE	D		

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK			FRICT			REVEITEMENT CLASS	NOTES
				SSD	PCC	CA	DUR	HMA	L2			ROCK	TYPE	BEDS
DIST 2 CRUSHED STONE											
3	ALLIAMAKEE	CRUSHED STONE								CONTINUED	
A03064	RAINBOW QUARRY LLC	RAINBOW	SE 26 T97N R05W							1-5	A B C D E
A03066	SKYLINE MATERIALS LTD	ELSBERN	NW 29 T97N R06W	2.61	3					2	A B C D E
A03068	BRUENING ROCK PRODUCTS INC	JEFFERSON	SW 30 T97N R05W							2-4	A B C D E
A03072	STRONG ROCK & GRAVEL	STRONG	SE 24 T99N R04W							1-8	A B C D E
A03074	RON WEYMILLER	W	NE 12 T100NR05W								
SAND AND GRAVEL											
A03502	SKYLINE MATERIALS LTD	HARPERS FERRY	SW 7 T97N R02W	2.67	3iB						
A03506	BRUENING ROCK PRODUCTS INC	HAMEL-BOONIES	SW 2 T99N R06W	2.67		X					
A03518	BRUENING ROCK PRODUCTS INC	IVERSON	NW 09 T99N R06W			H					
A03520	BRUENING ROCK PRODUCTS INC	IVERSON 2	NE 08 T99N R06W	2.65		X					
CRUSHED STONE											
DIST 5 CRUSHED STONE											
4	APPANOOSE	CRUSHED STONE									
A04016	L&W QUARRIES INC	WALNUT CITY	CT 35 T70N R19W	2.70	2					1-3	A B C D E
A04018	L&W QUARRIES INC	CLARKDALE #8	SE 15 T69N R18W							6	A B C D E
A04020	CANTERA AGGREGATES	PLANO	5 T69N R19W							4	D E
A04022	CANTERA AGGREGATES	CONFIDENCE	20 T70N R19W							1A	D E
5	AUDUBON	SAND AND GRAVEL								1C	A B C D E
A05506	HALLETT MATERIALS CO	EXIRA	SW 8 T78N R35W	2.68	3i					1	A B C D E
				2.66		X				3	A B C D E
DIST 4 SAND AND GRAVEL											
6	BENTON	CRUSHED STONE									
A06006	WENDLING QUARRIES INC	GARRISON B	NE 33 T85N R11W	2.64	2						
A06012	WENDLING QUARRIES INC	JABENS	SW 7 T85N R11W							6-16	A B C D E
										6-28	A B C D E
										6-TOP 2'	A B C D E
										BED 27	A B C D E
										32-37	A B C D E
										9-11	A B C D E
										9-12	A B C D E
										12	A B C D E
										10-12	A B C D E
										13-18	D
										20-23	A B C D E

NOTE 1: AASHTO 67 GRADATION #5 40% MAXIMUM; RESTRICTION DOES NOT APPLY TO STRUCTURAL CONCRETE

NOTE 2: BED 1, LOWER HALF ONLY

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK			FRICT			L2	ROCK	REVETMENT	NOTES
				SSD	PCC	SpGr	DUR	PCC	CA					FA	HMA	A	B	TYPE	BEDS	CLASS
DIST 6 CRUSHED STONE													
6	BENTON												
A06012	WENDLING QUARRIES INC	JABENS	SW 7 T85N R11W										
A06014	WENDLING QUARRIES INC	VINTON-MILROY	S2 10 T85N R10W					4	L			D	
A06016	WENDLING QUARRIES INC	COOTS	SW 36 T86N R11W									D	
SAND AND GRAVEL													
A06502	WENDLING QUARRIES INC	VINTON-MILROY	S2 10 T85N R10W	2.65				4	4				
A06504	WENDLING QUARRIES INC	COOTS SAND/VINTON	SW 31 T86N R10W	2.65				3	3				
A06506	WENDLING QUARRIES INC	PORK CHOP	CT 11 T85N R09W	DWU				4	4				
A06508	WENDLING QUARRIES INC	BRIGHT SAND	NW 28 T86N R10W					H					
DIST 2 CRUSHED STONE													
7	BLACK HAWK												
A07004	BMC AGGREGATES LC	WATERLOO SOUTH	NW 18 T87N R12W	DWU	3			5	5	L			
A07008	BMC AGGREGATES LC	MORGAN	NE 15 T89N R12W	2.48	3i			4	4	L			
				2.63	3i			4	4	D			
A07018	BMC AGGREGATES LC	RAYMOND-PESKE	SW 1 T88N R12W	2.66				4	4	L			
				DWU	2			4	4	L			
				2.59	2			4	4	D			
				2.59	2			4	4	L			
A07020	BMC AGGREGATES LC	STEINERON	SE 1 T88N R11W	2.60	3			4	4	D			
A07022	BMC AGGREGATES LC	MESSERLY	NE 8 T90N R14W	2.60	2			4	4	L			
A07504	BMC AGGREGATES LC	SAND AND GRAVEL WATERLOO SAND	SW 9 T89N R13W	2.65				3	3				
A07506	WENDLING QUARRIES INC	ASPRO	NW 1 T88N R13W	2.65				4	4				
A07508	BMC AGGREGATES LC	GILBERTVILLE	16 T88N R12W	DWU	2			4	4				
A07512	BMC AGGREGATES LC	ZEIEN S&G	NW 23 T87N R12W	2.65				4	4				

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK SSD SPGr	DUR PCC CA	FRICT HMA FA	L2 ROCK TYPE	REVETMENT CLASS	NOTES
7	BLACK HAWK	DIST 2 SAND AND GRAVEL							
A07518	BMC AGGREGATES LC	JANESVILLE	NE 14 T90N R14W	2.66	X	3			
A07520	BENTONS SAND & GRAVEL	BENTON'S LAKE	1 T89N R14W	2.66	X	3			
8	BOONE	DIST 1 SAND AND GRAVEL							
A08504	STRATFORD GRAVEL INC	JENSEN	SE 35 T85N R25W		H				
A08526	STRATFORD GRAVEL INC	POWERS	SE 29 T84N R28W		H				
A08528	STRATFORD GRAVEL INC	LEININGER	SW 26 T85N R25W		H				
9	BREMER	DIST 2 CRUSHED STONE							
A09002	BMC AGGREGATES LC	FREDERIKA	NE 12 T93N R13W			5	2-8		
A09006	BMC AGGREGATES LC	TRIPOLI-PLATTE	SW 36 T93N R13W	2.65	3iB	4	1-6		
A09008	BMC AGGREGATES LC	DENVER #2	NE 20 T91N R13W	2.65	3iB	4	1-4	A B C D E	
A09508	BMC AGGREGATES LC	SAND AND GRAVEL					2	A B C D E	
A09510	CROELL REDI MIX	TRIPOLI-PLATTE	SW 36 T93N R13W		H				
A09512	BMC AGGREGATES LC	PLAINFIELD/ADAMS	NE 32 T93N R14W	2.66	X				
10	BUCHANAN	DIST 6 CRUSHED STONE							
A10002	BARD MATERIALS	WESTON-LAMONT	NW 14 T90N R07W	2.61	3iB	4	1-6	A B C D E	
A10004	BMC AGGREGATES LC	BLOOM-JESUP		2.57	3i	4	6-7	A B C D E	
A10008	BRUENING ROCK PRODUCTS INC	OELWEIN		2.65	3i	4	8-9	A B C D E	
A10010	BRUENING ROCK PRODUCTS INC	HAZELTON		2.63	3	4	1-7	A B C D E	
A10012	BMC AGGREGATES LC	MILLER-INDEPENDENCE		2.64	3i	4	2-5	A B C D E	
A10014	BMC AGGREGATES LC	OELWEIN #1		2.63	3iB	4	1-7	A B C D E	
A10016	BMC AGGREGATES LC	OELWEIN #2		2.67	3i	5	2-8	D	
A10022	BRUENING ROCK PRODUCTS INC	BROOKS		2.60	3i	4	4-5	A B C D E	
A10024	BMC AGGREGATES LC	RASMUSSEN #2		2.60	3i	4	4-6	A B C D E	
A10028	WENDLING QUARRIES INC	HERTZBERGER		2.63	3iB	4	4	A B C D E	
A10030	BARD MATERIALS	SOUTH AURORA		2.63	3iB	5	1-12	A B C D E	
A10040	BMC AGGREGATES LC	ZUPKE-OELWEIN		2.63	3iB	4	13-16	A B C D E	
A10042	BRUENING ROCK PRODUCTS INC	BRANDON I-380		2.63	3iB	4	13-17	A B C D E	
						4	1-6	A B C D E	
						5	1-6 + QRY	D	
						4	FLR		
						4	1-3	A B C D E	

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK SSD SpGr	DUR PCC CA	FRICT HMA FA	L2 ROCK TYPE	REVEITEMENT CLASS	NOTES
DIST 6 CRUSHED STONE									
10	BUCHANAN	DIST 6							
A10044	BMC AGGREGATES LC	PARKER	NE 6 T88N R10W						
SAND AND GRAVEL									
A10516	BMC AGGREGATES LC	MILLER	NW 14 T88N R09W	2.65		X			
A10518	WENDLING QUARRIES INC	YEAROUS	SE 19 T89N R09W	2.65		X			
A10520	BRUENING ROCK PRODUCTS INC	BROOKS	SW 2 T88N R09W	DWU		X			
A10522	BARD MATERIALS	NIEMANN-DECKER	NW 14 T90N R07W	2.66		X			
A10524	BRUENING ROCK PRODUCTS INC	CRAWFORD	SE 10 T90N R07W	2.64		X			
DIST 3 SAND AND GRAVEL									
11	BUENA VISTA	DIST 3							
A11512	BUENA VISTA COUNTY	MARATHON	SE 19 T93N R35W			H	4	4	
A11514	REDINGS GRAVEL & EXCAVATING CO	OATMAN	SW 18 T90N R36W			H	4	4	
A11516	HALLETT MATERIALS CO	STOUX RAPIDS	W2 12 T93N R37W			H	3	3	
A11518	STRATFORD GRAVEL INC	MOLGAARD	NW 3 T93N R38W			H			
A11520	WETHERELL SAND & GRAVEL	WETHERELL	02 T93N R38W			H			
DIST 2 CRUSHED STONE									
12	BUTLER	DIST 2							
A12004	BRUENING ROCK PRODUCTS INC	LUBBEN	NW 25 T93N R17W				5	5	4-16
								5	1-21
									1-20
									1-11
A12008	BRUENING ROCK PRODUCTS INC	FLOTTY-STEERE	CT 8 T93N R17W				5		
A12010	SKYLINE MATERIALS LTD	CLARKSVILLE-ENGLE	NE 16 T92N R15W						D
A12014	BMC AGGREGATES LC	OLTMANN	SE 8 T91N R16W				5	5	1-4
									1-TOP 1/2
									BED 10
									9-16
									17-18
									1-11
									1-5
A12016	BRUENING ROCK PRODUCTS INC	WIEGMANN-BRISTOW	SE 23 T92N R18W						
A12018	BRUENING ROCK PRODUCTS INC	NEYMEYER	SW 28 T90N R18W						D
A12020	BRUENING ROCK PRODUCTS INC	BRUNS #2	NW 21 T91N R18W				5	5	D
SAND AND GRAVEL									
A12502	CROELL REDI MIX	CLARKSVILLE	NW 1 T92N R16W	2.67	2		4	4	
				2.67		X			
A12516	BRUENING ROCK PRODUCTS INC	JENSEN	S2 18 T93N R16W			H	4	4	
A12518	BMC AGGREGATES LC	SHELL ROCK-ADAMS	NE 3 T91N R15W				3	3	
A12520	CROELL REDI MIX	PARKERSBURG	E2 19 T90N R16W	2.66		X			
A12522	BMC AGGREGATES LC	HOBSON	34 T92N R15W	DWU		X			
				2.66		X			
DIST 3 SAND AND GRAVEL									
13	CALHOUN	DIST 3							
A13502	STRATFORD GRAVEL INC	KRUSE	NE 26 T86N R34W			H	4	4	
A13504	TIEFENTHALER AG-LIME INC	JENSEN	SW 7 T86N R34W	2.67		X			
A13506	MOHR SAND, GRAVEL, & CONST LLC	MOHR	NW 23 T86N R34W	DWU		X			

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK		FRICT			L2	REVTMENT	NOTES
				SSD	SpGr	DUR	PCC	HMA				ROCK	CLASS
DIST 3 SAND AND GRAVEL											
I 3	CALHOUN										
A13508	STRATFORD GRAVEL INC	PACKER	NE 26 T86N R34W								
A13510	MOHR SAND, GRAVEL, & CONST LLC	SMITH	NW 23 T86N R34W			H	3	3			
DIST 3 SAND AND GRAVEL											
I 4	CARROLL										
A14504	STRATFORD GRAVEL INC	REINHART	NW 21 T85N R33W	DWU		X					
A14510	TIEFENTHALER AG-LIME INC	LANESBORO	NW 17 T85N R33W	2.72		X	4	4			
				2.68							
A14514	TIEFENTHALER AG-LIME INC	MACKE	SW 6 T85N R33W	2.69		X	4	4			
				2.66							
A14516	STRATFORD GRAVEL INC	RICHLAND	NE 23 T83N R33W			H	4	4			
A14518	TIEFENTHALER AG-LIME INC	MILLER	21 T85N R33W	DWU		X					
				DWU							
DIST 4 CRUSHED STONE											
I 5	CASS										
A15004	SCHILDBERG CONSTRUCTION CO	LEWIS	SE 17 T75N R37W								
A15008	SCHILDBERG CONSTRUCTION CO	ATLANTIC MINE	SW 13 T76N R37W				5	5	25		D
									25B-25E		D
									20A-20C		
A15012	SCHILDBERG CONSTRUCTION CO	HANSEN	SE 29 T76N R36W				5	5	L		ARGENTINE
DIST 6 CRUSHED STONE											
I 6	CEDAR										
A16004	WENDLING QUARRIES INC	LOWDEN-SCHNECKLOTH	NW 4 T81N R01W	DWU		3i	4	4	D		A B C D E
A16006	WENDLING QUARRIES INC	STONEMILL	SE 14 T80N R03W	DWU		3iB	4	4	D		A B C D E
											D
A16012	WEBER STONE CO INC	ONION GROVE	NW 14 T82N R02W	2.61		3i	4	4	D		A B C D E
A16014	WENDLING QUARRIES INC	TOWNSEND	NW 2 T79N R02W								A B C D E
A16022	WENDLING QUARRIES INC	TRICON	N2 9 T82N R04W	DWU		3i	4	4	D		A B C D E
				DWU		3i	4	4	D		A B C D E
A16026	WENDLING QUARRIES INC	PEDEN #2	SW 10 T79N R03W								
		SAND AND GRAVEL									
		SHARPLISS	NW 12 T79N R03W				4	4			
A16502	WENDLING QUARRIES INC	ONION GROVE	NE 14 T82N R02W	2.65		X					
A16506	WEBER STONE CO INC	CEDAR BLUFF	SW 28 T81N R04W	2.65		X					
A16510	CROELL REDI MIX			DWU		X					
DIST 2 CRUSHED STONE											
I 7	CERRO GORDO										
A17008	MARTIN MARIETTA AGGREGATES	PORTLAND WEST	NE 19 T96N R19W	2.75		3iB	4	4	L		A B C D E
A17012	MARTIN MARIETTA AGGREGATES	UBBEN	SW 26 T94N R20W	2.68		2	5	5	L	3	
							5	5	L	1-3	
A17020	MARTIN MARIETTA AGGREGATES	MASON CITY	NE 29 T97N R20W	DWU		3i	5	5	L	7	
				2.73		3	5	5	L	7-9	
							4	4	L	8-9	

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK		DUR	FRICT			L2	ROCK	REVETMENT	NOTES
				SSD	SpGr		CA	FA	HMA					A	B	TYPE	BEDS	CLASS
DIST 2 CRUSHED STONE													CONTINUED
17	CERRO GORDO	MASON CITY	NE 29 T97N R20W				4	4		D		A B C D E	
A17020	MARTIN MARIETTA AGGREGATES	HOLCIM RIVERVIEW	SE 19 T97N R20W NE 29 T96N R19W				4	4	4	L	9-15 1-6		
A17022	NORTH IA SAND & GRAVEL INC						4	4	4	L	1-12		
A17024	HEARTLAND ASPHALT INC						4	4	4	L	1-15		
							4	4	4	L	13-15		
							5	5	5	L	13-17		
							5	5	5	L	16-17		
SAND AND GRAVEL													
A17514	MARTIN MARIETTA AGGREGATES	HOLCIM SAND	NE 19 T97N R20W	DWU	3								
				2.65			X						
A17518	HEARTLAND ASPHALT INC	AIRPORT	NE 8 T96N R21W	2.67	3		H						
A17520	NORTH IA SAND & GRAVEL INC	TUTTLE	NE 13 T97N R21W	2.64			X						
DIST 3 SAND AND GRAVEL													
18	CHEROKEE	CHEROKEE SOUTH	NE 16 T91N R40W	2.70	2								
A18506	HALLETT MATERIALS CO			2.69			X						
A18514	L G EVERIST INC	LARRABEE-MONTGOMERY	NE 20 T93N R39W	2.67	3		X						
A18526	HALLETT MATERIALS CO	CHEROKEE NORTH	SW 23 T92N R40W	2.63			X						
A18528	L G EVERIST INC	WASHTA	SW 31 T90N R41W	2.70	3		X						
A18534	HALLETT MATERIALS CO	NELSON	CT 23 T92N R40W	2.67	2		X						
				2.64			X						
				2.68			X						
				2.68			X						
DIST 2 CRUSHED STONE													
19	CHICKASAW	DEERFIELD-MAHONEY	SE 33 T97N R14W										
A19004	BRUENING ROCK PRODUCTS INC	BOICE	NE 16 T95N R14W								2-5	D	
A19008	BRUENING ROCK PRODUCTS INC												
SAND AND GRAVEL													
A19508	SKYLINE MATERIALS LTD	BUSTA	SE 23 T96N R11W	2.65			X			4			
A19512	BRUENING ROCK PRODUCTS INC	PEARL ROCK	SE 31 T94N R14W	2.65			X			4			
A19514	BRUENING ROCK PRODUCTS INC	NASHUA	SW 33 T95N R14W	DWU			X			3			
A19516	BMC AGGREGATES LC	REWOLDT	NE 25 T94N R13W	2.64			X						
A19520	BMC AGGREGATES LC	ROSONKE	SE 16 T95N R14W				H						
A19522	CROELL REDI MIX	BUCKY'S	NW 3 T95N R11W	2.68	3iB					3			
				2.65			X						

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK SSD SpGr	DUR PCC CA	FRIC HMA FA	L2 ROCK TYPE	REVETMENT CLASS	NOTES
DIST 5 CRUSHED STONE									
20	CLARKE	OSCEOLA	NW 12 T72N R26W				5	25A-25E 20A-20C 20A 25B-25C	D A B C D E A B C D E
DIST 3 SAND AND GRAVEL									
21	CLAY	EVERLY	SW 31 T97N R38W	2.70	3		3		
A21506	DAVE'S SAND AND GRAVEL INC	SPENCER #1	SW 24 T96N R36W	2.68 2.69	2	X	3		
A21516	SIEH SAND & GRAVEL	SPENCER #2	SW 5 T97N R37W	2.66		X	4		
A21518	HALLETT MATERIALS CO	CLAY COUNTY	NW 20 T96N R35W			H	4		
A21526	CLAY COUNTY	GOEKEN	NE 5 T96N R38W	DWU	2	H	3		
A21528	DAVE'S SAND AND GRAVEL INC	BRAUNSCHEWIG	16 T94N R36W			H	3		
A21530	HALLETT MATERIALS CO	ELSER	CT 3 T94N R36W			H	3		
A21532	CLAY COUNTY	CLARK EVERLY	NW 6 T96N R38W			H	3		
A21534	HALLETT MATERIALS CO	GILLETT GROVE	NE 3 T94N R36W			H	3		
A21536	HALLETT MATERIALS CO	NORGAARD SAND & GRAVEL	NW 20 T96N R35W	2.65		X			
A21538	NSG, LLC	DELOSS	20 T96N R35W			H			
A21540	BD CONSTRUCTION SERVICES LLC								
DIST 2 CRUSHED STONE									
22	CLAYTON	TWIN ROCK-SCHRADER	NW 14 T94N R05W				4	1-11 3-11	A B C D E
A22002	BARD MATERIALS	BENTE-ELKADER-WATSON	SW 12 T93N R05W	2.66	2		4	6-9 1-9	A B C D E
A22004	SKYLINE MATERIALS LTD	ANDEREGG	SE 32 T92N R02W				4	5-9	A B C D E
A22008	BARD MATERIALS	OSTERDOCK	SE 2 T91N R03W	2.67	2		4	2-8 2-5	A B C D E
A22010	BARD MATERIALS	SCHMIDT	NE 33 T91N R01W	2.66	3i		4	1-8 3-8	A B C D E
A22012	BARD MATERIALS	BLUME	NE 9 T93N R03W	2.64	2		4	4B -6 2-6	A B C D E
A22014	SKYLINE MATERIALS LTD	GISLESON	NW 6 T95N R04W	2.66	3i		4	1-7 1-12	A B C D E
A22016	BARD MATERIALS	ZURCHER	SE 1 T94N R05W				4	1-8	A B C D E
A22018	CJ MOYNA & SONS INC	MUELLER	NE 30 T94N R03W	DWU	3i		4	1-15	A B C D E
A22020	BARD MATERIALS						4	1-8	A B C D E

NOTE 1: FRICTION TYPE TO BE DETERMINED WHEN USED ON WINTERSET BEDS 20A-20C

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK			FRICT			L2 ROCK	REVETMENT CLASS	NOTES
				SSD SpGr	PCC CA	DUR FA	HMA A	B	TYPE				BEDS
DIST 2 CRUSHED STONE												
22 CLAYTON												
A22024	MIELKES QUARRY	MIELKE QUARRY	NE 21 T95N R04W				4	4		D	CONTINUED	A B C D E
A22026	BARD MATERIALS	DOERRING-LUANA	SE 5 T95N R05W				4	4			1-2	A B C D E
A22030	BARD MATERIALS	EBERHARDT	NW 27 T93N R05W	2.72	3		4	4			3-5	A B C D E
											1-5	A B C D E
											1-8	A B C D E
A22032	BARD MATERIALS	WELLMAN	NW 25 T92N R06W				4	4			1-6	A B C D E
A22034	BARD MATERIALS	KRUSE	NW 17 T92N R04W	2.70	3B		4	4			1-6	A B C D E
				2.70	2		4	4			5-11	A B C D E
							4	4			5-12	A B C D E
							4	4			2-12	A B C D E
A22038	BARD MATERIALS	FASSBINDER	SW 9 T92N R03W	2.67	3i		4	4		D	2B -6	A B C D E
							4	4			2-6	A B C D E
A22040	BARD MATERIALS	HARTMAN	NW 29 T91N R06W	2.68	3i		4	4		D	1-4	A B C D E
A22042	SKYLINE MATERIALS LTD	MORAREND	CT 35 T92N R03W				4	4		D	1-8	A B C D E
							4	4		D	1-10	A B C D E
											1-9	A B C D E
A22044	BARD MATERIALS	BOGE	SW 18 T91N R02W									A B C D E
A22048	SKYLINE MATERIALS LTD	TUCKER	SW 18 T91N R05W								1-3	D
A22058	SKYLINE MATERIALS LTD	ST. OLAF	NW 25 T94N R05W									A B C D E
A22060	CROELL REDI MIX	JOHNSON	NW 26 T93N R04W	2.64	3i		4	4		D	2-5	A B C D E
							4	4		D	1-5	A B C D E
A22062	CJ MOYNA & SONS INC	SNY MAGILL	SE 22 T94N R03W	2.73	3i		4	4		D	6-10	A B C D E
A22068	RIVER CITY STONE INC	MILLVILLE	NW 10 T91N R02W	DWU	3i		4	4		D	1-8	A B C D E
A22070	BRUENING ROCK PRODUCTS INC	BERNHARD/GIARD	NW 35 T95N R04W	DWU	3i		4	4		D	1-3	A B C D E
A22074	RIVER CITY STONE INC	STRAWBERRY POINT	NE 19 T91N R06W	2.69	3i		4	4		D	1-2	A B C D E
A22076	BRUENING ROCK PRODUCTS INC	LARSON	NW 8 T93N R05W									A B C D E
A22078	BRUENING ROCK PRODUCTS INC	LINK	NW 7 T93N R06W									A B C D E
A22080	BARD MATERIALS	HILINE	NW 8 T91N R03W									A B C D E
A22084	CJ MOYNA & SONS INC	MOYNA	14 T93N R05W	2.66	3i		4	4		L	BED 6--TOP 3' OF 8 6-9	A B C D E
												A B C D E
A22086	CJ MOYNA & SONS INC	WILLIE	SW 18 T93N R02W				4	4		D		A B C D E
A22088	CJ MOYNA & SONS INC	KEPPLER	NW 29 T94N R05W				4	4		D		A B C D E
A22090	FATTISON COMPANY LLC	FRENCHTOWN	7 T93N R02W	2.68	3iB		4	4		D	S1C-S1D	A B C D E
				DWU	3		4	4		D	S1B	A B C D E
							4	4		D	S1B-S1D	A B C D E
				2.68	3		4	4		D	G4	A B C D E
				2.68	3i		4	4		D	G2-G3	A B C D E
				2.66	3		4	4		D	ONEOTA	A B C D E
				2.72	3i		4	4		D	G2-G4	A B C D E

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK SSD SpGr	DUR PCC CA	FRICT HMA FA	L2 ROCK TYPE	BETS	REVETMENT CLASS				NOTES
									A	B	C	D	
DIST 2 CRUSHED STONE													
A22090	PATTISON COMPANY LLC	FRENCHTOWN	7 T93N R02W				D	G1					A B C D E
A22092	CJ MOYNA & SONS INC	LARSON	07 T94N R06W										
A22094	CJ MOYNA & SONS INC	BACKES	SE 19 T92N R03W										
SAND AND GRAVEL													
A22510	SKYLINE MATERIALS LTD	BENTE	SE 15 T93N R05W	2.66	X	4	4						
A22520	BARD MATERIALS	WELTERLEN	SE 32 T91N R05W	2.65	X								
A22522	CJ MOYNA & SONS INC	MOYNA	13 T93N R05W	2.64	X	4	4						
DIST 6 CRUSHED STONE													
A23002	PRESTON READY MIX CORP	ELWOOD-YEAGER	NW 8 T83N R02E	DWU	3i	4	4	D	1-2				A B C D E
A23004	WENDLING QUARRIES INC	BEHR	SW 2 T81N R03E	2.61		4	4	D	5-6				
A23006	WENDLING QUARRIES INC	SHAFFTON	NE 11 T80N R05E	DWU	3i	4	4	D	1-2				A B C D E
				DWU	3i	4	4	D	16-17				
				DWU	3i	4	4	D	17-18				
				DWU	3i	4	4	D	18-19				
				DWU	3i	4	4	D	20-21				
				DWU	3	4	4	D	20-23				A B C D E
				DWU	3	4	4	D	3-14				D
				DWU	3	4	4	D	3-15				
						4	4	D	16-21				A B C D E
						4	4	D	1-10				
									2-4				D E
									2-4				A B C D E
									UPPER OR LOWER LEDGE				D E
A23010	WENDLING QUARRIES INC	GOOSE LAKE	SW 22 T83N R05E			4	4	D					
A23012	WENDLING QUARRIES INC	TEEDS GROVE	SW 3 T83N R06E										
A23016	WENDLING QUARRIES INC	LYONS	NW 18 T82N R07E										
A23026	WENDLING QUARRIES INC	MILL CREEK	NE 22 T82N R06E										
A23028	WENDLING QUARRIES INC	DELMAR	SE 6 T83N R04E										
A23030	WENDLING QUARRIES INC	EDEN VALLEY	4 T83N R01E										
A23032	ANDERSON SAND AND GRAVEL CO	ANDERSON	23 T81N R03E										
SAND AND GRAVEL													
A23504	WENDLING QUARRIES INC	BEHR	SW 2 T81N R03E	2.68		4	4						
A23506	WENDLING QUARRIES INC	SCHNECKLOTH	S2 10 T80N R05E	2.68	X		4						
A23514	ANDERSON SAND AND GRAVEL CO	ANDERSON	NW 23 T81N R03E	2.67	X								
A23516	WENDLING QUARRIES INC	OLSON	NW 23 T81N R02E	2.68	X								
DIST 3 SAND AND GRAVEL													
A24512	HALLETT MATERIALS CO	DUNLAP	SE 27 T82N R41W	2.70		3	3						
				2.66	X								

RECENTLY ACTIVE AGGREGATE SOURCES

CODE	OPERATOR	SOURCE NAME	LOCATION	BULK			FRICT			L2	ROCK	REVEMENT	NOTES
				SSD	PCC	SpGr	DUR	CA	FA					HMA	A	B	TYPE	BEDS	CLASS
DIST 4 SAND AND GRAVEL													
25	DALLAS	SAND AND GRAVEL											
A25510	HALLETT MATERIALS CO	PERRY	NW 1 T81N R29W	2.70	2				4	4			
				2.67					X				
A25514	HALLETT MATERIALS CO	BOONEVILLE	S2 26 T78N R26W	2.68	2				3	3			
				2.66					X				
A25516	HALLETT MATERIALS CO	VAN METER SOUTH	21 T78N R27W	2.68	2				3	3			
				2.66					X				
A25518	MARTIN MARIETTA AGGREGATES	RACCOON RIVER SAND	27 T78N R26W	2.66	2				3	3			
				2.65					X				
A25520	LEGACY MATERIALS	LEGACY MATERIALS	29 T78N R26W	DWU	2								
				2.66					X				
A25522	HALLETT MATERIALS CO	BOONEVILLE WEST	25 T78N R27W	DWU	2								
				2.66					X				
DIST 5 CRUSHED STONE													
26	DAVIS	CRUSHED STONE											
A26004	DOUDS STONE LLC	LEWIS	W2 2 T69N R12W	2.60	3				4	4	L		D E
									5	5	L		D E
									4	4	L		D E
A26006	DOUDS STONE LLC	BROWN	NW 2 T69N R12W	2.60	3				4	4	L		D E
									5	5	L		D E
									4	4	L		D E
DIST 5 CRUSHED STONE													
27	DECATUR	SAND AND GRAVEL											
A26502	DOUDS STONE LLC	ELDON-FRANKLIN	SW 1 T70N R12W	2.67					X				
DIST 5 CRUSHED STONE													
A27002	SCHILBERG CONSTRUCTION CO	GRAND RIVER	NW 22 T70N R27W							5		25A-25C	D
												TOP 5.5'	
												BED 25E	
												20C	A B C D E
												25A-25E	2
												25C	D
												20A	C D E
													3
DIST 6 CRUSHED STONE													
28	DELAWARE	CRUSHED STONE											
A28008	BARD MATERIALS	EDGEWOOD WEST	CT 4 T90N R05W	2.69	3i				4	4	D		2B-3B
				2.65	3				4	4	D		3B
									4	4	D		1-3B

NOTE 1: TOP 4' ONLY OF BED 25C
 NOTE 2: FRICTION TYPE TO BE DETERMINED WHEN USED FOR BED 20C.
 NOTE 3: TOP 2.5' ONLY OF BED 25E.

EXAM WORKSHEETS

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	_____
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	_____
	Air			0.060
		Subtotal	=	_____
		1.000 - Subtotal	=	_____
		Total	=	1.000

% FA Agg.: _____	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% In. Agg.: _____	Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	_____
% CA Agg.: _____	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	_____
	Aggregate Total	=	_____

Aggregate Weights	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	_____

Summary	Cement _____ (lbs/cy)
	Fly Ash _____ (lbs/cy)
	Slag _____ (lbs/cy)
	Water _____ (lbs/cy)
	Fine Agg. _____ (lbs/cy)
	Interm. Agg. _____ (lbs/cy)
	Coarse Agg. _____ (lbs/cy)

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes

Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (1.00 X 62.4 X 27) = _____

Air **0.060**

Subtotal = _____

1.000 - Subtotal = _____

Total = **1.000**

% FA Agg.: _____

Fine Aggregate (1.000 - Subtotal) X % In Mix = _____

% In. Agg.: _____

Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: _____

Coarse Aggregate (1.000 - Subtotal) X % In Mix = _____

Aggregate Total = _____

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Summary

Cement _____ (lbs/cy)

Fly Ash _____ (lbs/cy)

Slag _____ (lbs/cy)

Water _____ (lbs/cy)

Fine Agg. _____ (lbs/cy)

Interm. Agg. _____ (lbs/cy)

Coarse Agg. _____ (lbs/cy)

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: _____

County : _____

Mix No.: _____

Abs Vol. Cement: _____

Type: _____

Cement (IM 401): _____ lbs

Source: _____

Sp. Gr.: _____

Fly Ash (IM 491.17): _____ %

Source: _____

Sp. Gr.: _____

Slag (IM 491.14): _____

Source: _____

Sp. Gr.: _____

Adjusted lbs. Cement:

Total Cementitious _____

Total % Replacement = _____

IM T203 Fine Aggregate Source: _____

Sp. Gr.: _____

IM T203 Interm. Aggregate Source: _____

Sp. Gr.: _____

IM T203 Coarse Agregate Source: _____

Sp. Gr.: _____

Basic w/c _____

Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Max w/c _____

Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = _____

Absolute Volumes

Cement (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Fly Ash (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Slag (lbs/cy) / (Sp. Gr. X 62.4 X 27) = _____

Water (lbs/cy) / (1.00 X 62.4 X 27) = _____

Air **0.060**

Subtotal = _____

1.000 - Subtotal = _____

Total = **1.000**

% FA Agg.: _____

Fine Aggregate (1.000 - Subtotal) X % In Mix = _____

% In. Agg.: _____

Interm. Aggregate (1.000 - Subtotal) X % In Mix = _____

% CA Agg.: _____

Coarse Aggregate (1.000 - Subtotal) X % In Mix = _____

Aggregate Total = _____

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = _____

Summary

Cement _____ (lbs/cy)

Fly Ash _____ (lbs/cy)

Slag _____ (lbs/cy)

Water _____ (lbs/cy)

Fine Agg. _____ (lbs/cy)

Interm. Agg. _____ (lbs/cy)

Coarse Agg. _____ (lbs/cy)



Iowa Department of Transportation
Office of Materials
PORTLAND CEMENT SHIPMENT YIELD REPORT

Report No. _____

Date Submitted _____

Contract ID: _____

Project No.: _____

County: _____

Source: _____

Contractor: _____

Plant Location: _____

Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type

Mix No.	Cement Per CY (Lbs.)	Batched (CY)	Cement Batched (Tons)
Left in Scale (Tons)	This Check (+)		
	Previous Yield Check (-)		
	Total Weighed (Batch Scale)		

Total Billed Weight (Tons) _____

Yield = _____ %

C.P.I.: _____