# PORTLAND CEMENT CONCRETE LEVEL II

## INSTRUCTION MANUAL

## 2023-2024

## TECHNICAL TRAINING AND CERTIFICATION PROGRAM

# TABLE OF CONTENTS

# IOWA DOT CONTACT INFORMATION

| CONTACT PERSON | ADDRESS | PHONE # | FAX # |
|---|---|---|---|
| Brian Squier - TTCP Coordinator<br>brian.squier@iowadot.us<br><br>Hope Arthur - TTCP Coordinator<br>hope.arthur@iowadot.us | Technical Training & Certification<br>Program and District 1 Materials<br>800 Lincoln Way<br>Ames, Iowa 50010 | 515-290-5998<br><br><br>515-509-8302 | 515-239-1092 |
| Jon Kleven<br>jon.kleven@iowadot.us | District 2 Materials<br>428 43rd Street SW<br>Mason City, Iowa 50401 | 641-422-9428 | 641-422-9463 |
| Alex Crosgrove<br>alex.crosgrove@iowadot.us | District 3 Materials<br>6409 Gordon Drive<br>Sioux City, Iowa 51106 | 712-239-4713 | 712-239-4970 |
| Mike Magers<br>michael.magers@iowadot.us | District 4 Materials<br>2310 E. Seventh St.<br>Atlantic, Iowa 50022 | 712-243-7649 | 712-243-5302 |
| Ellen Davidson<br>ellen.davidson@iowadot.us | District 5 Materials<br>205 E. 227th St.<br>Fairfield, Iowa 52556 | 641-472-3103 | 641-469-3427 |
| Tammy Siebert<br>tammy.siebert@iowadot.us | District 6 Materials<br>5455 Kirkwood Blvd. SW<br>Cedar Rapids, Iowa 52404 | 319-364-0235 | 319-730-1565 |
| Wesley Musgrove | Construction & Materials Engineer | 515-239-1843 | 515-239-1092 |
| Ashley Buss | Bituminous Materials Engineer | 515-233-7837 | 515-239-1092 |
| Todd Hanson | PCC Materials Engineer | 515-239-1226 | 515-239-1092 |
| Mahbub Khoda | Prestressed Concrete Engineer | 515-239-1649 | 515-239-1092 |
| Elijah Gansen | PCC Field Engineer | 515-239-1769 | 515-239-1092 |
| Kyle Frame | Structures Group Manager | 515-239-1619 | 515-239-1092 |
| Jesse Peterson | Structures Field Engineer | 515-239-1585 | 515-239-1092 |
| Chris Brakke | Pavement Management Engineer | 515-239-1882 | 515-239-1092 |
| Jeffrey Schmitt | Bituminous Field Engineer | 515-239-1013 | 515-239-1092 |
| Bob Dawson | Chief Geologist | 515-239-1339 | 515-239-1092 |
| Melissa Serio | Soils & Grading Field Engineer | 515-239-1280 | 515-239-1092 |
| Mike Lauritsen | District 1 Materials Engineer | 515-357-4350 | 515-239-1943 |
| Robert Welper | District 2 Materials Engineer | 641-422-9421 | 641-422-9463 |
| Vacant | District 3 Materials Engineer | 712-239-4713 | 712-239-4970 |
| Timothy Hensley | District 4 Materials Engineer | 712-243-7629 | 712-243-6788 |
| Allen Karimpour | District 5 Materials Engineer | 641-469-4040 | 641-469-3427 |
| Shane Neuhaus | District 6 Materials Engineer | 319-366-0446 | 319-730-1565 |

# ORGANIZATIONS CONTACT INFORMATION

Asphalt Paving Association of Iowa
1606 Golden Aspen Drive Ste 102
Ames, IA 50010
Scott Dockstader 515-233-0015
www.apai.net

Iowa Limestone Producers Association
4438 114th St
Urbandale, IA 50322
Randy Olson 515-262-8668
www.limestone.org

Iowa Concrete Paving Association
360 SE Delaware Ave.
Ankeny, Iowa 50021
Greg Mulder 515-963-0606
www.concretestate.org

Iowa Ready Mix Concrete Association
380 SE Delaware Ave.
Ankeny, Iowa 50021
Greg Mulder 515-965-4575
www.iowareadymix.org

Iowa Prestress Association
Dennis Drews 402-291-0733

**Des Moines Area Community College (DMACC)**
Boone Campus
1125 Hancock Drive
Boone, Iowa 50036

Kelli Bennett
Phone number: 515-433-5232
E-mail: kabennett@dmacc.edu

or

Renee White
Phone number: 515-433-5056
E-mail: crwhite@dmacc.edu

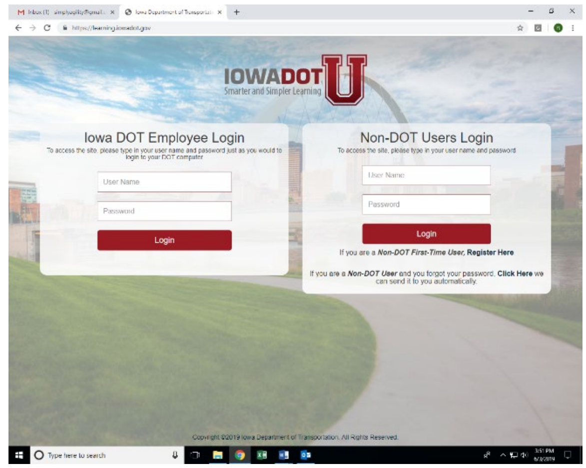
# WEBSITES USED IN TTCP CLASSES

There are 2 websites you will use as a TTCP Student.  You will set yourself up as a user of each of these websites.  It's important that you remember your user name and password for each site (hint:  since you are setting each of them up yourself, you could use the same password for each site.)

**IOWADOTU**

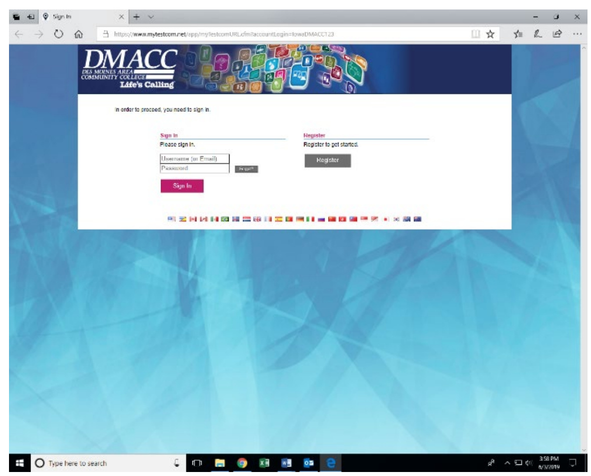
https://learning.iowadot.gov/

This is where you register for classes and take web-based training.  You can also print your training records transcripts here.   Step-by-step instructions are available at https://iowadot.gov/training/technical-training-and-certification-program




**COMPUTER TESTING**

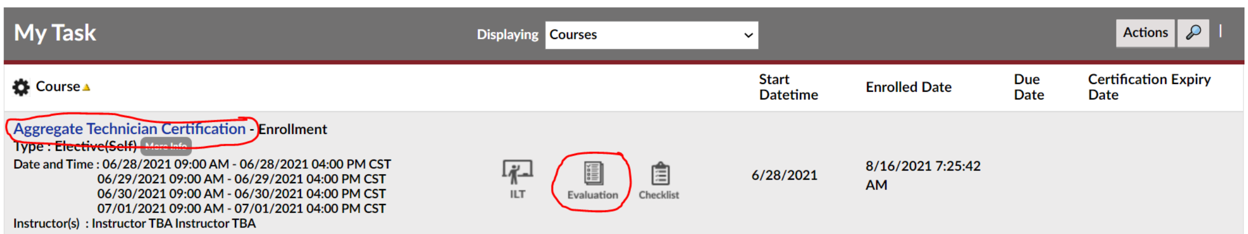
All TTCP Exams will be done on the computer.  Your instructor will guide you to the Test.Com website and assist with any registration requirements.  Questions are multiple choice, and you will be able to see your score immediately as well as the questions that you missed.



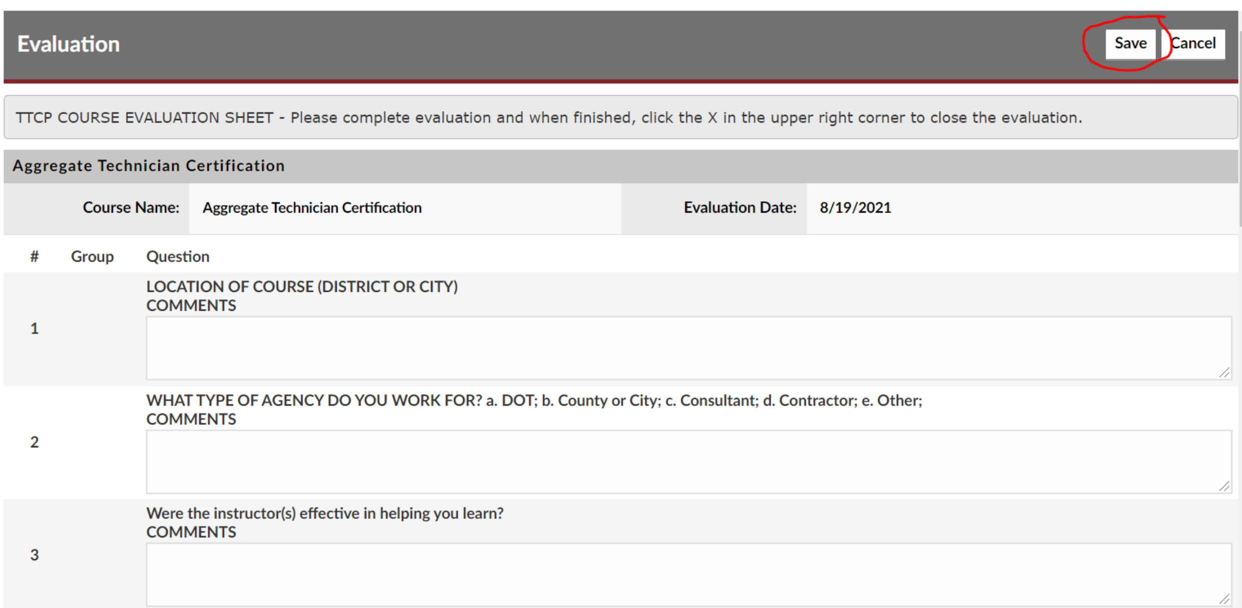
# CLASS EVALUATIONS

Evaluations will now be completed outside of the classroom. They are available in IowaDOTU and can be found at this web address: https://learning.iowadot.gov/

Please login to the system and then scroll down to where you see the “My Task” line. Locate the class that you were enrolled in and completed. To the right of the class name, you will see an icon for the Evaluation. Click the Evaluation icon and it will open the evaluation for you to complete electronically.




Once you have completed the 11 questions on the evaluation, scroll to the top of the page and click the “Save” button. Thank you for completing this evaluation!



# 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 cementitous materials.

**Dry Batch Weights** – The weights of the aggregate, cementitous 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 (cementitous) or Type F (non-cementitous).

**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-23001 –October 2023

**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    130.4 = 130    130.46 = 130

Rounding to tenths-
130.55 = 130.6    130.54 = 130.5    130.646 = 130.6

Rounding to hundredths-
130.555 = 130.56    130.544 = 130.54    130.5545 = 130.55

Rounding to thousandths-
130.5555 = 130.556    130.5544 = 130.554    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 - ¼ inch – 3 ½  2 ¾

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 ¼ 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 2023
# (U.S. Units)

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

| Paving | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Slip form | A~~B~~C, QMC | | | | 6 | 8 | 10 | 2301.02 B |
| Non-slip form | A~~B~~C, QMC | 0.5 | | 4 | 5.5 | 7 | 8.5 | 2301.02 B |
| Concrete Base (Non-slip form) | A, C | 0.5 | | 4 | 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 | | 4 | 5.5 | 7 | 8.5 | 2512.02 & 2301.02 |
| Sidewalk | ~~B,~~ C | | | 4 | 5.5 | 7 | 8.5 | 2511.02 & 2301.02 |
| Intakes and manholes | C | | | 4 | 5.5 | 6.5 | 8.5 | 2403.02 |

**Repair**

| Repair | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| 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 | | | | |
| | | *(when Mid-Range WR used)* | | | | | | |
| Underseal and grouting, flowing mortar | | By Flow Cone | | | | | | 2539.02 B & 2506 |

**Overlays**

| Overlays | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Unbonded, white topping Bonded | C, QMC | same as specified concrete | | | | | | 2310.02 |

**Lighting & Highway Signing**

| Lighting & Highway Signing | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Foundation | C | 1 | 4 | 5 | 5.5 | 6.5 | 8.5 | 2403.02 A & B |

# Concrete Specifications Summary - October 2023
# (U.S. Units)

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

| Structures | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Seal Coat | X | 0 | | 8 | | | | 2405.02 D |
| Sub-Structure & Super-structure | C<br>HPC | 1 | 4 | 5 | 5.5<br>5.5 | 6.5<br>7.5 (when placed by pumping/belting) | 8.5<br>9.5 | 2403.02 A & B<br>2412.02 |
| 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<br>HPC | 0<br>1 | 0.75<br>4 | 1<br>5 | 5.5 | 6.5 | 8.5 | 2413.02 D.1<br>2413.02 D.2 |
| Bride Deck - Class B Repair | O or D | 1 | | 3 | 5.5 | 6.5 | 8.5 | 2403.02 B, 2412<br>(2413.03 D) |
| Barrier Rail - Cast in place | C | 1 | 4 | 5 | 6 | 7 | 8.5 | 2513.03 A<br>2403<br>2414.02 |
| Barrier Rail - Slipform | BR | | | | 6 | 7 | 8.5 | 2513.03 A<br>2403<br>2414.02 |

**Guardrail**

| Structures | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| End anchors | C | 1 | 4 | 5 | 4 | | 7 | 2403.02 &<br>2505.03 B |

# Concrete Specifications Summary - October 2023

# (U.S. Units)

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

| Paving | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Slip form | A~~B~~C, QMC | | | | 6 | 8 | 10 | 2301.02 B |
| Non-slip form | A~~B~~C, QMC | 0.5 | | 4 | 5.5 | 7 | 8.5 | 2301.02 B |
| Concrete Base (Non-slip form) | A, C | 0.5 | | 4 | 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 | | 4 | 5.5 | 7 | 8.5 | 2512.02 & 2301.02 |
| Sidewalk | ~~B,~~ C | | | 4 | 5.5 | 7 | 8.5 | 2511.02 & 2301.02 |
| Intakes and manholes | C | | | 4 | 5.5 | 6.5 | 8.5 | 2403.02 |

**Repair**

| Repair | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| 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 | | | | |
| | | (when Mid-Range WR used) | | | | | | |
| Underseal and grouting, flowing mortar | | By Flow Cone | | | | | | 2539.02 B & 2506 |

**Overlays**

| Overlays | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Unbonded, white topping Bonded | C, QMC | same as specified concrete | | | | | | 2310.02 |

**Lighting &**
**Highway Signing**

| Lighting & Highway Signing | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Foundation | C | 1 | 4 | 5 | 5.5 | 6.5 | 8.5 | 2403.02 A & B |

# Concrete Specifications Summary - October 2023
# (U.S. Units)

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

| Structures | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| Seal Coat | X | 0 | | 8 | | | | 2405.02 D |
| Sub-Structure & Super-structure | C | 1 | 4 | 5 | 5.5 | 6.5 | 8.5 | 2403.02 A & B 2412.02 |
| | HPC | | | | 5.5 | 7.5 | 9.5 | |
| | | | | | (when placed by pumping/belting) | | | |
| 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 | 0 | 0.75 | 1 | 5.5 | 6.5 | 8.5 | 2413.02 D.1 |
| | HPC | 1 | 4 | 5 | | | | 2413.02 D.2 |
| Bride Deck - Class B Repair | O or D | 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**

| Structures | Type of Concrete | Slump (in.) Min. | Slump (in.) Target | Slump (in.) Max. | % Air Content Min. | % Air Content Target | % Air Content Max | Specification Reference |
|---|---|---|---|---|---|---|---|---|
| End anchors | C | 1 | 4 | 5 | 4 | | 7 | 2403.02 & 2505.03 B |

# 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 to update your PCC Reference Manual |

# 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 will be placed in your permanent file with the District Materials Office in which you reside. It will also be placed on the statewide computer file.

The goal of the Technical Training and Certification Program (TTCP) is to work with contractors, producers, cities, and counties 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

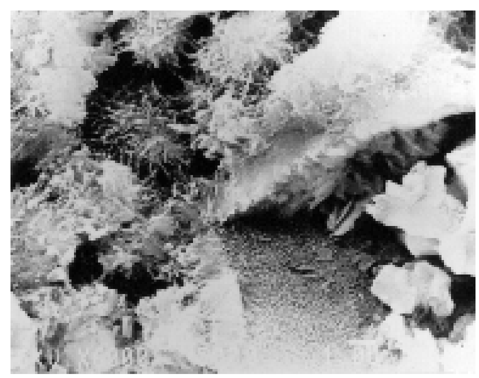
# III. CONCRETE MATERIALS

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(%) |

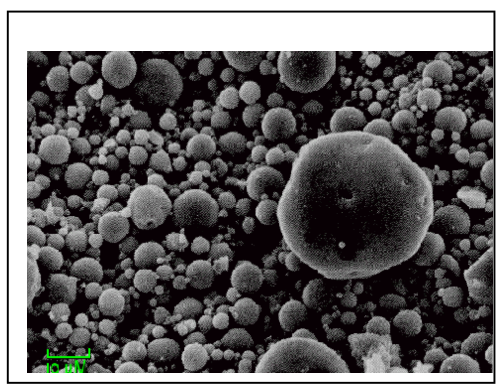
Type I or Type II cement may be used for pavements, structures, and other applications. Type III cement may be used in precast and prestressed concrete only. Type IP, Type IS, or Type IL cement may be furnished at the Contractor's option when Type I or Type II cement is specified. Use the same unit volume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

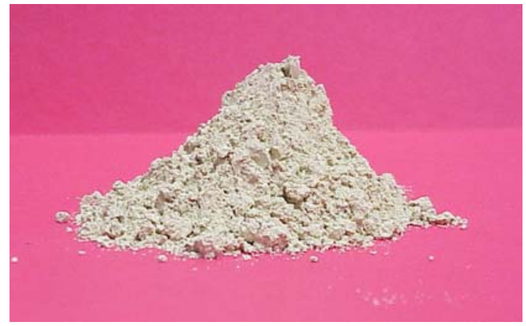
**2. Fly Ash - Article 4108, IM 491.17**

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
- Magnesim
- 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.

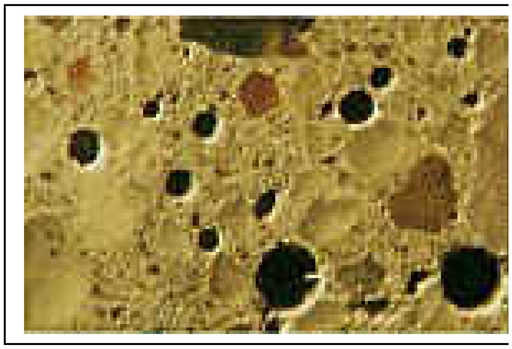
Reasons for using admixtures are:

- 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.

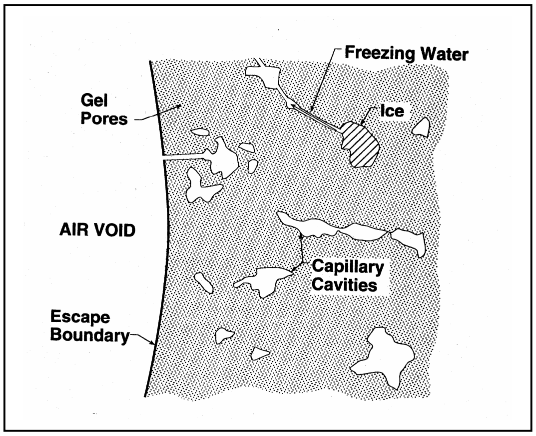


- Freeze Thaw Durability
- Increase Workability

**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

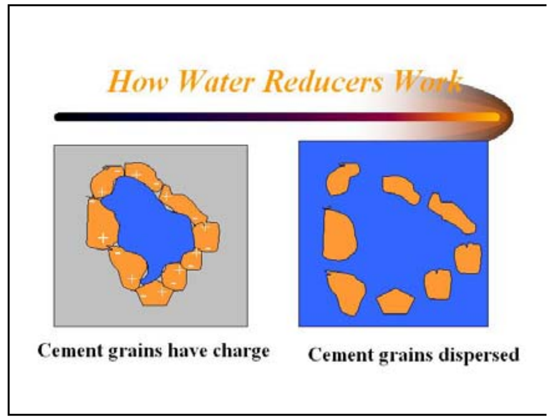
Without air voids, the repeated freezing and thawing will damage the concrete. This damage is increased with deicing salts.

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<br><br>Very low alkali cements (less than 0.3%) reduces air content | Dosage may be reduced up to 40% for high alkali cements<br><br>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<br><br>Air content decreases with increase in LOI | Increase dosage rates of up to 100%<br><br>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.<br>Delay addition of water reducer by 15 secs.<br>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<br><br>Air may be unstable with some combinations of fly ash, cement, and AEA's<br><br>LOI's greater than 1%<br><br>LOI's greater than 2% may cause air to be very unstable over time<br><br>Finer fly ashes decreases air content | LOI's may vary as the peak load at the power plant causing variability load to load<br><br>Prepare trial mixes and evaluate air<br><br>Usually increases AEA demand<br><br>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")<br><br>Well graded aggregates aid in retention of smaller entrained air bubbles | Total air content required to protect concrete decreases<br><br>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<br><br>Increased amount of fines passing the No. 100 sieve will decrease air content<br><br>Organic contaminants may result in large fluctuations in air | Monitor sand gradations<br><br>Monitor sand gradations<br><br>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<br>Clay or silt fines in sand decrease air content<br><br>Combined totals greater than 2% may decrease air contents<br>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<br><br>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.)<br>Increase in slump to greater than 6 in. decreases air content<br><br>Difficult to entrain air in low slump concrete (less than 1in.) | Increase slump 1" -increase air 0.5%<br><br>Increase slump |

## *Factors Affecting Control of Air in Concrete*

| Category | Characteristic | Effects | Guidance |
|---|---|---|---|
| Production | Batching Sequence | Simultaneous batching may lower air content<br>Batching AEA on to cement reduces AEA effectiveness<br><br>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<br>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)<br>Air content will decrease after 20 minutes of mixing (transit)<br><br>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<br><br>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<br>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<br>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<br>8000 vpm max. internal vibrators |
| | Finishing | Air content reduced in surface layer by excessive finishing | Avoid finishing with bleed water on surface<br>DO NOT add water to surface to finish |
| | Temperature | Air content decreases with increasing temperature<br>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<br><br>Utilize coldest water possible for Hot Weather Concreteing (well water) |

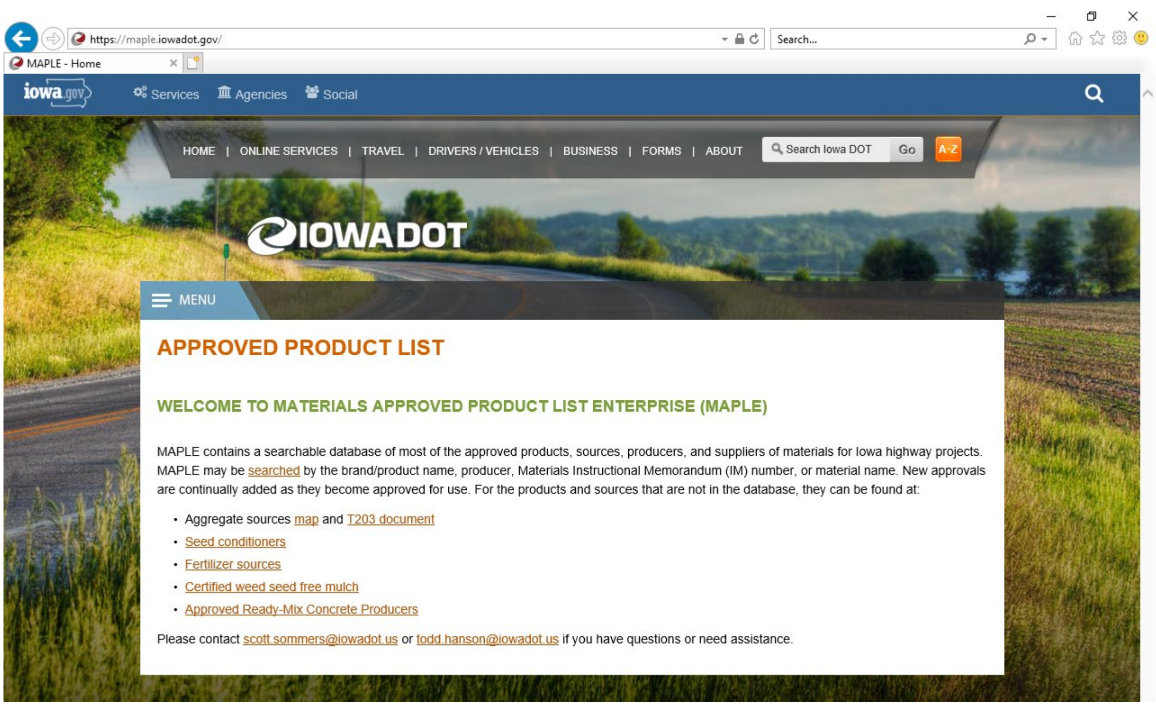
# User's Guide for
# Materials Approved List Enterprise (MAPLE)

## 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.

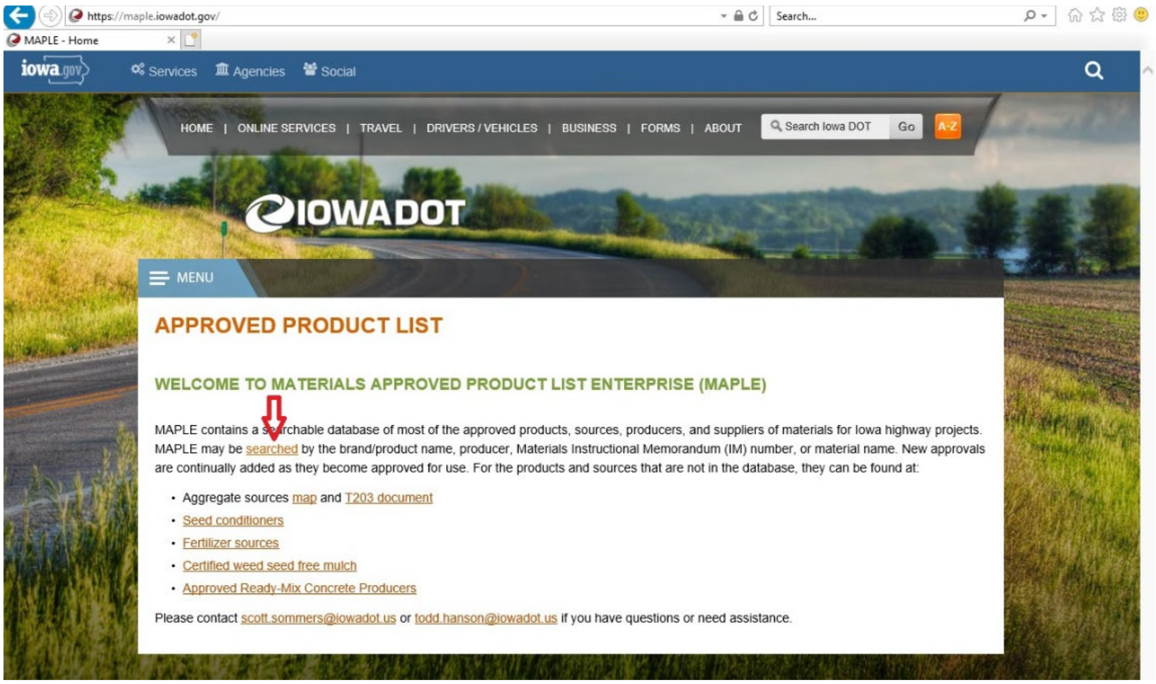
## 2 How to get to MAPLE

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

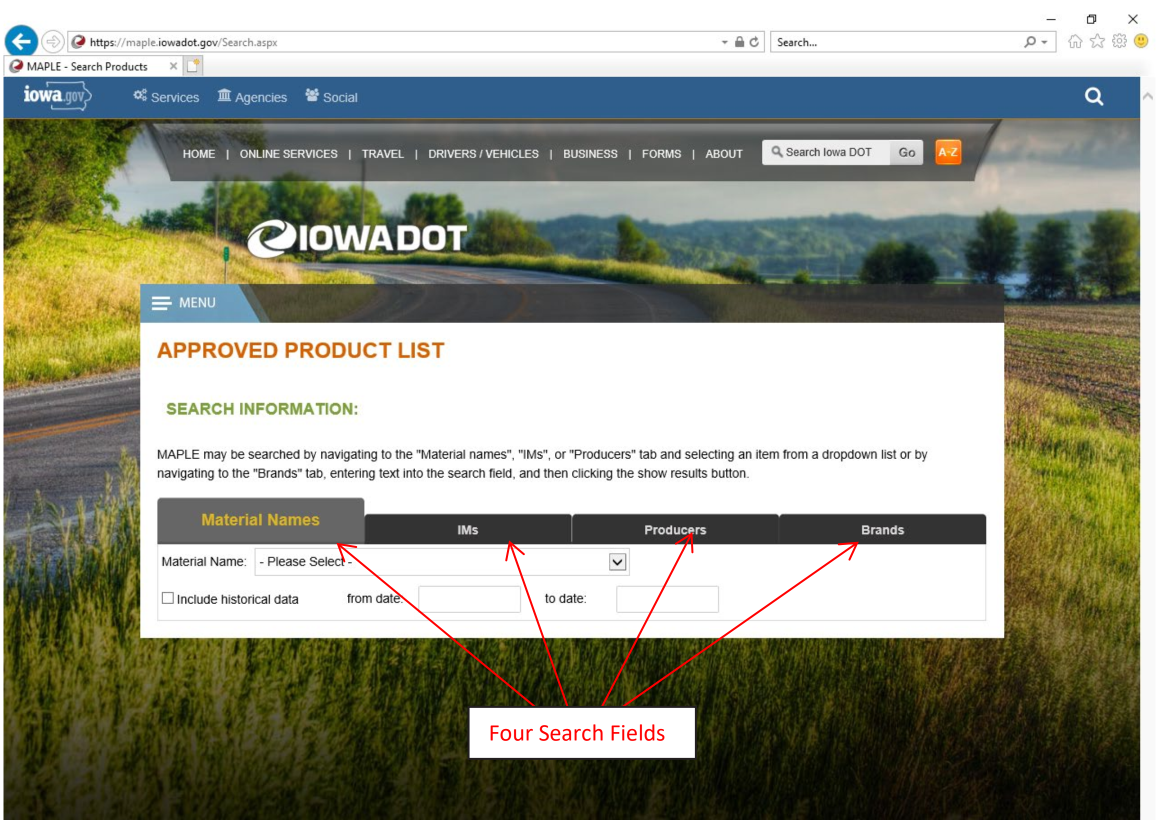


## 3. Searching MAPLE

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

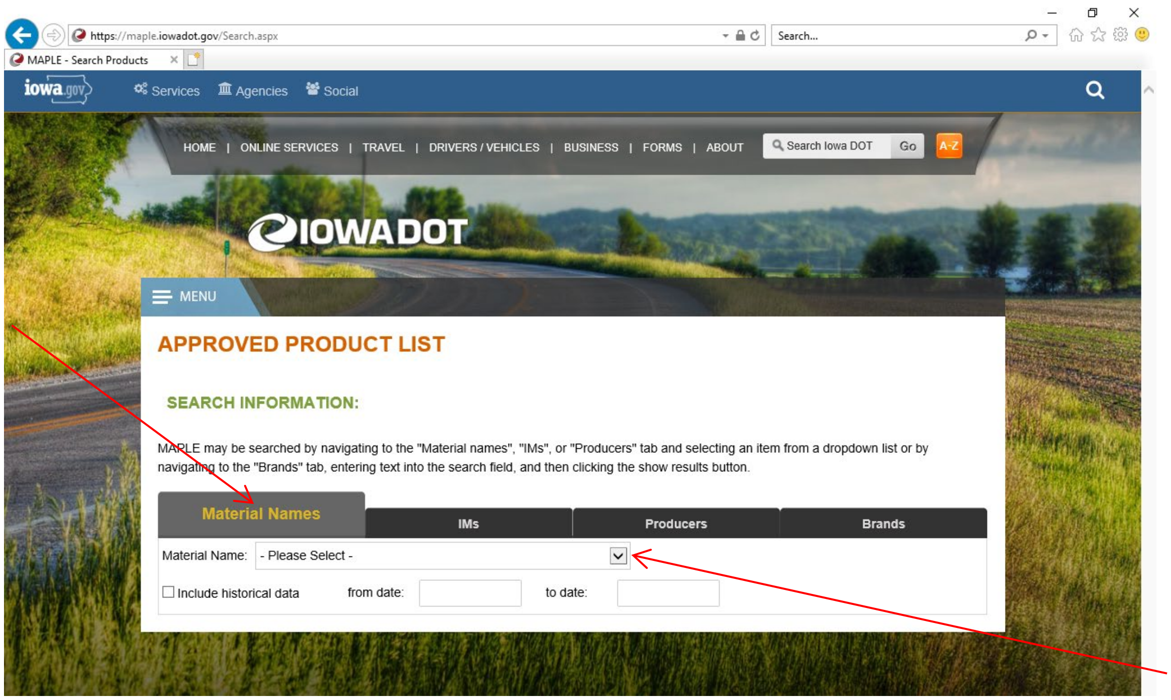


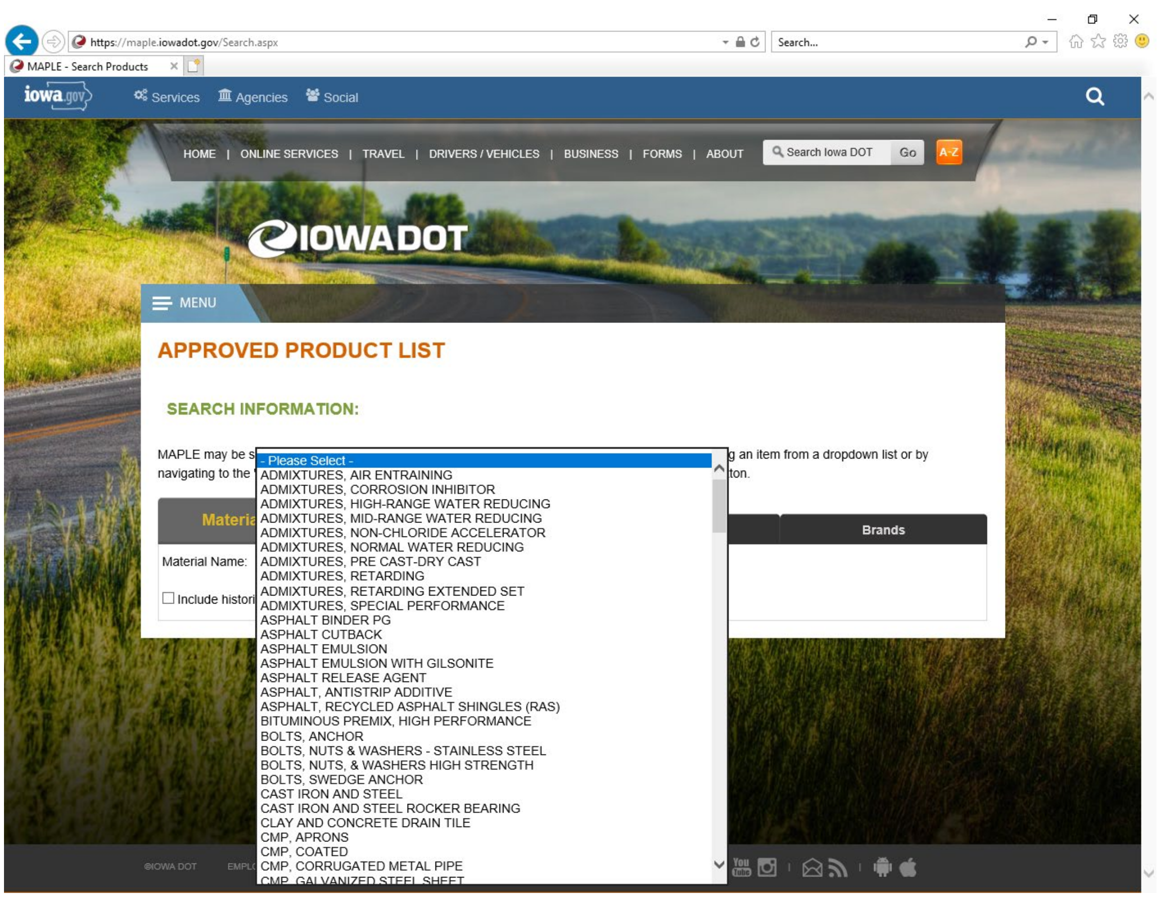

The user can search **MAPLE** through one of four fields listed: **Material Names, IMs, Producers, and Brands**.



## 4. Search by Material Names

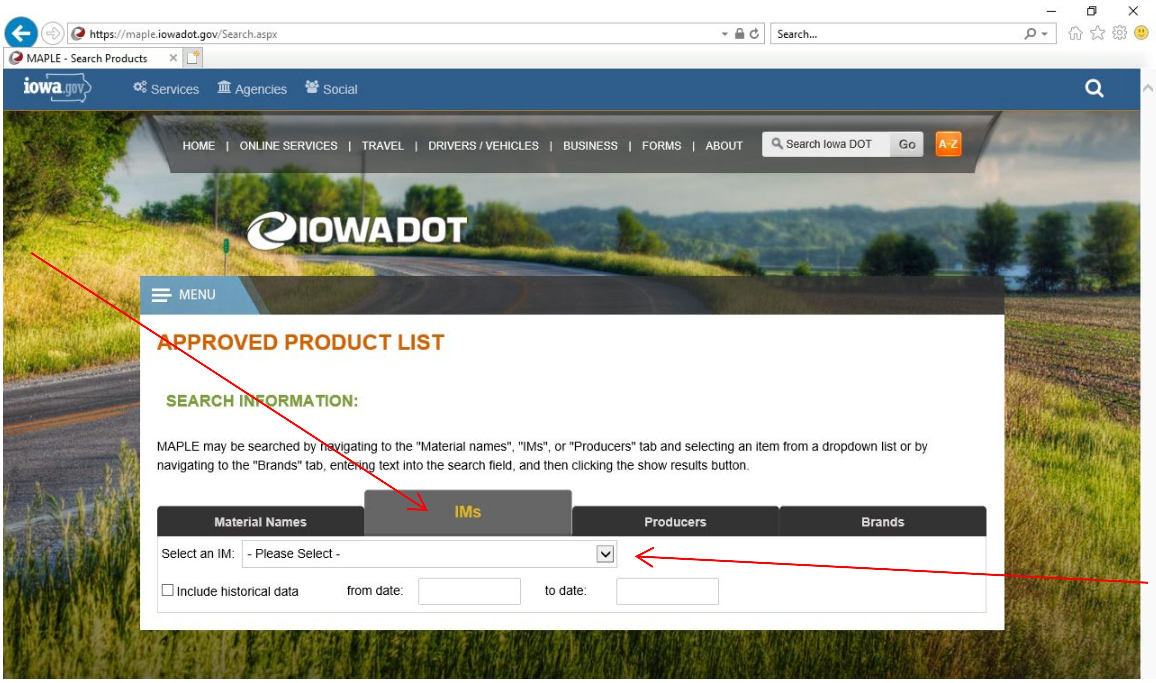
Click on the **Material Names** tab to search by type of material. Click on the arrow and a list will appear as shown. Click on any of the material names to produce an approved product list.

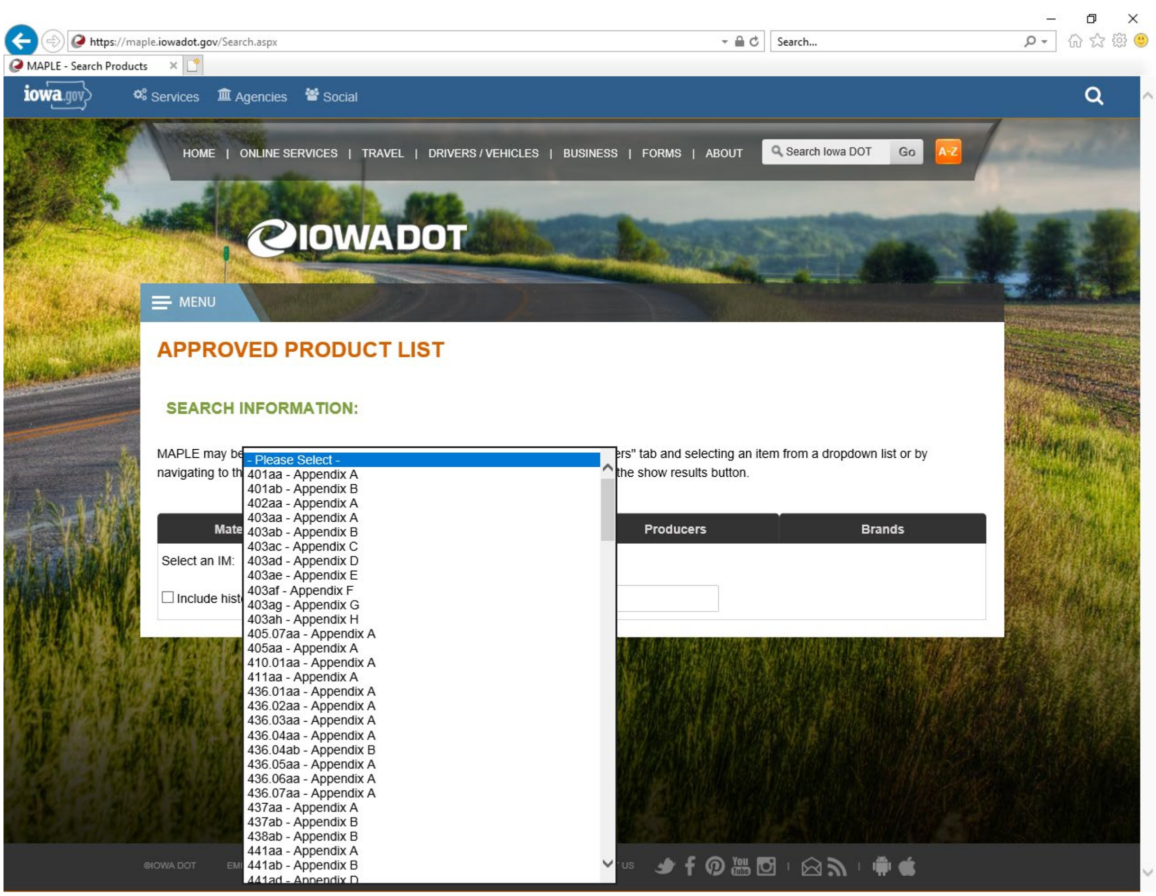


## 5. Searching by IMs

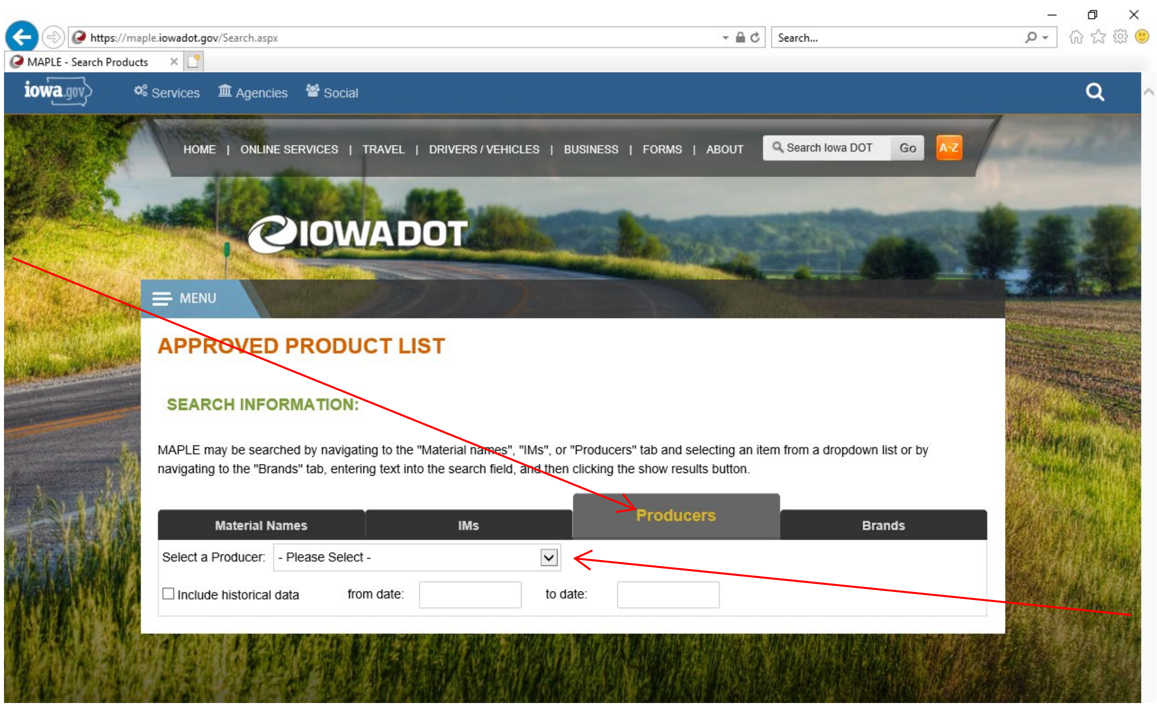
Click on the **IMs** tab to search by IM number. Click on the arrow and a list will appear as shown. Click on any of the IM's listed to produce a list of approved products in that IM.

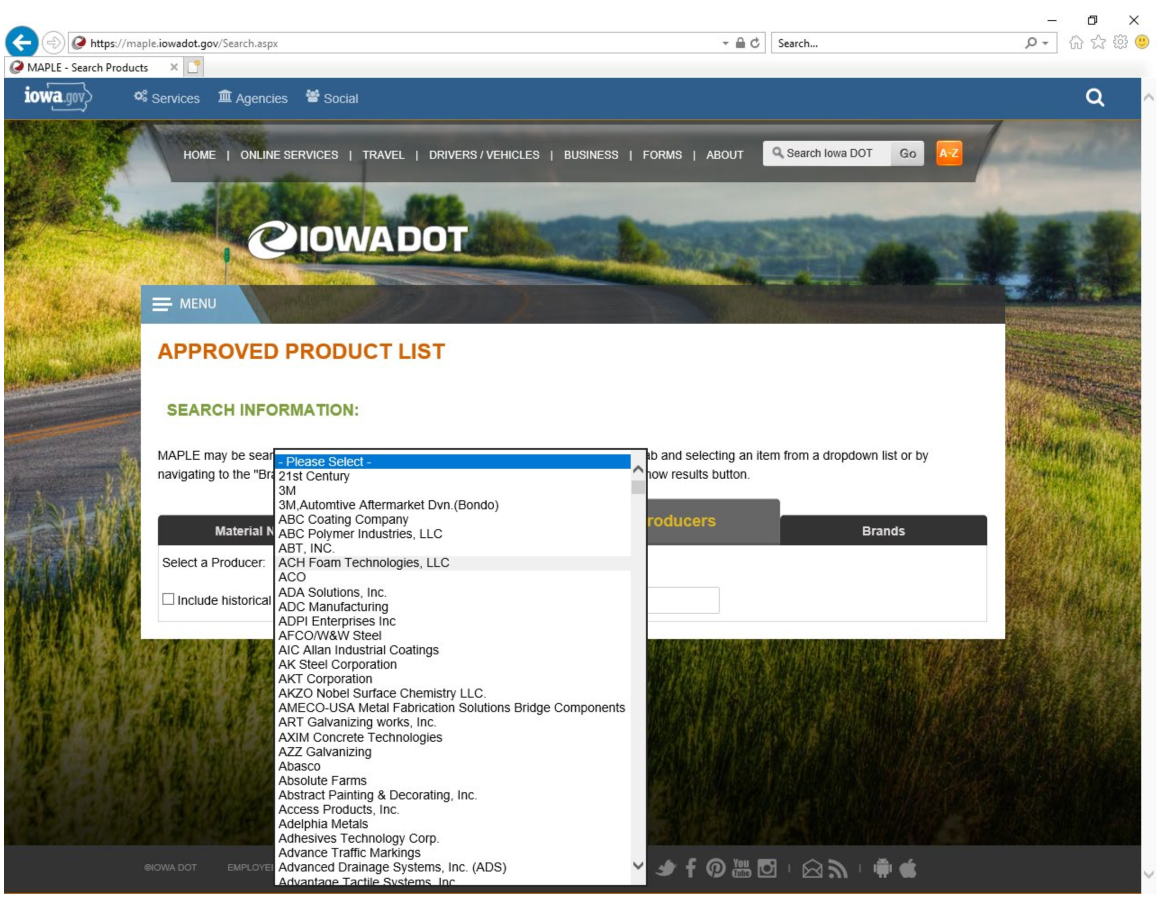


## 6. Searching by Producers

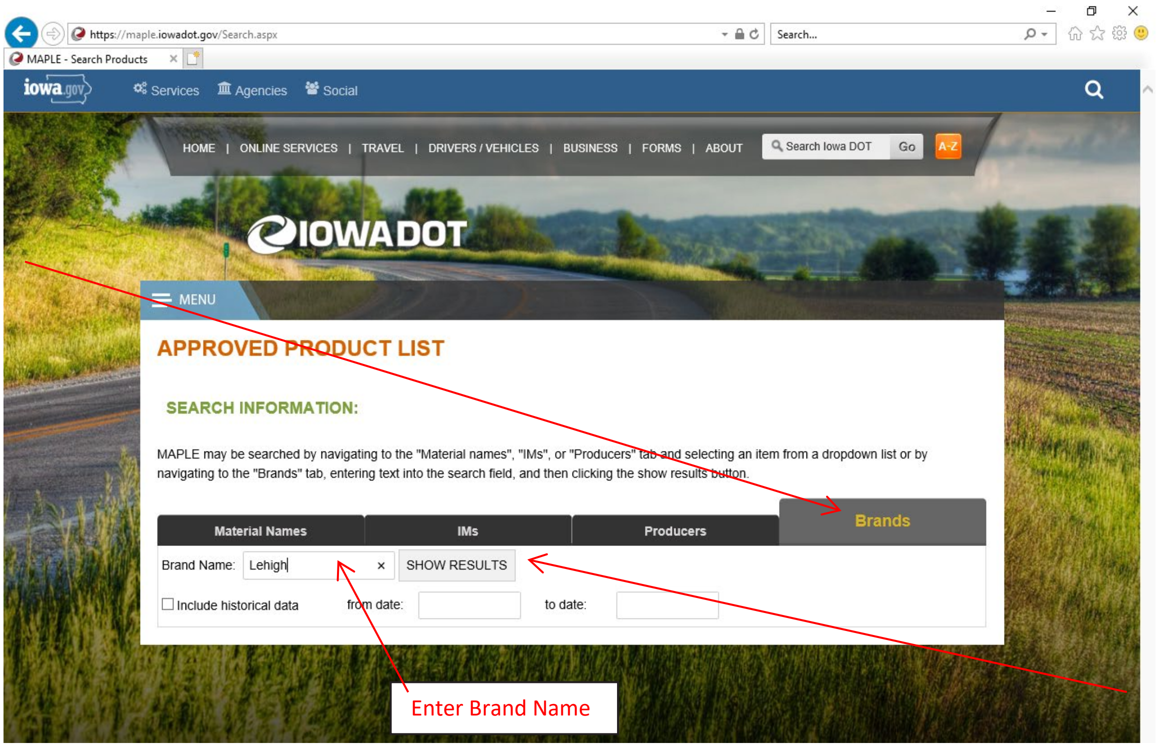
Click on the **Producers** tab to search by producer. Click on the arrow and a list will appear as shown. Click on any producer for a list of all approved products manufactured by that particular producer.

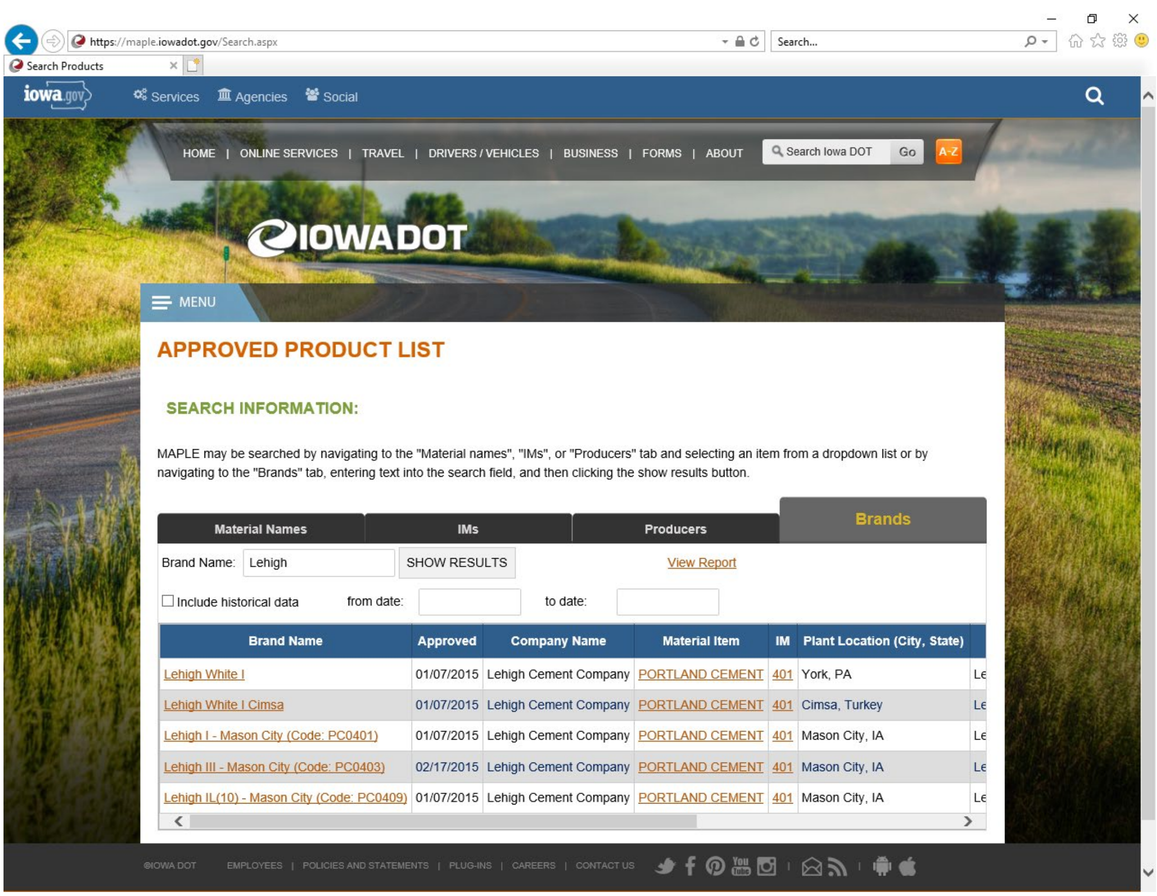


## 7. Searching by Brand Name

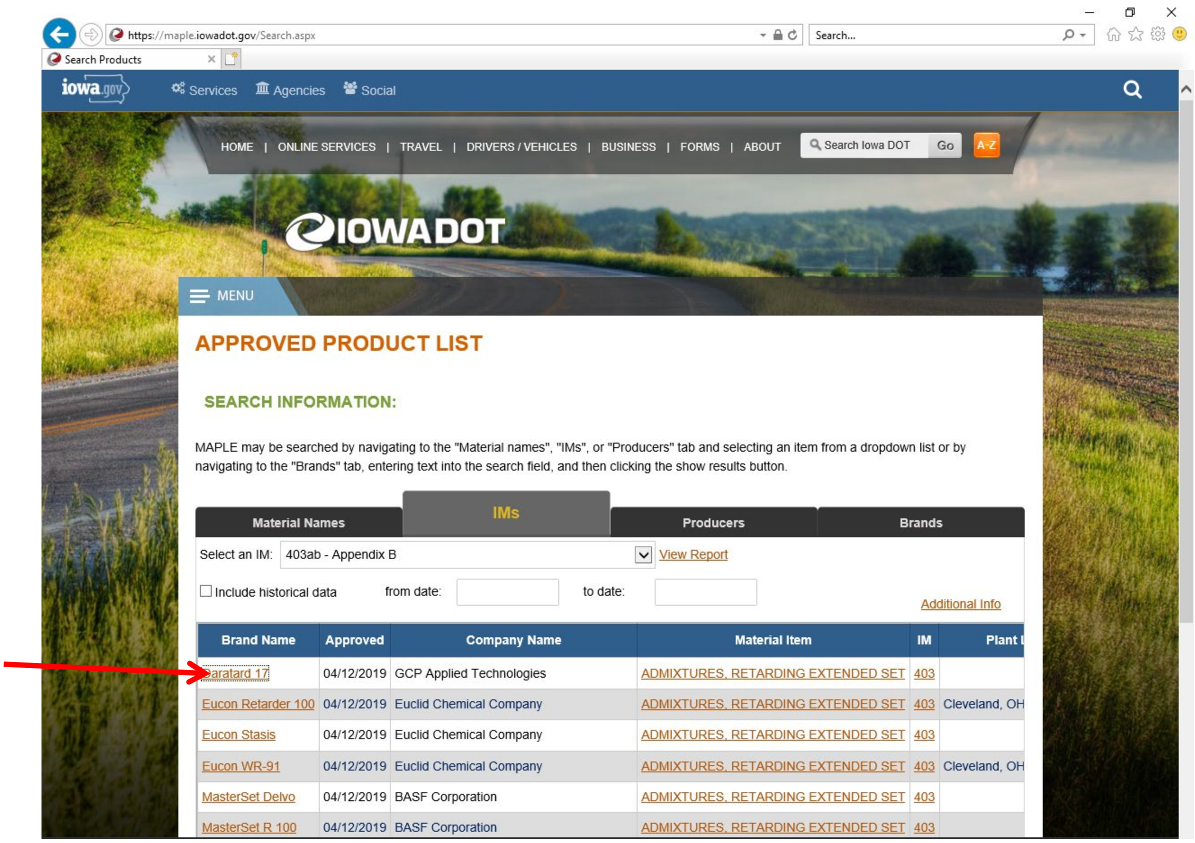
Click on the Brands tab to search by freeform typing the brand name of the product.



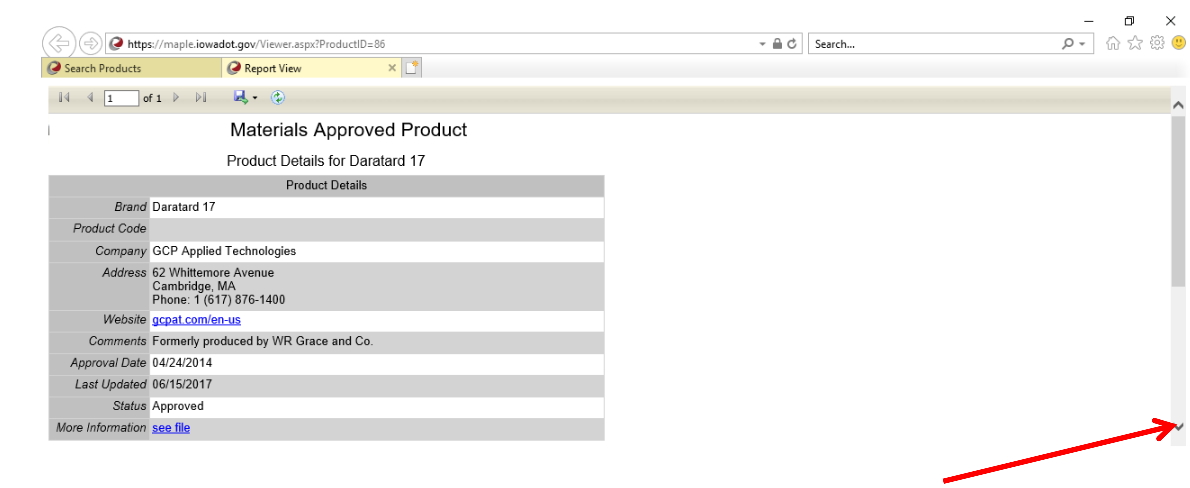



## 8. Selecting a Product

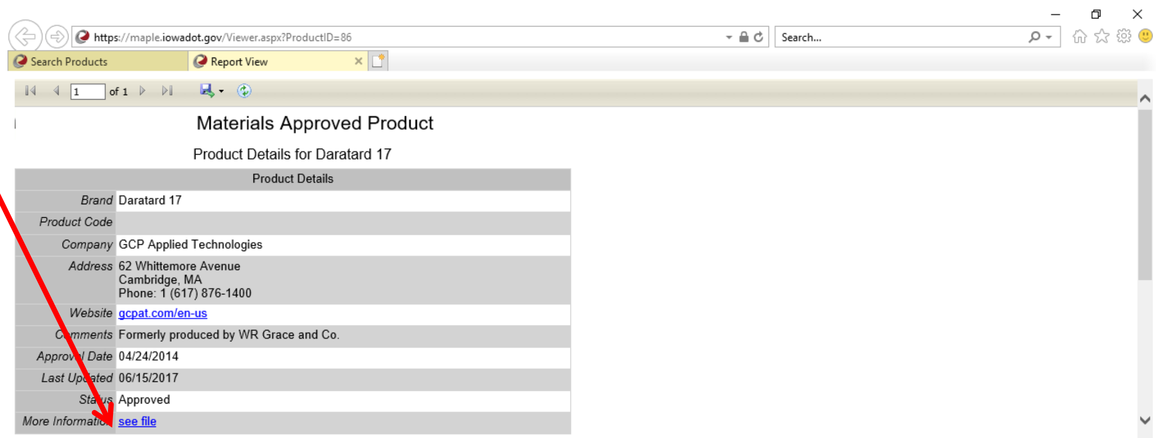
After a list of products has been displayed, click on the individual Brand Name to display more information about the product.




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



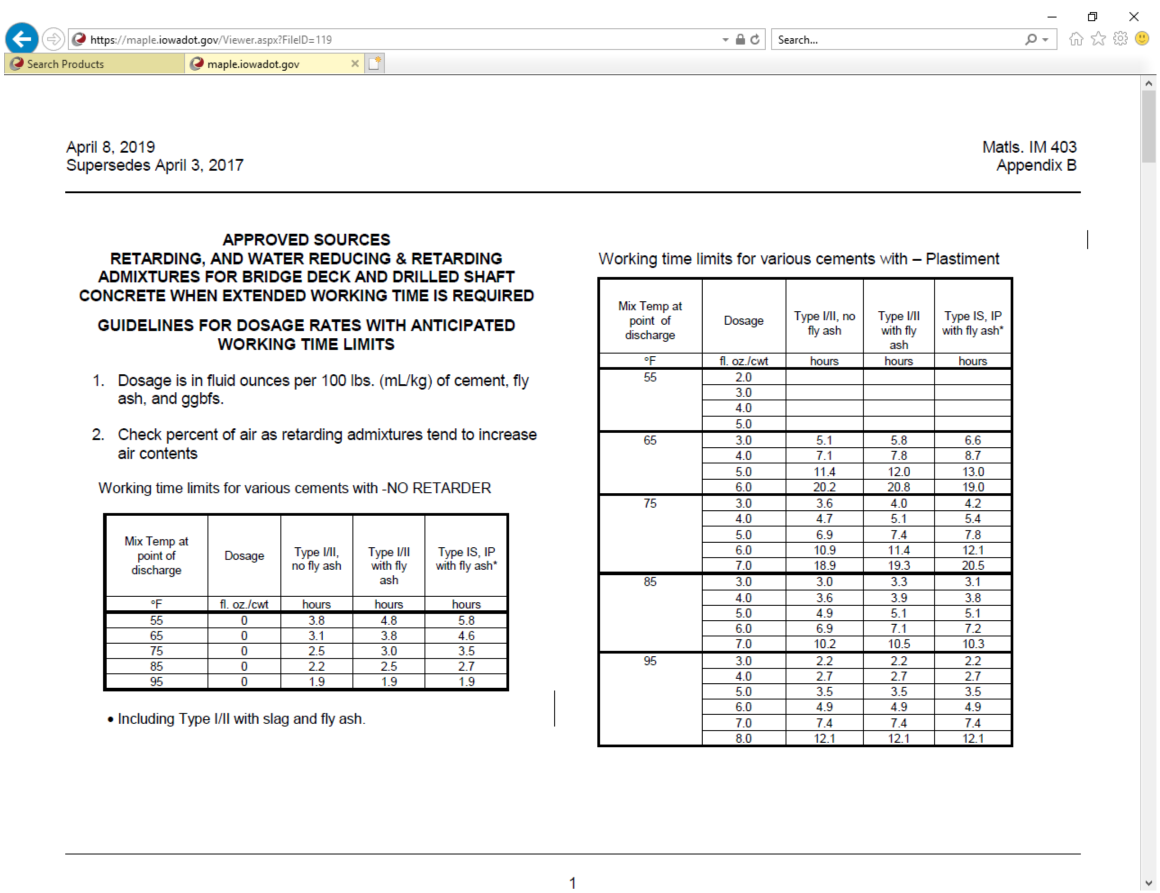
Some products may have a link in the **More Information** field. A pdf with the additional information will appear after clicking on see file. Additional info may be found on the following IM's: 403ab, 445.01ab, 451ad, 455.02aa, 455aa, 462aa, and 557ab.



Materials Approved Product

Product Details for Daratard 17

| Product Details | |
|---|---|
| Brand | Daratard 17 |
| Product Code | |
| Company | GCP Applied Technologies |
| Address | 62 Whittemore Avenue<br>Cambridge, MA<br>Phone: 1 (617) 876-1400 |
| Website | gcpat.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 |



April 8, 2019
Supersedes April 3, 2017

Matls. IM 403
Appendix B

**APPROVED SOURCES**
**RETARDING, AND WATER REDUCING & RETARDING ADMIXTURES FOR BRIDGE DECK AND DRILLED SHAFT CONCRETE WHEN EXTENDED WORKING TIME IS REQUIRED**

**GUIDELINES FOR DOSAGE RATES WITH ANTICIPATED WORKING TIME LIMITS**

1. Dosage is in fluid ounces per 100 lbs. (mL/kg) of cement, fly ash, and ggbfs.
2. Check percent of air as retarding admixtures tend to increase air contents

Working time limits for various cements with -NO RETARDER

| Mix Temp at point of discharge | Dosage | Type I/II, no fly ash | Type I/II with fly ash | Type IS, IP with fly ash* |
|---|---|---|---|---|
| °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 |

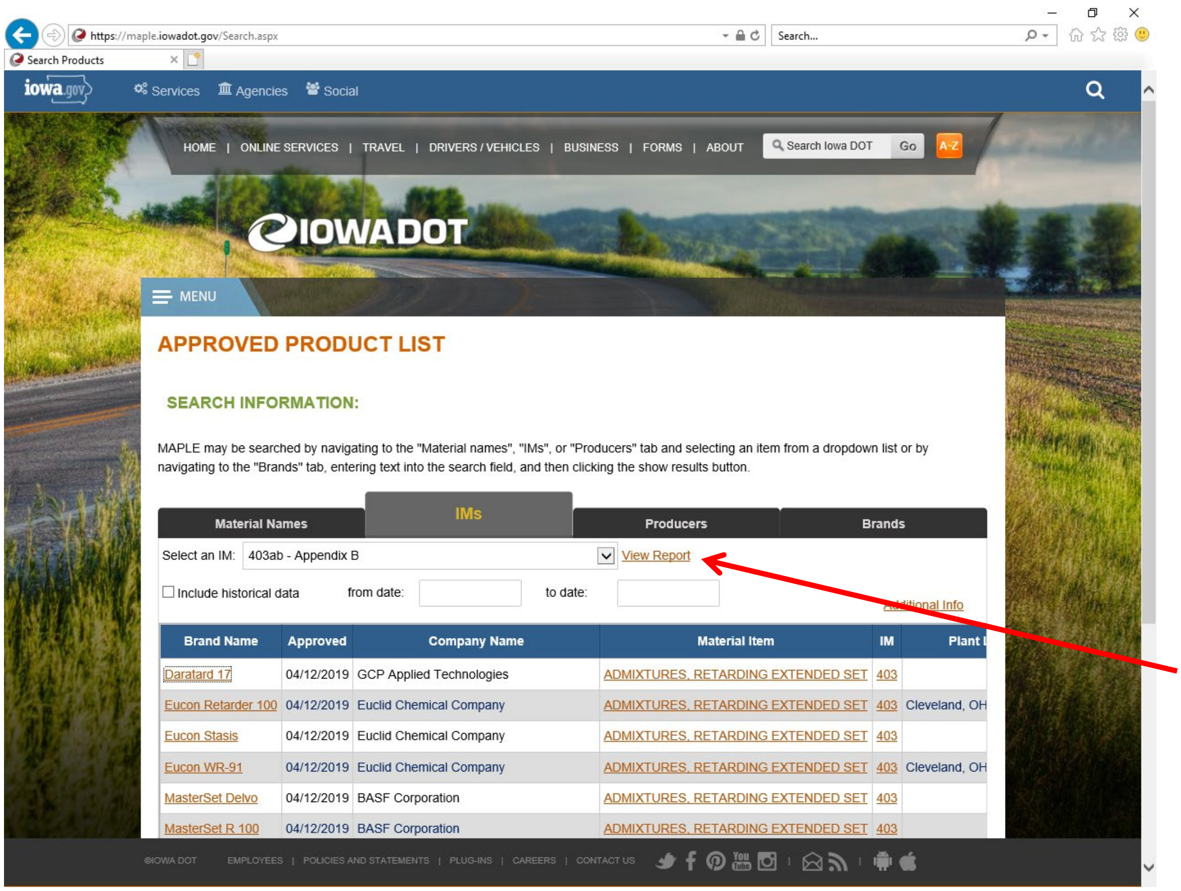
• Including Type I/II with slag and fly ash.

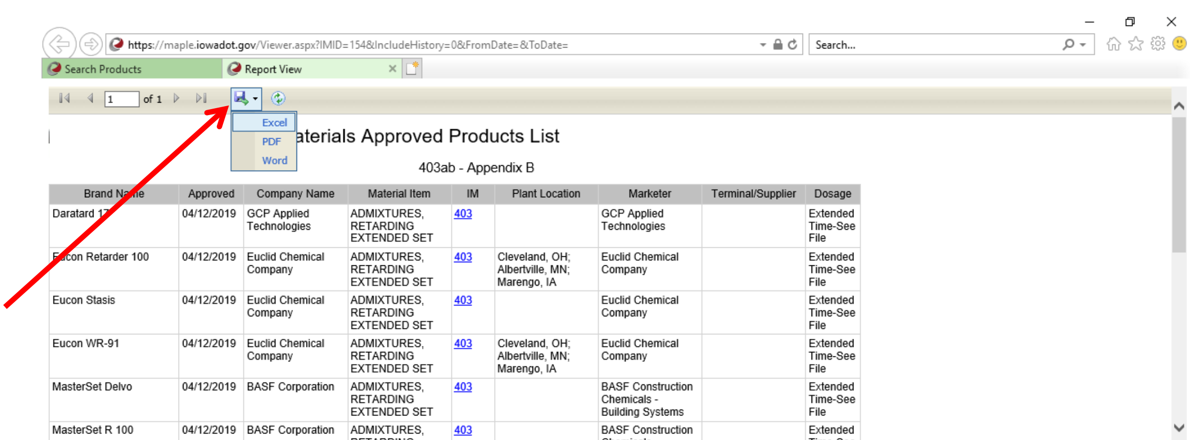
Working time limits for various cements with – Plastiment

| Mix Temp at point of discharge | Dosage | Type I/II, no fly ash | Type I/II with fly ash | Type IS, IP with fly ash* |
|---|---|---|---|---|
| °F | fl. oz./cwt | hours | hours | hours |
| 55 | 2.0 | | | |
| | 3.0 | | | |
| | 4.0 | | | |
| | 5.0 | | | |
| 65 | 3.0 | 5.1 | 5.8 | 6.6 |
| | 4.0 | 7.1 | 7.8 | 8.7 |
| | 5.0 | 11.4 | 12.0 | 13.0 |
| | 6.0 | 20.2 | 20.8 | 19.0 |
| 75 | 3.0 | 3.6 | 4.0 | 4.2 |
| | 4.0 | 4.7 | 5.1 | 5.4 |
| | 5.0 | 6.9 | 7.4 | 7.8 |
| | 6.0 | 10.9 | 11.4 | 12.1 |
| | 7.0 | 18.9 | 19.3 | 20.5 |
| 85 | 3.0 | 3.0 | 3.3 | 3.1 |
| | 4.0 | 3.6 | 3.9 | 3.8 |
| | 5.0 | 4.9 | 5.1 | 5.1 |
| | 6.0 | 6.9 | 7.1 | 7.2 |
| | 7.0 | 10.2 | 10.5 | 10.3 |
| 95 | 3.0 | 2.2 | 2.2 | 2.2 |
| | 4.0 | 2.7 | 2.7 | 2.7 |
| | 5.0 | 3.5 | 3.5 | 3.5 |
| | 6.0 | 4.9 | 4.9 | 4.9 |
| | 7.0 | 7.4 | 7.4 | 7.4 |
| | 8.0 | 12.1 | 12.1 | 12.1 |

1

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



# Chapter 5
# PROPORTIONS

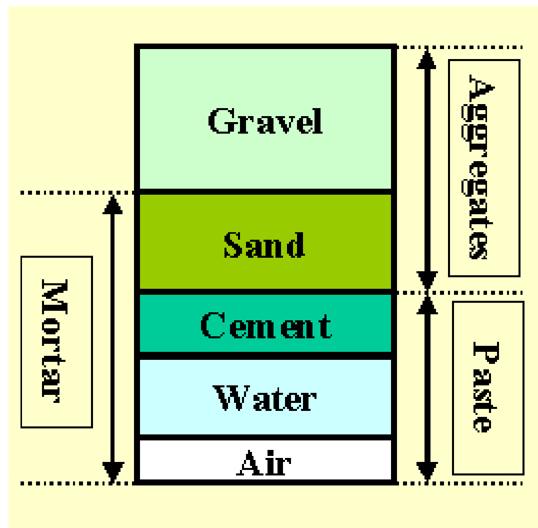
# Proportions

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 cementitous 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 cementitous 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 cementitous 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**

| Absolute Volumes | |
|---|---|
| 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

Cement Weight = 0.108 x 3.14 x 62.4 lbs/$ft^3$ x 27 $ft^3/yd^3$
= 571 lbs. per cubic yard

Basic Water = 0.146 x 1.00 x 62.4 lbs/$ft^3$ x 27 $ft^3/yd^3$
= 246 lbs. per cubic yard

Fine Agg. = 0.309 x 2.65 x 62.4 lbs/$ft^3$ x 27 $ft^3/yd^3$
= 1380 lbs. per cubic yard

Coarse Agg. = 0.377 x 2.65 x 62.4 lbs/$ft^3$ x 27 $ft^3/yd^3$
= 1683 lbs. per cubic yard

# Calculate the Batch Weights for the Materials

## M-3 Mix

| Materials | Source | Absolute Volume | Specific Gravity | Batch Weight |
|---|---|---|---|---|
| Cement | PC0002 Type I/II | 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 (IS) | 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 | PC0201 | 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 (IS) | PC0209 | | 3.11 | |
| Fine Aggregate | A23506 | | 2.66 | |
| Coarse Aggregate | A10010 | | 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 lbs ÷ 3.14 ÷ 62.4 lbs/$ft^3$ ÷ 27 $ft^3/yd^3$<br>= 0.086 |
| Abs. Vol. fly ash | = 114 lbs ÷ 2.59 ÷ 62.4 lbs/$ft^3$ ÷ 27 $ft^3/yd^3$<br>= 0.026 |
| Weight Water | = 0.430 X 571 lbs.<br>= 246 lbs per cubic yard |
| Abs. Vol. Water | = 246 ÷ 1.00 ÷ 62.4 lbs/$ft^3$ ÷ 27 $ft^3/yd^3$<br>= 0.146 |
| Abs. Vol. Air | = 0.060 |
| Abs. Vol.<br>(subtotal) | = 0.086 + 0.026 + 0.146 + 0.060<br>= 0.318 |
| (1-subtotal) | = 1 - 0.318<br>= 0.682 |
| %Coarse | = 0.55 X 0.682<br>= 0.375 |
| %Fine | = 0.45 X 0.686<br>= 0.307 |
| Weight Fine Agg. | = 0.307 X 2.65 X 62.4 lbs/$ft^3$ X 27 $ft^3/yd^3$<br>= 1371 lbs per cubic yard |
| Weight Coarse Agg. | = 0.375 X 2.65 X 62.4 lbs/$ft^3$ X 27 $ft^3/yd^3$<br>= 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 |
| 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) X 100 = 50% replacement for C-3WR-C20-S30

Abs. Vol. cement = 286 lbs ÷ 3.14 ÷ 62.4 lbs/ft$^3$ ÷ 27 ft$^3$/yd$^3$
= 0.054

Abs. Vol. fly ash = 114 lbs ÷ 2.59 ÷ 62.4 lbs/ft$^3$ ÷ 27 ft$^3$/yd$^3$
= 0.026

Abs. Vol. GGBFS = 171 lbs ÷ 2.88 ÷ 62.4 lbs/ft$^3$ ÷ 27 ft$^3$/yd$^3$
= 0.035

Weight Water = 0.430 X 571 lbs.
= 246 lbs per cubic yard

Abs. Vol. Water = 246 ÷ 1.00 ÷ 62.4 lbs/ft$^3$ ÷ 27 ft$^3$/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 X 0.679
= 0.373

%Fine = 0.45 X 0.683
= 0.306

Weight Fine Agg. = 0.306 X 2.65 X 62.4 lbs/ft$^3$ X 27 ft$^3$/yd$^3$
= 1366 lbs per cubic yard

Weight Coarse Agg. = 0.373 X 2.65 X 62.4 lbs/ft$^3$ X 27 ft$^3$/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 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

## 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 | PC0201 |
| Fly Ash | FA000C |
| 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 | PC0002 |
| Fly Ash | FA008C |
| 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

# 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

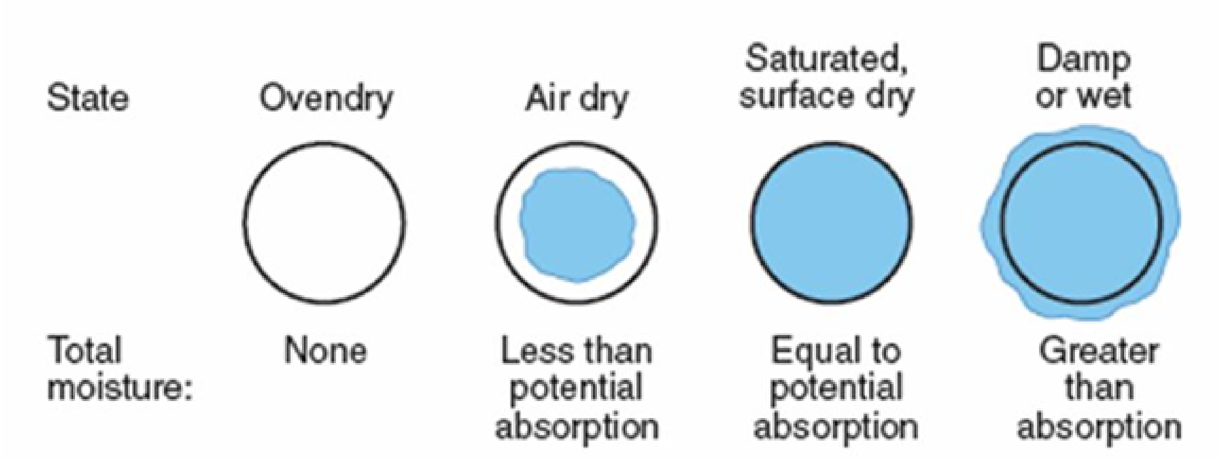
Aggregates can be in four different states. They are the following:

**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 aggregate.

**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 succesive 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. =** $\dfrac{\textbf{Batch wt., SSD}}{\textbf{(100 - \% moisture)}}$ **x 100**

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

Wet Batch wt., fine = $\dfrac{1366 \text{ lbs.}}{(100 - 3.1)}$ x 100 = 1410 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 | 44 |
| | 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. =** $\dfrac{\textbf{Batch wt., SSD}}{\textbf{(100 - \% moisture)}}$ **x 100**

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

Wet Batch wt., fine = $\dfrac{1366 \text{ lbs.}}{(100 - 3.1)}$ x 100 = 1410 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 | 44 |
| | 194 lbs. |

**Maximum Allowed Water** = 0.450 x 571 lbs./yd$^3$ = 256 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 ________

*Answer Fine 3.5 Fine Adjusted Batch Weight __1469__*

*Coarse 0.7 Coarse Adjusted Batch Weight __1571__*

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 ______________

   *Answer* *Total Adjusted Batch Weights* ____3040_____
   *Total Dry Batch Weights* ____2978_____
   *Total Water in Aggregate* _____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 ____________

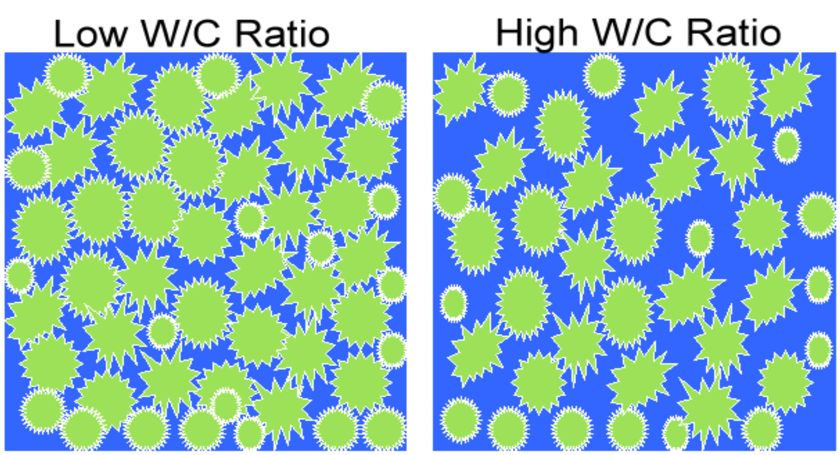
4. M-3-C20
   225 lbs. water added at the plant
   55 lbs. water in the aggregate
   788 lbs. cementitious material
   Maximum water that can be added at the grade ____________

# 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 | 95 | Material | 47 |
| | 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 x 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 | 62 | Grade | 42 |
| | 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,<br>1 per 3 days thereafter | 1/day >500 $yd^3$<br>2/day >1000 $yd^3$ | 1/day > 500 $yd^3$ | 1/day |
| Intermittent | 1/week | 1/day >500 $yd^3$<br>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 $m^3$) 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 $m^3$) 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

A. It is a good idea to try to test each aggregate before the work begins.

B. This gives the pycnometer weight for the moisture test

C. 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 verifcation 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 diferences; 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 | 1 1/2” | 1.00” | 3/4” | 1/2” | 3/8” | 4 | 8 | 30 | 50 | 100 | 200 | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percent Passing | | | | | | | | | | | |
| 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 | 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.~~06~~ 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 | 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 | | | | | | 10-100 | | | | 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 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 ±0.5% of the load and must operate (delivery tolerance) within ±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 ±1% of the required batch amount

- Water Measuring Device

  - Water delivered to the batch must be accurate to 2.2 pounds or ±1% of the amount shown by the indicator; whichever is greater

- Admixture Dispensing Equipment

  - Equipment for dispensing liquid admixtures must be accurate to ±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.

    - Cementitous 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 thorougly 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.

    - Cementitous 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. Cementitous 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 $yd^3$/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.


CAT

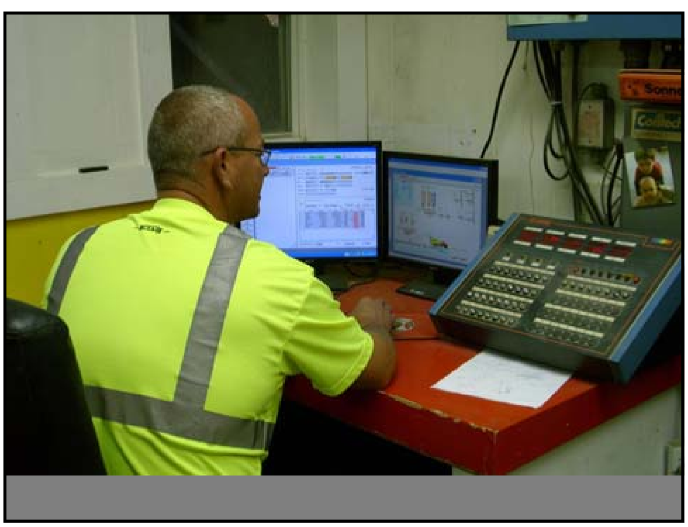

CAT


MANATTS


WIDE LOAD
270106


Cedar Valley
USDOT288800


CON-E-CO




328209


2010/10/06


5000.1


2010/10/06


2010/10/06


2010/10/06


2010/10/06


2010/10/06

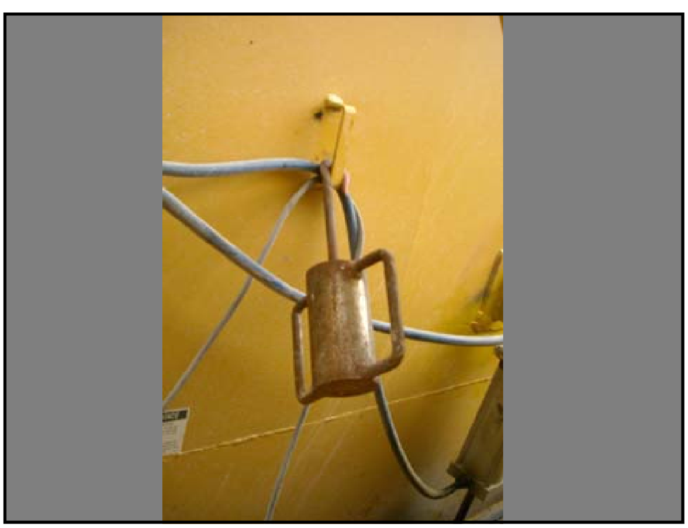

2010/10/06


2010/10/07


2010/10/07

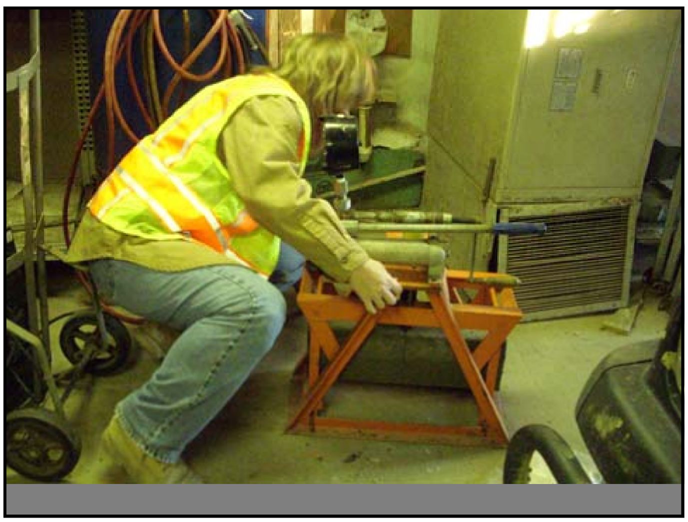

CON-E-CO
9937095

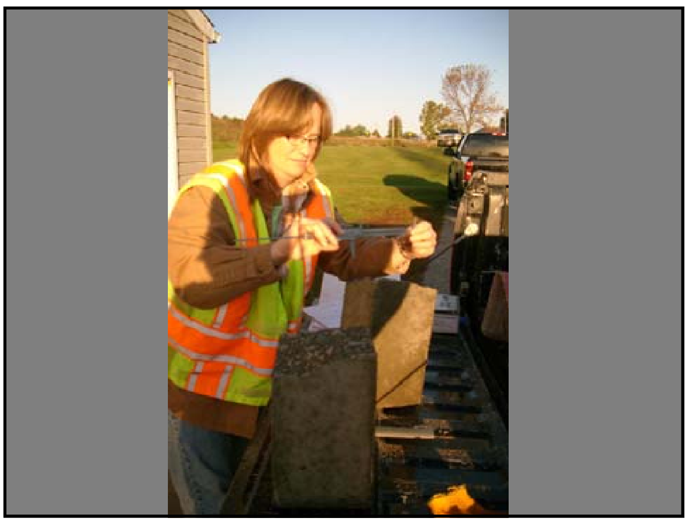

27880
1 2 3 4 5
6 7 8 9 0
738

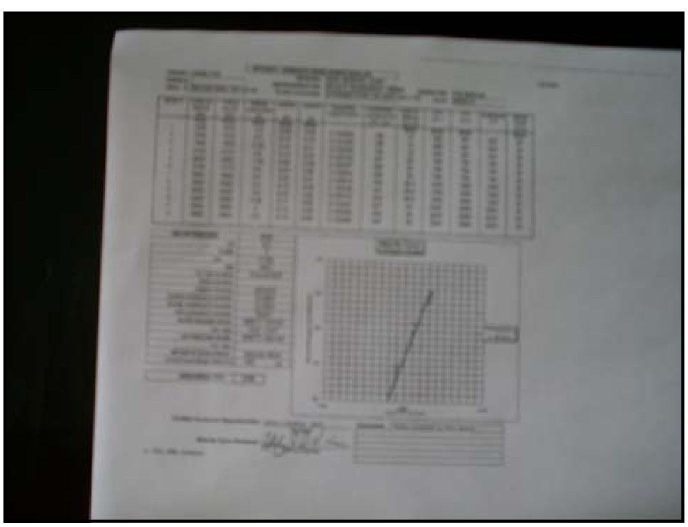



27900
738

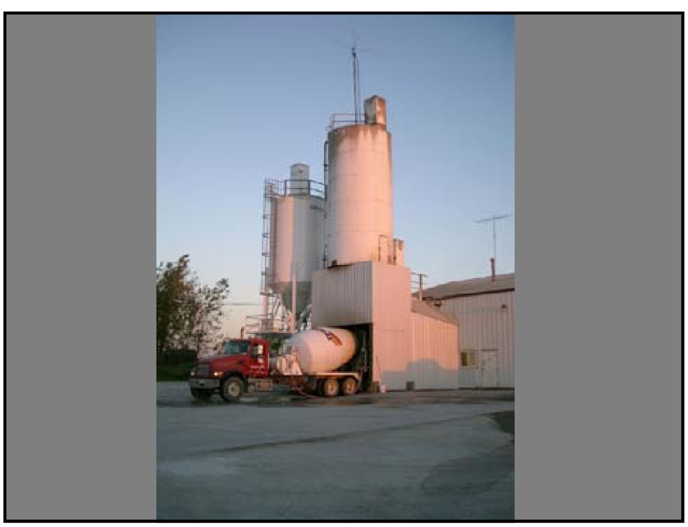

CONCRETE
MATURITY METER








SPEED
LIMIT
40




221601


24


MANATTS

# 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.xlsm
- 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 *(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. _____________________________________

Form 820907
5-00

Iowa Department of Transportation

# 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 ______________ Signature ______________________

Date ______________ Signature ______________________

Date ______________ 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./$m^3$

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/$m^3$

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. ESSN-015-1(7)--3T-76

Mix No. C-4WR-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 | 49 gal./L | | lbs./kg |
| Added *(Plant)* | 134 gal./L | | lbs./kg |
| Subtotal | 183 gal./L | | lbs./kg |
| Added Grade | 7 gal./L | | lbs./kg |
| TOTAL WATER | 190 gal./L | | lbs./kg |

Maximum Water Allowed 208 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 ¾ 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./$m^3$

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/$m^3$

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. ________________________

Form 820912E
8-00

**Iowa Department of Transportation**

Office of Materials

## PORTLAND CEMENT SHIPMENT YIELD REPORT

Report No. ___________________
Date Submitted _______________

Contract ID: _________________________
Project No.: _________________________
County: _________________________
Plant Location: _______________________________________________________________
Source: ___________________________
Contractor: ___________________________

| 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.: ___________________________

**Distribution:** ____ DME ____ RCE ____ Central Materials ____ Contractor ____ Inspector

Form 820912E - computer

Report No.: 1
Date Submitted: 09/24/10

E - Units

**Portland Cement Shipment Yield Report**

Contract ID: 78889
Project No.: STP388-(34)-445
County: Henry
Plant Location: Hwy. 34
Source: Ash Grove
Contractor: Benson Paving

| Date | Invoice Number | Billed Tons | Type | Date | Invoice Number | Billed Tons | Type | Date | Invoice Number | Billed Tons | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/20 | 11456 | 24.30 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/20 | 11779 | 23.77 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/20 | 12467 | 24.11 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/20 | 12888 | 23.67 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/20 | 13664 | 23.98 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/20 | 14321 | 24.22 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/21 | 14478 | 24.46 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/21 | 14555 | 24.12 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/21 | 15522 | 24.43 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/21 | 15688 | 24.21 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 09/21 | 15777 | 23.87 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |
| 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II | 0 | 0 | 0.00 | I/II |

| Mix No. | Cement batched lbs / yd3 | Batched yd3 | | Cement Batched Tons |
|---|---|---|---|---|
| C-4WR | 624 | 788.00 | ............ | 245.86 |
| M-4 | 825 | 49.00 | ............ | 20.21 |
| 0 | 0 | 0.00 | ............ | 0.00 |
| 0 | 0 | 0.00 | ............ | 0.00 |
| 0 | 0 | 0.00 | ............ | 0.00 |
| Left In Scale | This Check ( + ) | | | 2.10 |
| (Tons) | Previous Yield Check ( - ) | | | 1.90 |
| Total Weighed ( Batch Scale ) | | | | 266.27 |

| Total Billed Wt. | Tons | 265.14 |
|---|---|---|

Yield = 100.4 %

C.P.I.: ______________________
Signature

Distribution: _____ DME _____ RCE _____ Central Materials _____ Contractor _____ Inspector

## 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.

## 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.

800240E - 04/00 computer

| Date of Placement | Location From | To |
|---|---|---|
| Mix 1 05/02/98 | 101+13 | 133+69 |
| Mix 2 11/29/99 | | |
| Mix 3 | | |
| Mix 4 | | |

Project No.: NHS-18-5(123)--19-17
Plant Name: CARLSON's HWY 65 & HWY 18
Contractor / Sub: FRED CARLSON
Weather: MOSTLY SUNNY

Contract ID: 17-0185-11
County: CERRO GORDO
Temp. (°F) Min: 48
Temp. (°F) Max: 70

Report No.: 2
Date This Report: 06/02/96
Date Of Last Report: 06/01/96

| Check Mix( x ) | | Check One( x ) | | SEND |
|---|---|---|---|---|
| Central | X | Paving | X | (Daily) |
| Ready | | Structure | | (Weekly) |
| | | Incidental | | (Weekly) |
| | | Patching | | (Weekly) or end of Lot |

| | Mix | Batched (CY) | % Of Est. Used | Fine Aggregate Moist. (%) | Fine T-203 Sp. G. | Fine Wt. SSD (lbs) | Intermediate Aggregate Moist. (%) | Inter. T-203 Sp. G. | Inter. Wt. SSD (lbs) | Coarse Aggregate Moist. (%) | Coarse T-203 Sp. G. | Coarse Wt. SSD (lbs) | Actual Quantities Used Per cy (in pounds) Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C15 | 1,100.00 | 101.3 | 4.0 | 2.67 | 1,390 | | | | 0.9 | 2.75 | 1,751 | 470 | 83 | | 1,448 | | 1,767 | 74 | 164.0 | | 0.430 | 0.489 |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |

| Coarse | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 50-100 | 30-100 | 20-75 | 5-55 | 0-10 | 0-5 | 0-1.5 | Y/N |
| | 100 | 75 | 49 | 31 | 14 | 4.1 | 0.5 | 0.5 | Y |
| | | | | | | | | | |
| | | | | | | | | | |

| Inter. | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Y/N |
| | | | | | | | | | NA |
| | | | | | | | | | NA |
| | | | | | | | | | NA |

| Fine | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 90-100 | 70-100 | | 10-60 | | | 0-1.5 | Y/N |
| | 100 | 88 | 69 | 44 | 25 | 11 | 4.7 | 0.3 | Y |
| | | | | | | | | | |
| | | | | | | | | | |

| Concrete Treatment (x) | | lb / cy |
|---|---|---|
| Ice | | |
| Heated Water | | |
| Heated Materials | | |

| Check One (X) | Batched Today | Week | Total To Date |
|---|---|---|---|
| | X | | |
| Concrete (CY): | 1,100.00 | | 17,279.60 |
| Cement (tons): | 258.50 | | 5,007.39 |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | SIKA AEA 15 | 7 OZ./CY | C80005M |
| Water Reducer: | SIKA PLASTOCRETE 161 | 3 OZ./CWT | D80002P |
| Retarder: | | | |
| Calcium Chloride: | | | |
| Superplasticizer: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IS | 3.04 | HOLNAM |
| Fly Ash: | C | 2.56 | PORTAGE 1 |
| GGBFS: | | | |

| Adjusted % Passing Calculated Combined Gradation | 1.5" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Within Target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Target | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

| | T-203 A - # | Grad No. |
|---|---|---|
| Coarse: | A17008 | 4 |
| Intermediate: | | |
| Fine: | A17514 | 1 |

| Remarks |
|---|
| This is a test report |
| |
| |

Distribution: ____ Central Materials ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: JEFFREY BOLSINGER NE118
Monitor: JASON RUTER NE443

800240 computer v5.6

# PCC Plant Report

E - Units

| Date of Placement | Location From | To |
|---|---|---|
| Mix 1 | | |
| Mix 2 | | |
| Mix 3 | | |
| Mix 4 | | |
| Mix 5 | | |

Project No.: ______
Plant Name: ______
Contractor: ______
SubContractor: ______
Weather: ______
Maturity Used?: ______

Contract ID: ______
County: ______
Temp. Min: ______ ºF
Temp. Max: ______ ºF
Maturity Mix ID: ______
TTF: ______

Report No.: ______
Date This Report: ______
Date Of Last Report: ______
Structures Des. No: ______
Curve / Validation date: ______
Curve #: ______

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

Max On Grade W/C Ratio: ______

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

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

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

| Check One (X) | Batched Today | Week | Total To Date |
|---|---|---|---|
| Concrete: yd3 | | | |
| Cement: tons | | | |

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

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | | | |
| Water Reducer (Normal): | | | |
| Retarder: | | | |
| Calcium Chloride: | | | |
| Superplasticizer: | | | |

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

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | | | |
| Fly Ash: | | | |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

| | Source | T-203 A # | Grad. No. |
|---|---|---|---|
| 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

800240 computer v5.6

# PCC Plant Report

E - Units

| Date of Placement | Location From | To |
|---|---|---|
| Mix 1 | | |
| 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 ) | | Check One( x ) | | SEND |
|---|---|---|---|---|
| Central | | Paving | | (Daily) |
| Ready | | Structure | | (Weekly) |
| | | Non-structural | | (Monthly) |
| | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio: ____

| | Mix | Batched | % Of Est. | Fine Aggregate | | | Intermediate Aggregate | | | Coarse Aggregate | | | Actual Quantities Used - lbs/yd3 | | | | | | Water | | | Avg | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | yd3 | Used | 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 | GGBFS | Fine | Inter. | Coarse | In Agg. | Plant | Grade | w/c Ratio | w/c Ratio |
| 1 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | |

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

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

| | Batched | | |
|---|---|---|---|
| Check One (X) | Today | Week | Total To Date |
| Concrete: yd3 | | | |
| Cement: tons | | | |

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

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | | | |
| Water Reducer (Normal): | | | |
| Retarder: | | | |
| Calcium Chloride: | | | |
| Superplasticizer: | | | |

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

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | | | |
| Fly Ash: | | | |
| GGBFS: | | | |

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

| | Source | T-203 A # | Grad. No. |
|---|---|---|---|
| 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

800240 computer v10.1

PCC Plant Report

E - Units

| Date of Placement | | Location 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 #:

Contract ID: 67592
County: 58-Louisa
Temp. Min: 69 °F
Temp. Max: 87 °F
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 ) | | Placement Type | | Report | SEND |
|---|---|---|---|---|---|
| Central | X | Paving | Continous | X | (Daily) |
| Ready | | | | | (Weekly) |
| | | | Non-structural | | (Monthly) |
| | | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD lbs | Actual Quantities Used - lbs/yd3 Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C20 | 1,256.00 | 0.0 | 0.00 | 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 | C-3WR-C20 | 1,384.00 | 0.0 | 0.00 | 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 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |

| Coarse | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | 100 | 95-100 | | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | | | | | | | | | Y/N |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

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

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

| | Batched Check One (X) | Daily X | | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| Concrete: | yd3 | 2640.00 | | | 0.00 | |
| Cement: | tons | 588.72 | | | | |

| CarbonCure: | Dose (oz/cy) | Cement Redux. % |
|---|---|---|
| | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Daravair 1000-GCP | 5.0 oz/yd | 233998 |
| Normal Water Reducer: | Eucon WR-75-Euclid | 3 oz./100lbs | 557882 |
| Mid-Range Water Reducer: | | | |
| High-Range Water Reducer: | | | |
| Retarder: | | | |
| Special Performance Admixturer: | | | |
| Concrete Fibers: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IS(25) | 3.06 | PC0707-Central Plains - EaglePave-IS(25) |
| Fly Ash: | C | 2.62 | FA004C-Council Bluffs Unit #3 |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A10030-SOUTH AURORA | 3 |
| Intermediate: | | |
| Fine: | A06502-VINTON-MILROY | 1 |

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

800240 computer v10.1

# PCC Plant Report

E - Units

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

Project No.: FM-91(15)--66-91
Plant Name: Warren _R63
Contractor: Knife River
SubContractor:
Weather: Sunny/Cool
Maturity?: Curve #:

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

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

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

Max On Grade W/C Ratio:

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

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

| Intermediate Sample Date: | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Y/N |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

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

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

| | Dose (oz/cy) | Cement Redux. | % |
|---|---|---|---|
| CarbonCure: | | | |

| | Batched Check One (X) | Daily | | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| | | X | | | | |
| Concrete: | yd3 | | | | | |
| Cement: | tons | | | | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Sika Air-Sika | 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: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IL | | PC0009-Ash Grove - Louisville-IL |
| Fly Ash: | | | |
| GGBFS: | | | |

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

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A22010-OSTERDOCK | 3 |
| Intermediate: | | |
| Fine: | A06502-VINTON-MILROY | 1 |

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

**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

800240 computer v10.1

# PCC Plant Report

| Date of Placement | | Location 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 #:

Contract ID: 67592
County: 58-Louisa
Temp. Min: 69 °F
Temp. Max: 87 °F
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 ) | | Placement Type | | E - Units Report | SEND |
|---|---|---|---|---|---|
| Central | X | Paving | Continous | X | (Daily) |
| Ready | | | | | (Weekly) |
| | | | Non-structural | | (Monthly) |
| | | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD lbs | Actual Quantities Used - lbs/yd3 Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C20 | 1,256.00 | | | 3.3 | | | | | | 0.5 | | | | | | | | | | 175.0 | | | |
| 2 | C-3WR-C20 | 1,384.00 | | | 3.0 | | | | | | 0.3 | | | | | | | | | | 190.0 | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | |

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

| Intermediate Sample Date: | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply Y/N |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

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

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

| | Batched Check One (X) | Daily | | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| | | X | | | | |
| Concrete: | yd3 | | | | | |
| Cement: | tons | | | | | |

| CarbonCure: | Dose (oz/cy) | Cement Redux. % |
|---|---|---|
| | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Daravair 1000-GCP | 5.0 oz/yd | 233998 |
| Normal Water Reducer: | Eucon WR-75-Euclid | 3 oz./100lbs | 557882 |
| Mid-Range Water Reducer: | | | |
| High-Range Water Reducer: | | | |
| Retarder: | | | |
| Special Performance Admixturer: | | | |
| Concrete Fibers: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IS(25) | 3.06 | PC0707-Central Plains - EaglePave-IS(25) |
| Fly Ash: | C | 2.62 | FA004C-Council Bluffs Unit #3 |
| GGBFS: | | | |

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

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A10030-SOUTH AURORA | 3 |
| Intermediate: | | |
| Fine: | A06502-VINTON-MILROY | 1 |

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

**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**

800240 computer v5.6

# PCC Plant Report

E - Units

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

| | | | | | |
|---|---|---|---|---|---|
| Project No.: | STP-99(19)30-85 | Contract ID: | 15876 | Report No.: | 4 |
| Plant Name: | Manatt's Paving - Nevada | County: | Story | Date This Report: | 10/01/15 |
| Contractor: | Manatt's | Temp. Min: | 72 ºF | Date Of Last Report: | 09/30/15 |
| SubContractor: | | Temp. Max: | 85 ºF | Structures Des. No: | |
| Weather: | Warm/Dry | Maturity Mix ID: | | Curve / Validation date: | |
| Maturity Used?: | | TTF: | | Curve #: | |

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

Max On Grade W/C Ratio:

| | | | | Fine Aggregate | | | Intermediate Aggregate | | | Coarse Aggregate | | | Actual Quantities Used - lbs/yd3 | | | | | | Water | | | Avg | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mix | Batched yd3 | % Of Est. Used | 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 | GGBFS | Fine | Inter. | Coarse | In Agg. | Plant | Grade | w/c Ratio | w/c Ratio |
| 1 | C-4-C15 | 975.00 | | 2.9 | | | | | | 0.3 | | | | | | | | | | 225.0 | | | |
| 2 | M-4 | 128.00 | | 2.9 | | | | | | 0.3 | | | | | | | | | | 238.0 | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | |

| Coarse | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| 48.0 | | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | 0-2.5 | Y/N |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |

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

| | Batched | | |
|---|---|---|---|
| Check One (X) | Today | Week | Total To Date |
| | X | | |
| Concrete: yd3 | | | |
| Cement: tons | | | |

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

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

| Fine | 1/2" | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| 40.0 | | 100 | 90-100 | 70-100 | | 10-60 | | | 0-1.5 | Y/N |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | I/II | | PC0002 |
| Fly Ash: | C | | FA003CF |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

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

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

Rev 05/09

Form E820150E

**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**

800240 computer v10.1

# PCC Plant Report

| Date of Placement | Location From | Location 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 | | E - Units Report | SEND |
|---|---|---|---|---|---|
| Central | X | Paving | Continous | X | (Daily) |
| Ready | | | | | (Weekly) |
| | | | Non-structural | | (Monthly) |
| | | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine T-203 Sp. G. | Fine Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate T-203 Sp. G. | Intermediate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse T-203 Sp. G. | Coarse Wt. SSD lbs | Actual Quantities Used - lbs/yd3: Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C20 | 1,256.00 | | | 3.8 | | | | | | 0.7 | | | | | | | | | | 151.0 | 26.0 | | 0.450 |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | |

Coarse

| Sample Date: | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | 0-2.5 | Y/N |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Intermediate

| Sample Date: | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Y/N |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Fine

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

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

| | Dose (oz/cy) | Cement Redux. | % |
|---|---|---|---|
| CarbonCure: | | | |

| | Check One (X) | Daily | | Batched Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| | | X | | | | |
| Concrete: | yd3 | 1256.00 | | | | |
| Cement: | tons | | | | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Sika AEA-14-Sika | 5.0 oz/yd | 77AA4356 |
| Normal Water Reducer: | Eucon WR-75-Euclid | 3 oz./100lbs | ME88934C |
| Mid-Range Water Reducer: | | | |
| High-Range Water Reducer: | | | |
| Retarder: | | | |
| Special Performance Admixturer: | | | |
| Concrete Fibers: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | I/II | | PC3402-St Marys - Charlevoix-II |
| Fly Ash: | C | | FA010C-Muscatine Power & Water |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A23004-BEHR | 3 |
| Intermediate: | | |
| Fine: | A05506-EXIRA | 1 |

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

Rev 05/09

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

Form E820150E

**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 | PC0002 Type I/II | 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 | PC0201 | 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** | **Abs Vol** | **Specific Gravity** | **Batch Wt.** |
|---|---|---|---|---|
| Cement | PC0209 | 0.108 | 3.11 | 566 |
| Fine Aggregate | A23506 | 0.309 | 2.66 | 1385 |
| Coarse Aggregate | A10010 | 0.377 | 2.66 | 1690 |
| Water | City | 0.146 | 1.00 | 246 |
| Air | | 0.060 | | |

# 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 | PC0201 |
| Fly Ash | FA000C |
| Fine Aggregate | A26502 |
| Coarse Aggregate | A26004 |
| Water | City |
| Air | |

# Solution for Page 5-17

Rev 02/01

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

Form E820150
E - Units

**Project No.:** ______ **County :** ______

**Mix No.:** M-4-C10 **Abs Vol. Cement:** 0.156 **Type:** ______

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cement (IM 401):** | 825 | lbs | **Source:** | PC0201 | **Sp. Gr.:** | 3.14 |
| | % | | | | | |
| **Fly Ash (IM 491.17):** | 10 | 83 | **Source:** | FA000C | **Sp. Gr.:** | 2.80 |
| **Slag (IM 491.14):** | | 0 | **Source:** | | **Sp. Gr.:** | |

**Adjusted Cement:** 742 lbs

**Total Cementitious** 825 lbs **Total % Replacement =** 10

| | | | | |
|---|---|---|---|---|
| **IM T203** | **Fine Aggregate Source:** | A26502 | **Sp. Gr.:** | 2.67 |
| **IM T203** | **Interm. Aggregate Source:** | | **Sp. Gr.:** | |
| **IM T203** | **Coarse Agregate Source:** | A26004 | **Sp. Gr.:** | 2.60 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Basic w/c** | 0.328 | **Water** | **lbs/cy** | **= Basic w/c X (Total Cementitious)** | **=** | 271 |
| **Max w/c** | 0.400 | **Max. Water** | **lbs/cy** | **= Max w/c X (Total Cementitious)** | **=** | 330 |

**Absolute Volumes**

| | | | |
|---|---|---|---|
| **Cement** ............ | **(lbs/cy) / ( Sp. Gr. X 62.4 X 27)** | **=** | 0.140 |
| **Fly Ash** ............ | **(lbs/cy) / ( Sp. Gr. X 62.4 X 27)** | **=** | 0.018 |
| **Slag** ............ | **(lbs/cy) / ( Sp. Gr. X 62.4 X 27)** | **=** | |
| **Water** ............ | **(lbs/cy) / ( Sp. Gr. X 62.4 X 27)** | **=** | 0.161 |
| **Air** ............ | | | 0.060 |

| | | |
|---|---|---|
| **Subtotal** | **=** | 0.379 |
| **1.000 - Subtotal** | **=** | 0.621 |
| **Total** | **=** | 1.000 |

| | | | | |
|---|---|---|---|---|
| **% FA Agg.:** | 50 | **Fine Aggregate ( 1.000 - Subtotal ) X % In Mix** | **=** | 0.310 |
| **% In. Agg.:** | | **Interm. Aggregate ( 1.000 - Subtotal ) X % In Mix** | **=** | |
| **% CA Agg.:** | 50 | **Coarse Aggregate ( 1.000 - Subtotal ) X % In Mix** | **=** | 0.311 |
| | | **Aggregate Total** | **=** | 0.621 |

**Aggregate Weights**

| | | | |
|---|---|---|---|
| **Fine:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | **=** | 1395 |
| **Intermediate:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | **=** | |
| **Coarse:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | **=** | 1362 |

**Summary**

| | | |
|---|---|---|
| **Cement** | 742 | **lbs/cy** |
| **Fly Ash** | 83 | **lbs/cy** |
| **Slag** | 0 | **lbs/cy** |
| **Water** | 271 | **lbs/cy** |
| **Fine Agg.** | 1395 | **lbs/cy** |
| **Interm. Agg.** | | **lbs/cy** |
| **Coarse Agg.** | 1362 | **lbs/cy** |

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

# Solution for Page 5-18

## 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 | PC0009 |
| Fly Ash | FA009C |
| Fine Aggregate | A19522 |
| Coarse Aggregate | A22040 |
| 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: | PC0009-Ash Grove - Louisv | 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: | A19522-BUCKY'S | Sp. Gr.: | 2.65 |
| IM T203 | Interm. Aggregate Source: | | Sp. Gr.: | |
| IM T203 | Coarse Agregate Source: | A22040-HARTMAN | Sp. Gr.: | 2.68 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 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) | = | 0.025 |
| 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 | = | 0.315 |
| | 1.000 - Subtotal | = | 0.685 |
| | Total | = | 1.000 |

| | | | | |
|---|---|---|---|---|
| % FA Agg.: | 45 | Fine Aggregate ( 1.000 - Subtotal ) X % In Mix | = | 0.308 |
| % 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 | = | 0.685 |

**Aggregate Weights**

| | | | |
|---|---|---|---|
| Fine: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1375 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1702 |

**Summary**

Plant Name & Location:
CPI:
Cert #:

| | | |
|---|---|---|
| Cement | 453 | lbs/cy |
| Fly Ash | 113 | lbs/cy |
| Slag | 0 | lbs/cy |
| Water | 243 | lbs/cy |
| Fine Agg. | 1375 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1702 | lbs/cy |

# 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 | Form E820150
Office Of Materials | E - Units
PORTLAND CEMENT CONCRETE

| | | | | | |
|---|---|---|---|---|---|
| Project No.: | | | | County : | 91-Warren |
| Mix No.: | C-3WR-C20S20 | Abs Vol. Cement: | 0.1080 | Type: | IL |
| Cement (IM 401): | 566 | lbs | Source: PC0009-Ash Grove - Louisv | Sp. Gr.: | 3.11 |
| Fly Ash (IM 491.17): | % 20 | 113 | Source: FA009C-Louisa Generating | Sp. Gr.: | 2.69 |
| Slag (IM 491.14): | % 20 | 113 | Source: SL00A-Skyway Cement | Sp. Gr.: | 2.87 |
| CarbonCure: | % 0 | 0 | Cement Reduction | | |
| Adjusted Cement: | 340 | lbs | | | |
| Total Cementitious | 566 | lbs | Total % Replacement = | 46 | |

| | | | | |
|---|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A19522-BUCKY'S | Sp. Gr.: | 2.65 |
| IM T203 | Interm. Aggregate Source: | | Sp. Gr.: | |
| IM T203 | Coarse Agregate Source: | A22040-HARTMAN | Sp. Gr.: | 2.68 |

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

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

**Aggregate Weights**

| | | | |
|---|---|---|---|
| Fine: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1371 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1698 |

**Summary**

Plant Name & Location:
CPI:
Cert #:

| | | |
|---|---|---|
| Cement | 340 | lbs/cy |
| Fly Ash | 113 | lbs/cy |
| Slag | 113 | lbs/cy |
| Water | 243 | lbs/cy |
| Fine Agg. | 1371 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1698 | lbs/cy |

# 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



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-S30 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 | 47 | gal./L | | lbs./kg |
| Added *(Plant)* | 108 | gal./L | | lbs./kg |
| Subtotal | 155 | gal./L | | lbs./kg |
| Added Grade | 14 | 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 NW999

# Solution for Page 9-11



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 | 69 | gal./L | | lbs./kg |
| Added *(Plant)* | 198 | gal./L | | lbs./kg |
| Subtotal | 267 | gal./L | | lbs./kg |
| Added Grade | 27 | 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 x 623 = 3, 035, 256 lb ÷ 2000 = **1517.63**

615 x 604 = 371, 460 lb ÷ 2000 = **185.73**

66 x 823 = 54,318 lb ÷ 2000 = **27.16**

**Total = 3, 461, 034 lb ÷ 2000 = 1730.52**

Left in scale hopper: 3000 lb ÷ 2000 = **1.50**

Left from last check: 4096 lb ÷ 2000 = **2.05**

1730.52 + 1.50 - 2.05 = **1729.97**

**Total billed = 3, 333, 333 ÷ 2000 = 1666.67**

(1729.97 ÷ 1666.67) x 100 = **103.8 %**

**Remember:**

1. Cement shipment yield determination must be made every 10,000 $yd^3$ 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 yd.$^3$ X 492 lb./ yd.$^3$ = 728,160 lb.. ÷ 2000 lb./ton = **364.08 ton**

500 yd.$^3$ X 571 lb./ yd.$^3$ = 285,500 lb. ÷ 2000 lb./ton = **142.75 ton**

**Total batched 506.83 ton**

Left in scale

Last check 2600 ÷ 2000 = **1.30 ton**

This check 3000 ÷ 2000 = **1.5 ton**

Total billed: 1,024,100 ÷ 2000 = **512.05 ton**

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

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

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

# Solution for Page 9-29

800240 computer v10.1

## PCC Plant Report

| E - Units | |
|---|---|
| Report | SEND |
| X | (Daily) |
| | (Weekly) |
| | (Monthly) |
| | (Project) |

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

Project No.: FM-91(15)--66-91
Plant Name: Warren _R63
Contractor: Knife River
SubContractor:
Weather: Sunny/Cool
Maturity?: Curve #:

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

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

| Plant Type ( x ) | | Placement Type | |
|---|---|---|---|
| Central | X | Paving | Continous |
| Ready | | | |
| | | | Non-structural |
| | | | Miscellaneous |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD lbs | Actual Quantities Used - lbs/yd3 Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M-4 | 1,011.50 | 0.0 | 0.00 | 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 | 0.0 | 0.00 | 3.0 | 2.65 | 1,393 | | | | 0.3 | 2.67 | 1408 | 817 | | | 1436 | | 1412 | 47 | 245.0 | 0.0 | 0.358 | 0.400 |
| 3 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |

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

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

| | Check One (X) | Daily X | Batched | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| Concrete: | yd3 | 1090.50 | | | 0.00 | |
| Cement: | tons | 445.47 | | | | |

| Intermediate | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | | | | | | | | | Y/N |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| | Dose (oz/cy) | Cement Redux. | % |
|---|---|---|---|
| CarbonCure: | | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Sika Air-Sika | 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: | | | |

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

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IL | 3.11 | PC0009-Ash Grove - Louisville-IL |
| Fly Ash: | | | |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A22010-OSTERDOCK | 3 |
| Intermediate: | | |
| Fine: | A06502-VINTON-MILROY | 1 |

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 9-31

4/3/2023 Iowa Department Of Transportation Form E820150

Office Of Materials E - Units

PORTLAND CEMENT CONCRETE

**Project No.:** FM-91(15)--66-91 **County :** 91-Warren

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

| | | | | | |
|---|---|---|---|---|---|
| Cement (IM 401): | 566 | lbs | Source: PC0009-Ash Grove - Louisv | Sp. Gr.: | 3.11 |
| Fly Ash (IM 491.17): | % | 0 | Source: | Sp. Gr.: | |
| Slag (IM 491.14): | % | 0 | Source: | Sp. Gr.: | |
| CarbonCure: | % 0 | 0 | Cement Reduction | | |

Adjusted Cement: 566 lbs

Total Cementitious 566 lbs Total % Replacement = 10

| | | | | |
|---|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A06502-VINTON-MILROY | Sp. Gr.: | 2.65 |
| IM T203 | Interm. Aggregate Source: | | Sp. Gr.: | |
| IM T203 | Coarse Agregate Source: | A22010-OSTERDOCK | Sp. Gr.: | 2.67 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 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) | = | 0.108 |
| 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) | = | 0.144 |
| Air ............................................ | | | 0.060 |
| | Subtotal | = | 0.312 |
| | 1.000 - Subtotal | = | 0.688 |
| | Total | = | 1.000 |

| | | | | |
|---|---|---|---|---|
| % FA Agg.: | 45 | Fine Aggregate ( 1.000 - Subtotal ) X % In Mix | = | 0.310 |
| % In. Agg.: | | Interm. Aggregate ( 1.000 - Subtotal ) X % In Mix | = | |
| % CA Agg.: | 55 | Coarse Aggregate ( 1.000 - Subtotal ) X % In Mix | = | 0.378 |
| | | Aggregate Total | = | 0.688 |

**Aggregate Weights**

| | | | |
|---|---|---|---|
| Fine: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1384 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1700 |

**Summary**

Plant Name & Location: Warren _R63

CPI:

Cert #:

| | | |
|---|---|---|
| Cement | 566 | lbs/cy |
| Fly Ash | 0 | lbs/cy |
| Slag | 0 | lbs/cy |
| Water | 243 | lbs/cy |
| Fine Agg. | 1384 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1700 | lbs/cy |

| | | | |
|---|---|---|---|
| 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 9-33

4/3/2023 — Iowa Department Of Transportation — Form E820150

Office Of Materials — E - Units

PORTLAND CEMENT CONCRETE

Project No.: FM-91(15)--66-91    County : 91-Warren

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

Cement (IM 401): 817 lbs    Source: PC0009-Ash Grove - Louisv    Sp. Gr.: 3.11

| | % | | | | | |
|---|---|---|---|---|---|---|
| Fly Ash (IM 491.17): | | 0 | Source: | | Sp. Gr.: | |
| Slag (IM 491.14): | | 0 | Source: | | Sp. Gr.: | |
| CarbonCure: | 0 | 0 | Cement Reduction | | | |

Adjusted Cement: 817 lbs

Total Cementitious 817 lbs    Total % Replacement = 10

| | | | Sp. Gr.: |
|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A06502-VINTON-MILROY | 2.65 |
| IM T203 | Interm. Aggregate Source: | | |
| IM T203 | Coarse Agregate Source: | A22010-OSTERDOCK | 2.67 |

| | | | | | |
|---|---|---|---|---|---|
| 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) | = | 0.156 |
| 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) | = | 0.159 |
| Air ................................................................................................................... | | | 0.060 |
| | Subtotal | = | 0.375 |
| | 1.000 - Subtotal | = | 0.625 |
| | Total | = | 1.000 |

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

**Aggregate Weights**

| | | | |
|---|---|---|---|
| Fine: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1393 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1408 |

**Summary**

Plant Name & Location: Warren _R63

CPI:

Cert #:

| | | |
|---|---|---|
| Cement | 817 | lbs/cy |
| Fly Ash | 0 | lbs/cy |
| Slag | 0 | lbs/cy |
| Water | 268 | lbs/cy |
| Fine Agg. | 1393 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1408 | lbs/cy |

| | | | |
|---|---|---|---|
| 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 9-35

800240 computer v10.1

**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)28-58
Plant Name: KR - Hwy 218 &F62
Contractor: Knife River
SubContractor:
Weather: Sunny
Maturity?: Curve #:

Contract ID: 67592
County: 58-Louisa
Temp. Min: 69 ºF
Temp. Max: 87 ºF
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 ) | | Placement Type | | E - Units Report | SEND |
|---|---|---|---|---|---|
| Central | X | Paving | Continous | X | (Daily) |
| Ready | | | | | (Weekly) |
| | | | Non-structural | | (Monthly) |
| | | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD lbs | Actual Quantities Used - lbs/yd3 Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C20 | 1,256.00 | 0.0 | 0.00 | 3.3 | 2.65 | 1,380 | | | | 0.5 | 2.63 | 1670 | 446 | 111 | | 1427 | | 1678 | 55 | 175.0 | 0.0 | 0.414 | 0.450 |
| 2 | C-3WR-C20 | 1,384.00 | 0.0 | 0.00 | 3.0 | 2.65 | 1,380 | | | | 0.3 | 2.63 | 1670 | 446 | 111 | | 1423 | | 1675 | 48 | 190.0 | 0.0 | 0.427 | 0.450 |
| 3 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |

| Coarse | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | 100 | 95-100 | | 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 |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | | | | | | | | Y/N |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

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

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

| Batched | Check One (X) | Daily | | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| | | X | | | | |
| Concrete: | yd3 | 2640.00 | | | 0.00 | |
| Cement: | tons | 588.72 | | | | |

CarbonCure: Dose (oz/cy) Cement Redux. %

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Daravair 1000-GCP | 5.0 oz/yd | 233998 |
| Normal Water Reducer: | Eucon WR-75-Euclid | 3 oz./100lbs | 557882 |
| Mid-Range Water Reducer: | | | |
| High-Range Water Reducer: | | | |
| Retarder: | | | |
| Special Performance Admixturer: | | | |
| Concrete Fibers: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IS(25) | 3.06 | PC0707-Central Plains - EaglePave-IS(25) |
| Fly Ash: | C | 2.62 | FA004C-Council Bluffs Unit #3 |
| GGBFS: | | | |

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A10030-SOUTH AURORA | 3 |
| Intermediate: | | |
| Fine: | A06502-VINTON-MILROY | 1 |

Adjusted % Passing Calculated Combined Gradation

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

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 9-37

4/3/2023 | Iowa Department Of Transportation | Form E820150
Office Of Materials | E - Units
PORTLAND CEMENT CONCRETE

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

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

| | | | | | | |
|---|---|---|---|---|---|---|
| Cement (IM 401): | 557 | lbs | Source: | PC0707-Central Plains - Eag | Sp. Gr.: | 3.06 |
| Fly Ash (IM 491.17): | 20 % | 111 | Source: | FA004C-Council Bluffs Unit | Sp. Gr.: | 2.62 |
| Slag (IM 491.14): | % | 0 | Source: | | Sp. Gr.: | |
| CarbonCure: | 0 % | 0 | Cement Reduction | | | |

Adjusted Cement: 446 lbs

Total Cementitious 557 lbs    Total % Replacement = 40

| | | | | |
|---|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A06502-VINTON-MILROY | Sp. Gr.: | 2.65 |
| IM T203 | Interm. Aggregate Source: | | Sp. Gr.: | |
| IM T203 | Coarse Agregate Source: | A10030-SOUTH AURORA | Sp. Gr.: | 2.63 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basic w/c | 0.430 | Water | lbs/cy | = Basic w/c X (Total Cementitious) | = | 240 |
| Max w/c | 0.450 | Max. Water | lbs/cy | = Max w/c X (Total Cementitious) | = | 251 |

**Absolute Volumes**

| | | | |
|---|---|---|---|
| Cement ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.087 |
| Fly Ash ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.025 |
| Slag ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | |
| Water ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.142 |
| 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 | = | 1380 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1670 |

**Summary**

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

| | | |
|---|---|---|
| Cement | 446 | lbs/cy |
| Fly Ash | 111 | lbs/cy |
| Slag | 0 | lbs/cy |
| Water | 240 | lbs/cy |
| Fine Agg. | 1380 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1670 | lbs/cy |

| | | | |
|---|---|---|---|
| Air Entrainment: | Daravair 1000-GCP | Rate: | 5.0 oz/yd |
| Normal Water Reducer: | Eucon WR-75-Euclid | Rate: | 3 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 9-39

800240 computer v5.6

## PCC Plant Report

E - Units

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

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

Contract ID: 15876
County: Story
Temp. Min: 72 ºF
Temp. Max: 85 ºF
Maturity Mix ID:
TTF:

Report No.: 4
Date This Report: 10/01/15
Date Of Last Report: 09/30/15
Structures Des. No:
Curve / Validation date:
Curve #:

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

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Fine Aggregate Moist. (%) | Fine T-203 Sp. G. | Fine Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Int. T-203 Sp. G. | Int. Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse T-203 Sp. G. | Coarse Wt. SSD lbs | Actual Quantities Used - lbs/yd3 Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-4-C15 | 975.00 | 0.0 | 2.9 | 2.65 | 1,469 | | | | 0.3 | 2.68 | 1,490 | 530 | 94 | | 1,513 | | 1,494 | 48 | 225.0 | | 0.438 | 0.488 |
| 2 | M-4 | 128.00 | 0.0 | 2.9 | 2.65 | 1,389 | | | | 0.3 | 2.68 | 1,409 | 825 | | | 1,430 | | 1,413 | 46 | 238.0 | | 0.344 | 0.400 |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | |

| Coarse | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| 48.0 | | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | 0-2.5 | Y/N |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |

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

| Check One (X) | | Batched Today | Week | Total To Date |
|---|---|---|---|---|
| | | X | | |
| Concrete: | yd3 | 1,103.00 | | |
| Cement: | tons | 311.18 | | |

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

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

| Fine | 1/2" | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| 40.0 | | 100 | 90-100 | 70-100 | | 10-60 | | | 0-1.5 | Y/N |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |
| | | | | | | | | | | Y |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | I/II | 3.14 | PC0002 |
| Fly Ash: | C | 2.48 | FA003CF |
| GGBFS: | | | |

Adjusted % Passing Calculated Combined Gradation

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

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

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 9-41

Rev 02/01 | **Iowa Department Of Transportation** | Form E820150

**Office Of Materials** | E - Units

**PORTLAND CEMENT CONCRETE**

**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):** | 624 | lbs | **Source:** | PC0002 | | **Sp. Gr.:** | 3.14 |
| | % | | | | | | |
| **Fly Ash (IM 491.17):** | 15 | 94 | **Source:** | FA003CF | | **Sp. Gr.:** | 2.48 |
| **Slag (IM 491.14):** | | 0 | **Source:** | | | **Sp. Gr.:** | |
| **Adjusted Cement:** | 530 | lbs | | | | | |
| **Total Cementitious** | 624 | 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)** | = | 268 |
| **Max w/c** | 0.488 | **Max. Water** | **lbs/cy** | **= Max w/c X (Total Cementitious)** | = | 305 |

**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)** | = | 0.159 |
| **Air** ............................................................................................................ | | | 0.060 |
| | **Subtotal** | = | 0.341 |
| | **1.000 - Subtotal** | = | 0.659 |
| | **Total** | = | 1.000 |

| | | | | |
|---|---|---|---|---|
| **% FA Agg.:** | 50 | **Fine Aggregate ( 1.000 - Subtotal ) X % In Mix** | = | 0.329 |
| **% 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** | = | 0.659 |

**Aggregate Weights**

| | | | |
|---|---|---|---|
| **Fine:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | = | 1469 |
| **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** | 530 | **lbs/cy** |
| **Fly Ash** | 94 | **lbs/cy** |
| **Slag** | 0 | **lbs/cy** |
| **Water** | 268 | **lbs/cy** |
| **Fine Agg.** | 1469 | **lbs/cy** |
| **Interm. Agg.** | | **lbs/cy** |
| **Coarse Agg.** | 1490 | **lbs/cy** |

**Air Admixture: Darex II AEA**

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

# Solution for Page 9-43

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.:** M-4 **Abs Vol. Cement:** 0.156 **Type:** I/II

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cement (IM 401):** | 825 | lbs | **Source:** | PC0002 | **Sp. Gr.:** | 3.14 |
| | % | | | | | |
| **Fly Ash (IM 491.17):** | | 0 | **Source:** | FA003CF | **Sp. Gr.:** | 2.48 |
| **Slag (IM 491.14):** | | 0 | **Source:** | | **Sp. Gr.:** | |

**Adjusted Cement:** 825 lbs

**Total Cementitious** 825 lbs **Total % Replacement =** 0

| | | | | |
|---|---|---|---|---|
| **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** | 0.328 | **Water** | **lbs/cy** | **= Basic w/c X (Total Cementitious)** | = | 271 |
| **Max w/c** | 0.488 | **Max. Water** | **lbs/cy** | **= Max w/c X (Total Cementitious)** | = | 330 |

**Absolute Volumes**

| | | | |
|---|---|---|---|
| **Cement** ............................................ | **(lbs/cy) / ( Sp. Gr. X 62.4 X 27)** | = | 0.156 |
| **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)** | = | 0.161 |
| **Air** ............................................................................................................. | | | 0.060 |
| | **Subtotal** | = | 0.377 |
| | **1.000 - Subtotal** | = | 0.623 |
| | **Total** | = | 1.000 |

| | | | | |
|---|---|---|---|---|
| **% FA Agg.:** | 50 | **Fine Aggregate ( 1.000 - Subtotal ) X % In Mix** | = | 0.311 |
| **% In. Agg.:** | | **Interm. Aggregate ( 1.000 - Subtotal ) X % In Mix** | = | |
| **% CA Agg.:** | 50 | **Coarse Aggregate ( 1.000 - Subtotal ) X % In Mix** | = | 0.312 |
| | | **Aggregate Total** | = | 0.623 |

**Aggregate Weights**

| | | | |
|---|---|---|---|
| **Fine:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | = | 1389 |
| **Intermediate:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | = | |
| **Coarse:** | **Abs Vol. X Sp. Gr. X 62.4 X 27** | = | 1409 |

**Summary**

| | | |
|---|---|---|
| **Cement** | 825 | **lbs/cy** |
| **Fly Ash** | 0 | **lbs/cy** |
| **Slag** | 0 | **lbs/cy** |
| **Water** | 271 | **lbs/cy** |
| **Fine Agg.** | 1389 | **lbs/cy** |
| **Interm. Agg.** | | **lbs/cy** |
| **Coarse Agg.** | 1409 | **lbs/cy** |

**Air Admixture: Darex II AEA**

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

# Solution for Page 9-45

800240 computer v10.1

## PCC Plant Report

| Date of Placement | | Location 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 | | E - Units Report | SEND |
|---|---|---|---|---|---|
| Central | X | Paving | Continous | X | (Daily) |
| Ready | | | | | (Weekly) |
| | | | Non-structural | | (Monthly) |
| | | | Miscellaneous | | (Project) |

Max On Grade W/C Ratio:

| | Mix | Batched yd3 | % Of Est. Used | Waste yd3 | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD lbs | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD lbs | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD lbs | Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Water Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C20 | 1,256.00 | 0.0 | 0.00 | 3.8 | 2.61 | 1,350 | | | | 0.7 | 2.66 | 1685 | 457 | 114 | | 1403 | | 1697 | 65 | 151.0 | 26.0 | 0.424 | 0.450 |
| 2 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | 0.0 | | |

(Actual Quantities Used - lbs/yd3)

| Coarse | | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | 100 | 95-100 | | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date: | | | | | | | | | | Y/N |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

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

Adjusted % Passing Calculated Combined Gradation

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

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

| | Dose (oz/cy) | Cement Redux. | % |
|---|---|---|---|
| CarbonCure: | | | |

| Batched | Check One (X) | Daily X | | Total To Date | Waste | Waste To Date |
|---|---|---|---|---|---|---|
| Concrete: | yd3 | 1256.00 | | | 0.00 | |
| Cement: | tons | 287.00 | | | | |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | Sika AEA-14-Sika | 5.0 oz/yd | 77AA4356 |
| Normal Water Reducer: | Eucon WR-75-Euclid | 3 oz./100lbs | ME88934C |
| Mid-Range Water Reducer: | | | |
| High-Range Water Reducer: | | | |
| Retarder: | | | |
| Special Performance Admixturer: | | | |
| Concrete Fibers: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | II | 3.14 | PC3402-St Marys - Charlevoix-II |
| Fly Ash: | C | 2.76 | FA010C-Muscatine Power & Water |
| GGBFS: | | | |

| | T-203 A # & Source | Grad. No. |
|---|---|---|
| Coarse: | A23004-BEHR | 3 |
| Intermediate: | | |
| Fine: | A05506-EXIRA | 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:

# Solution for Page 9-47

| 4/3/2023 | Iowa Department Of Transportation<br>Office Of Materials<br>PORTLAND CEMENT CONCRETE | Form E820150<br>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): | 571 | lbs | Source: | PC3402-St Marys - Charlevo | Sp. Gr.: | 3.14 |
| Fly Ash (IM 491.17): | % 20 | 114 | Source: | FA010C-Muscatine Power & | Sp. Gr.: | 2.76 |
| Slag (IM 491.14): | % | 0 | Source: | | Sp. Gr.: | |
| CarbonCure: | % 0 | 0 | Cement Reduction | | | |

Adjusted Cement: 457 lbs

Total Cementitious 571 lbs Total % Replacement = 20

| | | | | |
|---|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A05506-EXIRA | Sp. Gr.: | 2.61 |
| IM T203 | Interm. Aggregate Source: | | Sp. Gr.: | |
| IM T203 | Coarse Agregate Source: | A23004-BEHR | Sp. Gr.: | 2.66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basic w/c | 0.430 | Water | lbs/cy | = Basic w/c X (Total Cementitious) | = | 246 |
| Max w/c | 0.450 | Max. Water | lbs/cy | = Max w/c X (Total Cementitious) | = | 257 |

**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) | = | 0.025 |
| Slag ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | |
| Water ............................................ | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.146 |
| Air ........................................................................................................ | | | 0.060 |
| | Subtotal | = | 0.317 |
| | 1.000 - Subtotal | = | 0.683 |
| | Total | = | 1.000 |

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

**Aggregate Weights**

| | | | |
|---|---|---|---|
| Fine: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1350 |
| Intermediate: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 0 |
| Coarse: | Abs Vol. X Sp. Gr. X 62.4 X 27 | = | 1685 |

**Summary**

Plant Name & Location: Shipley-Keota
CPI:
Cert #:

| | | |
|---|---|---|
| Cement | 457 | lbs/cy |
| Fly Ash | 114 | lbs/cy |
| Slag | 0 | lbs/cy |
| Water | 246 | lbs/cy |
| Fine Agg. | 1350 | lbs/cy |
| Interm. Agg. | 0 | lbs/cy |
| Coarse Agg. | 1685 | lbs/cy |

| | | | |
|---|---|---|---|
| Air Entrainment: | Sika AEA-14-Sika | Rate: | 5.0 oz/yd |
| Normal Water Reducer: | Eucon WR-75-Euclid | Rate: | 3 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

# Chapter 11
# IM 213 CERTIFICATION

# TECHNICAL TRAINING & CERTIFICATION PROGRAM

## GENERAL

The purpose of the Technical Training & Certification Program is to ensure Quality Control (QC)/Quality Assurance (QA) and Acceptance of Aggregates, Hot Mix Asphalt (HMA), Portland Cement Concrete (PCC), Soils, Erosion Control, Precast and Prestressed Concrete, and Pavement Profiles and to ensure proper documentation of quality control/quality assurance and acceptance procedures and test results by industry and Contracting Authority personnel.

This Instructional Memorandum (IM) explains the requirements to become certified and to remain certified to perform inspection and testing in the State of Iowa. This IM also describes the duties, responsibilities and the authority of persons assigned the position of Certified Technician in any of the above areas for construction or maintenance projects. Appendix C of this IM lists what tests and procedures the technician is qualified to perform for each level of certification they obtain.

Through a cooperative program of training, study, and examination, personnel of the construction industry, State DOT, and other Contracting Authorities will be able to provide quality management and certified inspection. Quality control/quality assurance and acceptance sampling, testing and inspection will be performed by certified personnel and documented in accordance with the IMs.

A technician who is qualified and holds a valid certification(s) shall perform quality control/quality assurance and acceptance at a production site, proportioning plant, or project site. Responsibilities cannot be delegated to non-certified technicians. The duties of a Certified Technician may be assigned to one or more additional Certified Technicians.

The Technical Training & Certification Program will be carried out in accordance with general policy guidelines established or approved by the Highway Division Director. A Board of Certification composed of the following members will advise the Director:

Director – Construction and Materials Bureau
Representative of District Materials Engineers**
Representative of District Construction Engineers**
Representative of Associated General Contractors (AGC of Iowa)
Representative of Iowa Concrete Paving Association (ICPA)
Representative of Asphalt Paving Association of Iowa (APAI)
Representative of Iowa Ready Mixed Concrete Association (IRMCA)
Representative of Iowa Limestone Producers Association (ILPA)
Representative of County Engineers
Representative of American Council of Engineering Companies (ACEC-Iowa)
Coordinator of Technical Training & Certification Program**

** Appointed by Program Director

The Director of the Construction and Materials Bureau will be the Program Director. Coordinators will be appointed by the Program Director to assist in administration of the program and to handle such planning, administration, and coordinating functions as may be needed.

## 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 applicable schooling 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 shall be valid for five years.

**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 December 31st of the fifth year. A 90-day grace period will be allowed. If the individual has not renewed their certification within the 90-day grace period, they are automatically decertified. The individual may obtain certification by taking the examination for the level of certification they are requesting. If the individual does not take the examination within one year after their certification(s) expire, i.e., 12/31/expiration year, they must retake all applicable schooling and pass the examinations. 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.

All certified technicians will be required to pass an examination in each level of certification they hold before recertification will be issued. Failure of any level shall require the applicant to retake the applicable schooling and pass the test.

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 permanent file with the District Materials Office in which the technician resides. The notice will also be placed on the statewide computer file. 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 10$^{th}$ 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 & RESPONSIBILITES

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 |
| | **CONTRACT ADMINISTRATION** | |
| Level II Contract Admin. | Level II Contract Admin. Tech | Level I Contract Admin. |
| Level III Contract Admin. | Level III Contract Admin. Tech | Level II Contract Admin., Level I HMA, Level II PCC |
| | **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.

| CERTIFICATION LEVEL | TITLE | PRE-REQUISITES |
|---|---|---|
| | **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 will be placed in your permanent file with the District Materials Office in which you reside. It will also be placed on the statewide computer file.

The goal of the Technical Training and Certification Program (TTCP) is to work with contractors, producers, cities, and counties 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

### LEVEL II CONTRACT ADMINISTRATION

- N/A

### LEVEL III CONTRACT ADMINISTRATION

- IM 101 – Review of Materials Used in Construction & Maintenance Projects
- IM 103 – Inspection Services Provided to Counties, Cities, and Other State Agencies
- IM 204 – Inspection of Construction Project Sampling & Testing

### 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

Duties of the Aggregate 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).

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.

## CONTRACT ADMINISTRATION TECHNICIAN DUTIES

Levels II and III perform duties described in Article 1105.06 “Authority & Duties of Inspector”. Duties of the Contract Administration Technician consist of, but are not limited to the following:

**Level I**

A. Field inspection on a single, or few, projects.

   1. Conduct measurements.
   2. Collect materials certifications.
   3. Perform inspection on small/medium projects.
   4. Daily log of contractor’s activities.
   5. Measure contract quantities for pay.

**Level II**

A. Lead inspector of medium-sized project or multiple small projects.

   1. Ensure work is completed according to contract documents.
   2. Ensure proper materials certifications.
   3. Coordinate and review inspector activities.
   4. Maintain project records.
   5. Prepare authorization for project progress reports and pay vouchers.
   6. Identify and report non-complying materials or activities.

**Level III**

A. Manages the inspection and documentation of large, complex highway construction projects and/or several small highway projects.

   1. Ensure work is done according to applicable contract documents, permits, laws, and other government regulations.
   2. Review project daily to ensure adequate inspection and compliance of work.
   3. Coordinate solution when contract documents do not completely and accurately address site conditions. Assists in negotiating change orders.

4. Make timely decisions to prevent non-complying work, avoid delays in project completion, and avoid potential claims due to loss of production by the contractor.

5. Perform end of project audit on incorporated materials.

6. Prepare project documents for final review.

7. Make determination on necessity of interest payment to the contractor and calculate that value.

## 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 301and 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 facia 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. Indentify 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. $C_3A$ 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 $Fe_2O_3$ 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 I/II - Chanute (Code PC0102) | 04/24/2014 | Ash Grove Cement Company | PORTLAND CEMENT | 401 | Chanute, KS | Ash Grove Cement Company | Chanute, KS; Des Moines, IA | 3.14 |
| Ash Grove I/II - Louisville (Code PC0002) | 04/24/2014 | Ash Grove Cement Company | PORTLAND CEMENT | 401 | Louisville, NE | Ash Grove Cement Company | Louisville, NE; Des Moines, IA | 3.14 |
| 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 |

# Materials Approved Products List

## 401aa - Appendix A - Portland Cement

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Specific Gravity |
|---|---|---|---|---|---|---|---|---|
| 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 | |
| Central Plains EaglePave IP(25) (Code PC2808) | 04/24/2014 | Central Plains Cement Company | PORTLAND CEMENT | 401 | Omaha, NE | Central Plains Cement Company | Sugar Creek, MO; Omaha, NE | 2.99 |
| Central Plains EaglePave IS(20) (Code PC2807) | 01/17/2020 | Central Plains Cement Company | PORTLAND CEMENT | 401 | Sugar Creek, MO | Central Plaines Cement Company | Sugar Creek, MO; Omaha, NE | 3.09 |
| Central Plains EaglePave IS(25) (Code PC0707) | 04/24/2014 | Central Plains Cement Company | PORTLAND CEMENT | 401 | | Central Plains Cement Company | Sugar Creek, MO; Omaha, NE | 3.06 |
| Central Plains EaglePave IS(38) (Code PC2817) | 01/17/2020 | Central Plains Cement Company | PORTLAND CEMENT | 401 | Sugar Creek, MO | Central Plains Cement Company | Sugar Creek, MO; Omaha, NE | 3.03 |
| Central Plains I/II - Sugar Creek (Code PC0702) | 06/11/2021 | Central Plains Cement Company | PORTLAND CEMENT | 401 | Sugar Creek, MO | Central Plains Cement Company | Sugar Creek, MO; Omaha, NE; West Des Moines (Continental Terminal) | 3.14 |
| 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 |
| 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) (L9) - Sugar Creek (Code PC0706) | 01/30/2023 | 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 I - Hannibal (Code PC0201) | 04/24/2014 | 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 | 3.14 |

IOWA DOT
SMARTER | SIMPLER | CUSTOMER DRIVEN

# Materials Approved Products List

## 401aa - Appendix A - Portland Cement

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Specific Gravity |
|---|---|---|---|---|---|---|---|---|
| Continental I/II - Davenport (Code PC0502) | 07/16/2015 | Continental Cement Company, LLC | PORTLAND CEMENT | 401 | Buffalo, IA | Continental Cement Company | Buffalo, IA (Davenport); West Des Moines, IA; St. Paul, MN; Minneapolis, MN; LaCrosse, WI | 3.14 |
| Continental I/II - Hannibal (Code PC0202) | 04/24/2014 | 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 ; Bettendorf, IA (LafargeHolcim Terminal); Des Moines (Ash Grove Terminal), IA | 3.14 |
| 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 |

## 401aa - Appendix A - Portland Cement

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Specific Gravity |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| Holcim I/II LA - Ada (Code PC1901) | 03/24/2022 | 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 | 3.14 |
| Holcim I/II LA - Alpena (Code PC1801) | 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 | 3.14 |
| Holcim I/II LA - Florence (Code PC2002) | 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 | 3.14 |

# 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 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 I/II - Grand Chain/Joppa (Code PC1302) | 03/24/2022 | Holcim (US) Inc. | PORTLAND CEMENT | 401 | Grand Chain, IL | Holcim | Des Moines, IA; St. Paul, MN; Fremont, NE; Superior, NE; Sioux Falls, SD; Bettendorf, IA: LaCrosse, WI; Kansas City, MO; St. Louis, MO | 3.14 |
| Holcim I/II - ST. Genevieve (Code PC3202) | 03/24/2022 | 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 | 3.14 |
| 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 |

# 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(8) - ST. Genevieve (Code PC3209) | 12/19/2022 | 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(S20)(P5) - Grand Chain/Joppa (Code PC1308) | 03/24/2022 | 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 | 3.07 |
| Holcim St. Genevieve IT (P25)(L6) (Code PC3206) | 01/30/2023 | 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 |
| Illinois I/II LA (Code PC3302) | 04/24/2014 | Illinois Cement Company | PORTLAND CEMENT | 401 | LaSalle, IL | Illinois Cement Company | LaSalle, IL | 3.14 |
| Lehigh I - Mason City (Code PC0401) | 01/07/2015 | Lehigh Cement Company | PORTLAND CEMENT | 401 | Mason City, IA | Lehigh Cement Company | Mason City, IA | 3.14 |
| Lehigh III - Mason City (Code PC0403) | 02/17/2015 | Lehigh Cement Company | PORTLAND CEMENT | 401 | Mason City, IA | Lehigh Cement Company | Mason City, IA | 3.15 |
| Lehigh IL(10) - Mason City (Code PC0409) | 01/07/2015 | Lehigh Cement Company | PORTLAND CEMENT | 401 | Mason City, IA | Lehigh Cement Company | Mason City, IA | 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 |

# Materials Approved Products List

## 401aa - Appendix A - Portland Cement

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Specific Gravity |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
|---|---|---|---|---|---|---|---|---|
| Lehigh White I | 01/07/2015 | Lehigh Cement Company | PORTLAND CEMENT | 401 | York, PA | Lehigh Cement Company | Plainfield, IL | 3.15 |
| Lehigh White I Cimsa | 01/07/2015 | Lehigh Cement Company | PORTLAND CEMENT | 401 | Cimsa, Turkey | Lehigh Cement Company | Plainfield, IL; Burnsville, MN | 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 ~~is~~ considered a special performance admixture. ~~CarbonCure~~ Carbon dioxide shall be added to the mix using the ~~CarbonCure~~ manufacturers delivery system. The delivery system shall be provided and calibrated by ~~CarbonCure~~ manufacturers and integrated into the PCC plant batching system. Use of ~~CarbonCure~~ carbon dioxide addition without Portland cement reduction requires no approval. Use of ~~CarbonCure~~ 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.

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 | |
| 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 | 10/16/2020 | Mapei Corporation | ADMIXTURES, AIR ENTRAINING | 403 | Eagen, MN | Mapei Corporation | | |
| Polychem SA-50 | 10/16/2020 | Mapei Corporation | ADMIXTURES, AIR ENTRAINING | 403 | Eagen, MN | Mapei Corporation | | |
| Polychem VR | 10/16/2020 | Mapei Corporation | ADMIXTURES, AIR ENTRAINING | 403 | | 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) | | |
| SikaControl AIR-160 | 11/14/2018 | Sika Corporation | ADMIXTURES, AIR ENTRAINING | 403 | Ottawa, IL | Sika Corporation | | |

# Materials Approved Products List

## 403aa - Appendix A - Air Admixtures

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 ggbfs.

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 I/II or IL No fly ash | Type I/II 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 |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | hours | hours | 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 |
| 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 |
| 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 |
| 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 |

| COMPANY: | BASF Corporation | | BRAND: | MasterSet R 100 |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | hours | hours | hours |
| 55 | 2 | | | |
| | 3 | | | |
| | 4 | | | |
| | 5 | | | |
| 65 | 3 | 9.0 | 9.7 | 10.5 |
| | 4 | | | |
| | 5 | | | |
| | 6 | | | |
| 75 | 3 | 6.1 | 6.6 | 7.1 |
| | 4 | 7.8 | 8.3 | 8.8 |
| | 5 | 9.2 | 9.7 | 10.2 |
| | 6 | | | |
| | 7 | | | |
| 85 | 3 | 5.2 | 5.5 | 5.7 |
| | 4 | 6.7 | 7.0 | 7.2 |
| | 5 | 8.1 | 8.4 | 8.6 |
| | 6 | | | |
| | 7 | | | |
| 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 | | | |

| 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz./cwt | hours | hours | hours |
| 55 | 2 | 4.5 | 5.5 | 5.5 |
| | 3 | 5.3 | 6.3 | 6.3 |
| | 4 | 6.8 | 7.8 | 8.8 |
| | 5 | | | |
| 65 | 3 | 4.6 | 5.3 | 6.1 |
| | 4 | 5.5 | 6.2 | 7.0 |
| | 5 | 6.8 | 7.5 | 8.3 |
| | 6 | | | |
| 75 | 3 | 4.7 | 5.2 | 5.7 |
| | 4 | 6.0 | 6.5 | 7.0 |
| | 5 | 7.2 | 7.7 | 8.2 |
| | 6 | | | |
| | 7 | | | |
| 85 | 3 | 4.6 | 4.9 | 5.1 |
| | 4 | 5.3 | 5.6 | 5.8 |
| | 5 | 6.4 | 6.7 | 6.9 |
| | 6 | | | |
| | 7 | | | |
| 95 | 3 | 4.1 | 4.1 | 4.1 |
| | 4 | 4.7 | 4.7 | 4.7 |
| | 5 | 5.6 | 5.6 | 5.6 |
| | 6 | 6.6 | 6.6 | 6.6 |

| COMPANY: | Euclid Chemical Company | | BRAND: | Eucon Retarder 100 |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | 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 |
| 65 | 3 | 8.2 | 8.9 | 9.7 |
| | 4 | 10.0 | 10.7 | 11.5 |
| | 5 | 11.7 | 12.4 | 13.2 |
| | 6 | 12.9 | 13.6 | 14.4 |
| 75 | 3 | 7.5 | 8.0 | 8.5 |
| | 4 | 9.9 | 10.4 | 10.9 |
| | 5 | 11.9 | 12.4 | 12.9 |
| | 6 | 12.5 | 13.0 | 13.5 |
| | 7 | | | |
| 85 | 3 | 6.8 | 7.1 | 7.3 |
| | 4 | 9.6 | 9.9 | 10.1 |
| | 5 | 11.9 | 12.2 | 12.4 |
| | 6 | 11.9 | 12.2 | 12.4 |
| | 7 | | | |
| 95 | 3 | 6.8 | 6.8 | 6.8 |
| | 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 No fly ash | Type I/II or IL With fly ash | Type IS, IP With fly ash or Ternary |
| °F | fl. oz/cwt | hours | hours | hours |
| 55 | 2 | 5.5 | 6.5 | 7.5 |
| | 3 | 7.5 | 8.5 | 9.5 |
| | 4 | 9.5 | 10.5 | 11.5 |
| 65 | 2 | 5.0 | 5.5 | 6.0 |
| | 3 | 6.0 | 6.5 | 7.0 |
| | 4 | 7.0 | 7.5 | 8.0 |
| | 5 | 8.5 | 9.0 | 9.5 |
| 75 | 3 | 4.0 | 4.5 | 5.0 |
| | 4 | 4.5 | 5.0 | 5.5 |
| | 5 | 5.5 | 6.0 | 6.5 |
| | 6 | 6.5 | 7.0 | 7.5 |
| | 7 | 7.5 | 8.0 | 8.5 |
| 85 | 4 | 4.5 | 4.7 | 5.0 |
| | 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 | | BRAND: | Eucon WR-91 |
|---|---|---|---|---|
| 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 |
| °F | 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 |
| 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 |
| 75 | 4 | 4.0 | 4.5 | 5.0 |
| | 5 | 4.5 | 5.0 | 5.5 |
| | 6 | 5.5 | 6.0 | 6.5 |
| | 7 | 6.5 | 7.0 | 7.5 |
| | 8 | 7.5 | 8.0 | 8.5 |
| 85 | 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 |
| | 8 | 6.7 | 7.0 | 7.2 |
| 95 | 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 |

| COMPANY: | Euclid Chemical Company | | BRAND: | Eucon DS |
|---|---|---|---|---|
| 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 |
| °F | 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 |
| 75 | 2 | 1.0 | 1.5 | 1.5 |
| | 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 |
| 85 | 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 |
| | 8 | 4.5 | 5.5 | 6.0 |
| | 9 | 5.5 | 6.5 | 7.0 |
| 95 | 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 |

| 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz/cwt | hours | hours | hours |
| 65 | 3 | | | |
| | 4 | | | |
| | 5 | | | |
| | 6 | | | |
| 75 | | | | |
| | 3 | 4.3 | 4.7 | 5.3 |
| | 4 | 6.6 | 7.1 | 7.6 |
| | 5 | 7.6 | 8.1 | 8.6 |
| | 6 | | | |
| 85 | | | | |
| | 3 | 4.3 | 4.6 | 4.8 |
| | 4 | 5.2 | 5.5 | 5.7 |
| | 5 | 6.5 | 6.8 | 7.0 |
| | | | | |
| 95 | 3 | 3.9 | 3.9 | 3.9 |
| | 4 | 4.4 | 4.4 | 4.4 |
| | 5 | 5.7 | 5.7 | 5.7 |
| | 6 | | | |
| | 7 | | | |

| 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz/cwt | hours | hours | hours |
| 65 | 3 | 5.4 | 6.5 | 7.5 |
| | 4 | 6.0 | 7.0 | 8.0 |
| | 5 | 6.8 | 7.8 | 8.8 |
| | 6 | 7.4 | 8.9 | 9.8 |
| 75 | | | | |
| | 3 | 4.8 | 5.8 | 6.8 |
| | 4 | 5.5 | 6.5 | 7.5 |
| | 5 | 6.3 | 7.3 | 8.3 |
| | 6 | 7.6 | 8.6 | 9.6 |
| 85 | | | | |
| | 3 | 4.4 | 5.4 | 6.4 |
| | 4 | 4.7 | 5.7 | 6.7 |
| | 5 | 5.3 | 6.3 | 7.3 |
| | 6 | 6.0 | 7.0 | 8.0 |
| 95 | | | | |
| | 3 | 2.8 | 3.8 | 4.8 |
| | 4 | 3.0 | 4.0 | 5.0 |
| | 5 | 3.7 | 4.7 | 5.7 |
| | 6 | 4.5 | 5.5 | 6.5 |

| COMPANY: | Mapei Corporation | | BRAND: | Polychem 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 |
| °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 | | BRAND: | Polychem 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 |
| °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:** | Polychem Renu |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | hours | hours | hours |
| 55 | 2 | 3.5 | 4.0 | 4.2 |
| | 4 | 4.8 | 5.5 | 5.8 |
| | 6 | 5.9 | 6.8 | 7.1 |
| | 8 | 7.3 | 8.4 | 8.8 |
| | 10 | 8.1 | 9.3 | 9.7 |
| | 12 | 9.6 | 11.0 | 11.5 |
| 65 | 2 | 3.4 | 3.9 | 4.1 |
| | 4 | 4.5 | 5.2 | 5.4 |
| | 6 | 5.7 | 6.6 | 6.8 |
| | 8 | 7.1 | 8.2 | 8.5 |
| | 10 | 7.8 | 9.0 | 9.4 |
| | 12 | 9.3 | 10.7 | 11.2 |
| 75 | 2 | 3.2 | 3.7 | 3.8 |
| | 4 | 4.2 | 4.8 | 5.0 |
| | 6 | 5.4 | 6.2 | 6.5 |
| | 8 | 6.9 | 7.9 | 8.3 |
| | 10 | 7.6 | 8.7 | 9.1 |
| | 12 | 9.1 | 10.5 | 10.9 |
| 85 | 2 | 3.1 | 3.6 | 3.7 |
| | 4 | 3.9 | 4.5 | 4.7 |
| | 6 | 5.2 | 6.0 | 6.2 |
| | 8 | 6.7 | 7.7 | 8.0 |
| | 10 | 7.4 | 8.5 | 8.9 |
| | 12 | 8.9 | 10.2 | 10.7 |

| COMPANY: | Sika Corporation | | BRAND: | Plastiment |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | hours | hours | 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 |
| 75 | 3 | 3.6 | 4.0 | 4.2 |
| | 4 | 4.7 | 5.1 | 5.4 |
| | 5 | 6.9 | 7.4 | 7.8 |
| | 6 | 10.9 | 11.4 | 12.1 |
| | 7 | 18.9 | 19.3 | 20.5 |
| 85 | 3 | 3.0 | 3.3 | 3.1 |
| | 4 | 3.6 | 3.9 | 3.8 |
| | 5 | 4.9 | 5.1 | 5.1 |
| | 6 | 6.9 | 7.1 | 7.2 |
| | 7 | 10.2 | 10.5 | 10.3 |
| 95 | 3 | 2.2 | 2.2 | 2.2 |
| | 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 | | BRAND: | Plastiment XR |
|---|---|---|---|---|
| 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 |
| °F | fl. oz./cwt | hours | hours | 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 |
| 95 | 4 | 3.8 | 3.9 | 4.0 |
| | 5 | 4.8 | 4.9 | 5.0 |
| | 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz./cwt | hours | hours | hours |
| 55 | 2 | 5.3 | 6.3 | 7.3 |
| | 3 | 6.2 | 7.2 | 8.2 |
| | 4 | 7.3 | 8.3 | 9.3 |
| | 5 | 8.6 | 9.6 | 10.6 |
| 65 | 2 | 4.6 | 5.3 | 6.1 |
| | 3 | 5.7 | 6.4 | 7.2 |
| | 4 | 6.8 | 7.5 | 8.3 |
| | 5 | 8.0 | 8.7 | 9.5 |
| 75 | 2 | 3.6 | 4.1 | 4.6 |
| | 3 | 4.7 | 5.2 | 5.7 |
| | 4 | 5.7 | 6.2 | 6.7 |
| | 5 | 6.8 | 7.2 | 7.8 |
| | 6 | 7.9 | 8.4 | 8.9 |
| 85 | 3 | 3.7 | 4.0 | 4.2 |
| | 4 | 4.6 | 4.9 | 5.1 |
| | 5 | 5.5 | 5.8 | 6.0 |
| | 6 | 6.6 | 6.9 | 7.1 |
| 95 | 4 | 3.6 | 3.6 | 3.6 |
| | 5 | 4.5 | 4.5 | 4.5 |
| | 6 | 5.4 | 5.4 | 5.4 |
| | 7 | 6.0 | 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz./cwt | hours | hours | hours |
| 65 | 2 | 4.3 | 5.9 | 7.1 |
| | 3 | 5.5 | 7.1 | 8.3 |
| | 4 | 7.2 | 8.8 | 10.0 |
| | 5 | 8.3 | 9.9 | 11.1 |
| | 6 | 10.5 | 12.1 | 13.3 |
| | 7 | 12.3 | 13.9 | 15.1 |
| | 8 | 13.0 | 14.6 | 15.8 |
| 75 | 2 | 3.5 | 4.9 | 5.8 |
| | 3 | 4.4 | 5.8 | 6.7 |
| | 4 | 5.4 | 6.2 | 7.1 |
| | 5 | 6.6 | 8.0 | 8.9 |
| | 6 | 8.0 | 9.4 | 10.3 |
| | 7 | 9.6 | 10.0 | 10.9 |
| | 8 | 10.4 | 11.8 | 12.7 |
| 85 | 3 | 3.1 | 4.3 | 4.9 |
| | 4 | 3.6 | 4.8 | 5.4 |
| | 5 | 4.2 | 5.4 | 6.0 |
| | 6 | 4.9 | 6.1 | 6.7 |
| | 7 | 5.7 | 6.9 | 7.5 |
| | 8 | 6.6 | 7.8 | 8.3 |
| | 9 | 7.6 | 8.8 | 9.4 |
| 95 | 4 | 2.7 | 3.7 | 4.0 |
| | 5 | 3.3 | 4.3 | 4.6 |
| | 6 | 4.0 | 5.0 | 5.3 |
| | 7 | 4.8 | 5.8 | 6.1 |
| | 8 | 5.7 | 6.7 | 7.0 |
| | 9 | 6.7 | 7.7 | 8.0 |
| | 10 | 7.8 | 8.8 | 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 | Type IS, IP With fly ash or Ternary |
| °F | fl. oz./cwt | hours | hours | hours |
| 65 | 2 | 4.0 | 5.0 | 5.5 |
| | 3 | 5.0 | 6.0 | 6.5 |
| | 4 | 5.5 | 6.5 | 7.0 |
| | 5 | 6.5 | 7.5 | 8.0 |
| | 6 | 8.0 | 9.0 | 9.5 |
| | 7 | 9.0 | 10.0 | 10.5 |
| | 8 | 10.5 | 11.5 | 12.0 |
| 75 | 2 | 3.5 | 4.5 | 5.0 |
| | 3 | 4.0 | 5.0 | 5.5 |
| | 4 | 4.5 | 5.5 | 6.0 |
| | 5 | 5.5 | 6.5 | 7.0 |
| | 6 | 6.5 | 7.5 | 8.0 |
| | 7 | 8.0 | 9.0 | 9.5 |
| | 8 | 9.0 | 10.0 | 10.5 |
| 85 | 3 | 3.0 | 4.0 | 4.5 |
| | 4 | 3.5 | 4.5 | 5.0 |
| | 5 | 4.5 | 5.5 | 6.0 |
| | 6 | 5.5 | 6.5 | 7.0 |
| | 7 | 7.0 | 8.0 | 8.5 |
| | 8 | 8.0 | 9.0 | 9.5 |
| | 9 | 10.0 | 11.0 | 11.5 |
| 95 | 4 | 2.5 | 3.5 | 4.0 |
| | 5 | 3.5 | 4.5 | 5.0 |
| | 6 | 4.5 | 5.5 | 6.0 |
| | 7 | 6.0 | 7.0 | 7.5 |
| | 8 | 7.0 | 8.0 | 8.5 |
| | 9 | 9.0 | 10.0 | 10.5 |
| | 10 | 11.0 | 12.0 | 12.5 |

# 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 |
| 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 400 NC | 10/16/2020 | Mapei Corporation | ADMIXTURES, RETARDING EXTENDED SET | 403 | | Mapei Corporation | | Extended Time-See File |
| Polychem Renu | 10/16/2020 | Mapei Corporation | ADMIXTURES, RETARDING EXTENDED SET | 403 | | Mapei Corporation | | Extended Time-See File |
| 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 |

# Materials Approved Products List

## 403ab - Appendix B - Retarders Bridge Deck

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 | 04/08/2022 | GCP Applied Technologies | ADMIXTURES, RETARDING | 403 | | | | |

# 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 | | | | |
| 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 |
| Clarena MC 2000 | 05/03/2017 | GCP Applied Technologies | ADMIXTURES, NORMAL WATER REDUCING | 403 | | GCP Applied Technologies | | 6.0 fl. oz/100 lb |
| 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 |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 | 04/06/2023 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 4 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 |
| 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 |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| KB 1200 | 10/16/2020 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 3.0 fl. oz/100 lb |
| KB 1200 | 10/16/2020 | Mapei Corporation | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | Mapei Corporation | | 6.0 fl. oz/100 lbs |

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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. |
| Mapefluid N200 | 10/16/2020 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 4 fl. oz./100 lbs |
| Mapeplast MR 107 | 10/16/2020 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 4 oz./100 lbs |
| Mapeplast MR 107 | 10/16/2020 | Mapei Corporation | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | Mapei Corporation | | 5 oz./100 lbs |
| Mapeplast N | 03/11/2021 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 2 fl. oz. / 100 lbs |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| Master X-Seed 66 | 12/01/2021 | 21st Century | ADMIXTURES, NORMAL WATER REDUCING | 403 | | | | |
| 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, MID-RANGE WATER REDUCING | 403 | | Master Builders Solutions US LLC | | 4 fl. oz/100 lbs |
| 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 |
| 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 |
| 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, MID-RANGE WATER REDUCING | 403 | | Master Builders Solutions US LLC | | 7.0 fl. oz/100 lb |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 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 |
| 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 |
| MasterPozzolith 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 |
| MasterPozzolith 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 |
| MasterPozzolith 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 |
| MasterPozzolith 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 | | | | |

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| OptiFlo MR | 12/01/2016 | Premiere Concrete Admixtures | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | Premiere Concrete Admixtures™ | | 7.0 fl. oz/100 lb |
| Optiflo 700 | 02/11/2022 | Premiere Concrete Admixtures | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | | | |
| 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 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 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 |
| Polychem 400 NC | 10/16/2020 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 3.0 fl. oz/100 lb |
| Polychem Paver Plus | 10/16/2020 | Mapei Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | | Mapei Corporation | | 3.0 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 |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 ViscoCrete 1000 | 07/02/2014 | Sika Corporation | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | Ottawa, IL | Sika Corporation (Construction) | | 5.0 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 |
| Sika ViscoFlow-2020 | 08/14/2017 | Sika Corporation | ADMIXTURES, NORMAL WATER REDUCING | 403 | Ottawa, IL | Sika Corporation | | 3.0 fl. oz/100 lb |
| 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 |

# Materials Approved Products List

## 403ac - Appendix C - Water Reducers

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 | 12/20/2021 | GCP Applied Technologies | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | GCP Applied Technologies | | 4.0 fl. oz/100 lb |

## 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 |
| Clarena MC 2000 | 05/03/2017 | GCP Applied Technologies | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | | GCP Applied Technologies | | 10.0 fl. oz/100 lb |
| Concera 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 |
| Dynamon NRG 546 | 10/16/2020 | Mapei Corporation | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | | Mapei Corporation | | 5.5 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 |
|---|---|---|---|---|---|---|---|---|
| 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 |
| EVO 2500 | 10/16/2020 | Mapei Corporation | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | Eagan, MN | Mapei Corporation | | 7.0 fl. oz./100 lb |
| 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 |
| Mapefluid N200 | 10/16/2020 | Mapei Corporation | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | | Mapei Corporation | | 8.5 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 |
|---|---|---|---|---|---|---|---|---|
| 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 | 10/16/2020 | Mapei Corporation | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | | Mapei Corporation | | 8.0 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 |
| 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 |
| Sikament-475 | 08/19/2016 | Sika Corporation | ADMIXTURES, HIGH-RANGE WATER REDUCING | 403 | Ottawa, IL | Sika Corporation | | 7.0 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 |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 yeard 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 |
| 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 Plus | 04/05/2023 | Mapei Corporation | ADMIXTURES, NON-CHLORIDE ACCELERATOR | 403 | | Mapei Corporation | | 20.0 fl. oz/100 lb |
| 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 |

# Materials Approved Products List

## 403ae - Appendix E - Non CL Accelerators

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| Polychem CI | 07/13/2022 | Mapei Corporation | ADMIXTURES, NON-CHLORIDE ACCELERATOR | 403 | | | | |
| Polychem Super Set | 10/16/2020 | Mapei Corporation | ADMIXTURES, NON-CHLORIDE ACCELERATOR | 403 | | Mapei Corporation | | 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 |
| 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 |
| MasterCast 900 | 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 |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

# Materials Approved Products List

## 403ag - Appendix G - WR Retarding

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

# Materials Approved Products List

## 403ag - Appendix G - WR Retarding

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| Polychem 400 NC | 10/16/2020 | Mapei Corporation | ADMIXTURES, RETARDING | 403 | | Mapei Corporation | | 6.0 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 |
| 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 |

IOWA DOT SMARTER | SIMPLER | CUSTOMER DRIVEN

# 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-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 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 Cast 600 | 12/14/2021 | GCP Applied Technologies | ADMIXTURES, MID-RANGE WATER REDUCING | 403 | | | | |
| 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 | | | | |
| DG-F | 01/20/2023 | Mapei Corporation | ADMIXTURES, SPECIAL PERFORMANCE | 403 | | Mapei Corporation | | See Manufacturers Recommendations |
| Eucon AWA-P20 | 07/08/2021 | Euclid Chemical Company | ADMIXTURES, SPECIAL PERFORMANCE | 403 | | Euclid Chemical Company | | 8 fl. oz. / 100 lbs |
| 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 |
| Master X-Seed 44 | 11/02/2022 | Master Builders Solutions US LLC | ADMIXTURES, SPECIAL PERFORMANCE | 403 | | Master Builders Solutions | | 15 oz. /100lbs. |

# Materials Approved Products List

## 403ah - Appendix H - Special Performance

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| Penetron Admix SB | 02/13/2023 | Penetron USA, Inc. | ADMIXTURES, SPECIAL PERFORMANCE | 403 | | Penetron USA, Inc. | | 1% weight of cement |
| Polychem VMA | 10/16/2020 | Mapei Corporation | ADMIXTURES, SPECIAL PERFORMANCE | 403 | | Mapei Corp. | | 2.0 fl oz./100 lbs |
| 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 |

# Materials Approved Products List

## 403ah - Appendix H - Special Performance

| Brand Name | Approved | Company Name | Material Item | IM | Plant Location | Marketer | Terminal/Supplier | Dosage |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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), 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 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 GGBFS source is based on the requirement of ASTM C989.

A source may furnish Ground Granulated Blast Furnace Slag 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 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 is properly certified.

   The supplier of certified Ground Granulated Blast Furnace Slag shall furnish, for the project records, two invoices or bill of lading copies, which bear the following certification statement ~~and the signature of a responsible company representative~~:

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 ________________________ ~~Signed~~ ~~______________________________~~

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 | GGBFS | 491.14 | Anshan City, Liaoning, China | Ozinga Cement | | 2.95 |
| NewCem (Code SL02A) | 03/24/2022 | Holcim (US) Inc. | GGBFS | 491.14 | Chicago | Holcim | Davenport, IA (Continental Terminal); Omaha, NE | 2.93 |
| Skyway Cement (Code SL00A) | 04/24/2014 | Skyway Cement Company | GGBFS | 491.14 | Chicago (Skyway), IL | Skyway Cement Company/Central Plains Cement Company | | 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 ~~statement and the signature of a responsible company representative~~:

   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 ____________________ ~~Signed~~ ________________________________

   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 $\pm$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/$cm^3$ 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 |
| CarbonSense Joppa C Ash (Code FA023C) | 04/08/2022 | Ozinga Cement | FLY ASH | 491.17 | Joppa, IL | Ozinga Cement | | 2.74 |
| 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 FA003CF) | 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 |

IOWA DOT SMARTER | SIMPLER | CUSTOMER DRIVEN

# 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 |
|---|---|---|---|---|---|---|---|---|
| Edwards Power Station, Unit #3 (Code FA349C) | 07/21/2022 | EM Resources LLC | FLY ASH | 491.17 | Bartonville, IL | EM Resources LLC | | 2.72 |
| Elm Road Generating Station Unit #1 (Code FA137F) | 03/24/2022 | Holcim (US) Inc. | FLY ASH | 491.17 | Oak Creek, WI | Holcim | | 2.68 |
| Elm 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 |
| Elm 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 Lancing 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) | 04/24/2014 | Kansas City Fly Ash, LLC | FLY ASH | 491.17 | Weston, MO | Kansas City Fly Ash, LLC | West Des Moines (Continental Terminal) | 2.78 |
| Iatan Generating Station, Unit #2 (Code FA005C) | 04/13/2015 | Kansas City Fly Ash, LLC | FLY ASH | 491.17 | Weston, MO | Kansas City Fly Ash | West Des Moines (Continental Terminal) | 2.68 |
| J.P. Madgett Station, Dairyland, Poz AC (Code FA032C) | 11/09/2020 | National Minerals Corporation | FLY ASH | 491.17 | Alma, WI | National Minerals Corporation | | 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) | 04/24/2014 | Kansas City Fly Ash, LLC | FLY ASH | 491.17 | La Cygne, KS | Kansas City Fly Ash, LLC | | 2.64 |

# 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 |
|---|---|---|---|---|---|---|---|---|
| Labadie Power Plant Labadie (Code FA022C) | 07/21/2022 | EM Resources LLC | FLY ASH | 491.17 | Labadie, MO | EM Resources LLC | | 2.73 |
| 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 |
| 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 | | 2.7 |
| 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 |
| 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 |
| Petersburg Generating Station, Unit #3 (Code FA038F) | 05/06/2014 | Charah, Inc | FLY ASH | 491.17 | Petersburg, IN | Charah, Inc | | 2.52 |

IOWA DOT
SMARTER | SIMPLER | CUSTOMER DRIVEN

# 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 |
|---|---|---|---|---|---|---|---|---|
| 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 |
| Praire 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 pavement 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 ± 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 furnish 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 choride 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 1st 3 days, 1 per 3 days thereafter | 1/day >500 $yd^3$<br>2/day >1000 $yd^3$ | 1/day >500 $yd^3$ | 1/day |
| Intermittent | 1/week | 1/day >500 $yd^3$<br>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 $yd^3$ | 1st day, then 1/ week |
| Intermittent and Low | 1/ week | 1st 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.

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.

$(0.114 \times 27 \times 3.14 \times 62.4) = 603$ lbs.

Fine aggregate - specific gravity 2.65
Specified unit absolute volume, from IM 529, 0.302.

$(0.302 \times 27 \times 2.65 \times 62.4) = 1348$ lbs.

Coarse aggregate - specific gravity 2.63
Specified unit absolute volume, From IM 529, 0.370.

$(0.370 \times 27 \times 2.63 \times 62.4) = 1639$ 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 x 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.

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 ÷ 96.6 x 100 = 1395 lbs.

Coarse aggregate -- 100.0 percent minus .7 percent = 99.3 percent
1639 ÷ 99.3 x 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. × 1.0351967 = 1395 lbs.

Coarse aggregate 1639 lbs. × 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 2007 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.

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.

| | | |
|---|---|---|
| <u>Example:</u> | (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. |

**<u>Date This Report</u>**
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).

**<u>Date of Last Report</u>**
Self-explanatory.

**<u>Design No.</u>**
Enter the design number of the structure where the concrete is being placed on each project. Leave this space blank on paving projects.

**<u>Check Mix (Central or Ready)</u>**
Place an "X" in the appropriate box provided indicating how the concrete is being produced.

**<u>Check Usage (Paving, Structural, Incidental, Patching)</u>**
Place an "X" in the appropriate box provided to indicate the type of work where the concrete is used.

**<u>Date (Mo./Day)</u>**
This column is only used for Ready Mix concrete applications. Enter the month and the date for each day of production during the week.

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

**<u>Mix Number</u>**
Enter the mix number being used that is listed in the proportion tables of IM 529.

**<u>Location- Station (Beg. /End/Dir)</u>**
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.

**<u>Batched</u>**
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.

**<u>% Of Est. Used</u>**
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

**<u>Fine, Intermediate & Coarse Aggregate (Moisture)</u>**
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.

800240E - 04/00 computer

| Date of Placement | | Location From | To |
|---|---|---|---|
| Mix 1 | 05/02/98 | 101+13 | 133+69 |
| Mix 2 | 11/29/99 | | |
| Mix 3 | | | |
| Mix 4 | | | |

Project No.: NHS-18-5(123)--19-17
Plant Name: CARLSON's HWY 65 & HWY 18
Contractor / Sub: FRED CARLSON
Weather: MOSTLY SUNNY

Contract ID: 17-0185-11
County: CERRO GORDO
Temp. (°F) Min: 48
Temp. (°F) Max: 70

Report No.: 2
Date This Report: 06/02/96
Date Of Last Report: 06/01/96

| Check Mix( x ) | | Check One( x ) | | SEND |
|---|---|---|---|---|
| Central | X | Paving | X | (Daily) |
| Ready | | Structure | | (Weekly) |
| | | Incidental | | (Weekly) |
| | | Patching | | (Weekly) |
| | | | | or end of Lot |

| | Mix | Batched (CY) | % Of Est. Used | Fine Aggregate Moist. (%) | Fine Aggregate T-203 Sp. G. | Fine Aggregate Wt. SSD (lbs) | Intermediate Aggregate Moist. (%) | Intermediate Aggregate T-203 Sp. G. | Intermediate Aggregate Wt. SSD (lbs) | Coarse Aggregate Moist. (%) | Coarse Aggregate T-203 Sp. G. | Coarse Aggregate Wt. SSD (lbs) | Actual Quantities Used Per cy (in pounds) Cement | Fly Ash | GGBFS | Fine | Inter. | Coarse | Water In Agg. | Water Plant | Grade | Avg w/c Ratio | Max w/c Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C-3WR-C15 | 1,100.00 | 101.3 | 4.0 | 2.67 | 1,390 | | | | 0.9 | 2.75 | 1,751 | 470 | 83 | | 1,448 | | 1,767 | 74 | 164.0 | | 0.430 | 0.489 |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |

| Coarse | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 50-100 | 30-100 | 20-75 | 5-55 | 0-10 | 0-5 | 0-1.5 | Y/N |
| | 100 | 75 | 49 | 31 | 14 | 4.1 | 0.5 | 0.5 | Y |
| | | | | | | | | | |
| | | | | | | | | | |

| Inter. | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Y/N |
| | | | | | | | | | NA |
| | | | | | | | | | NA |
| | | | | | | | | | NA |

| Fine | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Comply |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 90-100 | 70-100 | | 10-60 | | | 0-1.5 | Y/N |
| | 100 | 88 | 69 | 44 | 25 | 11 | 4.7 | 0.3 | Y |
| | | | | | | | | | |
| | | | | | | | | | |

| Concrete Treatment (x) | | lb / cy |
|---|---|---|
| Ice | | |
| Heated Water | | |
| Heated Materials | | |

| Check One (X) | Batched Today | Week | Total To Date |
|---|---|---|---|
| | X | | |
| Concrete (CY): | 1,100.00 | | 17,279.60 |
| Cement (tons): | 258.50 | | 5,007.39 |

| | Brand / Source | Rate | Lot Number |
|---|---|---|---|
| Air Entraining: | SIKA AEA 15 | 7 OZ./CY | C80005M |
| Water Reducer: | SIKA PLASTOCRETE 161 | 3 OZ./CWT | D80002P |
| Retarder: | | | |
| Calcium Chloride: | | | |
| Superplasticizer: | | | |

| | Type | Sp. Gr. | Source |
|---|---|---|---|
| Cement: | IS | 3.04 | HOLNAM |
| Fly Ash: | C | 2.56 | PORTAGE 1 |
| GGBFS: | | | |

| | Adjusted % Passing Calculated Combined Gradation 1.5" | 1" | 3/4" | 1/2" | 3/8" | #4 | #8 | #16 | #30 | #50 | #100 | #200 | Within Target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Target | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

| | T-203 A - # | Grad No. |
|---|---|---|
| Coarse: | A17008 | 4 |
| Intermediate: | | |
| Fine: | A17514 | 1 |

| Remarks |
|---|
| This is a test report |
| |
| |

Distribution: ____ Central Materials ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: JEFFREY BOLSINGER NE118
Monitor: JASON RUTER NE443

# EXAMPLE A

Rev 05/09

Form E820150E

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

**Project No.:** STPN-005-3(52)--2J-63

**County :** Marion

**Mix No.:** C-3WR-C20-S20 **Abs Vol. Cement:** 0.108 **Type:** I/II

| | | | | |
|---|---|---|---|---|
| Cement (IM 401): | 571 | lbs | Source: Lafarge I/II | Sp. Gr.: 3.14 |
| | % | | | |
| Fly Ash (IM 491.17): | 20 | 114 | Source: HW Chillicothe | Sp. Gr.: 2.73 |
| Slag (IM 491.14): | 20 | 114 | Source: Lafarge Newcem | Sp. Gr.: 2.93 |
| Adjusted lbs. Cement: | | 343 | | |
| Total Cementitious | | 571 | Total % Replacement = 40 | |

| | | | |
|---|---|---|---|
| IM T203 | Fine Aggregate Source: | A63512 | Sp. Gr.: 2.67 |
| IM T203 | Interm. Aggregate Source: | A63002 | Sp. Gr.: 2.51 |
| IM T203 | Coarse Agregate Source: | A63002 | Sp. Gr.: 2.51 |

Basic w/c 0.430 — Water (lbs/cy) = Design w/c ( wt. cement + wt Fly Ash +Slag) = 246

Max w/c 0.489 — Max. Water (lbs/cy) = Design w/c ( wt. cement + wt Fly Ash +Slag) = 279

**Absolute Volumes**

| | | | |
|---|---|---|---|
| Cement ............................................. | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.065 |
| Fly Ash ............................................. | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.025 |
| Slag ............................................. | (lbs/cy) / ( Sp. Gr. X 62.4 X 27) | = | 0.023 |
| Water ............................................. | (lbs/cy) / ( 1.00 X 62.4 X 27 ) | = | 0.146 |
| Air ......................................................................................................... | | | 0.060 |
| | Subtotal | = | 0.319 |
| | 1.000 - Subtotal | = | 0.681 |
| | Total | = | 1.000 |

| | | | | |
|---|---|---|---|---|
| % FA Agg.: | 45 | Fine Aggregate ( 1.000 - Subtotal ) X % In Mix | = | 0.306 |
| % In. Agg.: | | Interm. Aggregate ( 1.000 - Subtotal ) X % In Mix | = | |
| % CA Agg.: | 55 | Coarse Aggregate ( 1.000 - Subtotal ) X % In Mix | = | 0.375 |
| | | Aggregate Total | = | 0.681 |

**Aggregate Weights**

| | | |
|---|---|---|
| Fine Aggregate ( abs vol.) X Sp. Gr. X 62.4 X 27 | = | 1377 |
| Intermediate Aggregate ( abs vol.) X Sp. Gr. X 62.4 X 27 | = | |
| Coarse Aggregate ( abs vol.) X Sp. Gr. X 62.4 X 27 | = | 1586 |

**Summary**

| | | |
|---|---|---|
| Cement | 343 | (lbs/cy) |
| Fly Ash | 114 | (lbs/cy) |
| Slag | 114 | (lbs/cy) |
| Water | 246 | (lbs/cy) |
| Fine Agg. | 1377 | (lbs/cy) |
| Interm. Agg. | | (lbs/cy) |
| Coarse Agg. | 1586 | (lbs/cy) |

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

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. ______________________________

Form 820912E - computer

**Portland Cement Shipment Yield Report**

Report No.: 1
Date Submitted: 01/02/04

Contract ID: 29999
Project No.: FM-85(25)--55-85
County: Story

Plant Location: NW Corr E29

Source: Ash Grove
Contractor: Manatt's

| 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 |

| Mix No. | Cement Per CY (lbs) | Batched (CY) | | Cement Batched (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 Scale (Tons) | | | This Check ( + ) | 1.53 |
| | | | Previous Yield Check ( - ) | 1.68 |
| | | | Total Weighed ( Batch Scale ) | 1,566.91 |

Total Billed Weight (Tons) 1,555.84

Yield = 100.7 %

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<br>Producer Name & Location | SPECIFIC GRAVITY | DRY BATCH MASS |
|---|---|---|---|
| Aggregate (Coarse) | | | |
| Aggregate (Find) | | | |
| 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.
- ~~Accumulate calibration error at each increment that material replaces known weight.~~

~~**NOTE:** Example uses 2000 lbs. of known weights applied at 1000 lb. increments. Accumulated error applies only when exchanging known weight with material.~~

| ~~Applied Wt.~~ | ~~Scale Reading~~ | ~~Error~~ | ~~Accum. Error~~ | ~~Wt. Replaced By Material~~ |
|---|---|---|---|---|
| ~~1000~~ | ~~995~~ | ~~-5~~ | | |
| ~~2000~~ | ~~1995~~ | ~~-5~~ | ~~-5*~~ | ~~yes~~ |
| ~~3000~~ | ~~2990~~ | ~~-10~~ | ~~-15~~ | ~~<~~ |
| ~~4000~~ | ~~3995~~ | ~~-5~~ | ~~-10*~~ | ~~yes~~ |
| ~~5000~~ | ~~5000~~ | ~~0~~ | ~~-10~~ | ~~<~~ |
| ~~6000~~ | ~~6005~~ | ~~+5~~ | ~~-5*~~ | ~~yes~~ |
| ~~7000~~ | ~~7010~~ | ~~+10~~ | ~~+5~~ | ~~<~~ |

~~**NOTE:** *Accumulated error is from last known error prior to material replacement.~~

~~< Intermediate errors are measured to determine specification compliance, but are not part of the accumulated result.~~

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., WHICHEVER IS GREATER

**ADMIXTURES**-ACCURATE TO +/-3.0% OF QUANTITY REQUIRED

| metered | | scale reading | Error. % | area | | water reducer | | Retarder | |
|---|---|---|---|---|---|---|---|---|---|
| gal. | lbs. | | | meter oz. | meas. oz. | meter oz. | meas. oz. | meter oz. | meas. 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<br>If <50 $yd^3$ produced in a week 1/two weeks | First week, then 20% of samples obtained<br>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<br>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.

<u>Example:</u> 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 or C-WR 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 ~~Section 4117~~. The fine limestone aggregates in concrete mixes using Class V aggregate with/without fly ash shall meet the requirements of Article ~~4117.03~~ 4116.03 of the current specifications. Allowable cements and substitutions shall meet the requirements of Article ~~4117.05~~ 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 X 62.4 X 27 X 3.14 = 571 lbs. per cubic yard

Fly ash substitution 20% = 571 X 0.20 = 114 lbs. per cubic yard

Slag substitution 20% = 571 X 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 X 62.4 X 27 X 3.10 = 564 lbs. per cubic yard

Fly ash substitution 20% = 564 X 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 x 0.80 = 361 lbs. Portland cement
451 X 0.20 = 90 lbs. slag

Total replacement of Portland cement
((113 + 90) / 564 ) X 100 = 36%

Example: C-3WR-C10-S20 using Type IL cement

Absolute Volume Cement = 0.108

Cement = 0.108 X 62.4 X 27 X 3.11 = 566 lbs. per cubic yard

Fly ash substitution 10% = 566 X 0.10 = 57 lbs. per cubic yard

Slag substitution 20% = 566 X 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 X 0.90 = 356 lbs. Portland cement
396 X 0.10 = 40 lbs. inter-ground limestone

Total replacement of Portland cement
((57 + 113 + 40) / 566) X 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 X 62.4 X 27 X 3.11 = 566 lbs. per cubic yard

Fly ash substitution 20% = 566 X 0.20 = 113 lbs. per cubic yard

Weight of cement = 566 - 113 = 453 lbs. per cubic yard

3 percent Portland cement reduction = 0.03 X 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 =0.420**

| 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-V47BF[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 | 0.420 |
| 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.

[1]When Type IP cement is used.
[2]M-V47B mix shall use Type I/II cements for patching projects.
[3]When Type IS 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 ~~4117)~~ 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 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 |

## 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 cementious materials

## TO FIGURE CEMENT YIELD

Cement Yield = Total Cement Batched + Left in Scale This Check - Left in Scale Last Check x 100

## TO FIGURE MAXIMUM WATER

Maximum water cement ratio of the mix x total cementious materials

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 =0.420**

| 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-V47BF[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 | 0.420 |
| 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.

[1]When Type IP cement is used.
[2]M-V47B mix shall use Type I/II cements for patching projects.
[3]When Type IS 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 ~~4117)~~ 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 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 ¾" 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.

**<u>Placement</u>**
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 | •Observe stockpiling procedures.<br>•Check for segregation.<br>•Check for contamination.<br>•Check for degradation.<br>•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 | •Witness curve development or beam break.<br>•Verify that a valid maturity curve exists and has been signed by the DME.<br>•Check for monthly validation in accordance with Materials IM 383. | When available<br>Observe each occurrence |
| 3. Test Equipment | •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 | •Observe test performed in accordance with Materials IM 307 and IM 308. | Central Batch– once during first week<br>Ready Mix 1/ project (structural or paving) |

| | | |
|---|---|---|
| 6. Plant proportion control | •Observe delivery tolerance.<br>•Observe scale sensitivity.<br>•Observe admixture dispenser operation.<br>•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 | •Per Article 2001.21. | During visits |
| 8. Audit Checks and Test results in Plant Book | •Check for proper completion of Daily Plant Checklist and Plant Site Inspection List.<br>•Observe record of test results for moistures and specific gravities. | During visits |
| 9. Audit Daily Diary | •Review for proper recording of events. | During visits |
| 10. Plant Reports | •Check for proper project and mix identification.<br>•Check for dates and report number.<br>•Review batch weights and aggregate gradations.<br>•Check materials brands and sources.<br>•Check for correct concrete and cement totals (daily, weekly, and to date).<br>•Check for appropriate Plant Inspector signature or initials.<br>•Sign report after review.<br>•Check for hard copy or electronic backup of files | Daily / Weekly |
| 11. Inspect Transit Mixers | •Inspect for buildup in drum per Article 2001.21 B.<br>•Inspect for fin wear or broken fins per Article 2001.21 B.<br>•Check for current truck certification per Article 2001.21 B. | 1/Month |
| 12. Monitor agitors & dump trucks | •Check for properly cleaned dump box. | During visits |
| 13. Inspect plant facility | •Observe plant calibration to assure compliance with Materials IM 527.<br>•Check lab qualifications.<br>•Inspect test equipment. | Central Batch - startup<br>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 | |
|---|---|---|---|---|
| | | **Air & Slump** (No slump for slipform paving) | **Gradation QC** | **Gradation Verification** |
| 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/~~100~~ 200 $yd^3$ 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 |
| 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 |

(1) If less than 20 $yd^3$/ day, the engineer may waive air testing if inspection is not available and producer has exhibited consistency in prior placements
(3) Sampling and testing rate if no other concrete supplied. Use structural or paving test results to cover non structural concrete items.
(4) If less than 500 $yd^3$ 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.)

| | | Field Acceptance | Plant Acceptance | |
|---|---|---|---|---|
| Article | Work Type | Air & Slump | Gradation QC | Gradation Verification |
| 2403 | Structural Concrete | 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% |
| 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% |
| 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% |
| 2412 | Bridge Decks | 1/30 $yd^3$ (2) | 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% |
| 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 |
| 2413 | Deck Surfacing/Overlay Class O | 1/100 $yd^2$ (4) | 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% |
| 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% |
| 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% |
| 2423 | Support Structures | 1/30 yd3 | 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% |
| 2424 | Shotcrete | 1/30 $yd^3$ | S/T for Mix Design only | 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% |
| 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% |
| 2503 | intakes, utility access | 1/30 $yd^3$ | S/T 1/week, if <50 $yd^3$/wk S/T 1/ 2 weeks | 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% |
| 2505 | Guardail anchorage | 1/30 $yd^3$ | S/T 1/week, if <50 $yd^3$/wk S/T 1/ 2 weeks | 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% |
| 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% |

(1) If less than 20 $yd^3$/ day, the engineer may waive air testing if inspection is not available and producer has exhibited consistency in prior placements
(2) On large structural placements >350 $yd^3$, the DME may adjust air and slump testing to 1/50 $yd^3$ based on consistent results in the first 100 $yd^3$ placed
(3) Sampling and testing rate if no other concrete supplied. Use structural or paving test results to cover non structural concrete items.
(4) See 204 Appendix M for overlays >300 $yd^2$.

## PCC NON-STRUCTURAL & MISCELLANEOUS - FIELD AND PLANT SAMPLING AND TESTING GUIDE
(See Specifications for Complete Details.)

| Article | Work Type | Field Acceptance | Plant Acceptance | |
|---|---|---|---|---|
| | | Air & Slump | Gradation QC | Gradation Verification |
| | **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 $yd^3$/ day, the engineer may waive air testing if inspection is not available and producer has exhibited consistency in prior placements. 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 | | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA FA | FRICT HMA A B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | **DES MOINES** | **DIST 5** | **CRUSHED STONE** | | | | | | | | |
| A29002 | L&W QUARRIES INC | | YARMOUTH | SE 01 T071 R04W | 2.65 | 3 | 4 4<br>4 4<br>5 5 | L<br>L<br>L | 15<br>15 18<br>20<br>3 7 | <br>A B C D E<br><br>A B C D E | 1 |
| | | | **SAND AND GRAVEL** | | | | | | | | |
| A29502 | CESSFORD CONST CO | | SPRING GROVE | SW 36 T069 R04W | DWU<br>2.66 | 3<br>X | 4 4 | | | | |

**NOTE 1:** AASHTO 57 GRADATION MAXIMUM

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | FRICT HMA B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **ADAIR DIST 4** | **CRUSHED STONE** | | | | | | | | | | |
| A01002 | SCHILDBERG CONSTRUCTION CO | MENLO | NE 21 T77N R31W | | | | 5 | 5 | L | 15A-15C | A B C D E | |
| | | | | | | | | 4 | | 14 | | |
| A01006 | SCHILDBERG CONSTRUCTION CO | HOWE | SW 1 T76N R31W | | | | | 5 | | 25 | | |
| | | | | | | | | | | 25B-25E | D | |
| A01008 | SCHILDBERG CONSTRUCTION CO | JEFFERSON | NE 17 T77N R31W | | | | | 5 | | 20 | | |
| | | | | | | | | 5 | | 25 | | |
| | | | | | | | | | | 25B-25E | D | |
| **2** | **ADAMS DIST 4** | **CRUSHED STONE** | | | | | | | | | | |
| 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 | |
| **3** | **ALLAMAKEE DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A03002 | BRUENING ROCK PRODUCTS INC | WEXFORD | NE 36 T98N R03W | 2.70 | 3i | | 4 | 4 | D | 1C-6 | | |
| | | | | | | | 4 | 4 | D | 1-8 | | |
| | | | | | | | | | | 1B-8 | A B C D E | |
| A03004 | BRUENING ROCK PRODUCTS INC | LANGE | E2 17 T96N R06W | 2.60 | 3 | | 4 | 4 | L | 2-5 | A B C D E | |
| A03008 | BRUENING ROCK PRODUCTS INC | MCCABE | NE 6 T97N R05W | | | | 4 | 4 | L | 1-5 | | |
| A03010 | SKYLINE MATERIALS LTD | RUDE | SE 17 T100NR06W | | | | | | | | | |
| A03014 | BRUENING ROCK PRODUCTS INC | HAMMEL-BOONIES | SW 2 T99N R06W | DWU | 3i | | 4 | 4 | D | 2-4C | A B C D E | |
| A03022 | SKYLINE MATERIALS LTD | LIVINGOOD | SW 7 T96N R06W | | | | 4 | 4 | L | 4-7 | | |
| | | | | | | | | 4 | | 2-7 | | |
| A03026 | BRUENING ROCK PRODUCTS INC | BYRNES | SE 25 T99N R06W | | | | | | | | | |
| A03028 | BRUENING ROCK PRODUCTS INC | WELPER-JOHNSON | SW 35 T99N R04W | | | | | | | FULL FACE | A B C D E | |
| A03036 | BRUENING ROCK PRODUCTS INC | SWENSON | SE 19 T96N R05W | | | | | | | | | |
| A03038 | RIEHM CONSTRUCTION CO INC | RIEHM | SE 7 T100NR04W | DWU | 3i | | 4 | 4 | D | 1-4 | A B C D E | |
| A03040 | BRUENING ROCK PRODUCTS INC | DEE | SE 21 T99N R04W | DWU | 3i | | 4 | 4 | D | 5A-5D | A B C D E | |
| A03042 | BARD MATERIALS | CHURCHTOWN | SW 29 T99N R04W | | | | | 4 | | 1-3 | | |
| | | | | | | | 4 | 4 | D | 3 | | |
| A03046 | BRUENING ROCK PRODUCTS INC | MOHS | SW 29 T96N R04W | DWU | 2 | | 5 | 5 | | 1-2 | | |
| | | | | | | | | 5 | | 1-4 | | |
| A03048 | BRUENING ROCK PRODUCTS INC | POSTVILLE | SW 16 T96N R06W | 2.61 | 3 | | 4 | 4 | L | 6-8 | | |
| | | | | | | | | 4 | | 2-5 | | |
| A03050 | BRUENING ROCK PRODUCTS INC | GREEN | NW 16 T96N R06W | 2.63 | 3 | | 4 | 4 | L | 2-3A | | |
| | | | | | | | | | | 1-3 | A B C D E | |
| A03052 | BRUENING ROCK PRODUCTS INC | ROSSVILLE | NE 35 T97N R05W | | | | 4 | 4 | L | 1-5 | A B C D E | |
| A03054 | BRUENING ROCK PRODUCTS INC | WEST RIDGE | NE 8 T98N R06W | | | | | | | | | |
| A03058 | BRUENING ROCK PRODUCTS INC | ELON | SW 33 T98N R04W | | | | | | | | | |
| A03064 | RAINBOW QUARRY LLC | RAINBOW | SE 26 T97N R05W | | | | | | | FULL FACE | D | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3** | **ALLAMAKEE DIST 2** | **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 | | 4 | 4 | L | 2 | A B C D E | |
| A03068 | BRUENING ROCK PRODUCTS INC | JEFFERSON | SW 30 T97N R05W | | | | 5 | 5 | L | 2-4 | | |
| A03072 | STRONG ROCK & GRAVEL | STRONG | SE 24 T99N R04W | | | | 4 | 4 | D | 1-8 | A B C D E | |
| A03074 | RON WEYMILLER | WW | NE 12 T100NR05W | | | | | | | | | |
| | | **SAND AND GRAVEL** | | | | | | | | | | |
| A03502 | SKYLINE MATERIALS LTD | HARPERS FERRY | SW 7 T97N R02W | 2.67 | 3iB | | 3 | 3 | | | | |
| | | | | 2.67 | | X | | | | | | |
| A03506 | BRUENING ROCK PRODUCTS INC | HAMMEL-BOONIES | SW 2 T99N R06W | | | H | 4 | 4 | | | | |
| 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** | | | | | | | | | | |
| **4** | **APPANOOSE DIST 5** | **CRUSHED STONE** | | | | | | | | | | |
| A04016 | L&W QUARRIES INC | WALNUT CITY | CT 35 T70N R19W | 2.70 | 2 | | 5 | 5 | L | 1-3 | D | 1 |
| | | | | | | | 5 | 5 | L | 6 | A B C D E | |
| A04018 | L&W QUARRIES INC | CLARKDALE #8 | SE 15 T69N R18W | | | | | 5 | | 4 | D E | |
| | | | | | | | | | | 1A | D E | |
| | | | | | | | | | | 1C | A B C D E | |
| A04020 | CANTERA AGGREGATES | PLANO | 5 T69N R19W | | | | 5 | 5 | L | 1 | A B C D E | 2 |
| | | | | | | | | | | 3 | A B C D E | |
| **5** | **AUDUBON DIST 4** | **SAND AND GRAVEL** | | | | | | | | | | |
| A05506 | HALLETT MATERIALS CO | EXIRA | SW 8 T78N R35W | 2.68 | 3i | | 3 | 3 | | | | |
| | | | | 2.66 | | X | | | | | | |
| **6** | **BENTON DIST 6** | **CRUSHED STONE** | | | | | | | | | | |
| A06006 | WENDLING QUARRIES INC | GARRISON B | NE 33 T85N R11W | 2.64 | 2 | | 4 | 4 | L | 6-16 | | |
| | | | | | | | 5 | 5 | L | 6-28 | | |
| | | | | | | | | | | 6-TOP 2' BED 27 | A B C D E | |
| | | | | | | | 5 | 5 | L | 32-37 | | |
| A06012 | WENDLING QUARRIES INC | JABENS | SW 7 T85N R11W | DWU | 2 | | 5 | 5 | L | 6-11 | | |
| | | | | DWU | 2 | | 5 | 5 | L | 9-12 | A B C D E | |
| | | | | 2.63 | 2 | | 4 | 4 | L | 12 | A B C D E | |
| | | | | | | | 4 | 4 | L | 10-12 | | |
| | | | | | | | 4 | 4 | L | 13-18 | D | |
| | | | | | | | 4 | 4 | L | 20-23 | A B C D E | |
| | | | | | | | | | | 1-5 | D | |

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 SSD SpGr | DUR PCC CA | FA | FRICT HMA A | FRICT HMA B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | **BENTON** | **DIST 6** | **CRUSHED STONE** | | | | | | | | **CONTINUED** | | |
| A06014 | WENDLING QUARRIES INC | | VINTON-MILROY | S2 10 T85N R10W | | | | | 4 | L | 1-4 | | |
| | | | | | | | | | | | 1-7 | D | |
| A06016 | WENDLING QUARRIES INC | | COOTS | SW 36 T86N R11W | | | | | | | 2A ON | D | |
| | | | | | | | | | | | DOWN | | |
| | | | **SAND AND GRAVEL** | | | | | | | | | | |
| A06502 | WENDLING QUARRIES INC | | VINTON-MILROY | S2 10 T85N R10W | 2.65 | | X | 4 | 4 | | | | |
| A06504 | WENDLING QUARRIES INC | | COOTS SAND/VINTON | SW 31 T86N R10W | 2.65 | | X | 3 | 3 | | | | |
| A06506 | WENDLING QUARRIES INC | | PORK CHOP | CT 11 T85N R09W | DWU | | X | 4 | 4 | | | | |
| A06508 | WENDLING QUARRIES INC | | BRIGHT SAND | NW 28 T86N R10W | | | | | | | | | |
| **7** | **BLACK HAWK** | **DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A07004 | BMC AGGREGATES LC | | WATERLOO SOUTH | NW 18 T87N R12W | DWU | 3 | | 5 | 5 | L | 25 | | |
| | | | | | | | | 4 | 4 | L | 17-24 | | |
| | | | | | | | | 4 | 4 | L | 32-36 | A B C D E | |
| | | | | | | | | 5 | 5 | L | 5-24 | | |
| | | | | | | | | | | | 1-23 | A B C D E | |
| | | | | | | | | | | | 17-23 | A B C D E | |
| A07008 | BMC AGGREGATES LC | | MORGAN | NE 15 T89N R12W | 2.48 | 3i | | 4 | 4 | L | 5 | | |
| | | | | | 2.63 | 3i | | 4 | 4 | D | TOP 30' | | |
| | | | | | | | | | | | OF 9 | | |
| | | | | | | | | 5 | 5 | L | 1 | | |
| | | | | | | | | | 5 | | 1-3 | | |
| | | | | | | | | | 5 | | 4A-4B | | |
| A07018 | BMC AGGREGATES LC | | RAYMOND-PESKE | SW 1 T88N R12W | 2.66 | 2 | | 4 | 4 | L | 1B-5,2-5 | | |
| | | | | | DWU | 2 | | 4 | 4 | L | 3-12,3-13 | | |
| | | | | | 2.59 | 2 | | 4 | 4 | D | 2-10 | | |
| | | | | | 2.59 | 2 | | 4 | 4 | L | 3-10 | | |
| | | | | | | | | 4 | 4 | D | 1B-10 | | |
| | | | | | | | | 4 | 4 | L | 6-10 | A B C D E | |
| A07020 | BMC AGGREGATES LC | | STEINBRON | SE 1 T88N R11W | 2.60 | 3 | | 4 | 4 | L | 1B | | |
| | | | | | 2.60 | 2 | | 4 | 4 | L | 1A-1B | | |
| A07022 | BMC AGGREGATES LC | | MESSERLY | NE 8 T90N R14W | | | | | | | | | |
| | | | **SAND AND GRAVEL** | | | | | | | | | | |
| A07504 | BMC AGGREGATES LC | | WATERLOO SAND | SW 9 T89N R13W | | | | 3 | 3 | | | | |
| | | | | | 2.65 | | X | | | | | | |
| A07506 | WENDLING QUARRIES INC | | ASPRO | NW 1 T88N R13W | | | | 4 | 4 | | | | |
| | | | | | 2.65 | | X | | | | | | |
| A07508 | BMC AGGREGATES LC | | GILBERTVILLE | 16 T88N R12W | DWU | 2 | | 4 | 4 | | | | |
| | | | | | 2.65 | | X | | | | | | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **7** | **BLACK HAWK DIST 2** | **SAND AND GRAVEL** | | | | | | | | **CONTINUED** | | |
| A07512 | BMC AGGREGATES LC | ZEIEN S&G | NW 23 T87N R12W | 2.65 | | X | | | | | | |
| A07518 | BMC AGGREGATES LC | JANESVILLE | NE 14 T90N R14W | | | | 3 | 3 | | | | |
| | | | | 2.66 | | X | | | | | | |
| **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 | DWU | 3iB | | 4 | 4 | D | 1-6 | A B C D E | |
| | | | | | 3iB | | 4 | 4 | D | 1-4 | | |
| A09008 | BMC AGGREGATES LC | DENVER #2 | NE 20 T91N R13W | | | | | | | 2 | A B C D E | |
| | | **SAND AND GRAVEL** | | | | | | | | | | |
| A09508 | BMC AGGREGATES LC | TRIPOLI-PLATTE | SW 36 T93N R13W | | | H | | | | | | |
| A09510 | CROELL REDI MIX | PLAINFIELD/ADAMS | NE 32 T93N R14W | 2.66 | | X | | | | | | |
| A09512 | BMC AGGREGATES LC | BOEVERS | NE 31 T92N R11W | 2.64 | | X | | | | | | |
| **10** | **BUCHANAN DIST 6** | **CRUSHED STONE** | | | | | | | | | | |
| A10002 | BARD MATERIALS | WESTON-LAMONT | NW 14 T90N R07W | 2.61 | 3iB | | 4 | 4 | D | 1-6 | A B C D E | |
| | | | | 2.57 | 3i | | 4 | 4 | D | 6-7 | A B C D E | |
| | | | | 2.65 | 3i | | 4 | 4 | D | 8-9 | A B C D E | |
| | | | | | | | 4 | 4 | D | 1-7 | | |
| A10004 | BMC AGGREGATES LC | BLOOM-JESUP | SW 32 T89N R10W | 2.63 | 3 | | 4 | 4 | L | 2-5 | A B C D E | |
| | | | | | | | 4 | 4 | L | 1-7 | | |
| | | | | | | | | | | 2-8 | D | |
| A10008 | BRUENING ROCK PRODUCTS INC | OELWEIN | NW 2 T90N R09W | 2.65 | 3i | | 4 | 4 | D | 4-5 | A B C D E | |
| | | | | | | | 4 | 4 | D | 4-6 | | |
| A10010 | BRUENING ROCK PRODUCTS INC | HAZELTON | NW 11 T90N R09W | 2.63 | 3iB | | 4 | 4 | D | 4 | A B C D E | |
| A10012 | BMC AGGREGATES LC | MILLER-INDEPENDENCE | NW 14 T88N R09W | | | | | | | | | |
| A10014 | BMC AGGREGATES LC | OELWEIN #1 | SW 2 T90N R09W | | | | 5 | 5 | L | 1-12 | | |
| A10016 | BMC AGGREGATES LC | OELWEIN #2 | SE 3 T90N R09W | 2.68 | 3i | | 4 | 4 | D | 13-16 | | |
| | | | | | | | | | | 13-17 | A B C D E | |
| A10022 | BRUENING ROCK PRODUCTS INC | BROOKS | NW 2 T88N R09W | 2.60 | 3i | | 4 | 4 | L | 7 | | |
| | | | | | | | | 5 | | 1-6 | | |
| A10024 | BMC AGGREGATES LC | RASMUSSEN #2 | SE 21 T88N R08W | | | | | | | 1-6 + QRY FLR | D | |
| A10028 | WENDLING QUARRIES INC | HERTZBERGER | NE 36 T87N R10W | | | | | 5 | | | | |
| A10030 | BARD MATERIALS | SOUTH AURORA | NW 19 T90N R07W | 2.63 | 3iB | | 4 | 4 | D | 1-3 | A B C D E | |
| A10040 | BMC AGGREGATES LC | ZUPKE-OELWEIN | NE 4 T90N R09W | | | | | | | | | |
| A10042 | BRUENING ROCK PRODUCTS INC | BRANDON I-380 | E2 23 T87N R10W | | | | | | | | | |

RECENTLY ACTIVE AGGREGATE SOURCES

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | DUR FA | FRICT HMA A | FRICT HMA B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | **BUCHANAN DIST 6** | **CRUSHED STONE** | | | | | | | | **CONTINUED** | | |
| 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 | | | | | | |
| **11** | **BUENA VISTA DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| 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 | SIOUX 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 | | | | | | |
| **12** | **BUTLER DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A12004 | BRUENING ROCK PRODUCTS INC | LUBBEN | NW 25 T93N R17W | | | | 5 | 5 | L | 4-16 | | |
| | | | | | | | | 5 | | 1-21 | | |
| | | | | | | | | | | 1-20 | D | |
| A12008 | BRUENING ROCK PRODUCTS INC | FLORRY-STEERE | CT 8 T93N R17W | | | | | 5 | | 1-11 | | |
| A12010 | SKYLINE MATERIALS LTD | CLARKSVILLE-ENGLE | NE 16 T92N R15W | | | | | | | | | |
| A12014 | BMC AGGREGATES LC | OLTMANN | SE 8 T91N R16W | | | | 5 | 5 | L | 1-4 | | |
| | | | | | | | | | | 1-TOP 1/2 | D | |
| | | | | | | | | | | BED 10 | | |
| | | | | | | | | | | 9-16 | D | |
| | | | | | | | | | | 17-18 | D | |
| A12016 | BRUENING ROCK PRODUCTS INC | WIEGMANN-BRISTOW | SE 23 T92N R18W | | | | | | | 1-11 | | |
| A12018 | BRUENING ROCK PRODUCTS INC | NEYMEYER | SW 28 T90N R18W | | | | | | | | | |
| A12020 | BRUENING ROCK PRODUCTS INC | BRUNS #2 | NW 21 T91N R18W | | | | | 5 | | 1-5 | 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 | | | | |
| | | | | 2.66 | | X | | | | | | |
| A12520 | CROELL REDI MIX | PARKERSBURG | E2 19 T90N R16W | DWU | | X | | | | | | |
| A12522 | BMC AGGREGATES LC | HOBSON | 34 T92N R15W | 2.66 | | X | | | | | | |
| **13** | **CALHOUN DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| 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 SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **13** | **CALHOUN DIST 3** | **SAND AND GRAVEL** | | | | | | | | **CONTINUED** | | |
| A13508 | STRATFORD GRAVEL INC | PACKER | NE 26 T86N R34W | | | H | 3 | 3 | | | | |
| A13510 | MOHR SAND, GRAVEL, & CONST LLC | SMITH | NW 23 T86N R34W | | | | | | | | | |
| **14** | **CARROLL DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| A14504 | STRATFORD GRAVEL INC | REINHART | NW 21 T85N R33W | DWU | 2 | X | | | | | | |
| A14510 | TIEFENTHALER AG-LIME INC | LANESBORO | NW 17 T85N R33W | 2.72 | 2 | | 4 | 4 | | | | |
| | | | | 2.68 | | X | | | | | | |
| A14514 | TIEFENTHALER AG-LIME INC | MACKE | SW 6 T85N R33W | 2.69 | 2 | | 4 | 4 | | | | |
| | | | | 2.66 | | X | | | | | | |
| A14516 | STRATFORD GRAVEL INC | RICHLAND | NE 23 T83N R33W | | | H | 4 | 4 | | | | |
| A14518 | TIEFENTHALER AG-LIME INC | MILLER | 21 T85N R33W | DWU | 2 | | | | | | | |
| | | | | DWU | | X | | | | | | |
| **15** | **CASS DIST 4** | **CRUSHED STONE** | | | | | | | | | | |
| A15004 | SCHILDBERG CONSTRUCTION CO | LEWIS | SE 17 T75N R37W | | | | | | | | | |
| A15008 | SCHILDBERG CONSTRUCTION CO | ATLANTIC MINE | SW 13 T76N R37W | | | | | 5 | | 25 | | |
| | | | | | | | | | | 25B-25E | D | |
| | | | | | | | | | | 20A-20C | D | |
| A15012 | SCHILDBERG CONSTRUCTION CO | HANSEN | SE 29 T76N R36W | | | | 5 | 5 | L | ARGENTINE | | |
| **16** | **CEDAR DIST 6** | **CRUSHED STONE** | | | | | | | | | | |
| A16004 | WENDLING QUARRIES INC | LOWDEN-SCHNECKLOTH | NW 4 T81N R01W | DWU | 3i | | 4 | 4 | D | 1-4 | A B C D E | |
| A16006 | WENDLING QUARRIES INC | STONEMILL | SE 14 T80N R03W | DWU | 3iB | | 4 | 4 | D | 4 | A B C D E | |
| | | | | | | | | | | 1-4B | D | |
| A16012 | WEBER STONE CO INC | ONION GROVE | NW 14 T82N R02W | 2.61 | 3i | | 4 | 4 | D | 1-7 | A B C D E | |
| A16014 | WENDLING QUARRIES INC | TOWNSEND | NW 2 T79N R02W | | | | | | | 2-10 | A B C D E | |
| A16022 | WENDLING QUARRIES INC | TRICON | N2 9 T82N R04W | DWU | 3i | | 4 | 4 | D | 1 | A B C D E | |
| | | | | DWU | 3i | | 4 | 4 | D | 1-4 | A B C D E | |
| A16026 | WENDLING QUARRIES INC | PEDEN #2 | SW 10 T79N R03W | | | | | | | | | |
| | | **SAND AND GRAVEL** | | | | | | | | | | |
| A16502 | WENDLING QUARRIES INC | SHARPLISS | NW 12 T79N R03W | | | | 4 | 4 | | | | |
| | | | | 2.65 | | X | | | | | | |
| A16506 | WEBER STONE CO INC | ONION GROVE | NE 14 T82N R02W | 2.65 | | X | | | | | | |
| A16510 | CROELL REDI MIX | CEDAR BLUFF | SW 28 T81N R04W | DWU | | X | | | | | | |
| **17** | **CERRO GORDO DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A17008 | MARTIN MARIETTA AGGREGATES | PORTLAND WEST | NE 19 T96N R19W | 2.75 | 3iB | | 4 | 4 | L | 1-8 | 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 | A B C D E | |
| | | | | | | | 4 | 4 | L | 8-9 | | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **17** | **CERRO GORDO DIST 2** | **CRUSHED STONE** | | | | | | | | **CONTINUED** | | |
| A17020 | MARTIN MARIETTA AGGREGATES | MASON CITY | NE 29 T97N R20W | | | | 4 | 4 | D | 9-15 | | |
| | | | | | | | | | | 1-6 | A B C D E | |
| A17022 | NORTH IA SAND & GRAVEL INC | HOLCIM | SE 19 T97N R20W | | | | | | | | | |
| A17024 | HEARTLAND ASPHALT INC | RIVERVIEW | NE 29 T96N R19W | | | | 4 | 4 | L | 1-12 | | |
| | | | | | | | 4 | 4 | L | 1-15 | | |
| | | | | | | | 4 | 4 | L | 13-15 | | |
| | | | | | | | 5 | 5 | L | 13-17 | | |
| | | | | | | | 5 | 5 | L | 16-17 | | |
| | | **SAND AND GRAVEL** | | | | | | | | | | |
| A17514 | MARTIN MARIETTA AGGREGATES | HOLCIM SAND | NE 19 T97N R20W | DWU | 3 | | 3 | 3 | | | | |
| | | | | 2.65 | | X | | | | | | |
| A17518 | HEARTLAND ASPHALT INC | AIRPORT | NE 8 T96N R21W | | | H | 3 | 3 | | | | |
| A17520 | NORTH IA SAND & GRAVEL INC | TUTTLE | NE 13 T97N R21W | 2.64 | | X | | | | | | |
| **18** | **CHEROKEE DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| A18506 | HALLETT MATERIALS CO | CHEROKEE SOUTH | NE 16 T91N R40W | 2.70 | 2 | | 3 | 3 | | | | |
| | | | | 2.69 | | X | | | | | | |
| A18514 | L G EVERIST INC | LARRABEE-MONTGOMERY | NE 20 T93N R39W | 2.67 | 3 | | 3 | 3 | | | | |
| | | | | 2.63 | | X | | | | | | |
| A18526 | HALLETT MATERIALS CO | CHEROKEE NORTH | SW 23 T92N R40W | 2.70 | 3 | | 3 | 3 | | | | |
| | | | | 2.67 | | X | | | | | | |
| A18528 | L G EVERIST INC | WASHTA | SW 31 T90N R41W | 2.68 | 3 | | 3 | 3 | | | | |
| | | | | 2.64 | | X | | | | | | |
| A18534 | HALLETT MATERIALS CO | NELSON | CT 23 T92N R40W | 2.67 | 2 | | 3 | 3 | | | | |
| | | | | 2.68 | | X | | | | | | |
| **19** | **CHICKASAW DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A19004 | BRUENING ROCK PRODUCTS INC | DEERFIELD-MAHONEY | SE 33 T97N R14W | | | | | | | | | |
| A19008 | BRUENING ROCK PRODUCTS INC | BOICE | NE 16 T95N R14W | | | | | | | 2-5 | D | |
| | | **SAND AND GRAVEL** | | | | | | | | | | |
| A19508 | SKYLINE MATERIALS LTD | BUSTA | SE 23 T96N R11W | 2.65 | | X | 4 | 4 | | | | |
| A19512 | BRUENING ROCK PRODUCTS INC | PEARL ROCK | SE 31 T94N R14W | | | | 4 | 4 | | | | |
| | | | | 2.65 | | X | | | | | | |
| A19514 | BRUENING ROCK PRODUCTS INC | NASHUA | SW 33 T95N R14W | | | | 3 | 3 | | | | |
| | | | | DWU | | X | | | | | | |
| 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 | 3 | | | | |
| | | | | 2.65 | | X | | | | | | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **20** | **CLARKE DIST 5** | **CRUSHED STONE** | | | | | | | | | | |
| A20002 | SCHILDBERG CONSTRUCTION CO | OSCEOLA | NW 12 T72N R26W | | | | | 5 | | 25A-25E | D | |
| | | | | | | | | | | 20A-20C | | 1 |
| | | | | | | | | | | 20A | A B C D E | |
| | | | | | | | | | | 25B-25C | A B C D E | |
| **21** | **CLAY DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| A21506 | DAVE'S SAND AND GRAVEL INC | EVERLY | SW 31 T97N R38W | 2.70 | 3 | | 3 | 3 | | | | |
| | | | | 2.68 | | X | | | | | | |
| A21516 | SIEH SAND & GRAVEL | SPENCER #1 | SW 24 T96N R36W | 2.69 | 2 | | 3 | 3 | | | | |
| | | | | 2.66 | | X | | | | | | |
| A21518 | HALLETT MATERIALS CO | SPENCER #2 | SW 5 T97N R37W | | | H | 4 | 4 | | | | |
| A21526 | CLAY COUNTY | CLAY COUNTY | NW 20 T96N R35W | | | H | | | | | | |
| A21528 | DAVE'S SAND AND GRAVEL INC | GOEKEN | NE 5 T96N R38W | DWU | 2 | H | | | | | | |
| A21530 | HALLETT MATERIALS CO | BRAUNSCHWEIG | 16 T94N R36W | | | H | 3 | 3 | | | | |
| A21532 | CLAY COUNTY | ELSER | CT 3 T94N R36W | | | H | 3 | 3 | | | | |
| A21534 | HALLETT MATERIALS CO | CLARK EVERLY | NW 6 T96N R38W | | | H | | | | | | |
| A21536 | HALLETT MATERIALS CO | GILLETT GROVE | NE 3 T94N R36W | | | H | 3 | 3 | | | | |
| A21538 | NSG, LLC | NORGAARD SAND & GRAVEL | NW 20 T96N R35W | 2.65 | | X | | | | | | |
| A21540 | BD CONSTRUCTION SERVICES LLC | DELOSS | 20 T96N R35W | | | H | | | | | | |
| **22** | **CLAYTON DIST 2** | **CRUSHED STONE** | | | | | | | | | | |
| A22002 | BARD MATERIALS | TWIN ROCK-SCHRADER | NW 14 T94N R05W | | | | 4 | 4 | D | 1-11 | | |
| | | | | | | | 4 | 4 | D | 3-11 | A B C D E | |
| A22004 | SKYLINE MATERIALS LTD | BENTE-ELKADER-WATSON | SW 12 T93N R05W | 2.66 | 2 | | 4 | 4 | L | 6-9 | | |
| | | | | | | | 4 | 4 | D | 1-9 | | |
| | | | | | | | | | | 5-9 | A B C D E | |
| A22008 | BARD MATERIALS | ANDEREGG | SE 32 T92N R02W | | | | 4 | 4 | D | 2-8 | A B C D E | |
| A22010 | BARD MATERIALS | OSTERDOCK | SE 2 T91N R03W | 2.67 | 2 | | | | | 2-5 | | |
| | | | | | | | 4 | 4 | | 1-8 | | |
| | | | | | | | | | | 3-8 | A B C D E | |
| A22012 | BARD MATERIALS | SCHMIDT | NE 33 T91N R01W | 2.66 | 3i | | 4 | 4 | D | 4B -6 | | |
| | | | | | | | 4 | 4 | D | 2-6 | A B C D E | |
| A22014 | SKYLINE MATERIALS LTD | BLUME | NE 9 T93N R03W | 2.64 | 2 | | 4 | 4 | D | 1-7 | | |
| | | | | | | | 4 | 4 | D | 1-12 | A B C D E | |
| A22016 | BARD MATERIALS | GISLESON | NW 6 T95N R04W | 2.66 | 3i | | 4 | 4 | D | 1-8 | | |
| | | | | | | | 4 | 4 | | 1-15 | A B C D E | |
| A22018 | CJ MOYNA & SONS INC | ZURCHER | SE 1 T94N R05W | | | | 4 | 4 | | | | |
| A22020 | BARD MATERIALS | MUELLER | NE 30 T94N R03W | DWU | 3i | | 4 | 4 | D | 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 SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **22** | **CLAYTON DIST 2** | **CRUSHED STONE** | | | | | | | | **CONTINUED** | | |
| A22024 | MIELKES QUARRY | MIELKES QUARRY | NE 21 T95N R04W | | | | 4 | 4 | D | 1-2 | | |
| A22026 | BARD MATERIALS | DOERRING-LUANA | SE 5 T95N R05W | | | | | | | 3-5 | A B C D E | |
| A22030 | BARD MATERIALS | EBERHARDT | NW 27 T93N R05W | 2.72 | 3 | | 4 | 4 | | 1-5 | | |
| | | | | | | | | 4 | | 1-8 | | |
| | | | | | | | | | | 1-6 | A B C D E | |
| A22032 | BARD MATERIALS | WELLMAN | NW 25 T92N R06W | | | | | 4 | | 1-6 | | |
| A22034 | BARD MATERIALS | KRUSE | NW 17 T92N R04W | 2.70 | 3B | | 4 | 4 | | 5-11 | | |
| | | | | 2.70 | 2 | | 4 | 4 | | 5-12 | A B C D E | |
| | | | | | | | 4 | 4 | | 2-12 | | |
| A22038 | BARD MATERIALS | FASSBINDER | SW 9 T92N R03W | 2.67 | 3i | | 4 | 4 | D | 2B -6 | | |
| | | | | | | | | | | 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 | | | | | | | 1-8 | | |
| | | | | | | | 4 | 4 | D | 1-10 | | |
| | | | | | | | | | | 1-9 | A B C D E | |
| A22044 | BARD MATERIALS | BOGE | SW 18 T91N R02W | | | | | | | | | |
| A22048 | SKYLINE MATERIALS LTD | TUCKER | SW 18 T91N R05W | | | | | | | 1-3 | D | |
| A22058 | SKYLINE MATERIALS LTD | ST. OLAF | NW 25 T94N R05W | | | | | | | | | |
| 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 | | |
| 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 | | | | | | | | | |
| A22080 | BARD MATERIALS | HILINE | NW 8 T91N R03W | | | | | | | | | |
| A22084 | CJ MOYNA & SONS INC | MOYNA | 14 T93N R05W | 2.66 | 3i | | | | L | BED 6-<br>TOP 3' OF<br>8 | | |
| | | | | | | | 4 | 4 | L | 6-9 | A B C D E | |
| A22086 | CJ MOYNA & SONS INC | WILLIE | SW 18 T93N R02W | | | | | | | | | |
| A22088 | CJ MOYNA & SONS INC | KEPPLER | NW 29 T94N R05W | | | | | | | | | |
| A22090 | PATTISON SAND COMPANY LLC | FRENCHTOWN | 7 T93N R02W | 2.68 | 3iB | | 4 | 4 | D | S1C-S1D | | |
| | | | | DWU | 3 | | 4 | 4 | D | S1B | | |
| | | | | 2.68 | 3 | | 4 | 4 | D | S1B-S1D | | |
| | | | | 2.68 | 3i | | 4 | 4 | D | G4 | A B C D E | |
| | | | | 2.66 | 3 | | 4 | 4 | D | G2-G3 | A B C D E | |
| | | | | 2.72 | 3i | | 4 | 4 | D | O1A | A B C D E | |
| | | | | | | | | | | G2-G4 | A B C D E | |
| | | | | | | | | | | G1 | A B C D E | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **22** | **CLAYTON** **DIST 2** | **CRUSHED STONE** | | | | | | | | **CONTINUED** | | |
| 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 | | | | |
| **23** | **CLINTON** **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 | |
| | | | | | | | 4 | 4 | D | 5-6 | | |
| A23004 | WENDLING QUARRIES INC | BEHR | SW 2 T81N R03E | 2.61 | 3i | | 4 | 4 | D | 1-2 | A B C D E | |
| A23006 | WENDLING QUARRIES INC | SHAFFTON | NE 11 T80N R05E | 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 | |
| | | | | | | | 4 | 4 | D | 3-15 | | |
| | | | | | | | | | | 16-21 | A B C D E | |
| A23010 | WENDLING QUARRIES INC | GOOSE LAKE | SW 22 T83N R05E | | | | 4 | 4 | D | 1-10 | | |
| | | | | | | | | | | 2-4 | D E | |
| A23012 | WENDLING QUARRIES INC | TEEDS GROVE | SW 3 T83N R06E | | | | | | | 2-4 | A B C D E | |
| A23016 | WENDLING QUARRIES INC | LYONS | NW 18 T82N R07E | | | | | | | UPPER OR LOWER LEDGE | D E | |
| 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 | 2 | | 4 | 4 | | | | |
| | | | | 2.68 | | X | | | | | | |
| A23506 | WENDLING QUARRIES INC | SCHNECKLOTH | S2 10 T80N R05E | | | | 4 | 4 | | | | |
| | | | | 2.67 | | X | | | | | | |
| A23508 | WENDLING QUARRIES INC | GATEWAY | NE 27 T81N R06E | | | | 4 | 4 | | | | |
| | | | | 2.66 | | X | | | | | | |
| A23510 | WENDLING QUARRIES INC | SHAFFTON | N2 11 T80N R05E | | | | 4 | 4 | | | | |
| | | | | 2.66 | | X | | | | | | |
| A23514 | ANDERSON SAND AND GRAVEL CO | ANDERSON | NW 23 T81N R03E | 2.68 | | X | | | | | | |
| A23516 | WENDLING QUARRIES INC | OLSON | NW 23 T81N R02E | DWU | | X | | | | | | |

**RECENTLY ACTIVE AGGREGATE SOURCES**

| CODE | OPERATOR | | SOURCE NAME | LOCATION | BULK SSD SpGr | DUR PCC CA | FA | FRICT HMA A | B | L2 ROCK TYPE | BEDS | REVETMENT CLASS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **24** | **CRAWFORD** | **DIST 3** | **SAND AND GRAVEL** | | | | | | | | | | |
| A24512 | HALLETT MATERIALS CO | | DUNLAP | SE 27 T82N R41W | 2.70 | 2 | | 3 | 3 | | | | |
| | | | | | 2.66 | | X | | | | | | |
| **25** | **DALLAS** | **DIST 4** | **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 | | | | | | |
| **26** | **DAVIS** | **DIST 5** | **CRUSHED STONE** | | | | | | | | | | |
| A26004 | DOUDS STONE LLC | | LEWIS | W2 2 T69N R12W | 2.60 | 3 | | 4 | 4 | L | 1 | D E | |
| | | | | | | | | 5 | 5 | L | 3-7 | D E | |
| | | | | | | | | | 5 | | 3-5 | D | |
| | | | | | | | | 4 | 4 | L | 6-7 | D E | |
| A26006 | DOUDS STONE LLC | | BROWN | NW 2 T69N R12W | 2.60 | 3 | | 4 | 4 | L | 1 | D E | |
| | | | | | | | | 5 | 5 | L | 3-7 | D E | |
| | | | | | | | | | 5 | | 3-5 | | |
| | | | | | | | | 4 | 4 | L | 6-7 | | |
| | | | **SAND AND GRAVEL** | | | | | | | | | | |
| A26502 | DOUDS STONE LLC | | ELDON-FRANKLIN | SW 1 T70N R12W | 2.67 | | X | | | | | | |
| **27** | **DECATUR** | **DIST 5** | **CRUSHED STONE** | | | | | | | | | | |
| A27002 | SCHILDBERG CONSTRUCTION CO | | GRAND RIVER | NW 22 T70N R27W | | | | | 5 | | 25A-25C | | 1 |
| | | | | | | | | | | | TOP 5.5' | D | |
| | | | | | | | | | | | BED 25E | | |
| A27008 | SCHILDBERG CONSTRUCTION CO | | DECATUR | 05 T68N R26W | | | | | | | 20C | A B C D E | 2 |
| | | | | | | | | | 5 | | 25A-25E | | 3 |
| | | | | | | | | | | | 25C | D | |
| | | | | | | | | | | | 20A | C D E | |

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

Rev 05/09

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

Form E820150E

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

# 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

Form 820912E
8-00

**Iowa Department of Transportation**

Office of Materials

# PORTLAND CEMENT SHIPMENT YIELD REPORT

Report No. ___________________
Date Submitted _______________

Contract ID: ________________________
Source: __________________________
Project No.: ________________________
Contractor: __________________________
County: ________________________
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.: ____________________________

**Distribution:**____ DME ____ RCE ____ Central Materials ____ Contractor ____ Inspector

Form 820912E
8-00

**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.: ____________________________

**Distribution:**_____ DME _____ RCE _____ Central Materials _____ Contractor _____ Inspector

Form 820912E
8-00

**Iowa Department of Transportation**

Office of Materials

# PORTLAND CEMENT SHIPMENT YIELD REPORT

Report No. ____________________
Date Submitted ________________

Contract ID: _________________________ Source: ___________________________
Project No.: _________________________ Contractor: ___________________________
County: _________________________ 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.: ____________________________

**Distribution:**____ DME ____ RCE ____ Central Materials ____ Contractor ____ Inspector