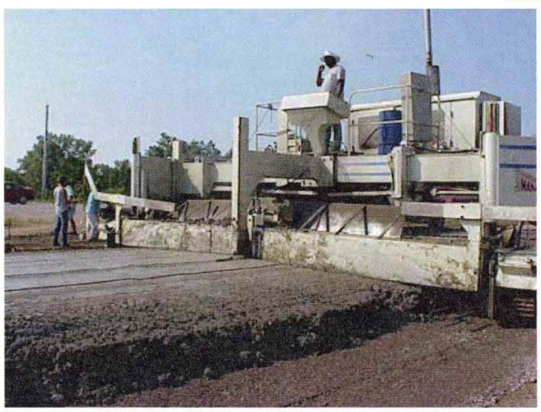
LEVEL II PORTLAND CEMENT CONCRETE

2007-2008

INSTRUCTION MANUAL



TECHNICAL TRAINING & CERTIFICATION PROGRAM

Iowa Department of Transportation

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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.

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.

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

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 – 6.02 5.98

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.

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. The actual documents are not included in this material because they are periodically updated. The documents are included in the PCC Reference Book. The PCC Reference Book is a good tool for technicians and contains the IMs and Specifications needed to perform inspection and testing of Portland Cement Concrete. **NOTE:** IMs and Specifications are updated each spring and fall and the technician should always make sure the most current IMs and specifications are in the Reference Book

> Remember to check for IM and Specification changes each spring and fall to update your PCC Reference Manual

II. 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 Level I and Level II Aggregate
- 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 by the Program Director (Director of the Office of Materials) in mid-May. The Certified Plant Technician's Certification Number will be the same as their Aggregate Certification Number.

Certifications are issued for a five-year period, but if two updates are not obtained in that five-year period, the applicant must retake all applicable schooling, as opposed to taking a refresher course.

If two updates are not obtained in a five-year period, the applicant must retake the entire course! **Refer to I.M. 213 for details**

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 2-4 and 2-5)

D. Responsibilities

IM 213

The Certified Plant Technician will:

- 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: _______________

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This notice is to inform you that your performance as a Certified Inspector/Technician was unsatisfactory for the reason(s) listed below. After receipt of two such notices you may be give a three-month suspension. After three notices, you are subject to decertification

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:

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District Materials Engineer

cc: Program Director – 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.

This describes certified plant inspection. 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, the Contractor shall furnish or be responsible for certified plant inspection for the work, as specified herein.

~~Based on satisfactory correlation with the Contracting Authority's test results, in accordance with Materials I.M. 216, the Contractor's process control test results for aggregate gradation shall be the basis of acceptance. The minimum frequency for acceptance testing shall be in accordance with Materials I.M. 204.~~

2521.02 REQUIREMENTS.

Certified plant inspection shall be in accordance with Materials I.M. 213, utilizing personnel certified for the type of inspection to be accomplished and utilizing prescribed test equipment furnished by the Contractor. The equipment shall also be available for use by the Engineer for monitoring purposes.

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.

Delivery of samples to the District Materials Laboratory may also be required. The provisions for this are in accordance with 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.

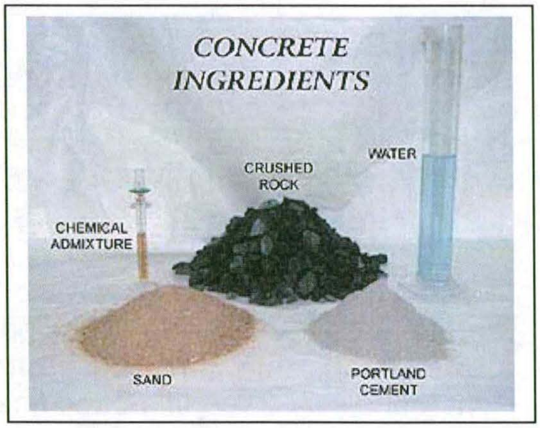
The Engineer may waive aggregate gradations, moisture, and specific gravity tests based on previous satisfactory experience with the plant for PCC which is furnished at a maximum rate of 25 cubic yards (25 m^2) per day, whether from one or more sources. This may be based on quantities planned by the Contractor several days ahead of placement.

2521.04 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

Certified plant inspection will not be measured or paid for separately. It shall be included in the contract unit price for the item for which this inspection is required.

III. CONCRETE MATERIALS

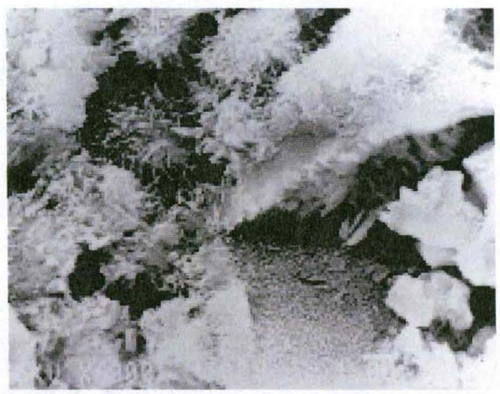
Concrete consists of three basic components-aggregates (both sand and rock), cement, and water. When mixed together and the chemical reaction is allowed to proceed, they form concrete. This material is one of the most versatile construction materials and has tremendous compressive strength. It is widely 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 -15 to 40% Pozzolan
I(PM) - 0 to 15% Pozzolan
IS -25 to 75% GGBFS
I(SM) - 0 to 25% GGBFS

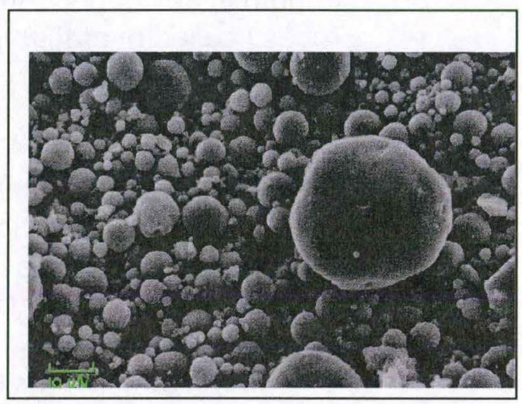
Type I used for most highway work and structures. Type II required on paving, except transit mix furnished less than 3000 m^3 (3600 yd^3). Type III ground finer than Type I cement. Blended cements may be furnished at Contractor's option when Type I or II is specified.

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

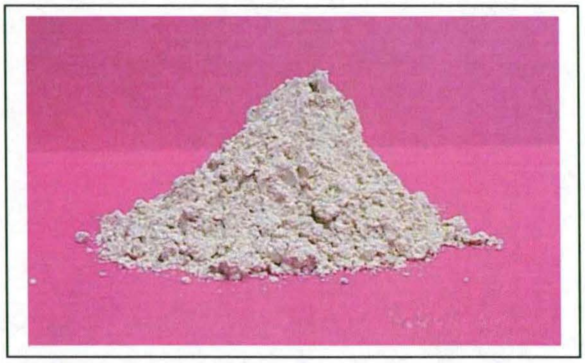
2. Fly Ash - Article 4108, IM 491.17

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



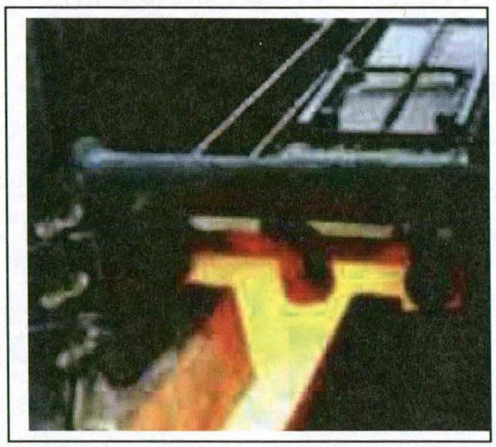
- Class C Fly Ash
  - Cementing
  - High Lime (CaO)
- Class F Fly Ash
  - Non-cementing
  - Low Lime (CaO)

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

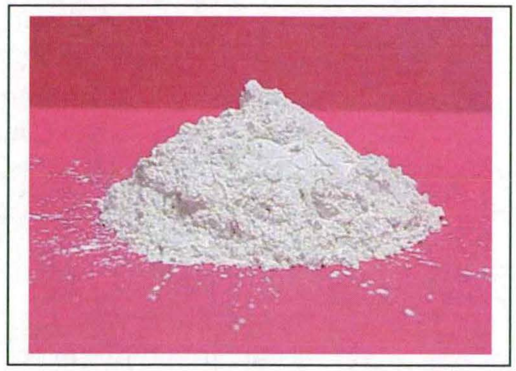
3. Ground Granulated Blast Furnace Slag (GGBFS) - Article 4108



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 I(SM) or IS blended cement.
Use of cement, fly ash, and GGBFS as a ternary mix is allowed in ready mix concrete only.

4. Aggregates - Articles 4109, 4110, 4111, 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

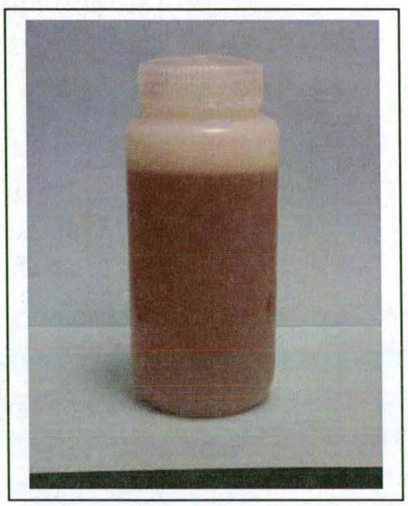
The water used in batching concrete can come from almost any source. Each source must be tested and approved if it is not potable. Often lakes or streams are used because they are close to the project. This water must meet hardness, alkalinity, and acidity requirements. During the summer, warm water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

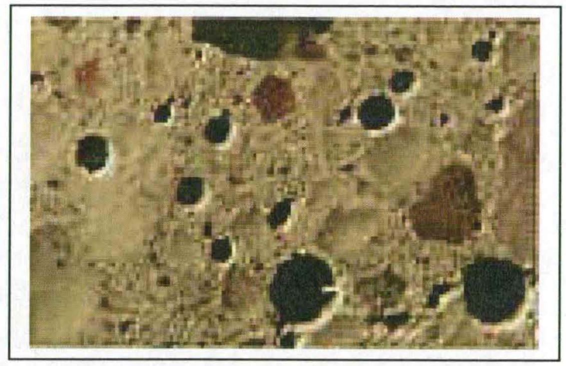


Reasons for using admixtures are:

- 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.

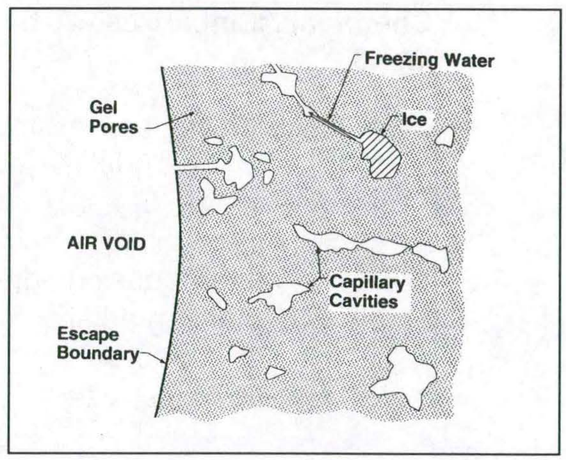


- Freeze Thaw Durability
- Increase Workability

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

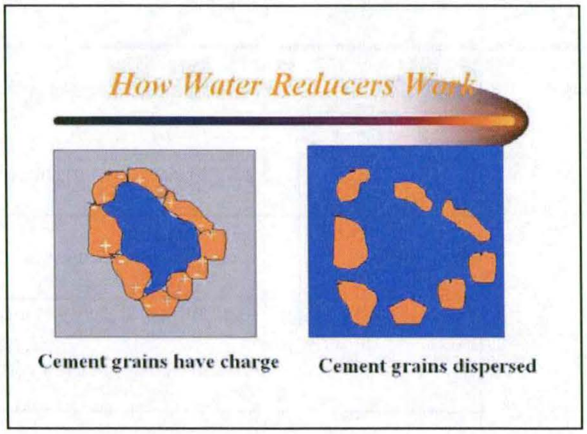
Without air voids, the repeated freezing and thawing will damage the concrete. This damage is increased with deicing salts.

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 County Paving
- Class B County Paving
- Class C Primary Paving & Structures
- Class D Structural
- Class M Patching/ high early strength
- Class O Deck Overlay

Factors Affecting Control of Air in Concrete

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

Factors Affecting Control of Air in Concrete

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

Factors Affecting Control of Air in Concrete

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

Factors Affecting Control of Air in Concrete

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

Factors Affecting Control of Air in Concrete

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

Factors Affecting Control of Air in Concrete

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

IV. METRICS

I. Tables of metric unit names, prefixes, and symbols

Following are terms commonly used in (or with) the metric system and the symbols for each.

Name	Symbol
Celsius Temperature	°C
centimeter	cm
square centimeter	cm^2
cubic centimeter	cm^3
day (time)	d
gram	g
hectare	ha
hour (time)	h
kilogram	kg
kilometer	km

Name	Symbol
square kilometer	km^2
liter	L
megagram	Mg
meter	m
square meter	m^2
cubic meter	m^3
metric ton	A.t
millimeter	mm
minute (time)	min
second (time)	s

Following are some technical metric units and the symbols for each:

Name	Symbol
ampere (electric current)	a
candela (luminous intensity)	cd
hertz (frequency)	Hz
joule (energy, work)	J
lumen (luminous flux)	lm
newton (force)	N
pascal (pressure, stress)	Pa
volt (electric potential)	V
watt (power)	W

Following are prefixes used in the metric system, along with the symbol and magnitude for each.

Prefix	Symbol	Magnitude		
micro	µ	0.000001	millionth	10^{-6}
milli	m	0.001	thousandth	10^{-3}
centi	c	0.01	hundredth	10^{-2}
deci	d	0.1	tenth	10^{-1}
deka	da	10	ten	10
hecto	h	100	hundred	10^{2}
kilo	k	1000	thousand	10^{3}
mega	M	1,000,000	million	10^{6}

The above table depicts the progression, by multiples of ten, from one prefix to the next. In practice, the prefixes *deci, deka,* and *hecto* are rarely used. Also the prefix *centi* is normally used only with *meter.* Preferred metric practice is to use units which represent multiples of 1000. Therefore, use of the centimeter and square centimeter while not disallowed, is discouraged. Another preferred practice is to choose a prefix so that the numerical value expressed is between 0.1 and 1000; e.g., 10 kilometers rather than 10,000 meters. Tables of numbers would be an exception to the practice.

Proper expression

1. Spacing

Do NOT leave a space between a prefix and unit symbol or name

Right: km　　Wrong: k m
Right: kilometer　　Wrong: kilo meter

2. Plurals

Do NOT add an *s* to a unit symbol to make it plural

Right: 45 kg　　Wrong: 45 kgs
Exception: 20°C

However, if a quantity is used as an adjective, use a hyphen instead of a space.

Examples: 35-mm film　3-meter pole

3. Area and Volume

The symbol for *square* is the superscript ^{2}

Example: 10 square meters is 10 m^2

The symbol for *cubic* is the superscript ^{3}

Example: 5 cubic meters is 5 m^3

4. Product and Quotient

With unit symbols, indicate the product of two or more units with a dot above the line. With unit names, use a space between words.

Examples: NAm　　newton meter

With unit symbols, indicate a quotient or rate with a forward slash (/). With unit names, use the word per.

Examples: km/h　　kilometers per hour

5. Mixing Names and Symbols

Do NOT mix unit names and symbols.

Right: km/h   Wrong: km/hour

6. WordPerfect 5.1 Hints

The following symbols can be produced by holding down the ALT key and typing numbers on the keypad (do not use the numbers at the top of the keyboard):

micro (µ) = ALT 230   degree (°) = ALT 248   product (A) = ALT 249

(*See Appendix A of the WordPerfect 5.1 Reference Manual for further information.*)

Conversion factors: When converting a quantity from U.S. customary units to metric units, multiply the quantity by a conversion factor that is more accurate than required. Do not round either the conversion factor or the quantity before multiplication, as accuracy may be reduced. After multiplication, round the result so that the converted value does not imply a greater degree of precision (i.e., more decimal places or more significant digits) than existed in the original value.

The next page is a table of simple conversion factors. Others may be found on ASTM E 380-92.

Conversion Factors

Quantity	From U.S. Customary Units	To Metric Units	Multiply By
Length	mile (U.S. Statute)*	km	1.609347
	mile (international)	km	1.609344**
	yard	m	0.9144**
	foot (U.S. Survey)*	m	0.3048333
	foot (international)	m	0.3048**
	inch	mm	25.4**
Area	square mile (U.S. Statute)*	km^2	2.589998
	square mile (international)	m^2	4046.873
	acre (U.S. Statute)*	ha (10,000 m^2)	0.4046873
	square yard	m^2	0.83612736**
	square foot	m^2	0.09290304**
	square inch	mm^2	645.16**
Volume	acre foot (U.S. Survey)*	m^3	1233.489
	cubic yard	m^3	0.76455486
	cubic foot	m^3	0.02831685
	cubic foot	cm	28316.85
	cubic foot	L (1000 cm^3)	28.31685
	100 board feet	m^3	0.2359737
	gallon	L	3.785412
	cubic inch	cm^3	16.387064**
	cubic inch	mm^3	16387.064**
Mass	Pound	kg	0.45359237**
	kip (1000 pounds)	Mg (1000 kg)	0.45359237**
Temperature	°F	°C	Formula: °C = (°F - 32)1.8**

* Conversion factors referenced to this footnote are based on the U.S. survey foot. The U.S. survey foot equals 1200/3937 meter.

**exact conversion

Visualizing or Relating to Metric Quantities

Length:

1 mm	-	Approximately the thickness of a dime
1 m	-	About 3 inches longer than a yardstick
1 km	-	A little more than 1/2 mile (0.62 mile)

Weight:

1 g	-	About the weight of a large paper clip
1 kg	-	A little heavier than 2 lb (2.2 lb)
1 metric ton	-	200 lb heavier than 1 short ton (2200 lb)

Volume:

1 mL	-	Approximately 1/3 quantity held in a teaspoon
1 L	-	Slightly more than 1 quart (1.06 quarts)
1 L	-	Approximately 34 fluid ounces (33.8 fl. oz)
1 gallon	-	Approximately 4 liters (3.785 liters)
1 m^3	-	1.3 yd^3
1 m^3	-	Approximately 265 gallons

Strength: (all approximate conversions)

1 MPa	-	145 psi
20 MPa	-	3000 psi
35 MPa	-	5000 psi
48 MPa	-	7000 psi
100 MPa	-	14,500 psi

Temperature:

Water Freezes	-	0°C	-	32°F
Water Boils	-	100°C	-	212°F
Body Temperature	-	37°C	-	98.6°F

Density (unit weight):

Aggregate dry rodded unit weight	= 105 lb/ft^3	= 1680 kg/m^3
Aggregate solid density	= 2.60 x 62.4	= 162.24 lb/ft^3
	= 2.60 x 1	= 2.60 g/cm^3
	= 2.60 x 1000	= 2600 kg.m^3

(where 2.60 is the specific gravity of the aggregate)

Unit weight of water	-	62.4 lb/ft^3
	-	1 g/cm^3
	-	1000 kg/m^3

Conversion Factors

Units of Length

To Convert From	Multiply by	To Obtain	To Convert From	Multiply by	To Obtain
Mm	0.03937 in/mm	In	in	25.40 mm/in	mm
Cm	0.3937 in/cm	In	in	2.540 cm/in	cm
M	3.281 ft/m	Ft	ft	0.3048 m/ft	m
M	1.094 yd/m	Yd	yd	0.9144 m/yd	m
Km	0.6214 mile/km	Mile	mile	1.609 km/mile	km

Example: Convert 50 ft to meters $50 \text{ ft} \times 0.3048 \frac{\text{m}}{\text{ft}} = 15.24 \text{ m}$

Units of Area

To Convert From	Multiply by	To Obtain	To Convert From	Multiply by	To Obtain
mm^2	0.001550 in^2/mm^2	In^2	in^2	645.2 mm^2/in^2	mm^2
m^2	10.76 ft^2/m^2	ft^2	ft^2	0.09290 m^2/ft^2	m^2
m^2	1.196 yd^2/m^2	Yd^2	yd^2	0.8361 m^2/yd^2	m^2
Ha	2.471 acre/ha	Acre	acre	0.4047 ha/acre	ha

Example: Convert 30 ft^2 to m^2 $30 \text{ ft}^2 \times 0.0929 \frac{\text{m}^2}{\text{ft}^2} = 2.79 \text{ m}^2$

Units of Volume

To Convert From	Multiply by	To Obtain	To Convert From	Multiply by	To Obtain
ML	0.03381 fl oz/mL	fl oz	fl oz	29.57 fl oz/mL	mL
L	0.2642 gallon/L	gallon	gallon	3.785 L/gallon	L
m^3	264.2 gallon/m^3	gallon	gallon	0.003785 m^3/ gallon	m^3
m^3	35.32 ft^3/m^3	ft^3	ft^3	0.02832 m^3/ft^3	m^3
m^3	1.308 yd^3/m^3	yd^3	yd^3	0.7645 m^3/yd^3	m^3

Example: Convert 10 yd^3 to m^3

$$10\ yd^3 \times 0.7645 \frac{m^3}{yd^3} = 7.6\ m^3$$

Units of Weight (mass)

To Convert From	Multiply by	To Obtain	To Convert From	Multiply by	To Obtain
G	0.0353 oz/g	oz	oz	28.35 g/oz	g
Kg	2.205 lb/kg	lb	lb	0.4536 kg/lb	kg
Metric Ton (1000 kg)	1.103	Short Ton (2000 lb)	Short Ton (200 lb)	0.9072	Metric Ton (1000 kg

Example: Convert 94 lb to kg

$$94\ lb \times 0.4536 \frac{kg}{lb} = 42.64\ kg$$

Temperature:

To convert Centigrade to Farenheit: $°C = \dfrac{(°F - 32)}{1.8}$

To convert Farenheit to Centigrade: $°F = (°C \times 1.8) + 32$

To Derive Necessary Metric Conversion Factors

Tip: Carry the units in the calculation to ensure accuracy

Example: Derive the conversion factor to convert admixture dosage expressed in fl oz/cwt (fl oz/10 cement) to mL/kg

$$\left(1\,fl.oz. \times 29.57\,\frac{mL}{fl.oz}\right) \times \left(\frac{1}{100\,lb} \times \frac{1}{0.4536\,kg}\right) = \frac{1 \times 29.57}{100 \times 0.4536} = 0652\,mL/kg$$

Other Conversion Factors (derived from basic units):

To Convert From	Multiply by	To Obtain	To Convert From	Multiply by	To Obtain
kg/m^3	0.06242	lb/ft^3	lb/ft^3	16.02	kg/m^3
kg/m^3	1.685	lb/yd^3	lb/yd^3	0.5935	kg/m^3
L/m^3	0.2022	$gallon/yd^3$	$gallon/yd^3$	4.944	L/m^3
mL/kg	1.534	fl oz/cwt	fl oz/cwt	0.6519	mL/kg
L/m^3	25.84	fl oz/yd^3	fl oz/yd^3	0.03870	L/m^3
Mpa	145.0	psi	psi	0.006895	MPa

Metric Equivalents of Typical Quantities in Concrete and Aggregate Technology

Note: Some converted quantities have been rounded off.

Example Concrete Mixture Proportions

Quantity	U.S System	Metric (SI) Equivalents
Cement	600 lb/yd^3	360 kg/m^3
Water	300 lb/yd^3 36 gallon/yd^3	180 kg/m^3 178 L/m^3
Sand	1400 lb/yd^3	830 kg/m^3
Stone	1800 lb/yd^3	1070 kg/m^3
Water Reducer	5 fl oz/cwt (100 lb cement) 30 fl oz/yd^3	3.3 mL/kg 1.2 L/m^3

Aggregate Properties:

Specific gravity, absorption, moisture content, and fineness modulus are either unitless quantities or expressed as percentages. The numerical values should not be conveerted for these quantities.

Dry rodded unit weight = 105 lb/ft^3 = 1680 kg/m^3

Sieve Sizes:
(Based on ASTM E 11- Standard Specification for Wire-Cloth Sieves for Testing Purposes)

Sieve	Opening in Inches	Metric SI Equivalent	Sieve	Opening in Inches	Metric SI Equivalent
3 in	3.0	75.0 mm	No. 8	0.0937	2.36 mm
2 in	2.0	50.0 mm	No.16	0.0469	1.18 mm
1 2 in	1.5	37.5 mm	No.30	0.0234	600 µm
1 in	1.0	25.0 mm	No. 50	0.0117	300 µm
3/4 in	0.75	19.0 mm	No. 100	0.0059	150 µm
3/8 in	0.375	9.5 mm	No.200	0.0029	75 µm
No. 4	0.187	4.75 mm			

Water:

Unit weight of water = 62.4 lb/ft^3 = 1000 kg/m^3
= 1 g/cm^3
= 1 kg/L

1 gallon of water = 8.33 lb = 3.78 kg

Concrete Properties:

Property	U.S System	Metric SI Eqivalents
Slump	6 inches	150 mm
Temperature	80°F	27°C
Unit Weight	150 lb/ft^3	2400 kg/m^3
Air Content	6%	6%
Compressive Strength	4000 psi	28 Mpa
Flexural Strength	800 psi	
Elastic Modulus	4 x 10 psi	27,580 MPa or 27.6 GPa

Metric Conversion

- Soft conversion

  Soft conversion is where the exact metric measurement is used.

- Hard conversion

  Hard conversion is where an equivilant rounded metric measurement is used

  .

  The number is divisible by 10, 5, 2, or 1

Note: Hard conversion will be used for converting from English to Metric measurements when practical.

Examples

- Soft conversion

  For 10 foot shoulder
  (10 ft.) · (0.3048m/ft.) = 3.048 m

  For 2 inch thick ACC Resurfacing
  (2 in.) · (25.40 mm/in.) = 50.8 mm

- Hard conversion

  For 10 foot shoulder
  The metric measurement that will probably be used is 3 meters

  For 2 inch thick ACC Resurfacing
  The metric measurement that will probably be used is 50 millimeters

V. SAMPLING & TESTING

AGGREGATES

Test Methods

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
  1. Sample splitter
  2. 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

TEST FREQUENCY

A. Paving Plants (IM 527)
   a. Once per day for continuous operation
   b. Once per week for small quantities (less than 250 yd^3 per day)

B. Ready Mix Plants (IM 528)
   a. One day's run or 250 cubic yards (190 m^3), whichever is greater.
   b. Once per week if less than 250 cubic yards (190 m^3) produced in week.

Specific Gravity

A. Paving Plants
   1. One sample (each aggregate) per day for the first 3 days - then every third day thereafter
      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

B. Ready Mix Plants

1. One sample (each aggregate) per week for the first 2 weeks.

2. One sample (each aggregate) every other week thereafter.

3. If sample varies more that 0.02 from the T-203 Sp.Gr. Contact District Materials Lab and begin testing another sample.

Moisture

A. Paving Plant

1. Minimum of 1 test per half day

2. Moisture shall not vary between batches by more than 0.5%

3. Spec. 2301.16 A
    a. Coarse aggregate with an absorption of 0.5% or more shall be wetted and allowed to drain at least one hour before batching.
    b. It is recommended to soak a pile if it shows absorption.

4. When water can be observed dripping from bins between batches, the material must not be used.
    a. Allow the stockpile to drain

B. Ready Mix Plants

1. Minimum of one sample (each aggregate) per lot.
    a. Use common sense on moisture samples.
        1. If it rains or snows, sample more often

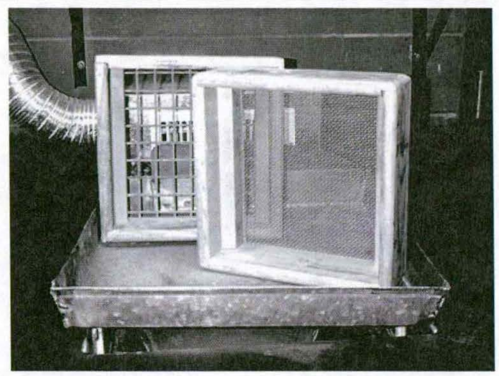
2. Moisture shall not vary, between batches by more than 0.5%

3. Spec. 2301.16 A
    a. Coarse aggregate with an absorption of 0.5% or more shall be wetted and allowed to drain at least one hour before batching.

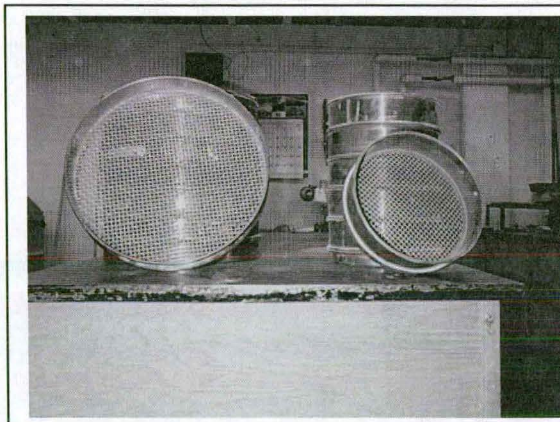
4. When water can be observed dripping from the bins between batches, the material must not be used.
    a. Allow the stockpile to drain.

Gradations

A. When certified plant inspection is required, the Contractor's test results for aggregate gradation shall be quality control. Quality control tests are used to ensure proper material being delivered from the source and to identify stockpile changes. A lot is accepted when a verification test by the agency is determined to be in compliance. The minimum frequency for quality control and verification testing shall be in accordance with IM 204.



B. CPI –Sample and test once per day (or lot).
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. Contractor may elect to have agency split verification sample. This allows both parties to check testing differences; however, IM 216 correlation is not required.

4. A lot is accepted when a verification test by the agency is determined to be in compliance.

AGGREGATE GRADATION TABLE – ENGLISH

Grad. No.	Section No.	Std. Sieve Size / Intended Use	1½"	1"	3/4"	1/2"	3/8"	#4	#8	#30	#50	#100	#200	*Notes
							Percent Passing							
1	4110,4125, 4133	PCC FA Cover Agg.					100	90-100	70-100	10-60			0-1.5	1
3	4115 (57, 2-8)	PCC CA	100	95-100		25-60		0-10	0-5				0-1.5	2,11
4	4115 (2-8)	PCC CA	100	50-100	30-100	20-75	5-55	0-10	0-5				0-1.5	11
5	4115 (67, 2-8)	PCC CA		100	90-100		20-55	0-10	0-5				0-1.5	11
6	4115.06 (Repair & Overlay)	PCC CA			100	97-100	40-90	0-30					0-1.5	11
7	4117 (Class V)	PCC FA & CA	100					80-92	60-75	20-40				
8	4117.03 (Class V)	Fine Limestone					100	90-100					0-30	
10	4120.02, 4120.03 (C Gravel)	Granular Surface			100			50-80	25-60					3
11	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
12a	4121 (Cr. St.)	Granular Subbase	100			40-80			5-25				0-6	6
12b	4121 (Cr. Gravel)	Granular Subbase	100			50-80			10-30		5-15		3-7	7
13	4122.02 (Cr. St.)	Macadam St. Base	3" nominal maximum size – screened over 3/4" or 1" screen											
14	4123	Modified Subbase	100		70-90				10-40				3-10	5,7
19	4125 (1/2" Cr. Gr. or Cr. St.)	Cover Aggregate			100	97-100	40-90	0-30	0-15				0-2	
20	4125 (1/2" Scr. Gr.)	Cover Aggregate			100	95-100	40-80	0-15	0-7				0-1.5	
21	4125 (3/8")	Cover Aggregate				100	90-100	10-55	0-20	0-7			0-1.5	
22	4124.02	Fine Slurry Mixture					100	85-100	40-95	20-60	14-35	10-25	5-25	10
23	4124.02 (Cr. St.)	Coarse Slurry Mixture					100	70-90	45-70	19-34	12-25	7-18	5-15	
29	4131	Porous Backfill			100	95-100	50-100	0-50	0-8					
30	4132.02 (Cr. St.)	Special Backfill	100						15-45				0-10	5
31	4132.03 (Gravel)	Special Backfill		100	90-100	75-100			30-55				3-7	
32	4133 (Sand/Gr./Cr. St.)	Granular Backfill	100% passing the 3" screen						20-100				0-10	8, 9
35	4133.05 (Natural Sand/Gr.)	Floodable Backfill	100						20-90				0-4	
36	4133.05 (Natural Sand)	Floodable Backfill							100				0-2	

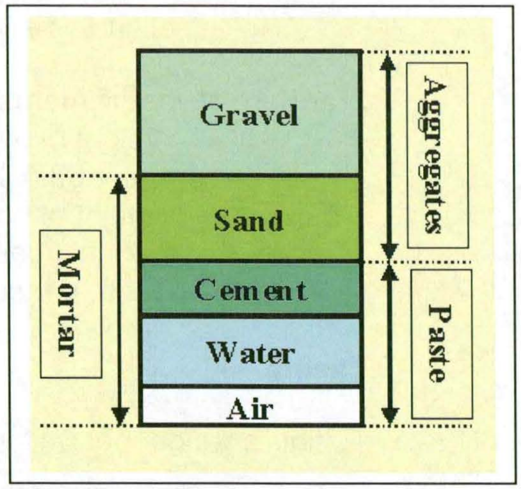
Notes: (Gradations Nos. 2, 9, 15, 16, 17, 18, 24, 26, 27, 28, 33 and 34 have been deleted.)

*For numbered notes, see page 2.

1. For Section 4110, when the fine aggregate is sieved through the following number sieves - 4, 8, 16, 30, 50, and 100 - not 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" sieve.
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 the 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 4121 gravel, one fractured face on 30% or more of the particles retained on the 3/8-inch sieve. For 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 1" sieve.
9. When granular backfill is used in floodable applications use gradation 35 or 36. When granular backfill is used under flowable mortar, one of the following alternative materials shall be used: natural sand compliant with Section 4110, except the % passing the No. 200 sieve shall not exceed 4%; gravel, crushed stone, or crushed concrete meeting the gradation requirements of Section 4121.
10. 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.
11. Maximum of 2.5% passing the No. 200 sieve allowed if generated from the parent material when documented production is 1% or less as determined by the Office of Materials.

HMA Gyratory gradation requirements are listed in IM 510, Appendix A.

VI. Proportions



1. Contractor representative makes batch weight calculations
2. Plant Inspector or Monitor cross check batch weights
3. No batching until both independent determinations have been made

IM 529

- Standard Iowa DOT Mixes
- Absolute Volumes
- SSD Batch Weights
- Basic and Maximum w/c

Source Information

To find specific gravities, source name, etc.

- IM 401 - Cement sources
- IM 491.14 - GGBFS sources
- IM 491.17 - Fly ash sources
- IM T-203 - Aggregate sources
- IM 403 - Admixtures

Batch Weight Calculations

- Based on absolute volumes
- 1 cubic yard – basic unit of volume
- Aggregate percentages

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

Example

An A-3, B-3, or C-3 Mix-

55% coarse aggregate &
45% Fine aggregate

w/c Ratio

- Basic w/c
- Maximum w/c ratio
- All cementitous materials are included in w/c calculation

Specific Gravity

- Used to convert volumes to equivalent weights
- Ratio of materials density to the density of water
- Use 3.14 for Type I or II cements

- Use 1.00 for water
- Air has no specific gravity, occupies a volume

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.

Examples

To figure weight per unit volume

Absolute Volume × Specific Gravity × Unit Weight of water × 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 = $0.108 \times 3.14 \times 62.4$ lbs/ft^3 $\times$ 27 ft^3/yd^3 = 571 lbs. per cubic yard
Basic Water = $0.146 \times 1.00 \times 62.4$ lbs/ft^3 $\times$ 27 ft^3/yd^3 = 246 lbs. per cubic yard
Fine agg. = $0.309 \times 2.65 \times 62.4$ lbs/ft^3 $\times$ 27 ft^3/yd^3 = 1380 lbs. per cubic yard
Coarse agg. = $0.377 \times 2.65 \times 62.4$ lbs/ft^3 $\times$ 27 ft^3/yd^3 = 1683 lbs. per cubic yard

Mineral Admixture Substitution

- Weight replacement (not volume)
- Pound for pound basis (1:1)
- Fly Ash – 20% maximum
- GGBFS – 35% Maximum
- Maximum total mineral admixture substitution rate of 50% for structures and 40% for paving.
- Fly ash permitted in concrete when GGBFS is substituted in ready mix concrete only (ternary mix)
- Ternary mixes – substitute fly ash first
- Time Period Allowed
  - Paving -Article 2301.04
  - Structural – Article 2403.03
  - New Decks – Article 2412.02

Calculate Batch Weights

- Multiply weight of cement by percent replacement
- Subtract amount from cement
- Absolute volume with fly ash more than cement alone
- Must adjust absolute volumes – changes coarse and fine aggregate batch weights

Example 2 - Fly ash substitution

C-3WR in Example 1
20% fly ash substitution
Assume 2.59 Sp. G. for fly ash

571 lbs. per cubic yard × 0.20 = 114 lbs. fly ash
571 – 114 = 457 lbs. cement

Abs. Vol. Cement = 457 ÷ 3.14 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/yd^3 = 0.086
Abs. Vol. Fly Ash = 114 ÷ 2.59 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.026

Weight Water = 0.430 × 571 = 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. = 0.318
1 – Subtotal = 0.682

%Coarse = 0.55 × 0.682 = 0.375
%Fine = 0.45 x 0.682 = 0.307

Fine agg. = 0.307 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1371 lbs. per cubic yard
Coarse agg. = 0.375 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1674 lbs. per cubic yard

Check to make sure Absolute Volumes = 1.00

Cement	0.086
Fly Ash	0.026
Water	0.146
Air	0.060
Coarse	0.375
Fine	0.307
Total	1.000

Example Fly ash and GGBFS substitution

C-3WR in Example 1
15% fly ash substitution
35% GGBFS substitution
Assume 2.59 Sp. G. for fly ash, 2.88 for GGBFS

Substitute for fly ash first
571 lbs. per cubic yard × 0.15 = 86 lbs. fly ash
571 – 86 = 485 lbs. cement left

Substitute for GGBFS with remaining cement
485 lbs. per cubic yard × 0.35 = 170 lbs. GGBFS
485 – 170 = 315 lbs. cement

Abs. Vol. Cement = 315 ÷ 3.14 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/yd^3 = 0.060
Abs. Vol. Fly Ash = 86 ÷ 2.59 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.020
Abs. Vol, GGBFS = 170 ÷ 2.88 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.035

Weight Water = 0.430 × 571 = 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

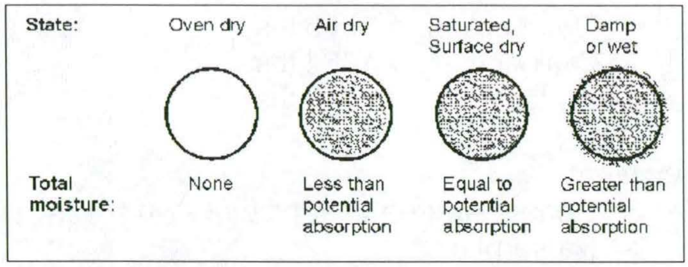
Abs. Vol. = 0.321
1 – Subtotal = 0.679

%Coarse = 0.55 × 0.679 = 0.373
%Fine = 0.45 x 0.679 = 0.306

Fine agg. = 0.306 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1366 lbs. per cubic yard
Coarse agg. = 0.373 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1665 lbs. per cubic yard

Moisture Corrections

- Must correct SSD batch weights for moisture
- Water in aggregate (or lack thereof)
- Adjust batch water
- If aggregate has moisture must reduce batch water, in absorption must add water
- Maximum permissible absorption is 0.5%



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

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%

Wet Batch Wt., Coarse

$$\frac{1665 \text{ lbs.}}{(100 - 0.3)} \times 100 = 1670 \text{ lbs.}$$

Wet Batch Wt., Fine

$$\frac{1366 \text{ lbs.}}{(100 - 3.1)} \times 100 = 1410 \text{ lbs.}$$

Adjust Water

Coarse
Wet Batch Weight – Dry batch weight
1670 – 1665 = 5 lbs.

Fine
1410 – 1366 = 44 lbs.

246 – 5 - 44 = 197 lbs.

Example

Coarse $1.000 - .003 = .997$ $\qquad \frac{1665}{.997} = 1670$

Fine: $1.000 - .031 = .969$ $\qquad \frac{1366}{.969} = 1410$

Example 2 - SSD Batch Weights

Coarse Agg. = 1665 lbs.
Fine Agg. = 1366 lbs.
Water = 246 lbs.

Assume

Coarse Aggregate Moisture = -0.5% (Absorption)
Fine Aggregate Moisture = 3.1%

Wet Batch Wt., Coarse

$$\frac{1665 \text{ lbs.}}{(100 - (-0.5))} \times 100 = 1657 \text{ lbs.}$$

Wet Batch Wt., Fine

$$\frac{1366 \text{ lbs.}}{(100 - 3.1)} \times 100 = 1410 \text{ lbs.}$$

Adjust Water

Coarse
Wet Batch Weight – Dry batch weight
1657 – 1665 = -8 lbs.

Fine
1410 – 1366 = 44 lbs.

246 – (-8) + 44 = 210 lbs.

Maximum Water

= 0.489 × 571 lbs./yd^3 = 279 lbs./yd^3

Total water allowed including moisture in aggregates

Example

Coarse $\begin{array}{r} 1.000 \\ +\ .005 \\ \hline 1.005 \end{array}$ $\qquad \frac{1665}{1.005} = 1657$

Fine $\begin{array}{r} 1.000 \\ -\ .031 \\ \hline .969 \end{array}$ $\qquad \frac{1366}{.969} = 1410$

Alternate Method to Compute Wet Weights

Table T-214A in IM Volume II has reciprocals that can be used to figure moisture and absorption of aggregate. Using the reciprocals with Example 1:

Fine Aggregate:
1366 x 1.0319917 = 1410 lbs.
Coarse Aggregate:
1665 x 1.0030090 = 1670 lbs.

The results are the same using either method. The first method will be used throughout this course. There is less chance for error using the first method.

RECIPROCALS FOR BATCH WEIGHT CALCULATIONS

	Moisture Content (Percentage Based on Wet Weight)						
	0	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**
0.0	1.0000000	1.0101010	1.0204082	1.0309278	1.0416667	1.0526316	1.0638298
diff.	.0010010	.0010213	.0010423	.0010639	.0010862	.0011092	.0011329
0.1	1.0010010	1.0111223	1.0214505	1.0319917	1.0427529	1.0537408	1.0649627
diff.	.0010030	.0010234	.0010444	.0010662	.0010884	.0011115	.0011354
0.2	1.0020040	1.0121457	1.0224949	1.0330579	1.0438413	1.0548523	1.0660981
diff.	.0010050	.0010255	.0010466	.0010683	.0010908	.0011139	.0011378
0.3	1.0030090	1.0131712	1.0235415	1.0341262	1.0449321	1.0559662	1.0672359
diff.	.0010071	.0010276	.0010487	.0010705	.0010930	.0011163	.0011402
0.4	1.0040161	1.0141988	1.0245902	1.0351967	1.0460251	1.0570825	1.0683761
diff.	.0010090	.0010296	.0010508	.0010727	.0010953	.0011186	.0011426
0.5	1.0050251	1.0152284	1.0256410	1.0362694	1.0471204	1.0582011	1.0695187
diff.	.0010111	.0010318	.0010530	.0010750	.0010976	.0011209	.0011451
0.6	1.0060362	1.0162602	1.0266940	1.0373444	1.0482180	1.0593220	1.0706638
diff.	.0010131	.0010338	.0010552	.0010772	.0010999	.0011234	.0011476
0.7	1.0070493	1.0172940	1.0277492	1.0384216	1.0493179	1.0604454	1.0718114
diff.	.0010152	.0010359	.0010574	.0010794	.0011023	.0011257	.0011500
0.8	1.0080645	1.0183299	1.0288066	1.0395010	1.0504202	1.0615711	1.0729614
diff.	.0010172	.0010381	.0010595	.0010817	.0011045	.0011282	.0011525
0.9	1.0090817	1.0193680	1.0298661	1.0405827	1.0515247	1.0626993	1.0741139
diff.	.0010193	.0010402	.0010617	.0010840	.0011069	.0011305	.0011550

RECIPROCALS FOR BATCH WEIGHT CALCULATIONS

	Absorption Required to Reach "Saturated Surface Dry" (SSD) Condition (Percentage Based on Weight Found) 0.0	1.0	2.0	3.0
0.0	1.00000000	0.99009901	0.98039216	
diff.	-.00099900	-.00097933	-.00096023	
0.1	0.99900100	0.98911968	0.97943193	
diff.	-.00099701	-.00097739	-.00095835	
0.2	0.99800399	0.98814229	0.97847358	
diff.	-.00099502	-.00097546	-.00095647	
0.3	0.99700897	0.98716683	0.97751711	
diff.	-.00099303	-.00097354	-.00095461	
0.4	0.99601594	0.98619329	0.97656250	
diff.	-.00099106	-.00097162	-.00095274	
0.5	0.99502488	0.98522167	0.97560976	
diff.	-.00098909	-.00096970	-.00095089	
0.6	0.99403579	0.98425197	0.97465887	
diff.	-.00098713	-.00096780	-.00094904	
0.7	0.99304866	0.98328417	0.97370983	
diff.	-.00098517	-.00096590	-.00094718	
0.8	0.99206349	0.98231827	0.97276265	
diff.	-.00098321	-.00096400	-.00094535	
0.9	0.99108028	0.98135427	0.97181730	
diff.	-.00098127	-.00096211	-.00094352	

PROBLEM 1

A. Compute the dry batch weights of a cubic yard for a B-4 mix using absolute volumes (IM 529) as the basis for your calculations given the following specific gravities:

Specific Gravity	
Cement	3.14
Fine Agg.	2.66
Coarse Agg.	2.68

B. Compute the wet batch weight based on the results form part A and correct the basic water batched by including free water from the aggregate. Convert your answer to gallons. Also, compute the maximum allowable mixing water in gallons given the following free moisture contents.

Assume Fine Aggregate Moisture	3.1%
Assume Coarse Aggregate Moisture	0.3%

PROBLEM 2

FIGURE THE DRY BATCH WEIGHTS OF A C-4 C15 MIX USING FORM 820150. THE SOURCES ARE LISTED BELOW.

Continental Cement Co. - Type I

ISG Resources – Louisa Generating Station

Coarse Aggregate – Kuhlman Const. – Gisleson Quarry – Clayton County

Fine Aggregate – Roverud Construction Co. – Bente Pit – Clayton County

FIGURE THE DRY BATCH WEIGHTS OF A C-4 MIX USING FORM 820150.

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Form E820150E

Project No.: ____________ County : ____________

Mix No.: ____________ Pounds Cement: ____________

1st Adjusted lbs. Cement: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.17 Fly Ash: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.14 Slag GGBFS: ____________ Source: ____________ Sp. Gr.: ____________

2nd Adjusted lbs. Cement: ____________

Total Cementitious ____________

I.M. T-203 Fine Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 Interm. Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________________ County : __________

Mix No.: __________ Pounds Cement: ________

1st Adjusted lbs. Cement: __________ Source: __________________ Sp. Gr.: __________

I.M. 491.17 Fly Ash: __________ Source: __________________ Sp. Gr.: __________

I.M. 491.14 Slag GGBFS: __________ Source: __________________ Sp. Gr.: __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 Fine Aggregate Source: ______________________ Sp. Gr.: __________
I.M. T-203 Interm. Aggregate Source: ______________________ Sp. Gr.: __________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

PROBLEM 3

PROPORTION AND PROBLEM SOLVING

PART A: Compute the dry batch weights of a cubic yard for an A-3 mix using absolute volumes (IM 529) as the basis for your calculations given the following specific gravities.

SPECIFIC GRAVITIES

Cement	3.14
Fine Aggregate	2.66
Coarse Aggregate	2.68

PART B: Compute the wet batch weights based on the results from Part A and adjust the basic water batched by correcting for free water (excess water) from aggregates. Convert your answer to gallons. Also, compute the maximum allowable mixing water in gallons. Given the following moisture contents.

Assume Fine Aggregate Moisture = 3.4%
Assume Coarse Aggregate Moisture = 0.5%

PROBLEM 4

1. **What is the total maximum water allowed for 5 cubic yards of C-4 mix?**

2. **What is the maximum water allowed for a 7 cubic yard batch of D57 mix?**

3. **What is the water/cement ratio (w/c), given the following information?**

Cement	603 lb/yd^3
Free Water	5 gal/yd^3
Added Water	27 gal/yd^3

4. **What is the water/cement ratio (w/c), given the following?**

Cement	529 lb/yd^3
Fly Ash	95 lb/yd^3
Free Water	50 lb/yd^3
Added Water	30 gal/yd^3

5. **What is the maximum number of gallons of water that can be added to a 7 cubic yard load of C-4 WR mix at the paver, given the following information?**

Cement	593 lb/yd^3
Free Water	48 lb/yd^3
Added water	24 gal/yd^3

PROBLEM 5

1. **What are the dry batch weights and the actual batch weights for an M-4 mix, given the following information?**

Fine Aggregate	Sp.Gr. = 2.67 Moisture = 2.8%
Coarse Aggregate	Sp.Gr. = 2.65 Moisture = 0.6%

2. **What is the total water per cubic yard when 30 gallons per cubic yard is added at the plant and 10 gallons are added to the 7 cubic yard load at the grade?**

3. **What is the water/cement ratio (w/c)?**

PROBLEM 6

1. **What are the dry batch weights and the actual batch weights for a C-3 WR mix, given the following information?**

Fine Aggregate Source	A33510	Moisture 3.0%
Coarse Aggregate Source	A10010	Moisture 0.5%

2. **What is the total water per cubic yard when 23 gallons per cubic yard is added at the plant and 15 gallons are added to a 7 yd^3 load at the grade?**

3. **What is the w/c?**

PROBLEM 7

1. **Which weight is more, a cubic yard of B-40C15 mix or a cubic yard of D-57-F15 mix?**

Given:

Fine Aggregate	Sp.Gr. = 2.66
Coarse Aggregate	Sp.Gr. = 2.71
Fly Ash (C)	Sp.Gr. = 2.65
Fly Ash (F)	Sp.Gr. = 2.60
Cement	Sp.Gr. = 3.14
Water	Sp.Gr. = 1.00

Note: Assume Sp.Gr. in each mix.

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________________ **County :** __________

Mix No.: __________ **Pounds Cement:** ________

1st Adjusted lbs. Cement: __________ **Source:** ________________ **Sp. Gr.:** __________

I.M. 491.17 **Fly Ash:** __________ **Source:** ________________ **Sp. Gr.:** __________

I.M. 491.14 **Slag GGBFS:** __________ **Source:** ________________ **Sp. Gr.:** __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 **Fine Aggregate Source:** ______________________ **Sp. Gr.:** __________
I.M. T-203 **Interm. Aggregate Source:** ______________________ **Sp. Gr.:** __________
I.M. T-203 **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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________ County : ____________

Mix No.: ____________ Pounds Cement: ____________

1st Adjusted lbs. Cement: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.17 Fly Ash: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.14 Slag GGBFS: ____________ Source: ____________ Sp. Gr.: ____________

2nd Adjusted lbs. Cement: ____________

Total Cementitious ____________

I.M. T-203 Fine Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 Interm. Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

PROBLEM 8

Calculate the batch weights for the following mix using Form 150: C-3WR-C15S35

Given:

Cement – LaFarge

Fly Ash – Louisa Generating

Slag – LaFarge – NewCem

Fine Aggregate – A37514

Coarse Aggregate – A94002

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________________ County : __________

Mix No.: __________ Pounds Cement: ________

1st Adjusted lbs. Cement: __________ Source: ________________ Sp. Gr.: __________

I.M. 491.17 Fly Ash: __________ Source: ________________ Sp. Gr.: __________

I.M. 491.14 Slag GGBFS: __________ Source: ________________ Sp. Gr.: __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 Fine Aggregate Source: ________________ Sp. Gr.: __________
I.M. T-203 Interm. Aggregate Source: ________________ Sp. Gr.: __________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

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 non-compliance, the Contractor is responsible for deciding corrective action, <u>not</u> 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

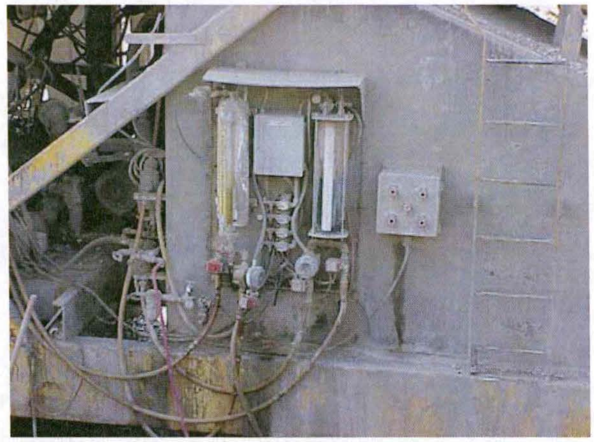
Proportioning equipment must be examined at least at 3-hour intervals for correctness of the amount being batched and for damage of the equipment

Scale Sensitivity shall be checked at least twice during a normal working day

Delivery tolerance shall be checked at least once during a normal working day

Cement shipment yield determinations must be made every 10,000 cubic yards after the original determination made near the end of the first full day of production

- 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 dayTruck 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

Charge time
+ Mixing time (60 sec. Minimum)
+ Discharge time
= Minimum batch cycle time

- Transportation Vehicles (Article 2301.13 and IM 527)
  - Stationary Mixing
    - Concrete must be placed from <u>non-agitating</u> 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 <u>agitating</u> 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

Determine and record the cement to water contact time at least once each day!

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.

Do not permit any new material to be used or stored with accepted material until satisfied the new material is acceptable.

- 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 IM 403. Dosage rates are also included in this IM Any admixture older than 18 months, or suspected of being frozen shall be tested before use.
  - Admixtures shall be mixed once a day to maintain the solids in suspension. Each 100 gallons of solution shall be circulated a minimum of 5 minutes per day.

*Admixtures shall be mixed thoroughly **once a day** prior to proportioning.*

- Storage and Handling of Materials
  - Storage and handling of all aggregates must comply with Article 2301.13. 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

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 twice 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 (10,000 cubic meters) 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 half day of operation.

M. 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.

N. If maturity not being used, one 20-in. (508-mm) long 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.

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. (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 speciments 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.

P. 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.

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.

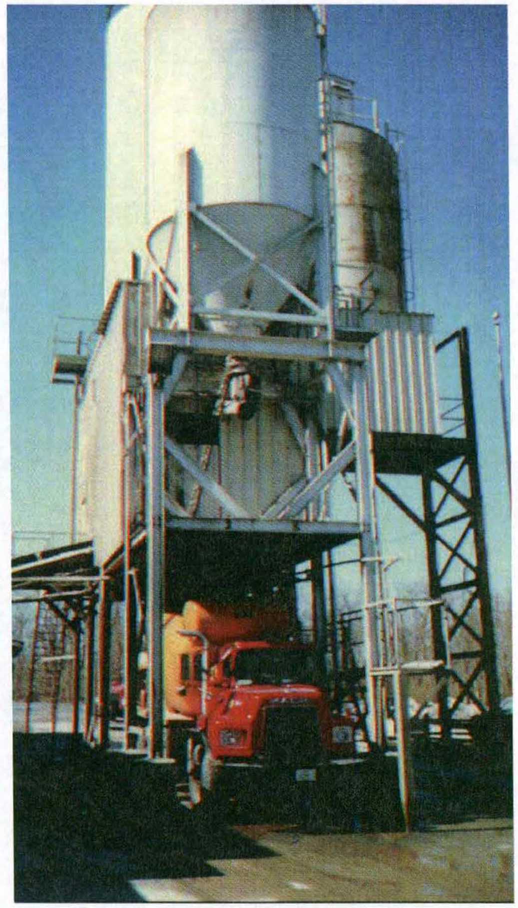
Structural Plant Inspection

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 determine 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

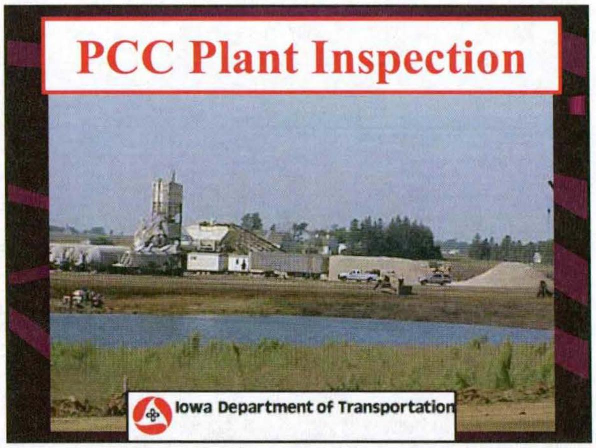
- Specific Gravity
    - 1 per week coarse and fine first two weeks, every other week thereafter.
    - Variations greater than 0.02 from T-203, inform Project Engineer and District Materials Engineer immediately.
- Moisture
    - One sample per lot

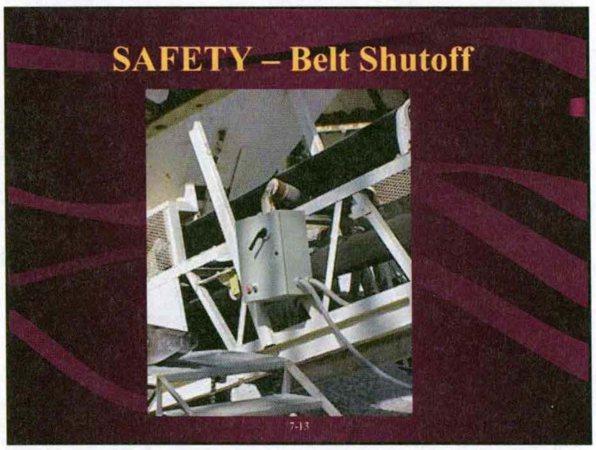
- Gradation (QC)
    - One sample per lot.
    - Day's run or 250 yd^3
    - Less than 250 yd^3 weekly
    - Bridge deck is one lot

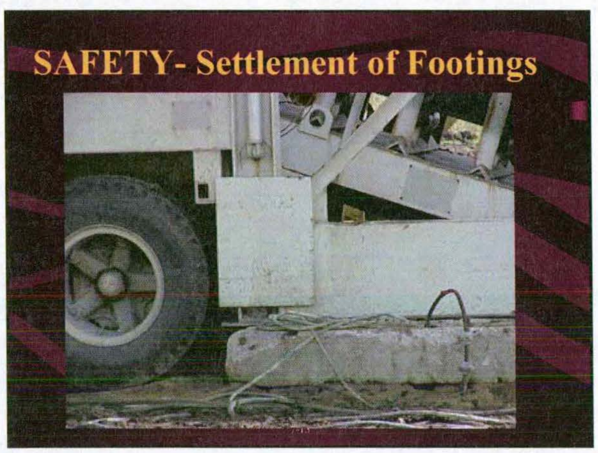
- Non-Critical Concrete
    - The items of work described in IM 528 may be designated as non-critical concrete, when placed at less than 35 cubic yards (30 cubic meters) per week.
    - When non-critical concrete is the only concrete produced for the project(s) from a given plant, quality control testing may be reduced to one gradation per two weeks.

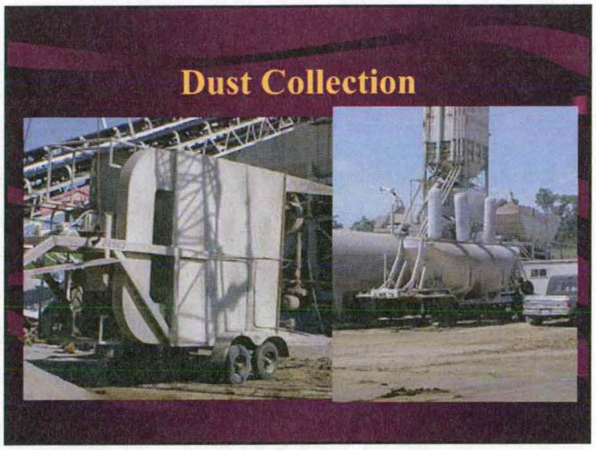
- Water cement ratio
    - Water demand exceeds design w/c ratio and approaches maximum - notify Project Engineer and District Materials Engineer
    - Check aggregate moistures, batch weights, scales, water meter, etc.
    - Shall not exceed maximum w/c ratio
    - May increase cement content with District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

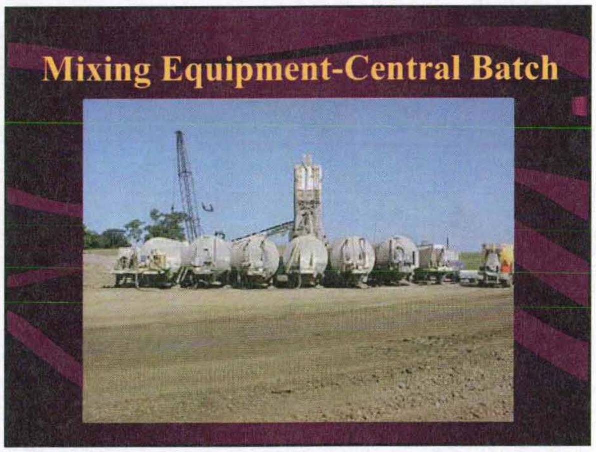
- Strength Tests – IM 316
    - Required for each section placed or day's placement
    - Abutment walls, pier footings, bridge end posts, and culvert curtain walls not considered critical structural units – strength testing not required.

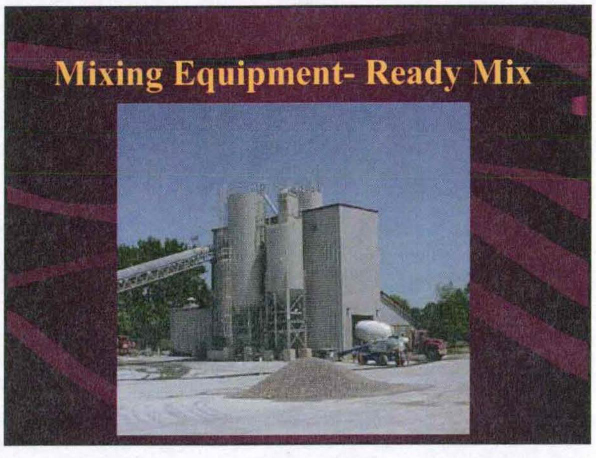

PCC Plant Inspection
Iowa Department of Transportation


SAFETY – Belt Shutoff

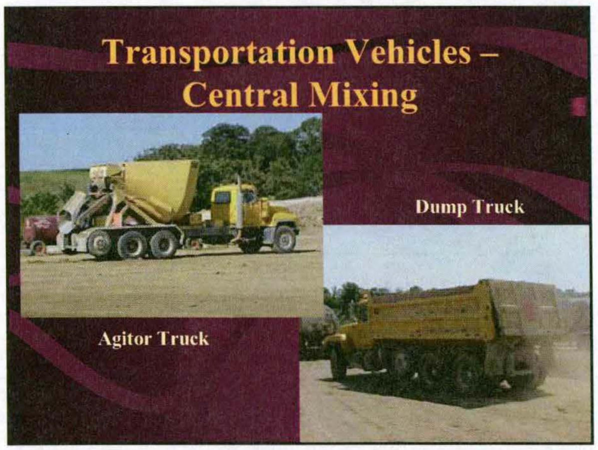

SAFETY- Settlement of Footings


Dust Collection

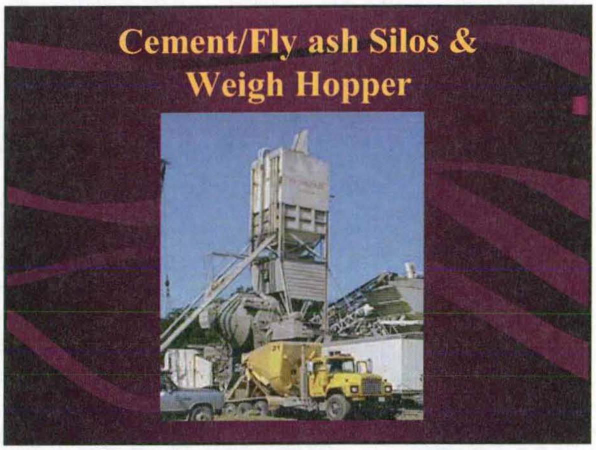

Mixing Equipment-Central Batch

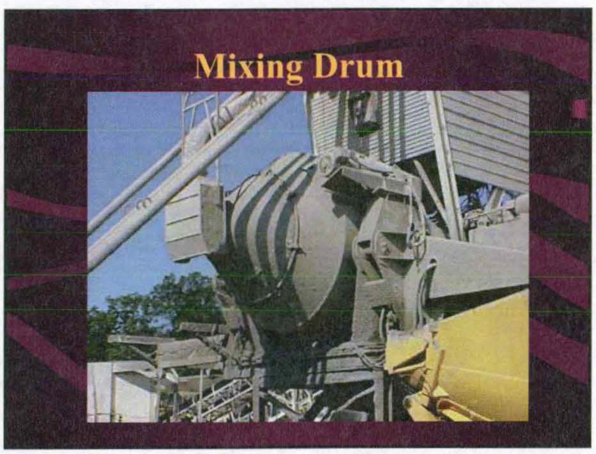

Mixing Equipment- Ready Mix

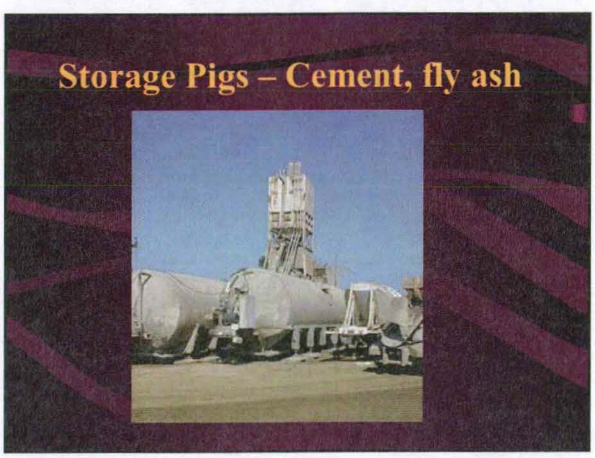

Mixing Equipment- Mobile Mixer


Transportation Vehicles –
Central Mixing
Dump Truck
Agitor Truck

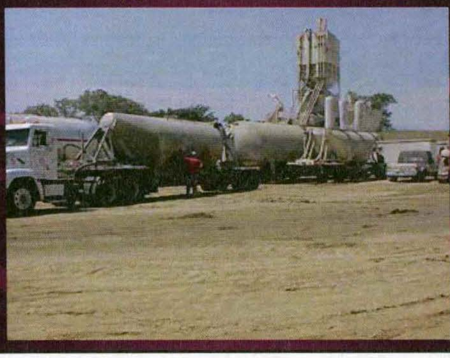

Transportation Vehicles –
Ready Mix
Ready Mix Truck


Cement/Fly ash Silos &
Weigh Hopper

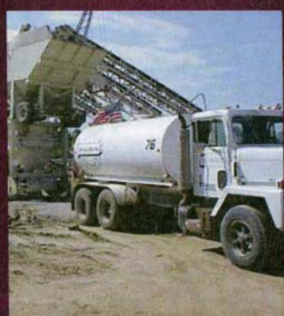

Mixing Drum


Storage Pigs – Cement, fly ash

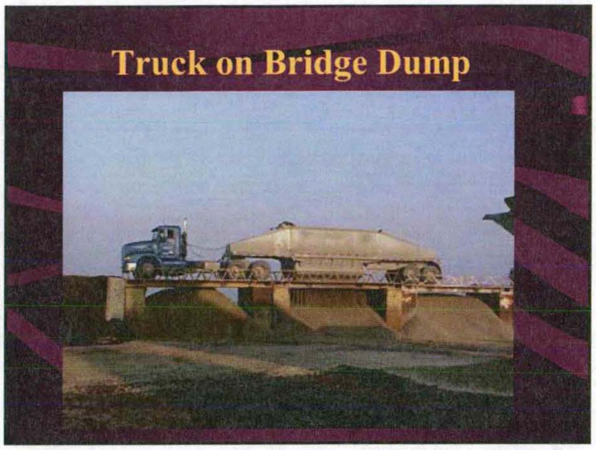
Loading Cement into Pig

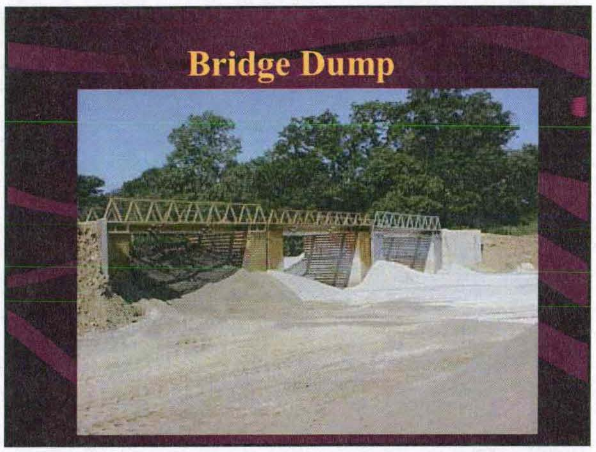


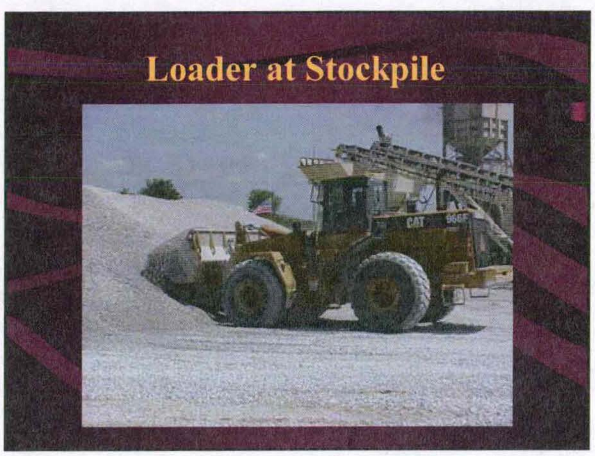
Water Truck



Admixture Bottles


Truck on Bridge Dump

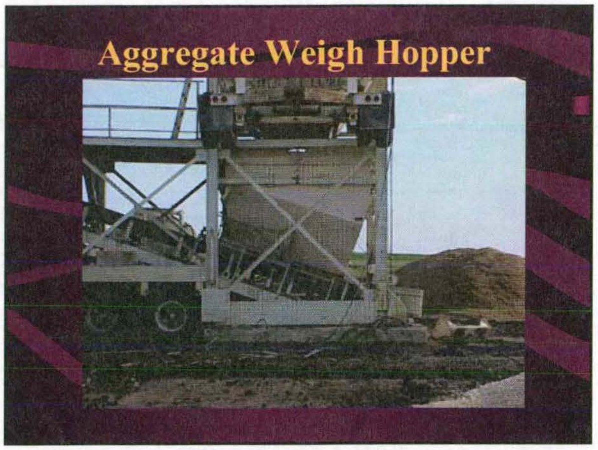

Bridge Dump

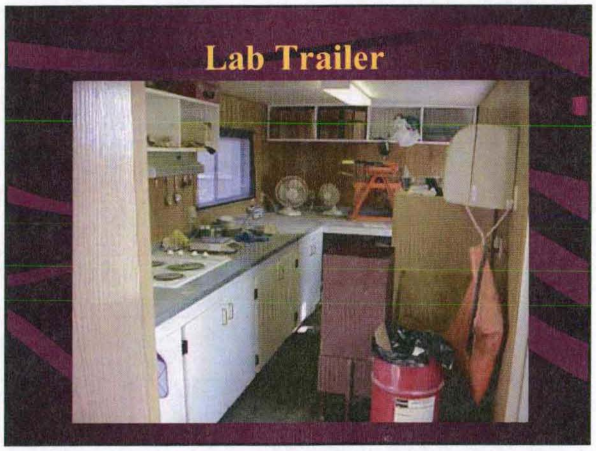

Loader at Stockpile
CAT

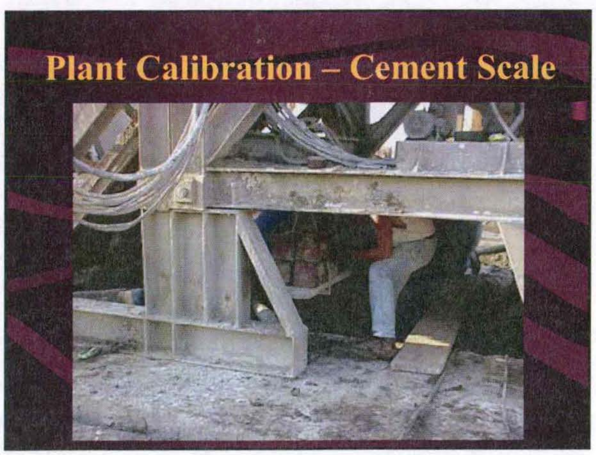
Loader at Aggregate belts

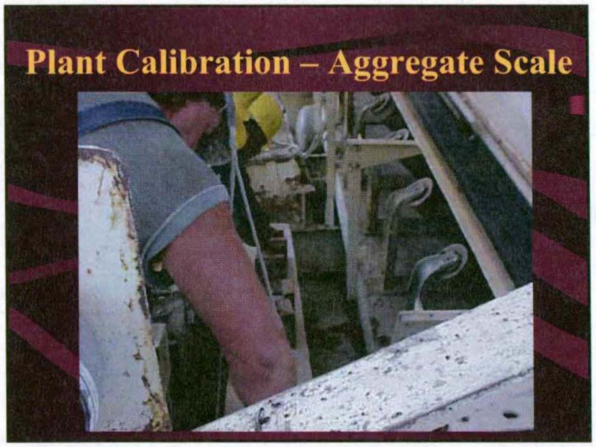
Aggregate Belts

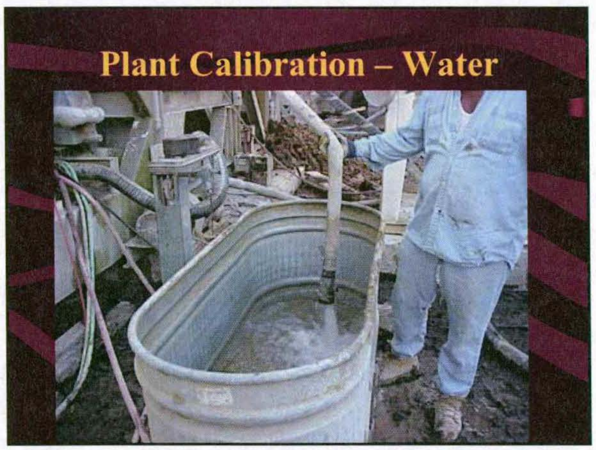
Aggregate Bins & Weigh Hopper

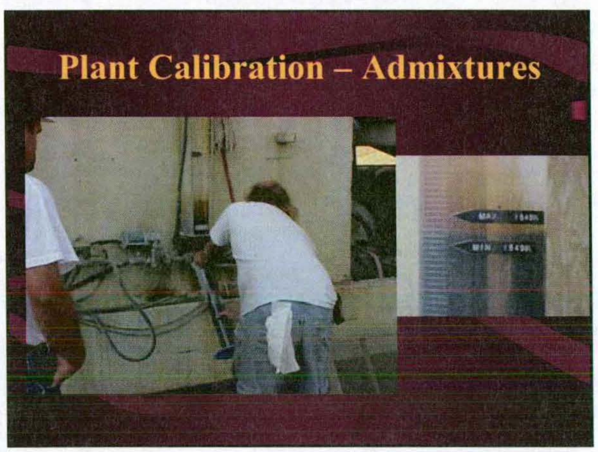

Aggregate Weigh Hopper

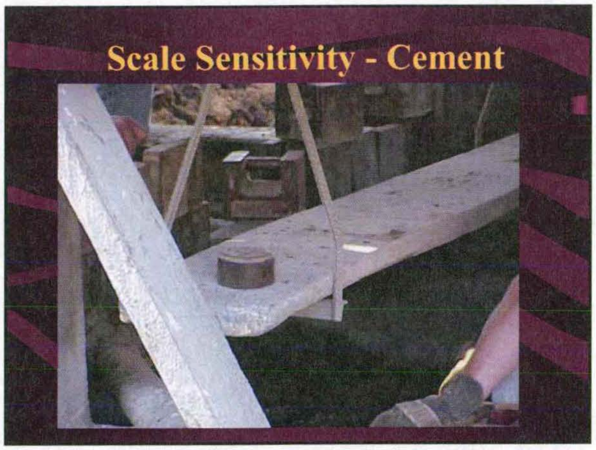

Lab Trailer

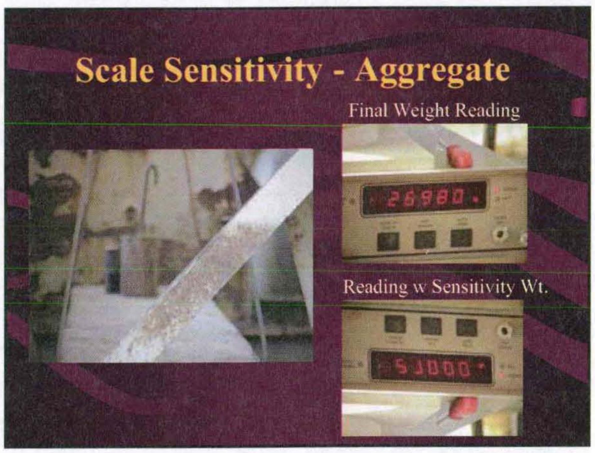

Plant Calibration – Cement Scale


Plant Calibration – Aggregate Scale


Plant Calibration – Water


Plant Calibration – Admixtures


Scale Sensitivity - Cement


Scale Sensitivity - Aggregate
Final Weight Reading
26980.
Reading w Sensitivity Wt.

VIII. References

Instructional Memorandums

- Volume II
- Volume IV

PCC Reference Manual

- IMs and Specifications pertaining to PCC Inspection and Testing
- Needs Updated Annually

Specifications

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

General Supplemental Specifications

- GS-01013 - October 2007

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

Concrete Specifications Summary
(U.S. Units)

CAUTION: CONSULT THE APPLICABLE SPECIFICATIONS FOR REQUIRED AIR CONTENT AND SLUMP BEFORE USING THIS CHART.

January 2008

Concrete Application	Type Conc.	Slump-in. Min.	Slump-in. Max.	Target	% Air Content Min.	% Air Content Max.	Specification Reference
Paving							
Slip Form	ABC	N/A	N/A	See Specification			2301.04 B&C
Non Slip Form	ABC	1/2	4	7	6	8 1/2	2301.04 B&C
Conc. Base (Non Slip Form)	A	1/2	4	7	6	8 1/2	2301.04 & 2201
Curb & Gutter	C		3	7	6	8 1/2	2512.03 & 2301.04
Sidewalk	C		4	7	6	8 1/2	2511.03 & 2301.04
Intakes & Manholes	C	1	3	6 1/2	5 1/2	8	2403.03 & 2503.03D
REPAIR							
Patches With CaCl	M-4, M-V	1 prior to add. of CaCl	3	5	3	7	2530.03B & 2529.02B
Patches Without CaCl	M	Target 1 to 3 Max. 4		6 1/2	5	8	2530.03B & 2529.02B
Underseal & Grouting, Flowing Mortar				By Flow Cone			2539.03 & 2506.02B
OVERLAYS							
Thin Bond PCC	C-4 WR, C-4 WR-C			Same as specified concrete			2310.02
STRUCTURES							
Seal Coat	X	0	8		0	0	2405.05
Sub-Structure Super-Structure	C	Target 1 to 3 Max. 4		6 1/2	5 1/2	8	2403.03 A&B 2412.02
Slope Protection	C	1	3	6 1/2	5 1/2	8 1/2	On the Plan Sheet
Piling Encased, Piling Brg. (Encased)	C	Target 1 to 3 Max. 4		6 1/2	5 1/2	8	2403-2501.04C-2501.19
Bridge Deck Overlay	O	Target 1/4 0 (2-4 min. delay)	1	6 1/2	5 1/2	8 1/2	2413.02A
	HPC	1	4				2413.02B
Bridge Deck Class B Repair	O or D	1	3	6 1/2	5 1/2	8	2403.03 A&B, 2412 (2413.05)
Barrier Rail w/Overlay	D	1	3	7	6	8 1/2	2413.01 2513.03B 2403.03B
Barrier Rail Cast in Place Slipform	C BR	0	2	7	6	8 1/2	2513.03B 2414.02
Lightweight Conc.							In Special Prov. 2403.04
BARRIER RAIL RE 44ABCDE, RE 46	BR	Target 1	3 Max. 4	7	6	8 1/2	2513.03A 2403.03 A&B
LIGHTING & HWY. SIGNING Foundation	C	Target 1 to 3 Max. 4		6 1/2	5 1/2	8	2403.03 A&B
END ANCHORS RE 26AB, RE 28	D	Target 1 to 3 Max. 4		6 1/2	5 1/2	8	2403.03 A&B
RE 29A, RE 29B RE 33AB, RE 52, RE 53	C	Target 1 to 3 Max. 4			4	7	2403.03 & 2505.04B
Shot Crete							2424.01

Concrete Specifications Summary
(Metric Units)

CAUTION: CONSULT THE APPLICABLE SPECIFICATIONS FOR REQUIRED AIR CONTENT AND SLUMP BEFORE USING THIS CHART.

January 2008

Concrete Application	Type Conc.	Slump-mm Min.	Slump-mm Max.	Target	% Air Content Min.	% Air Content Max.	Specification Reference
Paving							
Slip Form	ABC	N/A	N/A	See Specification			2301.04 B&C
Non-Slip Form	ABC	15	100	7	6	8 1/2	2301.04 B&C
Conc. Base (Non Slip Form)	A	15	100	7	6	8 1/2	2301.04 & 2201
Curb & Gutter	C		75	7	6	8 1/2	2512.03 & 2301.04
Sidewalk	C		100	7	6	8 1/2	2511.03 & 2301.04
Intakes & Manholes	C	25	75	6 1/2	5 1/2	8	2403.03&2503.03D
REPAIR							
Patches With CaCl	M-4, M-V	25 prior to add. of CaCl	75	5	3	7	2530.03B& 2529.02B
Patches Without CaCl	M	Target 25 to 75 Max. 100		6 1/2	5	8	2530.03B & 2529.02B
Underseal & Grouting, Flowing Mortar				By Flow Cone			2539.03 & 2506
OVERLAYS							
Thin Bond PCC	C-4 WR, C-4 WR-C	Same as specified concrete					2310.02
STRUCTURES							
Seal Coat	x	0	200		0	0	2405.05
Sub-Structure Super-Structure	C	Target 25 to 75 Max. 100		6 1/2	5 1/2	8	2403.03 A&B 2412.02
Slope Protection	C	25	75	6 1/2	5 1/2	8 1/2	On the Plan Sheet
Piling Encased, Piling Brg. (Encased)	C	Target 25 to 75 Max. 100		6 1/2	5 1/2	8	2403-2501.04C-2501.19
Bridge Deck Overlay	O	Target 20 0 (2-4 min. delay)	25	6 1/2	5 1/2	8 1/2	2413.02A
	HPC	25	100				2413.02B
Bridge Deck Class B Repair	O or D	25	75	6 1/2	5 1/2	8	2403.03 A&B, 2412 (2413.05)
Barrier Rail w/Overlay	D	25	75	7	6	8 1/2	2413.01 2513.03B 2403.03B
Barrier Rail Cast in Place Slipform	C BR	0	50	7	6	8 1/2	2513.03B 2414.02
Lightweight Conc.							In Special Prov. 2403.04
BARRIER RAIL RE 44ABCDE, RE 46	BR	Target 25 Max. 100	75	7	6	8 1/2	2513.03A 2403.03 A&B
LIGHTING & HWY. SIGNING Foundation	C	Target 25 to 75 Max. 100		6 1/2	5 1/2	8	2403.03 A&B
END ANCHORS RE 26AB, RE 28	D	Target 25 to 75 Max. 100		6 1/2	5 1/2	8	2403.03 A&B
RE 29A, RE 29B RE 33AB, RE 52, RE 53	C	Target 25 to 75 Max. 100			4	7	2403.03 & 2505.04B
Shot Crete							2424.01

beams, samples of aggregates or other materials, and the products of project site clearance.

Complete cleanup of the construction area or plant site, including test materials, is the responsibility of the contractor.

3.05 SALVAGED PROJECT MATERIALS REPORTING

Many project plans indicate that some removal items shall be stockpiled or salvaged to a nearby maintenance facility. To accomplish documentation of these items, a "Salvaged Project Materials" form has been developed. Copy the form in *Appendix 3-1* as needed.

The form shall be completely filled out any time project materials are salvaged to a maintenance facility. The form needs the signature and initials of the project inspector and the maintenance employee who received the material.

Distribute a copy of completed form to project engineer, area maintenance manager, Office of Inventory, and project file. The Office of Inventory will add the salvaged items to the 999 series of inventory for the maintenance facility that received these materials. Include copy of completed form in the final payment packet for the project per *Construction Manual 2.45*.

3.06 NOTICE OF SUSPENSION OR RESUMPTION OF WORK

The "Notice of Suspension or Resumption of Work" (Form 810036) shall be used to order a contractor to suspend work because of violation of specifications or a dispute regarding the quality of materials or manner of performing the work, as provided in *Specification 1105.09*. This notice shall include a description of the work to be suspended.

Upon settlement of the question at issue, the "Notice of Suspension or Resumption of Work" (Form 810036) shall be reissued to release the contractor from the work suspension order. Although the work suspension order may be issued by the inspector, the release requires the project engineer's signature.

Copies of the "Notice of Suspension or Resumption of Work" (Form 810036) should be given to the contractor, District Construction Engineer (DCE), and project engineer.

3.07 REQUIREMENTS FOR MONITORING THE CERTIFIED PLANT INSPECTION PROGRAM AND QUALITY MANAGEMENT - ASPHALT (QM-A)

The monitoring requirements listed in the appendices are intended to be the minimum for HMA or PCC plant operation. Field problems may necessitate increased monitoring. For PCC plant inspection, all monitoring requirements, except for plant calibration, will be performed by construction personnel. For HMA projects, monitoring responsibilities are shared between the plant monitor, grade inspector, and materials personnel. Materials personnel will primarily monitor activities involved with HMA materials production process and quality such as plant calibration, QM-A lab operation, contractor field process control, and for QM-A projects, will resolve discrepancies between the District Materials Lab and Contractor Lab results. Construction personnel will be primarily involved in administration and inspection activities. Materials engineers and resident construction engineers may mutually coordinate and shift responsibilities between personnel on an individual project basis to achieve the most efficient use of their respective personnel and minimize unproductive time spent at the contractor's HMA plant. See *Construction Manual 3.20* for responsibilities of project acceptance sampling and testing.

On certified plant inspection projects, it is a requirement for the plant monitor to be a certified technician for the type of work involved.

QM-A requirements can be considered an expansion of the certified plant program for HMA. In addition to normal certified plant inspection duties, under QM-A the contractor is also required to design and submit their own mix designs for agency approval. At the plant, the contractor is required to analyze and control mix production properties through frequent field testing, based on specified gyratory or Marshall mix design criteria.

For a QM-A project, the plant monitor must be a certified HMA technician. This certification is obtained by attending the Level I HMA course and passing the required examinations.

It is imperative that project engineers maintain an adequate staff of trained, experienced plant monitors. This can be accomplished by having employees participate in the appropriate technician training and certification programs and pass the examinations.

Certified plant inspection will apply to items of work as defined in *Specification 2521.03*. Any items of work excluded from certified plant inspection will be as noted in contract documents. Work excluded from certified plant inspection will also be excluded from QM-A requirements.

In the event the contractor's certified HMA technician is absent, the contractor must contact consultants or other available certified technicians to arrange for inspection.

For duties performed by the certified HMA technician on QM-A projects, the contractor must also contact consultants or other sources for available certified technicians in cases of absenteeism. Because of the laboratory skills necessary to perform this work and the decision making authority as a representative of the contractor, it is not possible or appropriate for the project engineer to provide certified HMA technician services to the contractor in cases of unexpected absences. If the contractor fails to provide certified HMA technicians as required by specification, work covered by QM-A shall be suspended until the project is properly staffed.

Portland Cement Concrete Paving Plant Monitoring

Appendix 3-2 lists the minimum monitoring requirements. A plant monitor will normally be assigned to each project with duties split between plant and grade inspection. Plant monitor should schedule work so the plant can be visited daily during production. The amount of time spent at the plant will depend on the overall quality control at the production plant.

Test beams for determining flexural strengths are to be transported from the grade to the plant site by contracting agency personnel.

Structural Concrete Plant Monitoring

Appendix 3-3 lists the minimum monitoring requirements. The project engineer and contractor should agree in advance whether aggregate gradations, moisture, and specific gravity tests will be waived for concrete which is furnished at a maximum rate of 20 m^3 (25 cubic yards) per day. This determination should be in accordance with *Materials I.M. 528.*

Ready mix tickets shall be prepared and signed by the certified plant inspector.

Test beams for determining flexural strengths are to be transported from the grade to the plant site by contracting agency personnel. The certified plant inspector is responsible for curing and storage of the beams. Contracting agency personnel are responsible for testing and reporting results.

Hot Mix Asphalt Paving Plant Monitoring

Appendix 3-4 lists the monitoring requirements. Responsibilities are shared between the plant monitor, grade inspector, and materials personnel. A plant monitor will normally be assigned to each project with duties split between plant and grade inspection, and may also be assigned to multiple projects under construction at the same time. The plant monitor should schedule work so that the plant can be visited daily during production, as required by *Appendix 3-4*. The amount of time spent at the plant, beyond minimum requirements, will depend on the overall quality control at the production plant. The project inspector will be providing production and placement information to be entered on the daily plant report.

Visits by the project inspector to the plant laboratory for exchange of information and to perform administrative activities will normally be done daily.

The plant monitor will typically be responsible for performing the density testing on HMA core samples.

Plant Reports

The project engineer should make arrangements with the certified technician for timely distribution of plant reports. On QM-A projects, the contractor shall FAX a copy of the daily plant report and QM-A Summary Sheet to the District Materials Engineer on a daily basis. The original and all copies of the plant report shall be kept at the plant until all documentation is completed. Normally, this will be the day following the end of the reporting period. Review and distribution of the reports will be made by the project engineer. This distribution will include a copy to be returned to the certified technician. Prompt consultation with the certified technician and monitor shall follow any significant error or omission.

Documentation

A documentation sample for the plant monitor is contained in *Appendix 3-5*. A separate field book should be set up on each project to document plant inspection. Some flexibility in the suggested format may be necessary depending on project size, type of plant, and if QM-A applies. It is important to document discrepancies and corrective action taken by contractor.

A copy of this documentation must be furnished to the District Materials Engineer (DME) at the time of project acceptance. Also include the certified technician's name, certificate number, and statement from the monitor regarding the work performance of certified technician. It may be necessary to consult with the DME regarding contractor technician performance for Marshall testing duties on a QM-A project. A sample format for providing this documentation is contained in *Appendix 3-6*.

Specification Violations

Failing test results are to be recorded on the daily plant report by the plant inspector.

Verbal notification of such failing results shall precede completion of paperwork to assure timely changes.

Failing test results on QM-A projects related to specified moving averages will be noted on the certified HMA technician data sheets and quality control charts. Special notes on these failures will also be reported in the comment section of the daily plant report. When average points move outside the specification limit, HMA mix production operations shall cease until the contractor proposes meaningful corrective action. The corrective action must be discussed with the DME prior to production start-up.

The plant monitor will convey to the responsible project inspector all specification violations, discrepancies in results with the plant inspector, and improper procedures and equipment used by the plant inspector. The project inspector will issue noncompliance notices for failing test results and inadequate testing procedures or equipment.

In order to use the contractor quality control test results for the acceptance decision, they must be validated by agency verification tests. It is important to notify the contractor and the DME when the results do not compare within the validation criteria in the Materials IM. The lot of material cannot be accepted until the validation issue is resolved by the DME.

All improper procedures, unresolved test discrepancies, or failure to perform inspection duties will be considered by the DME for possible decertification or other appropriate corrective action.

The role of the plant monitor is vital in assuring the DME is aware of any deficient or otherwise unsatisfactory work of the certified technician.

Testing Equipment & Supplies

Certain testing equipment is available for purchase from Department stock. Producers should refer to HMA and PCC Plant Inspection Manuals for specific information and Office of Materials Lab contacts. A list of equipment suppliers is included in the plant manuals.

Necessary plant inspection forms will be furnished to the producer at no cost. The producer can request these through the DME or project engineer. It is a good idea for the plant monitor to carry a supply of forms and make these available to the producers as needed.

The plant monitor can utilize contractor-furnished equipment for testing required at the plant site. HMA core density testing will most likely be done using the same balance, water bath, and thermometer as the contractor. Verification gradation testing should be done at a separate laboratory from the contractor's if possible.

Samples

Verification samples are to be taken by agency personnel or by contractor personnel when directed and witnessed by agency personnel. Materials IM 204 will indicate when contractor sampling assistance is required.

Verification samples that are not tested should be retained until the lot has been accepted.

If required by contract documents, transportation of secured verification samples to the District Materials Lab shall be performed by the contractor.

CHAPTER 9
PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

9.00 GENERAL

9.01 PRE-CONCRETING CONFERENCE

On all projects involving PCC pavement, the Project Engineer and inspectors should meet with appropriate contractor and supplier personnel to discuss concrete production and pavement placement quality issues before any materials are placed. When ready mix concrete is used, the ready mix producer should also attend.

For the various types of work, the following items should be covered:

- Approvals and required quantities of aggregate and cement, class of mix, time and rate of delivery, percent of air, slump, batch weights, volume per truck, total quantity required, preparation of delivery tickets, testing arrangements, procedures in case of load rejection (can air be increased or a wet load dried by adding cement and aggregate), responsibility for setting batch weights and amount of admixtures, placing, finishing and curing arrangements, and personnel work assignments.
- Settings and condition of paving equipment, dust control, subgrade treatment, procedure for checking steel placement, utility and street return box outs, heading-up equipment, joint sawing and cleaning, joint sealing, rain damage prevention, and cold weather protection.

Only one pre-concreting conference is considered necessary for thoroughly discussing the work, responsibilities, and duties of all involved in the project. On small projects it may be possible to include a pre-concreting conference with the preconstruction conference.

9.02 "PCC PLANT PAGE" (FORMS 800240E and 800240M)

The daily inspection report on paving work is a record of the construction progress, working conditions, weather, etc. during paving and plant operations which may affect pavement quality. This report keeps district and central offices advised on job status and serves as a detailed permanent record of the paving project. At the end of each day on which any pavement was placed, this report is to be completed by field inspection staff for appropriate distribution. Copies of forms are included in *Appendix 9-5.* Refer to *Materials I.M. 527* for instructions on preparing and distributing this form.

9.03 USE OF COMMERCIAL READY MIX CONCRETE ON PAVING PROJECTS

When the concrete source for a paving project is a commercial ready mix plant, each truck load of concrete must be identified by Form 830212 or an acceptable alternate plant ticket. A current copy of the Form 830212 is included in *Appendix 9-1*.

Required Information:

- 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 intermittent production other than mainline paving, such as bridge approaches and street returns, all information on Form 830212 is required for each load because of the greater possibility of need for water adjustment on grade.

Any water added on grade must be documented. Moisture tests must be made frequently to insure uniformity in concrete consistency. Discharge time must be entered on Form 830212 for each load.

9.04 CONCRETE DELIVERY TIMES

To insure that quality concrete is incorporated into pavement, maximum delivery times have been included in *Specification 2301.13D* for both continuous agitation (agitor and ready mix trucks) and non-agitated trucks (dump trucks).

These delivery times should be verified at least once during each day of normal paving. Per *Materials IM 527*, cement to water contact time should be recorded at least daily. These verifications should be recorded in project field books. During hot, dry, windy weather, maximum time limitations listed in specifications are critical limits to insure that quality concrete is being placed and incorporated into project.

included in Appendix 9-6. Project specific circumstances may dictate that repair methods other than those listed in Appendix 9-6 be allowed with approval of the Project Engineer.

D. Shrinkage Cracks
Remove and replace affected areas with new pavement in severe cases.

Minor cracks may be filled with pressure injected epoxy or repaired using Class A bridge floor repair methods.

E. Rough Pavement Sections
Surface variations, which exceed the specification smoothness requirements, require correction by the Contractor. Surface correction shall be accomplished with approved diamond grinding equipment. Use of milling machines, Roto Mill, Galion Scarifier, or other impact devices shall not be permitted.

F. Limitations
Necessary corrective measures on hardened concrete shall only be made after concrete attains age and strength requirements in *Specification 2301.31.*

All required corrective measures shall be completed prior to coring for pavement thickness measurements.

Consultation with the Office of Construction is recommended before placing an HMA or bonded PCC overlay.

9.54 MUD BALL REPAIR

Occasionally mud balls appear in the surface on new concrete pavements. These usually are due to clay balls from a quarry ~~or mud thrown into dump trucks from a portable batch plant located at a wet site~~ , trucks dropping mud from their axles when dumping from a bridge over a dump pit, or end loader operators digging too deep when removing material from a stockpile.

Correction of any discovered mud balls in a pavement surface shall be as follows:

- Any thin concrete skin around the perimeter of the mud ball should be removed so that nearly vertical void walls remain.
- Each void shall be cleaned by a high pressure washer, followed by air blasting to dry the void.
- Voids shall be filled with material meeting *Materials I.M. 491.20*, *Appendix A*. This material shall be used according to manufacturer's recommendations.
- The surface of filled voids shall be given the same texture as the surrounding pavement.
- A void repair shall be given the proper cure time recommended by the manufacturer prior to opening the roadway to normal traffic.

If a severe problem with mud balls is suspected on a specific project, formal acceptance by the Project Engineer should be delayed until the following spring. This will allow the winter freeze-thaw cycles and snowplowing activities to expose additional mud balls located adjacent to pavement surface. These newly discovered mud ball areas will then also require corrective measures as stated above.

9.55 COLD WEATHER PAVING AND PLANT OPERATIONS

Cold Weather Pavement Protection
During cold weather, *Specification 2301.19.B* requires that newly placed paving, less than 36 hours old, be protected against freezing temperatures. This protection is necessary to allow the hydration process of the curing concrete to continue in cold weather. Adequate protection of concrete allows for paving to be placed later in the season.

The required cold weather protection needed during any given day should be mutually agreed upon between the Contractor and Project Engineer. A daily predetermined weather forecast should be used. For example, the low temperature forecast from the 4:00 pm local radio newscast could be the agreed upon temperature forecast. Once a decision is made as to the appropriate cold weather protection needed, any changes to the amount of protection needed must be agreed between the Contractor and Project Engineer to avoid potential claims.

Below -4° C (25° F), *Specification 2301.19B* requires four layers of burlap between layers of 1.0×10^{-4} mm (4 mil) plastic or an equivalent commercial insulating material approved by the Project Engineer. Equivalent materials include:

- 3 layers of Burlene
- ~~1 layer of Fast Track Blankets per Specification 2301.19~~
- 1 layer of insulating blankets with a minimum R-value of 1.0
- 1 layer of 12 mm (1/2 inch) extruded polystyrene, must be weighted down
- 2 layers of 6 mm (1/4 inch) air celled polyethylene
- 1 layer of 12 mm (1/2 inch) air celled polyethylene

Specification 2301.19B also includes provisions for removal of the cold weather protection. Often a night or two of low temperatures is followed by several days of warmer temperatures. The provisions in *2301.19B* provide a means for allowing the removal of cold weather protection when it will no longer be necessary. This is especially important in that it allows the Contractor to reuse covering materials more quickly rather than unnecessarily leaving them on pavement that no longer needs to be covered.

When cold weather protection is required, the Contractor will be reimbursed for extra work per *Specification 2301.35.* The reimbursement amount is the same value regardless of number of layers of protection required.

Cold Weather Plant Operation
Specification 2301.29 states that concrete mixing and placement may be started when the air temperature is at least 1° C (34° F) and rising. In the late fall season before the subgrade begins to freeze and soil temperatures are still relatively warm, it is permissible to allow paving plant operations to begin below1° C (34° F) providing a decent weather forecast is predicted. Paving plant operations basically self regulate during these conditions.

The intent is to maximize the remaining good paving weather still available in the fall. This provision is not intended to make a paving day out of one that is not, but to allow for as much concrete pavement placement as possible during a day forecast for good weather.

After the subgrade begins to freeze, the above provisions should be halted and specifications strictly enforced.

9.56 CURING APPLICATION

The cure shall be applied to the pavement as soon as practical after the finishing operation is complete. This is normally applied with a machine that both applies the curing compound and creates the texture. This is a stop and go operation since curing and texturing can be accomplished faster than the paving operation. Curing shall not be delayed simply because the tines are creating too deep of a texture groove. The goal is a shallow groove and the texture machine can be adjusted in order for the tines to apply less pressure on the surface of the fresh concrete. With a consistent concrete mixture, the downward pressure on the tines can be adjusted in order to allow the tining machine, and thereby the curing process, to be kept right behind the finishers.

The curing shall be applied no later than one half hour after placement. In very hot, dry, windy conditions this is not soon enough. A price adjustment schedule is provided as Table C5 in Appendix 2-34C for areas of pavement where cure is not applied in a timely manner.

9.60 CONCRETE MATERIALS ISSUES

9.61 CONCRETE SAMPLING LOCATIONS

Concrete samples shall be taken as described in *Materials I.M. 327*. The sample location point shall be after plastic concrete has been placed on the grade, either by direct depositing from a batch truck or by use of a placer/spreader machine. On slipform paving projects, the optimum sample location is between placer/spreader and slipform paver machines. For safety considerations, samples may be taken from concrete deposited on the grade in front of the belt placer. Care should be taken to avoid sampling concrete that has been vibrated manually or mechanically. Samples should be taken at locations within the batch that appear to be representative.

9.62 TESTING PROCEDURES

When making test specimens, a sample should consist of about 0.03 cubic meters (one cubic foot) and should be remixed a minimum amount by use of a shovel to ensure uniformity. For routine air and slump tests, smaller samples may be used.

For standard methods of tests, refer to *Materials I.M. 327* (Sampling Freshly Mixed Concrete), *Materials I.M. 316* (Flexure Strength Tests), *Materials I.M. 317* (Slump Test), *Materials I.M. 318* (Air Content Test), and *Materials I.M. 328* (Making, Protecting, and Curing Beams).

9.63 AIR ENTRAINMENT IN PLASTIC CONCRETE

Specification 2301.04.C discusses the required percent of entrained air needed for concrete paving mixes. These percentages have been developed to allow for loss of entrained air as the plastic concrete is placed and consolidated as it goes through the paving operation. The concrete paving mixes have been developed to provide for consolidated concrete containing a 6% air content. To allow for this air loss through the paving operation, tests will be conducted both before and after the paver and a target air content determined. ~~Specification 2301.04.C specifies the procedure that shall be used.~~ The following process will be used in verifying entrained air content in PCC paving mixes:

Control of Air Content

QMC Paving Projects

On the first air test of each day, the contractor and agency shall run side by side tests to ensure air meters are within the tolerance in IM 216. If the air tests are outside the tolerance, the air meters should be calibrated in accordance with IM 318.

The unconsolidated air content limits will be established according to 2301.04C using witnessed contractor quality control test results. The contractor shall notify the engineer whenever an individual quality control test result is outside the tolerance for the target air content.

Non-QMC Paving Projects

The unconsolidated air content limits will be established according to 2301.04C using agency test results. The agency will notify the contractor whenever an individual test result is outside the tolerance for the target air content.

Verification

Lot acceptance shall be based on the agency verification test results on the unconsolidated mix on the grade. A lot is defined as the amount of a concrete mix placed since the last complying verification air content test.

Air Content Outside Tolerance

When a verification test result is outside the tolerance for the target air content, the contractor will be notified immediately. An air test will then be immediately run behind the paver to aid in identifying the limits of the non-complying air. In addition, the non-complying load will be tested behind the paver to ensure an accurate target air content. If found to be inaccurate, the target air content will be adjusted immediately based upon the air loss and a second lot verification test will be run. If the target air content is found to be accurate, the contractor shall make immediate adjustments to the mix production and placement process to bring the air content back within tolerance. Succeeding loads below the lower target air content tolerance by more than 0.5 % shall not be used. Each subsequent truck will be tested until air content is within tolerance for two consecutive loads. A price adjustment will be applied to all incorporated, non-complying loads that are out of tolerance.

Air Content More Than 0.5% Below Lower Target Content

When the lot verification test result is below the lower target air content by more than 0.5 percent, the contractor may elect to take concrete core samples from the pavement to define the portion of the lot that is non-complying. The lot will be divided into equal 200 square yard (170 square meter) sublots, from the last complying verification test, or witnessed and documented quality control test. A randomly located core will be identified in each sublot. Coring will be at the contractor's expense. The agency will direct and witness the taking of cores. The contractor may either:

1) Provide the agency with the cores for testing by Materials Laboratory Test Procedure 407.

2) Provide an independent laboratory for testing and a test procedure acceptable to the agency. The agency will take possession and ship the cores at the contractor's expense. Results will be directly reported to the agency and the testing will be at the contractor's expense.

A price adjustment will be applied to sublots represented by cores with an entrained air content below 5.0 percent.

Appendix 2-34(C) is the price adjustment table that lists price adjustments to be applied to concrete in which test results fall outside the specified limits.

Aggregate Correction Factor

~~Note:~~ Per *Materials I.M.* 318, an adjustment to the target air content called an aggregate correction factor may be required for some quarries in east central Iowa that have highly absorptive aggregates. The aggregate correction factor may be obtained from the District 6 Materials Office. The target air content for PCC mixes utilizing these aggregates would be the specified target for the application plus the aggregate correction factor (see example below). Applying the aggregate correction factor when using aggregates from these quarries helps ensure that proper air content is achieved in the hardened concrete and also reduces excessive bleeding.

Example: For slip form PCC paving utilizing ready mixed concrete, specified air is 7.5% plus 1.5% or minus 1.0% for the first day of paving. For an aggregate correction factor of 1.0%, the target would be 8.5% (8.5% equals the specified target of 7.5% plus the aggregate correction factor of 1.0%) plus 1.5% or minus 1.0%.

The aggregate correction factor is in addition to any correction added for air content lost through the paver.

9.64 CONCRETE VIBRATION AND CONSOLIDATION

Specification 2301.07.A.6.a requires vibration frequency to be maintained between 4000 and 8000 vibrations per minute for concrete paving finishing machines. To ensure proper consolidation of the plastic concrete, the vibration system used in the finishing machine should provide continuous and full coverage.

The depth of penetration into the concrete of internal vibrators should be set to mid slab height or as deep as possible while passing above any reinforcing steel. An operating position locking device should be provided so that no part of the vibrating unit can be lowered to the extent that it will come in contact with reinforcing steel or tie bars while paving.

Horizontal spacing of vibrators should not exceed the manufacturer's recommendation or 16 inches (410 mm), whichever is less. The Engineer may allow exceptions to this spacing in situations where centerline tie steel placement may be adversely affected or structural elements of the paver make it impractical to maintain exact spacing.

The longitudinal axis of the vibrator body should be mounted approximately parallel to the direction of paving with the exception that the trailing end of each vibrator shall be tilted downward to an approximate slope of 15 degrees below horizontal.

On ~~some~~ large projects, greater than 50,000 square yards (40,000 square meters), an electronic monitoring device, which monitors and records the frequency of each vibrator on the paver, is required. The inspector will periodically check the electronic monitor by use of a manual device. The inspector will periodically check the monitor during the paving day and review, on a spot basis, the daily record of the vibration frequencies. *Specification 2301.07, A, 6, a, 2* requires submittal of vibration monitoring data daily for the first three days of paving and weekly thereafter. It is important that these submittals occur because it gives the Engineer the opportunity to review the vibration data to ensure that vibrators are being operated within the allowable frequencies. Upon completion of the project, all vibration monitoring data should be submitted to the Office of Materials.

When a vibrator monitor is not required, vibrator readings should be taken and recorded at the start of concrete placement. Vibrators may be checked in the morning, before paving operation begins. This check can detect malfunctioning or dead vibrators. But, the frequencies will change as the hydraulic oil is heated once paving begins. A check of frequency levels needs to be made after the paver has been operating for some period of time, at least after the first 20 minutes or half hour. Readings should also be taken at least twice daily to check for mechanical failures or problems in the vibration system of the paver. Vibrator readings should be recorded on Form 830213 "Project Information/Paver Inspection." A copy of this form is included in *Appendix 9-3*.

If vibrator frequencies are greater than allowed by the specification, the Contractor should be informed to adjust the paving operations so that future measurements are within required specifications. Excessive vibration frequencies have been known to produce lower entrained air and premature concrete pavement deterioration with shorter pavement life.

It is also helpful to watch for the presence of vibrator trails in the plastic concrete surface behind the transverse texturing operation (but before the curing compound application). These trails show in the surface of the plastic concrete by a deeper groove in the textured surface. This deeper texture follows the path of the vibrator. Many existing portland cement concrete pavements are showing these "vibrator trails."

9.65 PAVEMENT THICKNESS CORES

Materials I.M. 346 describes procedures for coring PCC pavement for evaluating thickness requirements. The procedures are the basis for acceptance and payment of work. ~~It is intended that the Engineer witness the coring and take possession of the core samples as they are drilled to ensure a proper chain of custody for acceptance.~~ The Engineer will witness the coring and measure the cores immediately on the grade. If cores are not measured on the grade, the Engineer must take immediate possession of the core samples as they are drilled to ensure a proper chain of custody for acceptance. At no time should the contractor have possession of the cores prior to measurement by the Engineer.

9.66 PAVEMENT SMOOTHNESS

Pavement smoothness shall be evaluated in accordance with *Specification 2316* and *Materials I.M. 341*. See *Construction Manual 3.60* for additional information.

9.67 QUALITY MANAGEMENT CONCRETE (QM-C)

QM-C is the design, testing, placement, and monitoring of a Portland cement concrete mixture by a contractor in partnership with the owner for the purpose of making a superior product while promoting innovation and understanding.

The Iowa DOT requires QM-C on large paving projects greater than 50,000 square yards (42,000 square meters). It is mainly used on rural type paving projects, without a lot of staging and/or handwork. The mix design is based on an optimized gradation, usually requiring three aggregates of coarse, intermediate, and fine (sand) sizes. QM-C mixes are designed for use in slip-form paving operations only. The optimized gradation allows easier slip-form placement without edge slump, especially on pavements with thicker pavement section (i.e. 12 inch thick interstate pavements). The QM-C mix design is typically coarser than Class C mix design and is not intended for handwork placement. The QM-C supplemental specifications require Class C concrete for handwork. However, in some cases the QM-C mix may be workable enough to be acceptable for handwork. With approval from the Project Engineer, a QM-C mix may be used for handwork.

Since three aggregates are typically required to produce the optimized gradation, QM-C mix designs are better suited on large rural paving projects where batches are proportioned in a central plant. Many ready mix producers do not have the capability to handle more than two aggregates, thus, it is usually not feasible to require QM-C on ~~urban~~ small projects that would typically use ready mixed concrete.

The biggest misconception of using the QM-C specification is that the contracting authority does not have to do testing since the contractor performs testing. IM 530 describes the testing required by the contracting agency. The contracting agency's test results must ~~correlate with the contractor's test results, in accordance with IM 216, in order to allow contractor results to be used as acceptance.~~be used in the acceptance decision to comply with the requirement of the Materials Sampling and Testing Program. By not performing any ~~correlation~~ verification testing, the owner may jeopardize federal aid on the project.

Since the contractor incurs additional costs for mix design, grade testing, and increased amount of coarse aggregate in QM-C mixes, Class C concrete may be more economical on smaller projects, urban projects, and projects with extensive staging. Class C concrete will perform equally well as the QM-C mix design and is sometimes better suited for certain placements and field situations.

Measurement and Payment

Measurement and payment can be difficult when using QM-C mixes. Payment for full-depth QM-C pavements is made with two items. The first item is a QM-C cubic yard (cubic meter) item. This item is intended to compensate the contractor for the development of the Concrete Design Mixture (CDM) as well as the testing and process control necessary for production of the mix. The second item is a square yard (square meter) item intended to compensate the contractor for the pavement. An incentive payment is applied to the square yard (square meter) item based upon the aggregate gradation achieved in the CDM throughout the project. However, the incentive only applies to the area of pavement placed using the CDM.

Payment for PCC overlays using QM-C is made with three items. The first item is the QM-C cubic yard (cubic meter) item, and measurement and payment are the same as that used for full-depth pavements. The second item is a QM-C Furnish item. This item is intended to compensate the contractor for the cubic yards (cubic meters) of QM-C mix used on the project. Finally, the third item is a QM-C Placement item. This item is intended to compensate the contractor for placement of the QM-C mix.

NOTE: *For overlays, the incentive payment for gradation is applied to both the QM-C Furnish item and the QM-C Placement item.*

The square meter (yard) items for QM-C are plan quantity and typically would not need to be measured. However, because the Coarseness/Workability incentive payment only applies to the slip formed portion of the square meter (yard) item, the area of all hand pours must be measured and subtracted from the plan quantity to determine the appropriate Coarseness/Workability incentive payment. This is further complicated by the contractor's option to use the QM-C mix for non-QM-C pavements on a project. See *Appendix 9-7* for guidance on payment for PCC pavements under the QM-C specification.

Materials I.M. 530 requires submittal of all QM-C quality control charts and records to the Project Engineer. The Project Engineer should forward copies of these files to the Office of Materials upon completion of the project.

11.50 CONCRETE (STRUCTURAL, CLASS X, AND FLOWABLE MORTAR)

11.51 PCC PLANT PAGE (FORMS 800240E and 800240M)

The project engineer shall report weekly all concrete placed for each project on "PCC Plant Page" (Form 800240). This form will record concrete placements, all results of sieve analysis tests, and all data on test beams made and tested. The week covered by each report shall begin on Sunday morning and end on Saturday evening. A separate Form 800240 is required for each bridge design, including bridge deck surfacing and resurfacing, and each group of culverts. Refer to *Materials I.M. 527* for instructions on preparing this form.

11.52 USE OF READY MIXED STRUCTURAL CONCRETE

Prepour Meeting

It is very important to use the prepour meeting to discuss the specifics of placement, establish communication, and resolve potential "sticky" issues prior to placement. Generally it is recommended to discuss:

- Chain-of-command. Who is in charge for contractor? Who needs to be notified if material tests do not comply with specifications? Establish prior to placement how test results are reported (i.e., does the contractor want to be notified verbally, or in writing each time?).
- Material requirements and admixtures needed for the placement (Examples: Single cement source, concrete temperature and methods used to cool the mix, source and amount of any admixtures, specific mixes required for bridge decks, etc.).

  Procedures for introducing admixtures during mixing operations need to be discussed and formalized. For example: How and where will the air entraining agent be introduced? There is a growing concern that placement location of admixtures is causing significant variability in mixes. The plant monitor must watch and document how admixtures are introduced during mixing.
- Method and frequency of acceptance testing during placement. Inform the contractor what is expected if non-acceptable material is found during placement. Recommend to the contractor that they arrange to have a representative from the ready mix plant on site to coordinate concrete delivery, adjustments to concrete mix, and provide direct communication with the ready mix plant during concrete placements.
- Scheduling, truck availability, placement method, and required placement rates.
- Establish an acceptable source of preplacement weather forecasting. Agree on weather parameters which will be used for "go" or "no-go" decisions both "prior to" and "during" the placement activity.
- Review & Discuss items under “Concrete Bridge Floors” in Section 11.62.

Inspector's Checklist

A. Specifications regarding plant inspection, equipment approval, and batching operations should be reviewed for familiarity. In addition to proper plant calibration, the inspector should verify that each truck mixer used on the job has a current certification as required by *Specification 2001.21, Paragraph B* and *Materials I.M. 528.* It is good practice to inspect a random sample of ready mix trucks that will be used on the job, verifying that the certification accurately reflects the truck's condition. Truck certification numbers should be recorded in the inspector's diary and will need to be reverified at least every 30 days. Required information to be recorded on ready mixed concrete truck batch tickets shall be according to Construction Manual Section 9.03.

B. Batching and mixing should be limited to the lead truck until slump and air content have been tested for conformance with specifications. Contractors may make preliminary tests at the plant, but project acceptance is based on job site tests. It is intended that the ready mix plant supply concrete to the construction site that conforms to all applicable specifications at the point where the acceptance sample is taken.

Specification 2403.03, Paragraph A states for Structural Concrete: "Concrete shall be placed with a slump between 25 mm and 75 mm (1 and 3 inches) as a target range, allowing a maximum of 100 mm (4 inches) ..."

Specification 2403.03, Paragraph B states for Structural Concrete:
"... unvibrated structural concrete shall be 6.5 percent, as a target value, with a maximum variation of plus 1.5% or minus 1.0%." Note: As stated in I.M. 318, an adjustment to the target air content called an aggregate correction factor may be required for some aggregates obtained from quarries in east central Iowa that have highly absorptive aggregates. The aggregate correction factor may be obtained from the District 6 Materials Office. The target air content for structural concrete utilizing these aggregates would be the specified target for the application plus the aggregate correction factor (see example below). Applying the aggregate correction factor when using aggregates from these quarries helps ensure that proper air content is achieved in the hardened concrete and also reduces excessive bleeding.

Example: For structural concrete specified air content is 6.5% plus 1.5% or minus 1.0%. For an aggregate correction factor of 1.0%, the target would be 7.5% (7.5% equals a specified target of 6.5% plus aggregate correction factor of 1.0%) plus 1.5% or minus 1.0%.

If concrete is being delivered which deviates much from these target values, the contractor is responsible for taking corrective action to bring the mix to within target values. Even if the current mix is within specified limits. The intent of the tolerance is to provide latitude during placement for unforeseen changes in materials, mixes, and placement methods. Placing concrete "consistently" near a tolerance limit is not desirable and warrants additional sampling.

What is important, is the contractor's response to test results approaching tolerance limits. Continually having to add water and/or air agent to each load at the site will not be permitted. If such practice is occurring, the inspector shall notify the contractor (or whomever was designated as "the" responsible individual in charge of the concrete at the site). Ultimately, it is the contractor's responsibility to initiate immediate corrective action.

Non-responsiveness on the contractor's part is reason to initiate sampling and testing of each truck or halt placement. The purpose for additional testing is to ensure that no noncomplying materials are incorporated into the project.

In some cases admixtures, such as water reducers, are required to be added in split doses or sometimes totally at the site.

C. All Structural Concrete

- At the start of each day's placement, no concrete is to be placed in the forms or on the deck until the first truck has been sampled, tested, and approved. Incorporation of materials from this truck will not be permitted unless desired slump and air content are within specified limits. Continuous placement shall not begin until after test results indicate the material meets specified requirements.

  If the first load is close to a limit value, it is recommended to sample and test the second load unless site experience indicates it is not necessary.

- Initial start up test results (if taken from the truck chute) must account for method of placement. For example, if placement will be through a pump, air values should be on the high side of target to account for loss during pumping. Again, site/project experience should be factored in this decision.

- Routine acceptance testing will be at a minimum frequency of one sample per 25 cubic meters (30 cubic yards). This frequency may be changed for large, continuous placement where placement rates warrant a lesser frequency. Minimum *quantity* placed between routine acceptance tests is 25 cubic meters (30 cubic yards). This rate of testing may be ***increased*** (made more frequent) if the inspector has a concern that target values are not being met.

  NOTE: Only the District Materials Engineer has authority to approve ***decreasing*** (less frequent) testing frequencies from those listed in *Materials I.M. 204*. PLAN AHEAD and obtain approval for those cases where a variance would be reasonable.

- For routine acceptance testing, obtain a representative sample *at the last practical point* before incorporation, but prior to consolidation. The intent here is to obtain a sample that will most accurately represent the values of slump and air content of the concrete placed. There have been some questions regarding what is considered the *last practical point* before incorporation. This is an area for good judgement relative to the particular placement. As a guideline, if an inspector has access to the point of discharge of the concrete and will be in this location for other inspection being performed it would seem reasonable that a sample could be obtained for testing. The testing of the sample should be able to be conducted in a reasonably close proximity to the point of sampling.

  NOTE:
  When concrete is placed by means other than directly from the back of the truck, the sample shall be taken, if possible, after the concrete has passed through the conveyance method being used. (This includes placement by bucket, belt, pumps, power buggies, etc.)

- Routine acceptance sampling and testing does not require holding a truck until results are available. However, if there are obvious deficiencies, the inspector has the authority to hold that truck until test results are available.

- Inspectors should be alert to obvious visual changes in consistency, with routine acceptance air and slump tests being made as noted above. Any load having questionable consistency should be checked for slump.

- If noncomplying test results are found during routine acceptance sampling, no more material (from that truck or others) shall be incorporated until complying test results are obtained. When test results indicate noncomplying material:
  1. The rest of that load shall be rejected and not incorporated, unless adjustments can be made to bring it back into compliance *(Specification 1106.04)*. In an attempt to bring noncomplying concrete into compliance, the supplier may make field adjustments (i.e., add air entraining agent, add portland cement, or rotate the drum). Such "field" adjustments shall be an **EXCEPTION** and not the general rule and the 90 minute time restriction shall not be waived for any situation.

  2. For all noncomplying test results the inspector shall immediately notify the contractor or their representative in charge of the concrete. This notification shall also inform the Contractor if noncomplying materials have been incorporated into the structure.

  3. If test results indicated noncomplying materials have been incorporated, the inspector shall make a note in the diary indicating the test results, approximate volume incorporated, location the material was placed, and to whom the notification was given. The inspector should also note a noncomplying event on that particular truck's delivery ticket.

     At the end of each day or each placement event (whichever is sooner) the inspector shall prepare a Noncompliance Notice (Form 830245) for all noncomplying material incorporated and not removed/replaced during that day or placement event. This notice shall be given to the Contractor yet that day *(Materials I.M. 204)*.

  4. When noncomplying materials are found, the inspector will a) hold each truck, and b) initiate sampling and testing of each truck until two consecutive loads meet specifications. At this point, sampling and testing may return to normal project acceptance frequency.

D. *Specifications* and *Materials I.M.s* spell out requirements that materials must meet to be acceptable. Further, *Materials I.M. 204* identifies a frequency for sampling/testing and whether the test is an acceptance or assurance test.

Authority for initially rejecting noncomplying materials and poor quality work performance is given to the inspector in *Specification 1105.07*. This rejection authority is only superseded by the project engineer. There is an old saying to the effect, *"We shall not knowingly incorporate noncomplying material into a project."* This means exactly what it says and there is ample support in the specifications for this position.

E. During placements, the inspector should alternate sampling among the various trucks involved in the operation.

F. If there is a specific truck which is identified as causing a problem with consistency, that truck shall be rejected from further use. (Refer to *Specification 2001.21, Paragraph B.*)

G. Transit mixers shall be completely emptied of wash water before reloading. If the truck's top fill hopper is washed after loading, no wash water shall be allowed to enter the mixer.

H. When it is not practical to sample at the last point prior to incorporation, then a method of correlation between point of placement and the actual point of sampling must be developed. While such cases should be the **EXCEPTION and NOT THE GENERAL RULE**, one approved method is as outlined below:

When concrete reaches a stable consistency and is within target ranges, correlation tests can be run between the last practical sampling location and the place of deposition. If differences are consistent, then correlated tests can be taken at the last practical sampling location.

The following is a guideline if tests are not consistent:
Test a minimum of three loads of concrete sampled from the "last practical sampling location" and at the point of discharge. Average the difference between the test results. This average (correction factor) is used until another correlation is determined. Correlation tests should be determined, as a minimum, at the beginning, middle, and toward the end of a pour. The inspector needs to factor in situations such as size of pour, changing weather conditions, changes in conveyor length, changes in pumping configuration or pipe angles, and changes in batch proportions when determining frequency of correlation tests.

All subsequent "acceptance" tests are taken at the last practical sampling location and are adjusted using the correlation factor.

All correlation tests and correction factors are to be documented in the field books and noted on the "PCC Plant Page" (Forms 800240E and 800240M) or on a sheet attached to the form. Results reported using correction factors shall be identified with an asterisk (*) or written note.

I. The inspectors will need to satisfy themselves regarding compliance with the specifications for the number of drum revolutions at mixing speed.

J. If water, air entrainment, or other admixtures are added at the project site, acceptance testing will not be performed until all additions have been made AND 30 revolutions at mixing speed have been completed following the change.

11.53 ADMIXTURES

Admixtures are those ingredients in concrete other than portland cement, water, and aggregates, that are added to the mixture immediately before or during mixing. Admixtures typically encountered on our jobs can be classified by function as follows:

- Air entraining admixtures
- Water reducing admixtures
- Set retarding admixtures
- Set accelerating admixtures
- Corrosion inhibiting admixtures

- Finely divided and permeability mineral admixtures (Fly Ash, Ground Granulated Blast Furnace Slag & Silica Fume)
- Coloring agents (normally not used for Iowa DOT work)

The amount of any admixture used in a mix should be as recommended by the manufacturer and verified through laboratory testing or trial mixes. Effectiveness of an admixture depends upon such factors as type, brand, and amount of cement; water content; aggregate shape; gradation and proportions; mixing time; slump; and temperatures of concrete and air.

Air Entraining Admixtures
Air entraining admixtures are used to purposely entrain microscopic air bubbles in concrete. Air entrainment will dramatically improve the durability of concrete exposed to moisture during cycles of freezing and thawing. Entrained air greatly improves concrete's resistance to surface scaling caused by chemical deicers.

Rules-of-Thumb

- As cement content increases, air agent must increase to maintain equal entrained air.
- As cement fineness increases, the amount of air agent must increase to maintain equal entrained air.
- As coarse aggregate size decreases, the air content increases for a given amount of air agent.
- As fine aggregate volume increases, the air content increases for a given amount of air agent.
- As mixing water increases, the air content increases for a given amount of air agent.
- Air entraining admixtures should be introduced into mix at the plant, but additional may be added at the site to adjust mix for correct air content.
- Air entraining admixtures should (usually) be added to the front of the truck at the plant. If corrosion inhibiting admixture is used, air entraining agents should be added to the back of the truck.

Water Reducing Admixtures - Regular
Water reducing admixtures are used to reduce the quantity of mixing water required to produce concrete of a certain slump or reduce the water-cement ratio. Regular water reducers reduce water content by about 5% to 10%.

Adding a water reducing admixture to a mix without reducing water content can produce a mixture with a much higher slump.

Rules-of-Thumb

- Typically, water reducing admixtures do not reduce the rate of slump loss; in most cases, it is increased. Rapid slump loss results in reduced workability and less time to place concrete at the higher slump.
- Typically, water reducing admixtures have no effect on bleed water.
- Certain types of sulfate starved portland cements may cause false-set with certain brands of water reducers. Typically, water reducers contain lignosulfonates and these sulfates are easily attracted by sulfate starved cements. This action may cause early false-set.
- Despite reduction in water content, water reducing admixtures can cause a significant increase in drying shrinkage.

Water Reducing Admixtures - Super Plasticizers

Super plasticizers are simply "high-range water reducers." They are added to concrete with low-to-normal slump and water content to make high slump "flowable" concrete. Flowable concrete is a highly fluid, but workable concrete that can be placed with little or no vibration and can still be free of excessive bleeding or segregation. Flowable concrete has applications:

1. In areas of closely spaced and congested reinforcing steel
2. In tremied concrete where "self consolidation" is desirable
3. In pumped concrete to reduce pump pressure
4. To produce low water-cement ratio - high strength concrete. High-range "super plasticizers" can reduce water content by about 12% to 30%.

Rules-of-Thumb

- The effect of most super plasticizers in increasing workability or flowable concrete is short lived. Typically, maximum is 30 to 60 minutes followed by a very rapid loss in workability.
- Typically, super plasticizers are added as split treatments (part at the plant, part at the site). Sometimes the addition is totally at the site.
- Setting time may be affected depending on the brand used, dosage rate, and interaction with other admixtures.
- Excessively high slumps of 250 mm (10 inches) or more may cause segregation.
- High-slump, low water/cement super plasticized concrete has less dry-shrinkage than does high-slump high water/cement conventional concrete.
- Effectiveness of super plasticizer is increased with an increased amount of cement, and/or increased fineness of cement.
- Effectiveness of water reducers on concrete is a function of their chemical composition, cement composition and fineness, cement content, concrete temperature, and other admixtures being used.
- Some water reducing admixtures, such as lignosulfonates, may also entrain some air in the mix.

Retarding Admixtures

Retarding admixtures (retarders) are used to delay the initial set of concrete. High temperatures of fresh concrete 30°C (85°F) and up often cause an increased rate of hardening. Since retarders do not decrease the initial temperature of concrete, other methods of counteracting the effect of temperature must be used.

Rules-of-Thumb

- Retarders are sometimes used to delay initial set of concrete when difficult, long placement times, or unusual placement conditions exist.

  NOTE: Retarders are not to be used when the anticipated temperature of the mix is below 13°C (55°F); however, placement requirements must be met within the initial set time indicated for the non-retarded concrete.

  Retarding admixtures require a concrete temperature of 13°C (55°F) or greater in order to activate and effectively retard the set of concrete. If the proposed placement cannot be accomplished within the initial set time for non-retarded concrete, the concrete mix temperature will have to be increased through the use of heated materials. When heated materials are used, it is recommended that a concrete mix temperature of 18°C (65°F) be targeted for effective activation of retarding admixtures.

- Retarders offset the set acceleration effect of hot weather.
- Retarders can be added at the site.
- In general, some reduction in strength at early ages (one to two days) accompanies the use of retarders.
- Use of retarders must be closely monitored, because there is probably no single admixture which has caused more field problems.
- If too much retarder has been used in a mix:
  1. Time will usually counter the effects.
  2. "Be sure" to maintain the cure during the added time.

Accelerating Admixtures

Accelerating admixtures (accelerators) are used to accelerate the setting time and strength development of concrete at an early age. Strength development can also be accelerated by using:

- Type III "high-early" cement
- Lowering water/cement ratio
- Curing at controlled higher temperatures

Calcium Chloride ($CaCl_2$) is the material most commonly used in accelerating admixtures. Besides accelerating strength gain, calcium chloride also causes an increase in drying shrinkage, potential reinforcement corrosion, discoloration, and potential scaling.

Rules-of-Thumb

- Always add calcium chloride in solution form as part of the mixing water.
- Calcium chloride is not an antifreeze agent. When used in allowable amounts, it will only reduce the freezing point of concrete by a few degrees.

Corrosion Inhibiting Admixtures

Concrete protects embedded steel from corrosion through its highly alkaline nature (12.5 pH). This causes a passive and non-corroding protective oxide film to form on steel. However, carbonation or the presence of chloride ions from deicers, can destroy or penetrate the protective film. Once this happens, an electronic cell (very small battery) is formed and an electro-chemical process of corrosion begins. This process ultimately forms rust. Rust is expansive (up to 4 times original volume). This induces internal stress and eventually causes spalling to occur.

Corrosion inhibiting admixtures chemically inhibit the corrosion reaction. Calcium nitrite, the most commonly used inhibitor, blocks a corrosion reaction by chemically reinforcing the concrete's passive film.

Rules-of-Thumb

- Corrosion inhibitors should be added at the plant.
- Experience indicates corrosion inhibitors should be placed in the front of the truck (first-in) and air entrainment agent should be placed at the back (last-in).
- Corrosion inhibitors are accelerators and will affect set times. It is recommended to consider adding about a one-half dose of retarder to extend working times.
- Air content of mixes using corrosion inhibitors is often difficult to stabilize. Watch the target air closely.
- A certain amount of calcium nitrite can protect up to a certain threshold level of chloride. Therefore, the amount of corrosion inhibitor added to a mix must be

developed for an assumed maximum level of chloride ingress expected.

Finely Divided Mineral Admixtures
These admixtures are powdered or pulverized materials added to concrete to improve or change the properties (plastic or hardened) of concrete. Based on the mineral's chemical or physical properties, they are classified as: (1) Cementitious, (2) Pozzolans, (3) Pozzolanic and Cementitious, and (4) Nominally inert. Typical PCC mix designs use #3 above.

Pozzolanic Materials
A pozzolan is a siliceous or aluminosiliceous material that in itself possesses little or no cementitious value but will, in finely divided form and in the presence of water, chemically react with the calcium hydroxide released by the hydration of portland cement to form compounds possessing cementitious properties. Pozzolans include fly ash and silica fume.

Fly Ash (Class C & F)
Fly ash is a finely divided residue that results from the combustion of pulverized coal in electric power plants.

Silica Fume
Silica fume, also referred to as micro-silica or condensed silica fume, is another material that is used as a pozzolanic admixture. This light to dark gray powdery product is a result of the reduction of high-purity quartz with coal in an electric arc furnace.

Fly ash and silica fume have a spherical shape. Silica fume has an extremely small particle size (about 100 times smaller than the average cement particle). Although silica fume is normally in powder form, because of its small size and increased ease of handling the product is commonly available in liquid form.

Cementitious Materials
Cementitious materials are substances that alone have hydraulic cementing properties (set and harden in the presense of water). Cementitious materials include ground granulated blast furnace slag.

Ground Granulated Blast Furnace Slag (GGBFS)
GGBFS made from iron blast-furnace slag is a non-metallic product consisting essentially of silicates and aluminosilicates of calcium and other bases developed in a molten condition simultaneously with iron in a blast furnace. The molten slag is rapidly chilled in water to form a glassy sandlike material which is ground to a particle size similar to fly ash. Unlike fly ash and silica fume which have a spherical shape, GGBFS is rough and angular-shaped.

Rules-of-Thumb

- Mixes containing fly ash or GGBFS will generally require less water (about 1% to 10%) for a given slump. Silica fume concrete requires more water for a given slump.
- The amount of air-entraining admixture required to obtain a specified air content is normally greater when fly ash or silica fume is used. Ground slags have variable effects on the required dosage rate of air-entraining admixtures. The amount of air-entraining admixture for a certain air content is a function of the fineness, carbon content, and alkali content.

- Fly ash and ground slag will generally improve the workability of concretes of equal slump. However, fly ash in low slump concrete will tend to tear and have reduced workability. Silica fume tends to reduce workability, thus high-range water reducers are usually added to maintain workability.
- Concrete using fly ash or silica fume generally shows less segregation and bleeding than plain concrete. Concrete using some ground slags tend to have slightly higher bleeding than plain concretes, but have no adverse effect on segregation.
- Use of fly ash and ground slag will reduce the amount of heat build-up in concrete. Silica fume most likely will not reduce the heat of hydration, because typically high-range water reducers are used and they increase mass temperatures.
- Use of fly ash and ground slag will tend to generally retard the setting time of concrete. Silica fume alone will accelerate the setting time, however, high-range water reducers tend to offset this.
- Use of fly ash and ground slag generally aids the pumpability of concrete.
- With adequate and correct curing, fly ash and ground slag generally reduces the permeability. Silica fume is especially effective in this regard.

11.54 USE OF INSULATED FORMS FOR PROTECTION

Commercial insulation may be used for protecting concrete during cold weather, or when the contract documents require controlling the heat of hydration. This technique is the contractor's option and could be used in lieu of housing and heating. It will then be the contractor's responsibility to furnish insulation of sufficient quality and thickness to maintain concrete at a temperature of not less than 10°C (50°F) for the first 48 hours after placing, if air temperatures will be less than 5°C (40°F). (Refer to *Specification 2403.08, Paragraph H.*)

Concrete must be between 7°C and 27°C (45°F and 80°F) when placed. To ensure a concrete temperature of at least 10°C (50°F) for 48 hours after placement, the concrete for thin sections such as culvert walls, end posts, piling encasements, etc. should be 18°C (65°F) or higher, since the only additional heat source is the heat of hydration. Concrete for massive sections such as stub abutments, heavy piers, and footings should be in the 13° to 18°C (55° to 65°F) range.

Since only dry insulation is effective, any insulation that has a propensity to adsorb water or become saturated must be protected with a waterproof membrane. The insulation system must provide complete coverage and be secured to provide maximum protection during the full curing period.

For typical protection applications, insulated forms must be left undisturbed for 96 hours before being removed. (Refer to *Specification 2403.11.*)

Checking Temperature of Concrete

For checking compliance with minimum temperature requirements during the 48-hour period after placement, thermometer wells should be cast in the concrete during the pour. The following procedure for checking temperature is suggested:

1. Drill an 8 mm (5/16 inch) hole through the form at one or more locations where temperature checks will be made.
2. Grease the thermometer probe and insert it through the hole about 100 mm (4 inches) into the plastic concrete.
3. Remove probe after the concrete is set and cover hole with insulating material.

4. Further checks can be made by inserting the thermometer through the insulation into the well developed in step 2. Leave thermometer in place if desired, but protect from damage or theft.

NOTE: The thermometer stem should be inserted about 75 mm (3 inches) into the concrete because the sensitive portion of stem is about 70 mm (2 3/4 inches) below the groove.

Record temperature daily for 48 hours following the pour. Temperature readings below 10°C (50°F) during the first 48 hours should be reported to the Office of Construction for evaluation of possible damage or price adjustment.

11.55 DECK PLACEMENT AND HEAT OF HYDRATION

Cracking of concrete in bridge deck placements and large concrete elements (ie: bridge footings, columns, pier caps, etc.) can occur unless the placements are properly controlled. The following provides information on measures that are used in the effort to control cracking of concrete in bridge decks and large concrete element placements.

Deck Placement

Sometime ago the Office of Bridges and Structures, Office of Materials, and Office of Construction began evaluating the phenomena of bridge deck cracking. Measures have been implemented to manage bridge deck placement and prevent cracking through the use of Evaporation Rate Controls.

Research continues in the management of quality bridge deck placements and deck cracking control. To provide needed site specific data for this research, Forms E122, E139, M122 and M139 were developed. These reporting forms were initiated during 1991. Since that time, the information provided from the field has been compiled into a database for evaluation. The evaluation of this data is ongoing and includes review of the effectiveness of Evaporation Rate Controls and possible trends which may lead to a better understanding of crack development.

Forms E122, E139, M122 and M139 are included in *Appendix 11-16*. Since they are not available in Office Supplies, please photocopy as needed. Submit completed forms to the Office of Construction.

Deck Concrete Temperature and Curing

Specification 2412 identifies requirements for placing and curing concrete bridge floors. Of importance for this section are:

- Plastic concrete, when placed, shall not exceed 32°C (90°F).
- Concrete floors will not be placed if the theoretical rate of evaporation exceeds 1 kg/m^2/hr (0.2 lbs./sq.ft./hr.).

NOTE: A theoretical evaporation chart is included in *Specification 2412.05*. As an alternative, a computer program has been developed for calculation of theoretical rate of evaporation using Excel. This program incorporates the charts from the specifications in a formula table included on report Forms E122 and M122. The program simplifies the determination of the theoretical rate of evaporation and enables the user to perform trial evaluations for possible changes in air temperature, relative humidity, plastic concrete temperature, and wind velocity. A copy of the Excel program for theoretical rate of evaporation is available at www.dot.state.ia.us/construction/structures.htm.

- ~~The curing method requires application of white pigmented curing compound immediately after final finishing, followed by "wet" burlap cure for four (4) days. A sprinkling system is required to keep the burlap wet during this time.~~
- The curing method requires prewetted burlap to be placed within 10 minutes of final finishing and followed by a "wet" burlap cure for four (4) days. A continuous sprinkling system is required to keep the burlap wet during this time.
- Plastic, in addition to wet burlap, may only be used between October 1 and April 1. The plastic provides a moisture proof barrier above the wet burlap and replaces the sprinkling system after 20 hours of the application of water during cold weather.

The placing of concrete will require close monitoring to comply with the specification. The contractor or ready mix plant should determine temperature of previously placed concrete to project a mix temperature prior to a deck pour. Further, they should obtain a weather report to determine predicted air temperature, wind velocity, and relative humidity for the pour day. Based on this information, you will be able to reasonably predict an evaporation rate.

The above information should be discussed by the inspector, contractor, and ready mix plant operator before a deck pour. The pour should not be attempted if concrete temperature is predicted at 29°C (85°F) or higher and predicted air temperature is above 32°C (90°F). Also, the pour should not be attempted if an evaporation rate would exceed 1 kg/m^2/hr. (0.2 lbs./sq.ft./hr.).

District Materials Office has sling psychrometers and wind gauges available for usage the day of the pour. A sling psychrometer is used to determine the relative humidity by finding "wet" and "dry" bulb temperatures. (Refer to Charts in *Appendix 11-17*.) With these values, compute temperature difference and locate the "Difference Between Readings..." column. Then locate the row labeled with appropriate dry bulb temperature. The value at the intersection of "Difference" column and "Dry" bulb temperature is the relative humidity.

> **EXAMPLE:** (English units only)
> If the dry bulb temperature is 71°F and the wet bulb temperature is 64°F, the difference is 7°F. At the top of the chart, locate the column headed 7. Follow this column down to the dry bulb temperature row of 71°F. The intersection indicates a relative humidity of 68%.

Placement Considerations

A. If there is any doubt about the concrete temperature exceeding 29°C (85°F), the contractor needs to identify measures which will be implemented to keep mix temperatures within specifications. If the contractor is not prepared to maintain a mix temperature below specifications, the pour should be postponed.

   There are several ways concrete temperatures may be kept within specifications. They are:
   - Scheduling placements during cooler times of the day
   - Wetting the aggregate stockpiles
   - Covering/shading the aggregate stockpiles
   - Maintaining a supply of portland cement on hand to preclude getting hot material from the supplier
   - Chilling the mixing water is one of the most effective ways to lower mix temperatures.

- Shaved ice can be used, however, the ready mix operator must submit a proposal for this to the project engineer for review by the Office of Construction.

NOTE:

1. No payment will be made for methods taken to keep concrete temperatures and evaporation rates within specifications.
2. If pour has to be delayed because of temperature, and pouring is the controlling operation, no working days will be charged.

B. Location of permissible headers should be discussed with the contractor. If during the pour, it appears:

- The temperature may exceed 32°C (90°F)
- And/or the theoretical evaporation rate would exceed 1 $kg/m^2/hr.$ (0.2 lbs./sq.ft./hr.)

and these deficiencies cannot be corrected by immediate action, the placement shall be halted at the first permissible joint. On slab bridges, any joint location listed on the plans can be used. For girder beam bridges (steel or concrete), placement may be stopped, in an emergency, at locations as follows:

Case A. (Continuous or noncontinuous beams, positive section)
If the positive section has not been completed:
Complete the positive section and stop at the header location shown on the plans.

Case B. (Noncontinuous beams, negative section)
If placement has not proceeded beyond the pier:
Do not place concrete in the pier diaphragm, and stop just short of the beam end.

Case C. (Noncontinuous beams, negative section)
If placement has progressed beyond centerline of the pier:
Placement must continue through that negative section and stop at the header shown on the plans.

Case D. (Continuous beams, negative section)
If problem occurs after starting the negative section:
Placement must continue through the negative section, and stop at the header shown on the plans.

See *Appendix 11-24* for case illustration.

In every case listed above, contact the Office of Construction for curing times and beam break strengths before allowing the contractor to resume deck placement.

Field Documentation

The temperature of concrete should be taken as soon as concrete is placed. It should be taken when the first load is placed and at intervals shown on Forms E122 and M122, Appendix 11-16. Additional checking is warranted if temperature is running at or near maximum. Air temperature should also be taken about the same time as the concrete temperature.

Heat of Hydration

Occasionally, projects will require placement of large volumes of concrete for individual concrete elements (ie: bridge footings, columns, pier caps, etc.). Controlling the temperature of this large volume is important to reduce cracks and potential premature deterioration from thermal cracking that can result from a large temperature difference between the center of the concrete element and its surface. In these cases the contract documents may require monitoring the "heat of hydration." There will also be requirements for the differences between specified monitoring locations. For example: "The temperature difference between the edge of the concrete and the center shall not exceed 10°C (35°F)."

The cooling of large volumes of concrete can take considerable time, and during that time monitoring is required. A form to record these temperatures has been developed. (Refer to "Heat of Hydration" form in *Appendix 11-18*.) Since this form is not included in Office Supplies, please photocopy as needed. Submit completed forms to the Office of Construction.

11.56 PLACEMENT METHODS (PUMPING, BELTING, AND CRANE BUCKET)

Much concern has been expressed about the method of concrete placement because of lost entrained air. Rough handling of plastic concrete during placement has, at times, reduced entrained air to less than 2% not to mention potential segregation problems. While testing at the point of placement "should" identify such problems, varying placement conditions during the pour can affect concrete conditions significantly.

General conditions which must be avoided, or at least severely minimized, are as follows. If one of the following cannot be avoided, *at least* be aware of the condition, and *be sure* to conduct additional testing should any of the conditions present themselves.

Crane and Bucket

In the past it was felt the crane and bucket placement method did not adversely affect concrete. This is now in question when viewed from loss of air and potential segregation. Therefore, this method will now also require testing at the placement location, if practical.

Points-to-Watch For

- Free fall of unrestrained concrete shall not exceed 2 m (6 feet) for vertical placement and 1 m (3 feet) for floors and slabs. (Refer to *Specification 2403.08, Paragraph C.*) If the distance is exceeded: (1) reduce the pour depth, (2) remove a section of form work for intermediate placement, (3) or use a tremie.
- Discharge from the bucket must be controllable.
- Cross section of the drop-chute should permit inserting into the form work without interfering with reinforcing steel.

Belt Placement

Belt equipment is typically used to convey concrete to a (1) lower, (2) horizontal, or (3) somewhat higher level.

Points-to-Watch For

- Keep the number and distance of drops between belts to an absolute minimum. Drops tend to encourage segregation and reduce entrained air.
- As belt conveyors are removed from the line (i.e., as on deck pours), recheck the "as placed" air content.

- Be sure all mortar is being removed at the discharge. (No mortar should be on the return belt.)
- Check discharge for potential segregation problems.
- In adverse weather (hot and/or windy conditions), long belt runs need to be covered.

Pump Placement
The modern mobile pump with hydraulic placing boom is economical to use in placing both large and small quantities of concrete. These units are used to convey concrete directly from a truck unloading point to the concrete placement area.

Points-to-Watch For

- Typically, pumps are initially flushed with a thin water/cement paste mixture to coat the lines. This slurry must be wasted and the lines charged with the project mix before beginning. Observe, and be sure initial pump charge is thoroughly removed from the pipelines.
- Always pump at a constant rate and keep pipelines full of concrete. High air loss can occur when concrete is allowed to free-fall inside pump lines.
- Avoid, if at all possible, having steep angles in the pump pipelines. Steep angles and slow placement rates are probably the worst conditions for minimizing air loss and segregation. If this condition occurs:
  1. Attempt to relocate the pumper, thereby minimizing lift angle.
  2. If discharge is not maintaining a constant flow with partial concrete head in the pipe, request pump operator to place a reducer and short section of hose at the discharge end. The purpose is to avoid free falling concrete from impacting the epoxy coated reinforcing steel, deck or forms at high velocity. High velocity impact of concrete aggregate on epoxy coated bars can potentially damage the epoxy coating.
  3. If above condition is unavoidable, watch and test the discharge frequently for loss in air and potential segregation.

Rules-of-Thumb for Pumping

- Pump concrete with pipelines as flat as possible (or at least with minimal down angle)
- Minimize (or eliminate) free falling concrete in the pipelines. To do this, maintain some amount of concrete head in the pipelines
- Pump concrete through as few elbows and restrictions as possible
- Pump concrete at "some" constant rate
- Watch for, and test frequently, when situations are not optimized

11.57 FORM REMOVAL

Setting Beams
The following should be used as a guide in conjunction with *Specification 2403.19:*

A. On diaphragm piers, beams may be set as soon as doing so will not mar or chip the concrete. It is recommended that 24 hours be considered a minimum cure time. (In cooler weather, ambient temperatures below 5°C (40°F), the minimum time indicated should be increased to 48 hours.)

B. No beams may be set on pedestal (T or P10A) piers until the cap concrete is 7 days old and modulus of rupture is at least 3,800 kPa (550 psi) or more. The contractor has the option under *Specifiation 2403.03* to substitute Class M concrete mix for Class C except in bridge floors. When Class M concrete mix is used, beams may be set when the cap concrete is 3 days old and the modulus of rupture is at least 3,800 kPa (550 psi) or more. (Refer to *Specification 2403.19*.) If no test beams are made, the time must be extended to 14 days. (Refer to *Specification 2403.18*.)

There have been special situations where the contractor has been allowed to set beams on piers that have not attained the above strengths. In these cases, the bottom forms have remained in place for an extended period of time. Before approving any variance, contact the Office of Construction for approval.

C. On stub abutments or integral abutments, steel beams and girders may be set as under A above. Concrete beams on stub abutments or integral abutments, same as A above. (Stub abutments are abutments with battered piling, sliding bearings, and the abutment does not move. Integral abutments have vertical piling in prebored holes, beams are rigidly connected to the abutment, and the abutment moves.) On full abutments (solid and continuous from spread footing), same as A above.

11.58 CLASS 3 CONCRETE SURFACE FINISH (RAIL AND BEAMS)

Approval of Materials

Materials I.M. 491.10 lists the approved materials and proportions for use in obtaining a Class 3 finish required by *Specification 2403.21*. Any one of the listed materials may be used. However, for uniformity, only one type should be used on any one structure.

Approvals of this material will be on the basis of legible brand markings on the containers. Periodic sampling and testing will be the responsibility of the Office of Materials. The type used on any structure should be included in the project documentation.

Application of Finish

Surfaces to be given a Class 3 finish must first be given a Class 2 strip down finish immediately after removal of forms. Successful application and adhesion of any type of finish to concrete surfaces is dependent on concrete condition and concrete surface preparation. Factors such as pH of the concrete, concrete moisture content, cleanliness of the concrete surface, and concrete surface profile are all critical to ensuring any coating being applied will securely adhere. For additional information and guidance contact the Office of Construction.

Materials for a special surface finish should be mixed to a uniform condition, preferably with a power mixer. When using a power mixer, add dry ingredients to the liquid. One worker should place the material with a steel trowel, making sure it is pressed firmly into all voids and leveled. When the surface is set so it will not roll or lift, a second worker should smooth the surface uniformly with a rubber float.

Concrete Railings

Surfaces of concrete for barrier rails placed against fixed forms, either on site or in precasting, shall be given a surface finish described for exterior beams in *Specification 2407.14* before application of curing. This should be done as the forms are removed. The contractor may opt to broom (brush) finish the slipform barrier rail.

11.59 FLOWABLE MORTAR

Flowable mortar is being used for four separate purposes according to the current specification:

- **Backfilling culverts** with flowable mortar is specified for the purpose of preventing settlement in the excavation area. Flowable mortar backfill of open trench culverts is typically used when the excavation is in an existing roadway embankment and the excavation area is too small to facilitate normal soil backfill and compaction methods. In this case, flowable mortar fluidity, as discussed in the specifications, is considered non-critical.

- **Backfilling culverts constructed under bridges** with flowable mortar is specified when existing bridge structures are being converted into roadway embankment sections. This involves constructing a drainage structure under the bridge and converting the existing bridge superstructure into a fully supported roadway section. Flowable mortar backfill is used under the bridge superstructure to fill the embankment area under the bridge up to the bottom of the existing bridge deck. The flowable mortar method is specified since normal soil backfill and compaction methods are not practical and would not achieve the required embankment support for the converted bridge deck. In this case, flowable mortar fluidity is considered non-critical in the area placed below the bridge beams, but would be considered critical between the beams. Flowable mortar for this case is typically specified to be placed in two or more stages.

- **Filling void between culvert and culvert liner** with flowable mortar is specified to provide support between the culvert liner and existing culvert to prevent future culvert collapse. Flowable mortar is used since normal soil backfilling and compaction methods are not possible. In this case, flowable mortar fluidity is critical and flow distance is limited which may require incremental placement points.

- **Plugging culverts** with flowable mortar is specified when it is either not possible or practical to remove existing culverts, therefore these culverts are being abandoned in place. In this case, flowable mortar fluidity is critical and flow distance is limited which may require incremental placement points.

Depending on the application, samples of sand, cement, and fly ash may need to be submitted to the Office of Materials for a mix design. (Refer to *Specification 2506.02* for information as to when material will meet the required flow time as measured with a flow cone.) Free water in the sand pile must be considered as mix water because a mix design uses oven dried sand.

Refer to *Appendix of Materials I.M. 491.17* for approved fly ash sources and classes.

The success of all flowable mortar projects depends on establishing uniform under-drainage.

Where flowable mortar is to be placed against joints, the joints should be: (1) wrapped with a fabric as per *Specification 4196.01, Paragraph B*, or (2) sealed with a gasket, or (3) sealed with roofing cement.

If the contractor uses crushed limestone for granular backfill, it shall meet the requirements for Granular Backfill. (Refer to *Specification 4133.01*.)

Remember flowable mortar is a liquid which has a density of about 2,136 kg/m^3 (3,600 lbs./cu yd.) until the water has dissipated. Bulkheads should be strong enough to withstand those pressures.

Under normal conditions, flowable mortar should be set-up sufficiently within 24 to 48 hours for placement of the final lift of either earthfill or special backfill. If "set-up" does not occur or if it seems slow, typically the problem relates directly to drainage of the granular backfill. Often contamination or "dirty" granular backfill is the culprit. Check to be sure it is draining. If not, additional time will help. If time is critical, you may have to physically cut trenches (drainage paths) into the flowable mortar.

Backfilling Culverts - Typical Grading

For backfilling culverts, flowable mortar is used above the granular backfill elevation identified on the plans. There should be a 100 mm (4 inch) subdrain typically located at the culverts flow line elevation. This subdrain is placed to facilitate draining water from the flowable mortar. Therefore, for culverts with buried flow lines, the subdrain will need to be placed in the granular backfill at the lowest elevation possible and yet allow drainage.

Flowable mortar will nominally be placed 0.6 m (2 feet) thick over the entire culvert excavation. Plans, or typicals, define the area used to calculate plan quantities for flowable mortar and granular backfill. (Flowable mortar plan quantities should include 30% additional for anticipated consolidation of the granular backfill and shrink due to loss of water.) If the Contractor opts to excavate a larger area than assumed for plan quantity, additional excavation, backfill, and flowable mortar will not be considered for pay. We will however, require additional excavation to be backfilled in a manner as identified by the plans or typicals.

Placement of flowable mortar shall always be computed from "top down." This means allow for:

1. Pavement thickness
2. 0.3 m (1 foot) of special backfill, if required
3. Variable thickness of earth fill where cover heights are over 2.5 m (8 feet)
4. Placement of 0.6 m (2 feet) of flowable mortar

There are two general installation situations.

Situation 1:
Distance between the top of culvert and bottom of pavement is greater than 0.9 m (3 feet), but less than or equal to 2.5 m (8 feet). In this situation, the top of granular backfill will *vary* from 0.6 m (2 feet) below top of culvert to 1.5 m (5 feet) above the culvert top.

Example:

Assume:

1. Bottom of slab is elevation 30 m (100 feet) and top of culvert is 28.65 m (94 feet).
2. There is 0.3 m (1 foot) of Special Backfill. Elevation 29.7 m (99 feet)
3. 0.6 m (2 feet) of flowable mortar is required. Elevation 29.1 m (97 feet)

In this example, cover is less than 2.5 m (8 feet), granular backfill is placed from bottom of excavation up to elevation 29.1 m (97 feet).

Note: There will be consolidation in both the granular backfill and flowable mortar. It is recommended to place:

- Granular backfill to the required calculated elevation
- Flowable mortar to its calculated elevation
- Make up any final elevation difference due to total consolidation by additional thickness of special backfill

Situation 2:
Distance between "top of culvert and bottom of pavement" is greater than 2.5 m (8 feet). In this situation: A) the top of granular backfill will be fixed at the elevation of culvert top, B) 0.6 m (2 feet) of flowable mortar will be placed directly on top of the granular backfill, and C) compacted earthfill will be placed between flowable mortar and special backfill. In this example, the earthfill will have a minimum thickness of 1.5 m (5 feet) and no theoretical maximum thickness.

Example (Using English units only)

Assume:

1. Bottom of slab is Elevation 100.
2. There is 1 foot of Special Backfill (Elevation 99).
3. Earthfill is required, but thickness cannot be calculated yet. (Elevation ???)

At this point you must now calculate from the culvert top, up to the bottom of the earthfill.

4. Top of culvert, for this example, is assumed to be Elevation 86.
5. Granular backfill is fixed at the culvert top (Elevation 86).
6. 2 feet of flowable mortar is required. (Elevation is 86 + 2 = 88.)

In this situation, earthfill is placed from the top of flowable mortar (Elevation 88) to bottom of special backfill (Elevation 99). Specifically, 11 feet of earthfill is required. (Elevation 99 - 88 = 11 feet)

Plugging Culverts
For culverts 20 m (60 feet) or less in length, flowable mortar may be placed into the outlet first, then the inlet. For culverts more than 20 m (60 feet) long, the desirable spacing for placing flowable mortar should be 20 m (60 feet). The optimum travel of flowable mortar is 10 m (30 feet) with approximately 75 mm (3 inches) of fall in the surface. To avoid drilling through pavement, the spacing can be increased to 25 m (80 feet) if necessary.

Backfilling Culverts - Under Bridges
Prior to installing flowable mortar, the culvert must be backfilled with granular backfill to at least 75 mm (3 inches) over the culvert or 1.5 m (5 feet) below the lowest bridge elevation. As this granular backfill is placed, the outside fill should be brought up at the same time with soil.

Flowable mortar used for backfilling culverts under bridges is placed in two stages.

In the first stage, flowable mortar is placed to an elevation about 150 mm (6 inches) below the bottom of bridge deck or the beams whichever is lower. Bridge beams should be fitted with Styrofoam filler to full width of the flanges. Refer to illustration in *Appendix 11-25*. This will prevent adding dead load to the beams with flowable mortar.

In the second stage, flowable mortar is placed through holes drilled in the deck at spacings identified in the plans or specifications. Typically, begin at one abutment and continue longitudinally down the bridge until the other abutment has been reached, filling all holes on one side of the centerline. Then begin on the other side of the bridge and work holes nearest the centerline and proceed to the outside.

After flowable mortar has been placed, the contractor is required to saw a minimum of 75 mm (3 inches) deep cut into the original deck before any sidewalk, curb, or handrail is removed. It is important that this 75 mm (3 inch) saw cut be done prior to any curb removal, thereby preventing damage to the deck.

Placing flowable mortar under a bridge can be accomplished during staged construction. The specification requires a 72-hour delay between stage 1 and stage 2 placement of flowable mortar to allow for settlement of the granular backfill.

Filling Voids Between Culverts
If there is room to place granular backfill between culverts, do so to one-half the new culvert height. In situations such as multiple barrels, or a new pipe inside a box, the granular backfill will adequately maintain pipe location during flowable mortar placement.

If granular backfill cannot be used, culvert(s) should be blocked at 3 m (10 foot) intervals or less and flowable mortar placed as usual. If a pipe inside a culvert has to be blocked in place, the blocking must be situated in a manner to prevent damming and causing voids in the mortar. All blocking placed on the top of the inside culvert must be saddle shaped to fit the culvert. This distributes the buoyant forces over a larger area and reduces chance of pipe buckling. To further reduce buoyant forces:

- Place about one-half of the total flowable mortar
- Delay about four hours before placing the remainder

In all cases, a drainage system must be established on each side of the culvert(s). The drainage system should be a 100 mm (4 inch) slotted drain with a minimum of 150 mm (6 inches) of granular backfill cover. The drainage system reduces buoyancy effects and allows for dewatering of the flowable mortar.

Inspect all pipe joints and lifting holes for looseness and voids. Two approved repair methods are:

- Wrap joints with fabric approved per *Specification 4196.01, Paragraph B*
- Seal joints with sealant material such as roofing cement or gaskets

To be valid for bidding, the Proposal Schedule of Prices form included with this Estimating Proposal or an 'Expedite' generated Schedule of Prices form must be included with a "BIDDING DOCUMENT" issued by the Iowa D.O.T. Office of Contracts.

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*******************************************************************************
*                                          Bid Order No.: 108                 *
* Proposal ID No.: 97-7057-013            Letting Date: May 15, 2001          *
*                                                       9:00 A.M.             *
*   Type of Work: PCC PAVEMENT - REPLACE                                      *
*  Primary County: WOODBURY                      Design: ENGLISH              *
*       DBE Goal:  5.0 %                                1997 Std Spec         *
*  Pre-Qual Group: PCC PAVEMENT - RURAL                                       *
*                                                                             *
* Contracting Authority: CITY OF SIOUX CITY                                   *
*     Proposal Guaranty: $ 100,000.00                                         *
* Tied Proposal Package: None assigned to, or allowed with this Bid Order.    *
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This Proposal Includes The Following Project(s):

- -

Project: STP-U-7057(13)--70-97 | County: WOODBURY
Work Type: PCC PAVEMENT - REPLACE | Plans: Yes
Route: WESLEY WAY | Design: ENGLISH
Location: FROM JUST SOUTH OF I-29/U.S. 77 NORTH TO JUST NORTH OF SIXTH STREET IN THE CITY OF SIOUX CITY.
Road System: URBAN
Federal Aid - Predetermined Wages Are In Effect

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Proposal ID No.: 97-7057-013	Bid Order No.: 108
	Letting Date: May 15, 2001 9:00 A.M.

Type of Work: PCC PAVEMENT - REPLACE

Site Number	Contract Period/ Site Description	Working Days	Liquidated Damages
CONTRACT	LATE START DATE: 06/18/01	90	$ 1,200.00

PROPOSAL NOTES

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Vendor No.:	__.__.__.__	Bid Order No.:	108
Proposal ID No.:	97-7057-013	Letting Date:	May 15, 2001
Primary Work Type:	PCC PAVEMENT - REPLACE		9:00 A.M.
Primary County:	WOODBURY		

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
Section 0001 ROADWAY ITEMS						
0010	2101-0850002 CLEARING AND GRUBBING	20.000 UNIT	.		.	
0020	2102-0425046 SELECTED BACKFILL	100.000 CY	.		.	
0030	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW	4,408.000 CY	.		.	
0040	2102-2710080 EXCAVATION, CLASS 10, UNSUITABLE OR UNSTABLE MATERIAL	100.000 CY	.		.	
0050	2105-8425005 TOPSOIL, FURNISH AND SPREAD	1,400.000 CY	.		.	
0060	2109-8225100 SPECIAL COMPACTION OF SUBGRADE	28.090 STA	.		.	
0070	2111-8174100 GRANULAR SUBBASE	19,630.000 SY	.		.	
0080	2113-0001100 SUBGRADE STABILIZATION MATERIAL, POLYMER GRID	6,120.000 SY	.		.	
0090	2122-5190008 PAVED SHOULDER, P.C. CONCRETE, 8 IN.	258.000 SY	.		.	
0100	2123-7450020 SHOULDER FINISHING, EARTH	32.250 STA	.		.	

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Vendor No.:	|__.__.__.__.__|	Bid Order No.:	108
Proposal ID No.:	97-7057-013	Letting Date:	May 15, 2001
Primary Work Type:	PCC PAVEMENT - REPLACE		9:00 A.M.
Primary County:	WOODBURY		

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0110	2301-1033080 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 8 IN.	11,500.000 SY	.		.	
0120	2301-1033100 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 10 IN.	6,120.000 SY	.		.	
0130	2301-4875006 MEDIAN, P.C. CONCRETE, 6 IN.	118.000 SY	.		.	
0140	2301-6911722 PORTLAND CEMENT CONCRETE PAVEMENT SAMPLES	LUMP	LUMP		.	
0150	2303-9093000 DRIVEWAY, ASPHALT CEMENT CONCRETE	447.000 SY	.		.	
0160	2315-8275030 SURFACING, DRIVEWAY, CLASS C GRAVEL	10.000 TON	.		.	
0170	2401-6745760 REMOVAL OF INTAKE	8.000 EACH	.		.	
0180	2401-6745830 REMOVAL OF P.C. CONCRETE MEDIAN BARRIER	50.000 LF	.		.	
0190	2401-6745980 REMOVAL OF UTILITY ACCESS	3.000 EACH	.		.	
0200	2502-8212034 SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	4,157.000 LF	.		.	

Vendor No.: |__.__.__.__|
Proposal ID No.: 97-7057-013
Primary Work Type: PCC PAVEMENT - REPLACE
Primary County: WOODBURY

Bid Order No.: 108
Letting Date: May 15, 2001
9:00 A.M.

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number / Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0210	2502-8220193 SUBDRAIN OUTLET (RF-19C)	16.000 EACH	.		.	
0220	2503-4360110 INTAKE, MODIFICATION	2.000 EACH	.		.	
0230	2503-4388014 INTAKE, SPECIAL, AS PER PLAN	7.000 EACH	.		.	
0240	2503-4470480 INTAKE, RA-48	1.000 EACH	.		.	
0250	2503-4470635 INTAKE, RA-63 MODIFIED	3.000 EACH	.		.	
0260	2503-4470685 INTAKE, RA-68 MODIFIED	7.000 EACH	.		.	
0270	2503-4480495 UTILITY ACCESS, RA-49 MODIFIED	1.000 EACH	.		.	
0280	2503-4480499 UTILITY ACCESS, RA-49 MODIFIED, TOP ONLY	1.000 EACH	.		.	
0290	2503-7325015 SEWER PIPE, 2000D STORM, 15 IN. DIA.	414.000 LF	.		.	
0300	2503-7325018 SEWER PIPE, 2000D STORM, 18 IN. DIA.	337.000 LF	.		.	
0310	2503-8462100 UTILITY ACCESS, CONVERT INTAKE TO	1.000 EACH	.		.	

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Vendor No.: |__.__.__.__.__|
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UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number / Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0320	2504-8462510 SANITARY SEWER UTILITY ACCESS (PRECAST) (RA-51), MODIFIED	3.000 EACH	.		.	
0330	2505-4021331 GUARDRAIL, END ANCHORAGE, BEAM, RE-33A	2.000 EACH	.		.	
0340	2505-6300100 POSTS, REMOVE AND REINSTALL	58.000 EACH	.		.	
0350	2505-6765007 REMOVAL AND RE-ERECTION OF EXISTING RAIL, AS PER PLAN	LUMP	LUMP		.	
0360	2510-6745850 REMOVAL OF PAVEMENT	20,260.000 SY	.		.	
0370	2511-6745900 REMOVAL OF SIDEWALK	531.000 SY	.		.	
0380	2511-7526004 SIDEWALK, P.C. CONCRETE, 4 IN.	632.000 SY	.		.	
0390	2512-1725256 CURB AND GUTTER, P.C. CONCRETE, 2.5 FT.	166.000 LF	.		.	
0400	2512-1750006 CURB AND GUTTER, P.C. CONCRETE, AS PER PLAN	59.000 LF	.		.	
0410	2513-0471046 CONCRETE BARRIER, APPROACH, RE-46	1.000 EACH	.		.	

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Vendor No.: |__.__.__.__|
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Bid Order No.: 108
Letting Date: May 15, 2001 9:00 A.M.

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0420	2513-0473443 CONCRETE BARRIER, RE-44C	50.000 LF	.		.	
0430	2513-0474990 CONCRETE BARRIER, REINFORCED, AS PER PLAN	1,323.000 LF	.		.	
0440	2515-2475008 DRIVEWAY, P.C. CONCRETE, 8 IN.	929.000 SY	.		.	
0450	2515-6745600 REMOVAL OF PAVED DRIVEWAY	208.000 SY	.		.	
0460	2518-6890032 ROAD CLOSURE (URBAN), PERMANENT, RE-3B	2.000 EACH	.		.	
0470	2518-6910000 SAFETY CLOSURE	7.000 EACH	.		.	
0480	2520-3350010 FIELD LABORATORY	1.000 EACH	.		.	
0490	2523-0000200 ELECTRICAL CIRCUITS	2,130.000 LF	.		.	
0500	2523-0000310 HANDHOLES AND JUNCTION BOXES	18.000 EACH	.		.	
0510	2523-0000400 CONTROL CABINET	1.000 EACH	.		.	
0520	2525-2638030 SILT FENCE	500.000 LF	.		.	

Vendor No.: |__.__.__.__.__|
Proposal ID No.: 97-7057-013
Primary Work Type: PCC PAVEMENT - REPLACE
Primary County: WOODBURY

Bid Order No.: 108
Letting Date: May 15, 2001
9:00 A.M.

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number / Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0530	2527-9263110 PAINTED PAVEMENT MARKING	108.520 STA	.		.	
0540	2527-9263140 PAINTED SYMBOLS AND LEGEND	28.000 EACH	.		.	
0550	2527-9263180 PAVEMENT MARKING REMOVED	17.600 STA	.		.	
0560	2528-7575000 TRAFFIC CONTROL SIGNALS, FURNISH AND INSTALL	LUMP	LUMP		.	
0570	2528-8445110 TRAFFIC CONTROL	LUMP	LUMP		.	
0580	2528-8445112 FLAGGERS	10.00 DAY	205.00000		2,050.00	
0590	2533-4980005 MOBILIZATION	LUMP	LUMP		.	
0600	2598-3778012 GATE VALVE AND VALVE BOX, 12 IN.	1.000 EACH	.		.	
0610	2598-8805612 WATER MAIN, DUCTILE IRON, 12 IN.	240.000 LF	.		.	
0620	2598-8810200 WATER MAIN FITTINGS	234.000 LB	.		.	
0630	2599-0410116 ATTENUATOR, IMPACT, REMOVE AND REINSTALL	1.000 EACH	.		.	

****

Vendor No.: |__.__.__.__|
Proposal ID No.: 97-7057-013
Primary Work Type: PCC PAVEMENT - REPLACE
Primary County: WOODBURY

Bid Order No.: 108
Letting Date: May 15, 2001
9:00 A.M.

UNIT BIDS MUST BE TYPED OR SHOWN IN INK OR THE BID WILL BE REJECTED.

Line No	Item Number / Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0640	2599-9999005 ('EACH' ITEM) LIGHTING POLE, BOLLARD	46.000 EACH	.		.	
0650	2599-9999005 ('EACH' ITEM) LIGHTING POLE, PEDESTAL	18.000 EACH	.		.	
0660	2599-9999005 ('EACH' ITEM) PROJECT SIGN	2.000 EACH	.		.	
0670	2599-9999005 ('EACH' ITEM) REPLACE UTILITY ACCESS RING AND COVER	21.000 EACH	.		.	
0680	2601-2634100 MULCHING	1.000 ACRE	.		.	
0690	2601-2636044 SEEDING AND FERTILIZING (URBAN)	1.000 ACRE	.		.	
	SECTION 0001 TOTAL				.	
	TOTAL BID				.	

****

		Bid Order No.:	108
Proposal ID No.:	97-7057-013	Letting Date:	May 15, 2001
Primary Work Type:	PCC PAVEMENT - REPLACE		9:00 A.M.
Primary County:	WOODBURY		

Note Description

DBE--2001 January 26, 2001
STATE OF IOWA 2001 DIRECTORY OF CERTIFIED DISADVANTAGED BUSINESS ENTERPRISES

DBE-010515 May 15, 2001
AMENDMENT TO THE STATE OF IOWA 2001 DIRECTORY OF CERTIFIED DISADVANTAGED BUSINESS ENTERPRISES
(THIS LISTING IS ATTACHED TO THE BIDDING DOCUMENT.)

FHWA-1273.02 March 10, 1994
REQUIRED CONTRACT PROVISIONS - FEDERAL-AID CONSTRUCTION CONTRACTS (EXCLUSIVE OF APPALACHIAN CONTRACTS)

GS-97009 April 03, 2001
GENERAL SUPPLEMENTAL SPECIFICATIONS FOR CONSTRUCTION PROJECTS

IA01-1.1 March 16, 2001
PREDETERMINED WAGE RATE - GENERAL DECISION NUMBER IA000001
FOR HEAVY AND HIGHWAY CONSTRUCTION -- STATEWIDE (EXCEPT SCOTT COUNTY)
NOTE: THE CONTRACTOR SHALL REVIEW THE CONTRACT DOCUMENTS AND IS RESPONSIBLE FOR IDENTIFYING WHICH ZONE(S), AS DEFINED IN THE PREDETERMINED WAGE RATE SPECIFICATION, APPLY TO THE WORK ON THE CONTRACT.

*** ADDITIONAL REQUIREMENT ***
THE PRIME CONTRACTOR SHALL SUBMIT CERTIFIED PAYROLLS FOR ITSELF AND EACH APPROVED SUBCONTRAGTOR WEEKLY TO THE PROJECT ENGINEER. THE CONTRACTOR MAY USE THE IOWA D.O.T. CERTIFIED PAYROLL FORM OR OTHER APPROVED FORM. THE CONTRACTOR SHALL LIST THE CRAFT FOR EACH EMPLOYEE COVERED BY THE PREDETERMINED WAGE RATES. THE PRIME CONTRACTOR SHALL SIGN EACH OF THE SUBCONTRACTOR'S PAYROLLS TO ACKNOWLEDGE THE SUBMITTAL OF THE CERTIFIED PAYROLL.

SP-97569 May 15, 2001
SPECIAL PROVISONS FOR WATER MAIN

*** INTENDED FOR: WOODBURY COUNTY STP-U-7057(13)--70-97 ***

SP-97570 May 15, 2001
SPECIAL PROVISONS FOR TRAFFIC SIGNALIZATION

*** INTENDED FOR: WOODBURY COUNTY STP-U-7057(13)--70-97 ***

SS-97027 July 15, 1997
SUPPLEMENTAL SPECIFICATIONS FOR METRICATION

SS-97029 January 13, 1998
SUPPLEMENTAL SPECIFICATIONS FOR STRUCTURAL STEEL (WELDING)

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		Bid Order No.:	108
Proposal ID No.:	97-7057-013	Letting Date:	May 15, 2001
Primary Work Type:	PCC PAVEMENT - REPLACE		9:00 A.M.
Primary County:	WOODBURY		

Note Description

SS-97058 November 14, 2000
SUPPLEMENTAL SPECIFICATIONS FOR EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION REQUIREMENTS

SS-97059 November 14, 2000
SUPPLEMENTAL SPECIFICATIONS FOR SPECIFIC AFFIRMATIVE ACTION RESPONSIBILITIES (DISADVANTAGED BUSINESS ENTERPRISE) ON FEDERAL AID PROJECTS

005.02
*** BIDDING PROPOSAL PREPARATION INFORMATION ***
A PROPOSAL MAY CONTAIN MORE THAN ONE PROJECT. SEVERAL FORMS TO BE SUBMITTED WITH THE BIDDING PROPOSAL REQUEST THE BIDDER TO ENTER A "PROJECT NUMBER". THE BIDDER SHOULD ENTER THE "PROPOSAL ID" WHEREVER THE PROJECT NUMBER IS REQUESTED IN THE BIDDING DOCUMENTS.

005.1102
*** ANNUAL BID BOND ALLOWED ***
ADD THE FOLLOWING NEW PARAGRAPH TO THE END OF ARTICLE 1102.12, PROPOSAL GUARANTY:

AN 'ANNUAL BID BOND' (FORM 650043) MAY BE USED FOR THE PROPOSAL GUARANTY IN LIEU OF THE OTHER ALTERNATIVES SPECIFIED ABOVE. THE ANNUAL BID BOND WILL BE VALID FOR THE DESIGNATED LIFE OF THE ANNUAL BID BOND FOR USE FOR BIDS SUBMITTED FOR PROPOSALS FOR A LETTING IF RECEIVED AND APPROVED BY THE IOWA DEPARTMENT OF TRANSPORTATION CONTRACTS ENGINEER AT LEAST 5 BUSINESS DAYS PRIOR TO THE LETTING OF FIRST USE. REQUESTS AND INSTRUCTIONS FOR SUBMITTAL OF THE ANNUAL BID BOND ARE TO BE DIRECTED TO IOWA DEPARTMENT OF TRANSPORTATION, OFFICE OF CONTRACTS.

080.01
*** DBE GOAL INFORMATION ***

THE ESTABLISHED DBE GOAL FOR THIS CONTRACT CONCERNING PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISES (E.G., SUPPLIERS, AND SUBCONTACTORS) IS SHOWN ON THE FIRST PAGE OF THE 'ESTIMATING PROPOSAL' FORM AND APPLIES TO ALL FEDERAL AID PROJECTS INCLUDED IN THIS PROPOSAL.

REFER TO THE CURRENT "STATE OF IOWA DIRECTORY OF CERTIFIED DISADVANTAGED BUSINESS ENTERPRISES" AND TO THE CURRENT "SUPPLEMENTAL SPECIFICATION FOR SPECIFIC AFFIRMATIVE ACTION RESPONSIBILITES (DISADVANTAGED BUSINESS ENTERPRISES) FEDERAL AID PROJECTS" FOR ADDITIONAL INFORMATION AND INSTRUCTIONS.

IN ADDITION, IF THE WINNING BIDDER ELECTS TO USE DBE SUBCONTRACTORS AND/OR SUPPLIERS, FORM 830231 (SUBCONTRACT REQUEST AND APPROVAL) SHALL BE SUBMITTED TO THE OFFICE OF CONTRACTS WITH THE SIGNED CONTRACT AS PER ARTICLE 1108.01 OF THE STANDARD SPECIFICAITONS.

Bid Order No.: 108
Proposal ID No.: 97-7057-013 Letting Date: May 15, 2001
Primary Work Type: PCC PAVEMENT - REPLACE 9:00 A.M.
Primary County: WOODBURY

Note Description

500.02
*** WINTER WORK ***

EXCEPT FOR THE EROSION CONTROL WORK REQUIRED FOR THIS PROJECT, THE FREE TIME ALLOWED BETWEEN NOVEMBER 15 AND APRIL 1 WILL NOT BE PERMITTED. THE CONTRACTOR SHALL WORK DURING THE WINTER ON ALL WORKING DAYS AS DEFINED IN 1101.03 'WORKING DAY'.

660.23
*** SPECIALTY ITEM ***

THE ITEM 'SIGNALS, TRAFFIC CONTROL, FURNISH AND INSTALL' IS CONSIDERED A SPECIALTY ITEM FOR THIS PROJECT.

WHEN PERFORMED BY SUBCONTRACT, THE COST OF THIS SPECIALTY ITEM SO PERFORMED BY SUBCONTRACT MAY BE DEDUCTED FROM THE TOTAL COST BEFORE COMPUTING THE AMOUNT OF WORK REQUIRED TO BE PERFORMED BY THE PRIME CONTRACTOR WITH HIS/HER OWN ORGANIZATION. REFER TO ARTICLE 1108.01 OF THE STANDARD SPECIFICATIONS.

670.12
*** SUBLETTING OF CONTRACT ***

REPLACE THE FIRST PARAGRAPH OF STANDARD SPECIFICATIONS ARTICLE 1108.01 WITH THE FOLLOWING:

THE CONTRACTOR SHALL PERFORM AT LEAST 30% OF THE CONTRACT AMOUNT WITH HIS/HER OWN ORGANIZATION. ON THIS PROJECT ONLY, THE CONTRACTOR MAY SUBCONTRACT UP TO 70% OF THE CONTRACT AMOUNT.

THE BIDDERS SHOULD BE AWARE THAT THIS PROJECT REQUIRES SEVERAL TYPES OF WORK. PURCHASING OF MATERIALS FOR SUBCONTRACTORS WILL NOT BE AN ACCEPTABLE METHOD FOR THE PRIME CONTRACTOR TO MEET THE 30% REQUIREMENT.

ITEMS DESIGNATED AS SPECIALTY ITEMS MAY BE PERFORMED BY SUBCONTRACT, AND THE COST OF ANY SPECIALTY ITEMS SO PERFORMED BY SUBCONTRACT MAY BE DEDUCTED FROM THE TOTAL COST BEFORE COMPUTING THE AMOUNT OF WORK REQUIRED TO BE PERFORMED BY THE CONTRACTOR WITH HIS/HER OWN ORGANIZATION.

700.00
*** NO TIES BETWEEN PROPOSALS WILL BE ALLOWED ***

ALL SECTIONS AND ALL ITEMS ON THIS PROPOSAL FORM MUST BE BID WITH THE EXCEPTION OF ALTERNATE ITEMS OR ALTERNATE SETS OF ITEMS. NO OTHER TIES BETWEEN PROPOSALS WILL BE ALLOWED.

IX. REPORTS

Paving and Structural Report
- Daily or Weekly
- Form 800240E or 800240M

Portland Cement Shipment Yield
- Every 10,000 cubic yards
- Form 820912

Ready Mix Tickets
- Form 830212

Calibration Reports
- Form 820917

Transit Mixer Condition
- Form 820907

PCC PAVING PLANT BOOK

Plant Information Sheet

Portland Cement Concrete Form
- Batch Weights
- Form 820150E or 820150M

PCC Plant Report
- Form 800240E or 800240M

Portland Cement Shipment Yield Report
- Form 820912 E

Fly ash Shipments
- Form E203 and M203

Aggregate Certifications (Coarse and Fine)
- Form E204 and M204

Specific Gravities
- Form E205 and M205

Moistures (Pycnometer)
- Form E206 and M206

Daily Plant Checklist
- Form E212 and M212

Plant Site Inspection List
- Form E210 and M210

Beams Made and Tested
- Form E114 and M114

REPORTS AND 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 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 M or E 115	Air & Slump Record
Form M or 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 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 (Ready Mix).

Report No.
Start with the number 1 at the beginning of work for each item on 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 200-mm 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.

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.

Batched
Enter the total cu. yds. (m^3) batched for each mix for a paving plant. Enter the total cu. yds. (m^3) batched for each unit poured for structures.

% Of Est. Used
Enter the percent of estimated concrete used.

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 Mass or Wt.)
Enter the weight (mass) of each aggregate calculated by absolute volumes.

Actual Quantities Used Per cu. yds. (m^3) in Kilograms (Pounds)

Cement	Enter the pounds (kilograms) of cement calculated by absolute volumes.
Fly Ash	Enter the pounds (kilograms) of fly ash calculated by absolute volumes.
GGBFS	Enter the pounds (kilograms) of ggbfs calculated by absolute volumes.
Fine	Enter the actual pounds (kilograms) of fine aggregate adjusted by moisture content.
Inter.	Enter the actual pounds (kilograms) of intermediate aggregate adjusted by moisture content.
Coarse	Enter the actual pounds (kilograms) of coarse aggregate adjusted by moisture content.
In Agg.	Enter the calculated difference between the actual weights (masses) and the dry weights (masses) of both fine and coarse aggregates.
Plant	Enter the average pounds (kilograms) of water added at the plant for each cu. yd. (m^3).
Grade	Enter the average pounds (kilograms) of water added on the grade (when permitted by specification).

Avg. W/C Ratio
Enter the ratio of total water in one cu. yd. (m^3) divided by the total sum of cement and fly ash in one cu. yd. (m^3), 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. If one of the tests fail and backups are tested, record the average in the column provided, which is located just right of the specifications column.

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. (m^3) 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. (m^3), 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 (kilograms) of ice per cu. yd. (m^3).

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	Location 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	% Of Est.	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg	Max
		(CY)	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	Water In Agg.	Water Plant	Water Grade	w/c Ratio	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

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

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

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

	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:			

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

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

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

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

Remarks
This is a test report

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

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

800240E computer VER 1-06

PCC Plant Report

Date of Placement		Location From	Location To
Mix 1	10/19/06		
Mix 2	10/19/06		
Mix 3			
Mix 4			
Mix 5			

Project No.: FM91(15)-56-91
Plant Name: Jensen - R63 & Hwy.92
Contractor: Irving F. Jensen
Weather: Sunny-cool

Contract ID: 73912
County: Warren
Temp. (°F) Min: 40
Temp. (°F) Max: 65

Report No.: 9
Date This Report: 10/19/06
Date Of Last Report: 10/18/06
Structures Des. No.:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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)	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	1,011.50		3.3						0.5										175.0	0.0		
2	C-3WR	425.00		3.0						0.3										173.0	0.0		
3																							
4																							
5																							

(Columns Cement through Water Grade are headed "Actual Quantities Used Per cy (in pounds)".)

6-9

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total To Date
Check One (X)	X		
Concrete (CY):			
Cement (tons):			

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

	Brand / Source	Rate	Lot Number
Air Entraining:	AEA-15/Sika	4.5 oz./yd.	J60038M
Water Reducer:	Plastocrete 161		J60011P
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			Ash Grove
Fly Ash:			
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													

	Source	T-203 A #	Grad. No.
Coarse:		A25512	3
Intermediate:			
Fine:		A77522	1

PROBLEM #9

Remarks

C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

Distribution: _____ DME _____ Proj. Eng. _____ Plant

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________ County : ________

Mix No.: ________ Pounds Cement: ________

1st Adjusted lbs. Cement: ________ Source: ________ Sp. Gr.: ________

I.M. 491.17 Fly Ash: ________ Source: ________ Sp. Gr.: ________

I.M. 491.14 Slag GGBFS: ________ Source: ________ Sp. Gr.: ________

2nd Adjusted lbs. Cement: ________

Total Cementitious ________

I.M. T-203 Fine Aggregate Source: ________ Sp. Gr.: ________
I.M. T-203 Interm. Aggregate Source: ________ Sp. Gr.: ________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

800240E computer VER 1-06

PCC Plant Report

Problem #11

Date of Placement		Location From	To
Mix 1	6/18/06		
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: FN-63-1(26)--38-63
Plant Name: Manatt's Hwy 146
Contractor: Manatt's Inc.
Weather: Warm-Cloudy

Contract ID: 28634
County: Jefferson
Temp. (°F) Min: 68
Temp. (°F) Max: 83

Report No.: 4
Date This Report: 06/18/06
Date Of Last Report: 06/17/06
Structures Des. No.:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	Mix	Batched (CY)	% Of Est. Used	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)	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-C20	500.00		2.7						2.7										240.0			
2																							
3																							
4																							
5																							

Actual Quantities Used Per cy (in pounds)

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total To Date
Check One (X)	X		
Concrete (CY):			
Cement (tons):			

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd.	399034
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	I/II		Ash Grove
Fly Ash:	C		Louisa Generating
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													

	Source	T-203 A #	Grad. No.
Coarse:	Moscow 3i	A70002	3
Intermediate:			
Fine:	Hoffman	A90504	1

Remarks

C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

Distribution: ____ DME ____ Proj. Eng. ____ Plant

PROBLEM #10

Rev 02/01

Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________________ **County :** __________

Mix No.: __________ **Pounds Cement:** __________

1st Adjusted lbs. Cement: __________ **Source:** ____________________ **Sp. Gr.:** __________

I.M. 491.17 Fly Ash: __________ **Source:** ____________________ **Sp. Gr.:** __________

I.M. 491.14 Slag GGBFS: __________ **Source:** ____________________ **Sp. Gr.:** __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 Fine Aggregate Source: ____________________ **Sp. Gr.:** __________
I.M. T-203 Interm. Aggregate Source: ____________________ **Sp. Gr.:** __________
I.M. T-203 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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

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PCC Plant Report

Problem #12

Date of Placement		Location From	To
Mix 1	8/6/06		
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: BROS-68(22)10
Plant Name: American Concrete - Carroll
Contractor: Iowa Culvert Builders
Weather: Warm-Dry

Contract ID: 28634
County: Carroll
Temp. (°F) Min: 72
Temp. (°F) Max: 85

Report No.: 1
Date This Report: 08/06/06
Date Of Last Report:
Structures Des. No: 517

Check Mix(x)		Check One(x)		SEND
Central		Paving		(Daily)
Ready	X	Structure	X	(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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	Water Grade	Avg w/c Ratio	Max w/c Ratio
1	C-3WR-C20S35	77.00		3.1						0.8										180.0	18.0		
2																							
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total
Check One (X)		X	To Date
Concrete (CY):			
Cement (tons):			

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd.	3890334
Water Reducer:	Plastocrete 161		5577882
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	I/II	3.14	Ash Grove
Fly Ash:	C		Burlington
GGBFS:			Holcim-Grancem

Adjusted % Passing Calculated Combined Gradation

	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Within Target
Target													

	Source	T-203 A #	Grad. No.
Coarse:		A57018	3
Intermediate:			
Fine:		A53508	1

Remarks

C.P.I.: John Doe NW000

Monitor: Mike Brown NW999

Distribution: ____ DME ____ Proj. Eng. ____ Plant

PROBLEM #11

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________ County: ______

Mix No.: ________ Pounds Cement: ______

1st Adjusted lbs. Cement: ______ Source: ______________ Sp. Gr.: ______

I.M. 491.17 Fly Ash: ______ Source: ______________ Sp. Gr.: ______

I.M. 491.14 Slag GGBFS: ______ Source: ______________ Sp. Gr.: ______

2nd Adjusted lbs. Cement: ______

Total Cementitious ______

I.M. T-203 Fine Aggregate Source: ______________ Sp. Gr.: ______
I.M. T-203 Interm. Aggregate Source: ______________ Sp. Gr.: ______
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

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PCC Plant Report

Problem #13

Date of Placement		Location From	To
Mix 1	9/17/06		
Mix 2	9/17/06		
Mix 3			
Mix 4			
Mix 5			

Project No.: STP-64(12)28-58
Plant Name: Carlson's - Hwy 218 & F62
Contractor: Fred Carlson Co.
Weather: Sunny-hot

Contract ID: 67592
County: Louisa
Temp. (°F) Min: 69
Temp. (°F) Max: 87

Report No.: 4
Date This Report: 09/17/06
Date Of Last Report: 09/16/06
Structures Des. No:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

				Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg	Max
																			Water			w/c	w/c
	Mix	Batched (CY)	% 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	Ratio	Ratio
1	C-3WR-C20	1,256.00		3.1						0.7										175.0			
2	C-3WR-C20	1,384.00		2.8						0.5										190.0			
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Check One (X)	Batched Today	Week	Total To Date
	X		
Concrete (CY):			
Cement (tons):			

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Ad/Aire	5.0 oz./yd.	233998
Water Reducer:	Daratard 17		5577882
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	1SM		LaFarge
Fly Ash:	C		Council Bluffs#3
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													

	Source	T-203 A #	Grad. No.
Coarse:		A57004	3
Intermediate:			
Fine:		A58504	1

Remarks

Distribution: ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

PROBLEM #12

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________ **County :** ________

Mix No.: ________ **Pounds Cement:** ________

1st Adjusted lbs. Cement: ________ **Source:** ________ **Sp. Gr.:** ________

I.M. 491.17 Fly Ash: ________ **Source:** ________ **Sp. Gr.:** ________

I.M. 491.14 Slag GGBFS: ________ **Source:** ________ **Sp. Gr.:** ________

2nd Adjusted lbs. Cement: ________

Total Cementitious ________

I.M. T-203 Fine Aggregate Source: ________ **Sp. Gr.:** ________
I.M. T-203 Interm. Aggregate Source: ________ **Sp. Gr.:** ________
I.M. T-203 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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

PORTLAND CEMENT CONCRETE

Project No.: ______________________ County : ____________

Mix No.: ____________ Pounds Cement: ________

1st Adjusted lbs. Cement: __________ Source: __________________ Sp. Gr.: ________

I.M. 491.17 Fly Ash: __________ Source: __________________ Sp. Gr.: ________

I.M. 491.14 Slag GGBFS: __________ Source: __________________ Sp. Gr.: ________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 Fine Aggregate Source: __________________ Sp. Gr.: ________
I.M. T-203 Interm. Aggregate Source: __________________ Sp. Gr.: ________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

800240E computer VER 1-06

PCC Plant Report

Problem #14

Date of Placement		Location From	To
Mix 1	8/6/06		
Mix 2	8/6/06		
Mix 3	8/6/06		
Mix 4			
Mix 5			

Project No.: STP-53-4(15)--2C-53
Plant Name: Kirk Ready Mix
Contractor: Kirk Const.
Weather: Sunny/Warm

Contract ID: 4920
County: Jones
Temp. (°F) Min: 65
Temp. (°F) Max: 85

Report No.: 1
Date This Report: 08/06/06
Date Of Last Report:
Structures Des. No: 4920

Check Mix(x)		Check One(x)		SEND
Central		Paving		(Daily)
Ready	X	Structure	X	(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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	Water Grade	Avg w/c Ratio	Max w/c Ratio
1	C-3WR-C15S35	182.00		3.7						0.7										175.0	19.0		
2	C-4-C15	35.00		3.4						0.8										183.0	25.0		
3	M-4	14.00		3.4						0.8										252.0	14.0		
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Check One (X)	Batched Today	Week X	Total To Date
Concrete (CY):			
Cement (tons):			

9-27

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Daravair 1400	3 oz./yd.	AA9912
Water Reducer:	WRDA w/Hycol		AWR99915
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	II		LaFarge
Fly Ash:	C		Burlington
GGBFS:	120		NewCem

Adjusted % Passing Calculated Combined Gradation

	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Within Target
Target													

	Source	T-203 A #	Grad. No.
Coarse:		A53004	3
Intermediate:			
Fine:		A53502	1

PROBLEM #13

Remarks

Distribution: ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: John Doe NE000

Monitor: Jane Doe NE999

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________________ County : __________

Mix No.: __________ Pounds Cement: ______

1st Adjusted lbs. Cement: ________ Source: ________________ Sp. Gr.: ________

I.M. 491.17 Fly Ash: ________ Source: ________________ Sp. Gr.: ________

I.M. 491.14 Slag GGBFS: ________ Source: ________________ Sp. Gr.: ________

2nd Adjusted lbs. Cement: ________

Total Cementitious ________

I.M. T-203 Fine Aggregate Source: ________________ Sp. Gr.: ________
I.M. T-203 Interm. Aggregate Source: ________________ Sp. Gr.: ________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________________ County : __________

Mix No.: ____________ Pounds Cement: ________

1st Adjusted lbs. Cement: __________ Source: __________________ Sp. Gr.: __________

I.M. 491.17 Fly Ash: __________ Source: __________________ Sp. Gr.: __________

I.M. 491.14 Slag GGBFS: __________ Source: __________________ Sp. Gr.: __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 Fine Aggregate Source: ____________________________ Sp. Gr.: __________
I.M. T-203 Interm. Aggregate Source: ____________________________ Sp. Gr.: __________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________________ **County :** __________

Mix No.: ____________ **Pounds Cement:** ________

1st Adjusted lbs. Cement: __________ **Source:** __________________ **Sp. Gr.:** __________

I.M. 491.17 **Fly Ash:** __________ **Source:** __________________ **Sp. Gr.:** __________

I.M. 491.14 **Slag GGBFS:** __________ **Source:** __________________ **Sp. Gr.:** __________

2nd Adjusted lbs. Cement: __________

Total Cementitious __________

I.M. T-203 **Fine Aggregate Source:** ____________________________ **Sp. Gr.:** __________
I.M. T-203 **Interm. Aggregate Source:** ____________________________ **Sp. Gr.:** __________
I.M. T-203 **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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

PROBLEM 14

Calculate the cement yield

- 4096 lb. cement in scale hopper from last cement yield check.
- 4872 batches at 623 lb./batch
- 615 batches at 604 lb./batch
- 66 batches at 823 lb./batch
- 3000 lb. left in scale hopper

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

PROBLEM 15

Calculate the cement yield given the following

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

PROBLEM 16

Cement Yield

- Tons Billed = 902.38
- Number of batches = 3180
- Batch Size = 1 yd^3
- 571 lb. cement per yd^3

Find cement yield in percent

IDOT
CUSTOMER NO.: 1
MASON CITY IA.

JOB NO./ID. 1 #5

TICKET NO.: 34 PLANT ID.: 2495 DATE:11-24-98 TIME-12:46
7.00 CY FORMULA NO.: 1 C-3-WR-C 15% TOLERANCE: 4
QTY ORD'D: 999999.00 QTY DEL'D: 16617.00 LOADS: 2378 REQ SLUMP: 0.00

GATE	DESCRIP.	TARGET	ACTUAL		MC	GATE	DESCRIP.	TARGET	ACTUAL	
AGG	2 ROCK	6180	6120	LB	0.5%					
AGG	1 SAND	10000	9960	LB	3.2%	WT2	2 WATER 2	154	154	GL
AGG	3 ROCK	6180	6240	LB	0.5%	AD2	2 ADA	29	29	OZ
						AD4	4 WR	116	117	OZ
CEM	1 CEM.	3290	3275	LB						
CEM	2 FLY ASH	580	590	LB +						

TIME-12:47 AGG 0:- 20 20 LB CEM 0: - 15 15 LB
WATA: 8 GL
TRUCK NO.: 47 DRIVER NAME: JIM H. DRIVER NUMBER: 0

IDOT
CUSTOMER NO.: 1
MASON CITY IA.

JOB NO./ID. 1 #5

TICKET NO.: 35 PLANT ID.: 2495 DATE:11-24-98 TIME-12:46
7.00 CY FORMULA NO.: 1 C-3-WR-C 15% TOLERANCE: 4
QTY ORD'D: 999999.00 QTY DEL'D: 16624.00 LOADS: 2379 REQ SLUMP: 0.00

GATE	DESCRIP.	TARGET	ACTUAL		MC	GATE	DESCRIP.	TARGET	ACTUAL	
AGG	2 ROCK	6180	6320	LB	0.5% +					
AGG	1 SAND	10000	10020	LB	3.2%	WT2	2 WATER 2	154	154	GL
AGG	3 ROCK	6180	6140	LB	0.5%	AD2	2 ADA	29	29	OZ
						AD4	4 WR	116	116	OZ
CEM	1 CEM.	3290	3280	LB						
CEM	2 FLY ASH	580	580	LB						

TIME-12:49 AGG 0:- 20 20 LB CEM 0: - 10 - 10 LB
WATA: 13 GL
TRUCK NO.: 48 DRIVER NAME: JON W. DRIVER NUMBER: 0

IDOT

IDOT
CUSTOMER NO.: 1
MASON CITY IA.

JOB NO./ID. 1 #5

TICKET NO.: 18 PLANT ID.: 2495 DATE:11-24-98 TIME-11:10
7.00 CY FORMULA NO.: 1 C-3-WR-C 15% TOLERANCE: 4
QTY ORD'D: 999999.00 QTY DEL'D: 16505.00 LOADS: 2362 REQ SLUMP: 0.00

GATE	DESCRIP.	TARGET	ACTUAL	MC	GATE	DESCRIP.	TARGET	ACTUAL
AGG	2 ROCK	6160	6200 LB	0.3%				
AGG	1 SAND	10020	9980 LB	3.4%	WT2	2 WATER 2	154	154 GL
AGG	3 ROCK	6160	6120 LB	0.3%	AD2	2 ADA	29	29 OZ
					AD4	4 WR	116	117 OZ
CEM	1 CEM.	3290	3295 LB					
CEM	2 FLY ASH	580	580 LB					

TIME-11:11 AGG 0:- 20 20 LB CEM 0: - 5 5 LB
WATA: 0 GL
TRUCK NO.: 48 DRIVER NAME: JON W. DRIVER NUMBER: 0

IDOT
CUSTOMER NO.: 1
MASON CITY IA.

JOB NO./ID. 1 #5

TICKET NO.: 19 PLANT ID.: 2495 DATE:11-24-98 TIME-11:13
7.00 CY FORMULA NO.: 1 C-3-WR-C 15% TOLERANCE: 4
QTY ORD'D: 999999.00 QTY DEL'D: 16512.00 LOADS: 2363 REQ SLUMP: 0.00

GATE	DESCRIP.	TARGET	ACTUAL	MC	GATE	DESCRIP.	TARGET	ACTUAL
AGG	2 ROCK	6160	6100 LB	0.3%				
AGG	1 SAND	10020	9960 LB	3.4%	WT2	2 WATER 2	154	154 GL
AGG	3 ROCK	6160	6140 LB	0.3%	AD2	2 ADA	29	29 OZ
					AD4	4 WR	116	115 OZ
CEM	1 CEM.	3290	3295 LB					
CEM	2 FLY ASH	580	580 LB					

TIME-11:14 AGG 0: 00 00 LB CEM 0: 5 0 LB
WATA: 2 GL
TRUCK NO.: 44 DRIVER NAME: POOR BOY DRIVER NUMBER: 0

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. ____________________________

Form 820917
11-94

Iowa Department of Transportation

Office of Materials

PLANT CALIBRATION REPORT

☐ Portland Cement Paving Plant
☐ Ready Mix Plant
☐ Initial Calibration ☐ Check Calibration ☐ Change in Material Source

Shaded area to be completed for paving plants and when applicable for ready mixed concrete plants.

Contractor/Producer	County
Plant Location	Project
Class of Concrete	Mix No.(s)
Design W/C Ratio(s)	Max W/C Ratio(s)

MATERIAL	SOURCE Producer Name & Location	SPECIFIC GRAVITY	DRY BATCH MASS
Aggregate (Coarse)			
Aggregate (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: 2301.13

- 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: 2301.13

- 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.
- 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.

As a guide, a working form to help record field calibration measurements is on page 4.

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	accum. error	applied weight	scale reading	error	accum. 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	accum. error	applied weight	scale reading	error	accum. error

WATER-ACCURATE TO +/-1.0% OR 2 LBS., WHICHEVER IS GREATER

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

metered gal.	metered lbs.	scale reading	error	area meter oz.	area meas. oz.	water reducer meter oz.	water reducer meas. oz.	Retarder meter oz.	Retarder meas. oz.

Form 820912E - computer

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

Portland Cement Shipment Yield Report

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	This Check (+)			1.53
Scale (Tons)	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 820907
4-94

Iowa Department of Transportation

TRANSIT MIXER
CONDITION CERTIFICATION

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 No. ______________________

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 ____________

English Ready Mix Plant Book Index

Plant Information Sheet

Project No.:______________________ Contract ID.:____________________

Prime Contractor:______________________

Plant Type:______________________

Plant Location:______________________

Pollution Control:______________________

Storm Water Permit No.:______________________

Date Calibrate:______________________

By:______________________

Material Sources

	Phone No.	Fax No.
Plant Superintendent:		
Certified Plant Inspector:		
Certification No.:		
Certified Plant Inspector:		
Certification No.:		
Certified QMA Inspector:		
Certification No.:		
Certified Plant Monitor:		
Certification No.:		
Certified Plant Monitor:		
Certification No.:		
Project Engineer:		
Project Manager:		
Project Inspector:		
Materials Inspector:		
Materials Inspector:		

Resident Auditor:______________________ TC Auditor:____________________

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________ County : ____________

Mix No.: ____________ Pounds Cement: ____________

1st Adjusted lbs. Cement: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.17 Fly Ash: ____________ Source: ____________ Sp. Gr.: ____________

I.M. 491.14 Slag GGBFS: ____________ Source: ____________ Sp. Gr.: ____________

2nd Adjusted lbs. Cement: ____________

Total Cementitious ____________

I.M. T-203 Fine Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 Interm. Aggregate Source: ____________ Sp. Gr.: ____________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

Page: ________

Report No.: ________

Date Submitted: ________

Portland Cement Shipment Yield Report

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)
			....	0.00
			....	0.00
			....	0.00
			....	0.00
			....	0.00
Left In Scale (Tons)	This Check (+)			
	Previous Yield Check (-)			
Total Weighed (Batch Scale)				0.00

Total Billed Weight (Tons)	0.00

Yield = 0.00 %

C.P.I.: ________________

Distribution: _____TCME _____ RCE _____ Central Materials _____Contractor _____ Inspector

Fly Ash Shipments

Spec. Grav.:____________

Source:______________________________

Project No.:____________________________

Page No.:____________

Type:____________

Contract ID.:________________

Date	Ticket No.	Certified (Tons)	To Date (Tons)	Used (Tons)	To Date (Tons)	Remarks	By

Checked By:__________________

Audited By:__________________

Rev 01/98 Form E204

Aggregate Certification

Spec. Grav.:____________ Page No.:____________

Source:____ Grad. No.:____________

Project No.:____ Contract ID.:____________

	Ticket #		Certified	To Date	Used	To Date	
Date	From	To	(Tons)	(Tons)	(Tons)	(Tons)	By

Checked By:____________________

Audited By:____________________

Rev 01/98 Form E205

Specific Gravity (I.M. 307)

Page No.:______________

Project No.:____________________________ **Contract ID.:**______________

Date	Aggregate Type	S (Grams)	P (Grams)	S + P (Grams)	W (Grams)	Actual Sp. Gr.	T-203 Sp. Gr.	By

Checked By:__________________

Specific Gravity=S \ (S+P-W)

Audited By:__________________

Moistures by Pycnometer (IM 308)

Page No.:___________

Project No.:________________________________ Contract ID.:_______________

Date	Aggregate Type	W (Grams)	W1 (Grams)	Diff. (Grams)	Moisture (%)	Remarks	By

Checked By:__________________

Audited By:__________________

Daily Plant Check List

Page No.:__________

Project No.:________________________

Contract ID.:____________

Date	Stock Piles	Scale Sens.	Mixing Speed	Mixing Time	Placed Time	Cem Delivery		Fly Ash Delivery		Agg. Delivery		Plant Site	Admix. Dispens.	By
						AM	PM	AM	PM	AM	PM			

Complies = Y

Discrepancy = D

Not Applicable = NA

Record Actual Mixing Time & Placed Time

Refer to Daily Diary For Discrepancies

Plant Site Inspection List (PCC)

Page No.:______________

Project No.:________________________ Contract ID.:______________

Date Checked	Item	Complies Yes	Complies No	Remarks	By
	Bins				
	Bin Dividers				
	Bin Supports				
	Screens				
	Guards				
	Ladders				
	Railings				
	Belt Lockouts				
	Sampling Location				
	Aggregate Scales				
	Cement Scales				
	Fly Ash Scales				
	Admixture Dispensers				
	Water Meter				
	Cement Storage				
	Fly Ash Storage				
	Mixing Equipment				
	Lab Location				
	Lab Condition				
	Lab Equipment				
	Air Condition				
	Heating				
	Telephone				
	Water				
	Exhaust Fan				
	Restroom				
	Fax Machine				
	Computer				

If an item does not apply to the project, write (not applicable) in the remarks column.

Rev 09/01

PC Concrete Beam Record

Form E114

Line No.: ____________

Item Code: ____________

Description: ____________

Project No.: ____________

Page No.: ____________

Category No.: ____________

Contract ID: ____________

Beams Made Information							Beam Break Information									
Date Made	Mix Number	Beam No.	Time	Air %	Slump (in)	W/C Ratio	Age (Days)	Loc. (in)	Depth (in)	Width (in)	Indicated Load (lbs)	Actual Load (lbs)	Comp. Factor	Mod. Of Rupture (psi)	Spec. psi	By
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		

Checked By: ____________

Page No.: ____________

Project No.: ____________________ Contract ID: ____________

Date: __________ Sunrise: ________ High: ____________

Day: __________ Sunset: ________ Low: ____________

Weather: ______________________________

By: ______________________

Page No.: ______________

Project No.: ______________________ **Contract ID:** ______________

Date: ____________ **Sunrise:** ________ **High:** ____________

Day: ____________ **Sunset:** ________ **Low:** ____________

Weather: ______________________________

By: ____________________

Date: ____________ **Sunrise:** ________ **High:** ____________

Day: ____________ **Sunset:** ________ **Low:** ____________

Weather: ______________________________

By: ____________________

English PCC Paving Plant book Index

Plant Information Sheet

Project No.: ____________________ **Contract ID.:** ____________________

Prime Contractor: ____________________
Plant Type: ____________________
Plant Location: ____________________
Pollution Control: ____________________
Storm Water Permit No.: ____________________
Date Calibrate: ____________________
By: ____________________

Material Sources

	Phone No.	Fax No.
Plant Superintendent:		
Certified Plant Inspector:		
Certification No.:		
Certified Plant Inspector:		
Certification No.:		
Certified QMA Inspector:		
Certification No.:		
Certified Plant Monitor:		
Certification No.:		
Certified Plant Monitor:		
Certification No.:		
Project Engineer:		
Project Manager:		
Project Inspector:		
Materials Inspector:		
Materials Inspector:		

Resident Auditor: ____________________ **TC Auditor:** ____________________

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________ County : ________

Mix No.: ________ Pounds Cement: ________

1st Adjusted lbs. Cement: ________ Source: ______________ Sp. Gr.: ________

I.M. 491.17 Fly Ash: ________ Source: ______________ Sp. Gr.: ________

I.M. 491.14 Slag GGBFS: ________ Source: ______________ Sp. Gr.: ________

2nd Adjusted lbs. Cement: ________

Total Cementitious ________

I.M. T-203 Fine Aggregate Source: ______________ Sp. Gr.: ________
I.M. T-203 Interm. Aggregate Source: ______________ Sp. Gr.: ________
I.M. T-203 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, ___ TC, ___ Proj. Engr., ___ Contractor

Cement Shipments

Spec. Grav.:____________ **Page No.:**____________

Source:______________________________ **Type:**____________

Project No.:____________________________ **Contract ID.:**________________

Date	Ticket No.	Certified (Tons)	To Date (Tons)	Used (Tons)	To Date (Tons)	Remarks	By

Checked By:________________

Audited By:________________

Rev 01/98 Form E203

Fly Ash Shipments

Spec. Grav.:__________ **Page No.:**__________

Source:____________________ **Type:**__________

Project No.:____________________ **Contract ID.:**____________

Date	Ticket No.	Certified (Tons)	To Date (Tons)	Used (Tons)	To Date (Tons)	Remarks	By

Checked By:____________

Audited By:____________

Rev 01/98 Form E204

Aggregate Certification

Spec. Grav.:____________ **Page No.:**____________

Source:____ **Grad. No.:**____________

Project No.:____________________________________ **Contract ID.:**____________

Date	Ticket #		Certified	To Date	Used	To Date	By
	From	To	(Tons)	(Tons)	(Tons)	(Tons)	

Checked By:____________________

Audited By:____________________

Specific Gravity (I.M. 307)

Page No.:______________

Project No.:___________________________

Contract ID.:______________

Date	Aggregate Type	S (Grams)	P (Grams)	S + P (Grams)	W (Grams)	Actual Sp. Gr.	T-203 Sp. Gr.	By

Checked By:__________________

Specific Gravity=S \ (S+P-W)

Audited By:__________________

Moistures by Pycnometer (IM 308)

Page No.:___________

Project No.:______________________________ **Contract ID.:**_______________

Date	Aggregate Type	W (Grams)	W1 (Grams)	Diff. (Grams)	Moisture (%)	Remarks	By

Checked By:_________________

Audited By:_________________

Mixer Data

Page No.:____________

Project No.:______________________________ **Contract ID.:**________________

Date	Truck No.	Date Certified	Mixer Brand	Mixing Capacity (CY)	Mixing Speed		Agit. Speed	Rev. Counter (man/auto)	By
					Rated	Actual			

Ready Mix Check List

Page No.:________

Project No.:________________________________ **Contract ID.:______________**

Date	Scale Sensitivity	Scale Operations	Mixing Revolutions	Mixing Time	Stockpiles	Admixture Dispensers	Plant Site	By

Complies = Y

Discrepancy = D **Refer to Daily Diary for Discrepancies**

Not Applicable = NA

Plant Site Inspection List (PCC)

Page No.:______________

Project No.:__________________________ Contract ID.:______________

Date Checked	Item	Complies Yes	Complies No	Remarks	By
	Bins				
	Bin Dividers				
	Bin Supports				
	Screens				
	Guards				
	Ladders				
	Railings				
	Belt Lockouts				
	Sampling Location				
	Aggregate Scales				
	Cement Scales				
	Fly Ash Scales				
	Admixture Dispensers				
	Water Meter				
	Cement Storage				
	Fly Ash Storage				
	Mixing Equipment				
	Lab Location				
	Lab Condition				
	Lab Equipment				
	Air Condition				
	Heating				
	Telephone				
	Water				
	Exhaust Fan				
	Restroom				
	Fax Machine				
	Computer				

If an item does not apply to the project, write (not applicable) in the remarks column.

Rev 09/01

PC Concrete Beam Record

Form E114

Line No.: ____________________

Item Code: ____________________

Description: ____________________

Project No.: ____________________

Page No.: ____________________

Category No.: ____________________

Contract ID: ____________________

Beams Made Information							Beam Break Information									
Date Made	Mix Number	Beam No.	Time	Air %	Slump (in)	W/C Ratio	Age (Days)	Loc. (in)	Depth (in)	Width (in)	Indicated Load (lbs)	Actual Load (lbs)	Comp. Factor	Mod. Of Rupture (psi)	Spec. psi	By
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
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													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		
													0.000000	0		

Checked By: ____________________

Page No.: ____________

Project No.: ______________________ Contract ID: ____________

Date: ____________ Sunrise: ________ High: ____________

Day: ____________ Sunset: ________ Low: ____________

Weather: ______________________________

By: ______________________

Page No.: ____________

Project No.: ______________________________ Contract ID: ____________

Date: ____________ Sunrise: ________ High: ____________

Day: ____________ Sunset: ________ Low: ____________

Weather: ____

By: ________________

Date: ____________ Sunrise: ________ High: ____________

Day: ____________ Sunset: ________ Low: ____________

Weather: ____

By: ________________

Solution 1

PART A

	Absolute Volume							*Dry Batch Masses*
Cement	0.093 yd^3	x	27 ft^3/yd^3	x	3.14	x	62.4 lb/ft^3	= **492 lb**
Fine Agg.	0.345 yd^3	x	27 ft^3/yd^3	x	2.66	x	62.4 lb/ft^3	= **1546 lb SSD**
Coarse Agg.	0.345 yd^3	x	27 ft^3/yd^3	x	2.68	x	62.4 lb/ft^3	= **1558 lb SSD**
Water	0.157 yd^3	x	27 ft^3/yd^3	x	1.00	x	62.4 lb/ft^3	= **265 lb**

PART B

Fine Aggregate Moisture

$$\begin{array}{r} 1.000 \\ \underline{-\ 0.031} \\ 0.969 \end{array} \qquad \frac{1546\text{ lb}}{0.969} = 1595\text{ lb}$$

1595 lb - 1546 lb = **49 lb excess water**

Coarse Aggregate Moisture

$$\begin{array}{r} 1.000 \\ \underline{-0.003} \\ 0.997 \end{array} \qquad \frac{1558\text{ lb}}{0.997} = 1563\text{ lb}$$

1563 lb - 1558 lb = **5 lb excess water**

Total Free Water = 54 lb

Correct basic water to be batched or added as mixing water.

As before, total free water contributed by aggregate is

49 lb water + 5 lb water = **54 lb**

Fine Agg.	Coarse Agg.	Total Free Water

265 lb water - 54 lb water = **211 lb water**

Basic	Free Water in aggregate	Mixing water corrected for excess water in aggregate

Conversion to gallons

211 lb/yd^3 / 8.33 lb/gal = **25 gal/yd^3 of mix water**

<u>Maximum water that can be added to the batch</u>

From I.M. 529

w/c = 0.600 lb/lb

0.600 = water/cement Maximum Allowable

Cement x 0.600 = water

492 lb x 0.600 = **295 lb maximum water per yd^3**

Maximum water per yd^3 - Maximum free water in agg. = Maximum allowable mixing water

295 lb - 54 lb = **241 lb/yd^3 Maximum allowable mixing water**

241 lb / 8.33 lb/gal = **29 gal/yd^3**

Maximum allowable water that may be added as mixing water.

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Solution #2

Form E820150E

Project No.: STP 27-3980-31 **County :** Clayton

Mix No.: C-4-C15 **Pounds Cement:** 624

	1st Adjusted lbs. Cement:	530	Source: Continental 1	Sp. Gr.:	3.14
IM 491.17	Fly Ash:	94	Source: Louisa Generating	Sp. Gr.:	2.68
IM 491.14	Slag GGBFS:		Source:	Sp. Gr.:	
	2nd Adjusted lbs. Cement:	530			
	Total Cementitious	624			

IM T203	Fine Aggregate Source:	Roverud	Sp. Gr.:	2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:	
IM T203	Coarse Agregate Source:	Gisleson Quarry	Sp. Gr.:	2.66

Basic w/c 0.430 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 268

Max w/c 0.488 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 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)	=	0.021
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.159
Air			0.060
	Subtotal	=	0.340
	1.000 - Subtotal	=	0.660
	Total	=	1.000

% FA Agg.:	50	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	0.330
% In. Agg.:		Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	
% CA Agg.:	50	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	0.330
		Aggregate Total	=	0.660

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1479
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1479

Summary

Cement	530	(lbs/cy)
Fly Ash	94	(lbs/cy)
Slag		(lbs/cy)
Water	268	(lbs/cy)
Fine Agg.	1479	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1479	(lbs/cy)

10-3

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

Solution #2

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: STP 27-3980-31　　County : Clayton

Mix No.: C-4　　Pounds Cement: 624

1st Adjusted lbs. Cement: 624　　Source: Continental 1　　Sp. Gr.: 3.14

IM 491.17　Fly Ash: ____　　Source: ____　　Sp. Gr.: 2.68

IM 491.14　Slag GGBFS: ____　　Source: ____　　Sp. Gr.: ____

2nd Adjusted lbs. Cement: 624

Total Cementitious 624

IM T203　Fine Aggregate Source: Roverud　　Sp. Gr.: 2.66
IM T203　Interm. Aggregate Source: ____　　Sp. Gr.: ____
IM T203　Coarse Agregate Source: Gisleson Quarry　　Sp. Gr.: 2.66

Basic w/c 0.430　　Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 268
Max w/c 0.488　　Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 305

Absolute Volumes			
	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27) =	0.118
	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) =	0.159
	Air		0.060
		Subtotal =	0.337
		1.000 - Subtotal =	0.663
		Total =	1.000

% FA Agg.: 50	Fine Aggregate (1.000 - Subtotal) X % In Mix =	0.331
% In. Agg.:	Interm. Aggregate (1.000 - Subtotal) X % In Mix =	
% CA Agg.: 50	Coarse Aggregate (1.000 - Subtotal) X % In Mix =	0.332
	Aggregate Total =	0.663

Aggregate Weights		
	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 =	1483
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 =	
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 =	1488

Summary

Cement	624	(lbs/cy)
Fly Ash		(lbs/cy)
Slag		(lbs/cy)
Water	268	(lbs/cy)
Fine Agg.	1483	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1488	(lbs/cy)

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

Solution 3

Proportion and Problem Solving

PART A

	Absolute Volume	**Dry Batch Masses**
Cement	$0.104\ yd^3 \times 3.14 \times 62.4\ lb/ft^3 \times 27\ ft^3/yd^3 =$	**550 lb**
Fine Agg.	$0.306\ yd^3 \times 2.66 \times 62.4\ lb/ft^3 \times 27\ ft^3/yd^3 =$	**1371 lb SSD**
Coarse Agg.	$0.375\ yd^3 \times 2.68 \times 62.4\ lb/ft^3 \times 27\ ft^3/yd^3 =$	**1693 lb SSD**
Water	$0.155\ yd^3 \times 1.00 \times 62.4\ lb/ft^3 \times 27\ ft^3/yd^3 =$	**261 lb**

PART B

Fine Aggregate Moisture

$$\begin{array}{r} 1.000 \\ \underline{-0.034} \\ 0.966 \end{array} \qquad \frac{1371}{0.966} = 1419\ lb$$

1419 lb - 1371 lb = **48 lb excess water**

Coarse Aggregate Moisture

$$\begin{array}{r} 1.000 \\ \underline{-0.005} \\ 0.995 \end{array} \qquad \frac{1693}{0.995} = 1702\ lb$$

1702 lb - 1693 lb = **9 lb excess water**

Total free water: **48 lb + 9 lb = 57 lb**

Basic - Agg. = Corrected

261 lb - 57 lb = 204 lb water

204 lb/yd ÷ 8.33 lb/gal = **24 gal/yd³**

Maximum allowable mixing water

0.532 lb/lb x 550 lb = 293 lb

293 lb - 57 lb = **236 lb**

236 lb ÷ 8.33 lb/gal = **28 gal**

Solution 4

1. Maximum w/c = 0.488

   Maximum Water = 0.488 x 624 lb = **305 lb/yd³**

   305 lb/yd³ ÷ 8.33 lb/gal = **37 gal/yd³**

   Water Allowed = 37 x 5 = **185 gal**

2. Maximum w/c = 0.450

   Maximum Water = 0.450 x 709 lb = **319 lb/yd³**

   319 lb/yd³ ÷ 8.33 lb/gal = **38 gal/yd³**

   Water Allowed = 38 x 7 = **266 gal**

3. Total Water = (5 gal/yd³ x 8.33 lb/gal) + (27 gal/yd³ x 8.33 lb/gal)

   = 42 lb + 225 lb

   = 267 lb

   w/c = 267 ÷ 603

   = 0.443

4. Total Water = 50 lb/yd³ + (30 gal/yd³ x 8.33 lb/gal)

   = 50 lb/yd³ + 250 lb/yd³

   = 300 lb/yd³

   Total Cement = 529 lb/yd³ + 95 lb/yd³

   = 624 lb/yd³

   w/c = 300 lb/yd³ ÷ 624 lb/yd³

   = 0.481

5. Maximum w/c = **0.489**

Maximum Water = 0.489 x 593 lb/yd^3 = 290.0 lb/yd^3

= **35 gal/yd^3**

Water Allowed = 35 gal/yd^3 x 7 yd^3 = **245 gal**

Total Water = 48 lb/yd^3 + (24 gal/yd^3 x 8.33 lb/gal) =

48 lb/yd^3 + 200 lb/yd^3 = **248 lb/yd^3**

= **30 gal/yd^3**

30 gal/yd^3 x 7 yd^3 = **210 gal**

Amount of water that can be added at the paver:

245 gal - 210 gal = **35 gal**

Solution 5

1. *Dry Batch Masses*

Cement

0.156 x 3.14 x 27 x 62.4 = **825 lb**

Fine Aggregate

0.311 x 2.67 x 27 x 62.4 = **1399 lb**

Coarse Aggregate

0.312 x 2.65 x 27 x 62.4 = **1393 lb**

Basic Water

0.161 x 1.00 x 27 x 62.4 = **271 lb or 33 gal**

Actual Batch Masses

Fine Aggregate: 1399 ÷ (1-0.028) = **1439 lb**

Coarse Aggregate: 1393 ÷ (1-0.006) = **1401 lb**

2. *Total Water*

Water in the Materials

Fine Aggregate: 1439 - 1399 = **40 lb**

Coarse Aggregate: 1401 - 1393 = **8 lb**

Water added at the plant: 30 x 8.33 = **250 lb**

Water added at the grade: (10 ÷ 7) x 8.33 = **12 lb**

310 lb

3. *Water/Cement Ratio*

310 ÷ 825 = **0.376**

Solution 6

1. Dry Batch Masses

Cement

0.108 x 3.14 x 27 x 62.4 = **571 lb**

Fine Aggregate

0.309 x 2.66 x 27 x 62.4 = **1385 lb**

Coarse Aggregate

0.377 x 2.60 x 27 x 62.4 = **1651 lb**

Basic Water

0.146 x 1.00 x 27 x 62.4 = **246 lb or 30 gal**

Actual Batch Masses

Fine Aggregate

1385 ÷ (1 - 0.030) = **1428 lb**

Coarse Aggregate

1651 ÷ (1 - 0.005) = **1659 lb**

2. Total Water

Water in the Materials — **Fine Aggregate:** 1428 - 1385 = **43 lb**

Coarse Aggregate: 1659 - 1651 = **8 lb**

Water Added at the Plant

23 x 8.33 = **192 lb**

Water Added at the Grade

(15 ÷ 7) x 8.33 = **18 lb**

Total Water

192 + 18 + 43 + 8 = **261 lb**

3. W/C

261÷ 571 = .457

Solution 7

Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ______________________ County : __________

Mix No.: B-4-C15 Pounds Cement: 492

1st Adjusted lbs. Cement: 418 Source: __________ Sp. Gr.: 3.14

IM 491.17 Fly Ash: 74 Source: __________ Sp. Gr.: 2.65

IM 491.14 Slag GGBFS: __________ Source: __________ Sp. Gr.: __________

2nd Adjusted lbs. Cement: 418

Total Cementitious 492

IM T203 Fine Aggregate Source: __________ Sp. Gr.: 2.66
IM T203 Interm. Aggregate Source: __________ Sp. Gr.: __________
IM T203 Coarse Agregate Source: __________ Sp. Gr.: 2.71

Basic w/c 0.536 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 264
Max w/c 0.600 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 295

Absolute Volumes

Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.079
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.017
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.157
Air			0.060
	Subtotal	=	0.313
	1.000 - Subtotal	=	0.687
	Total	=	1.000

% FA Agg.: 50 — Fine Aggregate (1.000 - Subtotal) X % In Mix = 0.343
% In. Agg.: ______ — Interm. Aggregate (1.000 - Subtotal) X % In Mix = ______
% CA Agg.: 50 — Coarse Aggregate (1.000 - Subtotal) X % In Mix = 0.344
Aggregate Total = 0.687

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1537

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

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1571

Summary

Cement	418	(lbs/cy)
Fly Ash	74	(lbs/cy)
Slag		(lbs/cy)
Water	264	(lbs/cy)
Fine Agg.	1537	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1571	(lbs/cy)

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

Solution 7

Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________ County : ______

Mix No.: D-57-F15 Pounds Cement: 709

1st Adjusted lbs. Cement: 603 Source: ______ Sp. Gr.: 3.14

IM 491.17 Fly Ash: 106 Source: ______ Sp. Gr.: 2.60

IM 491.14 Slag GGBFS: ______ Source: ______ Sp. Gr.: ______

2nd Adjusted lbs. Cement: 603

Total Cementitious 709

IM T203	Fine Aggregate Source:		Sp. Gr.: 2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:
IM T203	Coarse Agregate Source:		Sp. Gr.: 2.71

Basic w/c 0.423 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 300

Max w/c 0.450 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 319

Absolute Volumes				
	Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.114
	Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.024
	Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
	Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.178
	Air			0.060
		Subtotal	=	0.376
		1.000 - Subtotal	=	0.624
		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	=	0.312
	Aggregate Total	=	0.624

Aggregate Weights			
	Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1398
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1425

Summary

Cement	603	(lbs/cy)
Fly Ash	106	(lbs/cy)
Slag		(lbs/cy)
Water	300	(lbs/cy)
Fine Agg.	1398	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1425	(lbs/cy)

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

Solution 8

Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: Problem 9 County : ____

Mix No.: C-3WR-C15-S35 Pounds Cement: 571

	1st Adjusted lbs. Cement:	485	Source: Lafarge I/II	Sp. Gr.:	3.14
IM 491.17	Fly Ash:	86	Source: Louisa	Sp. Gr.:	2.68
IM 491.14	Slag GGBFS:	170	Source: Lafarge Newcem	Sp. Gr.:	2.93
	2nd Adjusted lbs. Cement:	315			
	Total Cementitious	571			

IM T203	Fine Aggregate Source:	A37514	Sp. Gr.:	2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:	
IM T203	Coarse Agregate Source:	A94002	Sp. Gr.:	2.65

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)	=	0.060
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.019
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.034
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	=	1371
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1674

Summary

Cement	315	(lbs/cy)
Fly Ash	86	(lbs/cy)
Slag	170	(lbs/cy)
Water	246	(lbs/cy)
Fine Agg.	1371	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1674	(lbs/cy)

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

800240E computer VER 1-06

PCC Plant Report

Date of Placement		Location From	Location To
Mix 1	10/19/06		
Mix 2	10/19/06		
Mix 3			
Mix 4			
Mix 5			

Project No.: FM91(15)-56-91
Plant Name: Jensen - R63 & Hwy.92
Contractor: Irving F. Jensen
Weather: Sunny-cool

Contract ID: 73912
County: Warren
Temp. (°F) Min: 40
Temp. (°F) Max: 65

Report No.: 9
Date This Report: 10/19/06
Date Of Last Report: 10/18/01
Structures Des. No.:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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	1,011.50		3.3	2.65	1,380				0.5	2.68	1,702	571			1,427		1,711	56	175.0		0.404	0.489
2	C-3WR	425.00		3.0	2.65	1,380				0.3	2.68	1,702	571			1,423		1,707	48	173.0		0.387	0.489
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total To Date
Check One (X)	X		
Concrete (CY):	1,436.50		
Cement (tons):	410.12		

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

	Brand / Source	Rate	Lot Number
Air Entraining:	AEA-15/Sika	4.5 oz./yd.	J60038M
Water Reducer:	Plastocrete 161	2 oz./100#	J60011P
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	1	3.14	Ash Grove
Fly Ash:			
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													

	Source	T-203 A #	Grad. No.
Coarse:		A25512	3
Intermediate:			
Fine:		A77522	1

Remarks

Distribution: ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

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SOLUTION #9

SOLUTION #9

Rev 02/01 | Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: FM91(15)-56-91 **County :** Warren

Mix No.: C-3WR **Pounds Cement:** 571

1st Adjusted lbs. Cement:	571	Source:	Ash Grove 1	Sp. Gr.:	3.14
IM 491.17 Fly Ash:		Source:		Sp. Gr.:	
IM 491.14 Slag GGBFS:		Source:		Sp. Gr.:	
2nd Adjusted lbs. Cement:	571				
Total Cementitious					

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) = 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)	=	0.108
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.146
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 Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1380
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1702

Summary

Cement	571	(lbs/cy)
Fly Ash		(lbs/cy)
Slag		(lbs/cy)
Water	246	(lbs/cy)
Fine Agg.	1380	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1702	(lbs/cy)

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

800240E computer VER 1-06

PCC Plant Report

Solution #11

Date of Placement		Location From	To
Mix 1	6/18/06		
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: FN-63-1(26)--38-63
Plant Name: Manatt's Hwy 146
Contractor: Manatt's Inc.
Weather: Warm-Cloudy

Contract ID: 28634
County: Jefferson
Temp. (°F) Min: 68
Temp. (°F) Max: 83

Report No.: 4
Date This Report: 06/18/06
Date Of Last Report: 06/17/06
Structures Des. No.:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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-4-C20	500.00		2.7	2.65	1,473				0.2	2.66	1,479	499	125		1,514		1,482	44	240.0		0.455	0.488
2																							
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total To Date
Check One (X)	X		
Concrete (CY):	500.00		
Cement (tons):	124.75		

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd.	399034
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	I/II	3.14	Ash Grove
Fly Ash:	C	2.70	Louisa Generating
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													

	Source	T-203 A #	Grad. No.
Coarse:	Moscow 3i	A70002	3
Intermediate:			
Fine:	Hoffman	A90504	1

Remarks

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C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

Distribution: ____ DME ____ Proj. Eng. ____ Plant

SOLUTION #10

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

SOLUTION #10

Form E820150E

Project No.: FN-63-1(26)--38-63 County : Jefferson

Mix No.: C-4-C20 Pounds Cement: 624

1st Adjusted lbs. Cement:	499	Source:	Ash Grove I/II	Sp. Gr.:	3.14
IM 491.17 Fly Ash:	125	Source:	Louisa Generating	Sp. Gr.:	2.70
IM 491.14 Slag GGBFS:		Source:		Sp. Gr.:	
2nd Adjusted lbs. Cement:	499				
Total Cementitious	624				

IM T203	Fine Aggregate Source:	Hoffman A90504	Sp. Gr.:	2.65
IM T203	Interm. Aggregate Source:		Sp. Gr.:	
IM T203	Coarse Agregate Source:	Moscow 3i A70002	Sp. Gr.:	2.66

Basic w/c 0.430 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 268

Max w/c 0.488 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 305

Absolute Volumes

Cement	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.094
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.027
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.159
Air			0.060
	Subtotal	=	0.340
	1.000 - Subtotal	=	0.660
	Total	=	1.000

% FA Agg.:	50	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	0.330
% In. Agg.:		Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	
% CA Agg.:	50	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	0.330
		Aggregate Total	=	0.660

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1473
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1479

Summary

Cement	499	(lbs/cy)
Fly Ash	125	(lbs/cy)
Slag		(lbs/cy)
Water	268	(lbs/cy)
Fine Agg.	1473	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1479	(lbs/cy)

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

800240E computer VER 1-06

PCC Plant Report

Solution #12

Date of Placement		Location From	To
Mix 1	8/6/06		
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: BROS-68(22)10
Plant Name: American Concrete - Carroll
Contractor: Iowa Culvert Builders
Weather: Warm-Dry

Contract ID: 28634
County: Carroll
Temp. (°F) Min: 72
Temp. (°F) Max: 85

Report No.: 1
Date This Report: 08/06/06
Date Of Last Report:
Structures Des. No: 517

Check Mix(x)		Check One(x)		SEND
Central		Paving		(Daily)
Ready	X	Structure	X	(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	Mix	Batched (CY)	% Of Est. Used	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 Per cy (in pounds) 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-C20S35	77.00		3.1	2.66	1,371				0.8	2.64	1,668	297	114	160	1,415		1,681	57	180.0	18.0	0.447	0.489
2																							
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total
Check One (X)		X	To Date
Concrete (CY):		77.00	
Cement (tons):		11.43	

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd.	3890334
Water Reducer:	Plastocrete 161	2 oz./100#	5577882
Retarder:			
Calcium Chloride:			
Superplasticizer:			

10-17

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

	Type	Sp. Gr.	Source
Cement:	I/II	3.14	Ash Grove
Fly Ash:	C	2.79	Burlington
GGBFS:		2.87	Holcim-Grancem

Adjusted % Passing Calculated Combined Gradation

	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Within Target
Target													

	Source	T-203 A #	Grad. No.
Coarse:		A57018	3
Intermediate:			
Fine:		A53508	1

SOLUTION #11

Remarks

Distribution: ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: John Doe NW000
Monitor: Mike Brown NW999

SOLUTION #11

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Form E820150E

Project No.: BROS-68(22)10 County : Carroll

Mix No.: C-3WR-C20S35 Pounds Cement: 571

	1st Adjusted lbs. Cement:	457	Source:	Ash Grove I/II	Sp. Gr.:	3.14
IM 491.17	Fly Ash:	114	Source:	Burlington	Sp. Gr.:	2.79
IM 491.14	Slag GGBFS:	160	Source:	Holcim-Grancem	Sp. Gr.:	2.87
	2nd Adjusted lbs. Cement:	297				
	Total Cementitious	571				

IM T203	Fine Aggregate Source:		Sp. Gr.:	2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:	
IM T203	Coarse Agregate Source:		Sp. Gr.:	2.64

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)	=	0.056
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.024
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.033
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	=	1371
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1668

Summary

Cement	297	(lbs/cy)
Fly Ash	114	(lbs/cy)
Slag	160	(lbs/cy)
Water	246	(lbs/cy)
Fine Agg.	1371	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1668	(lbs/cy)

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

800240E computer VER 1-06

PCC Plant Report

Solution #13

Date of Placement		Location From	To
Mix 1	9/17/06		
Mix 2	9/17/06		
Mix 3			
Mix 4			
Mix 5			

Project No.: STP-64(12)28-58
Plant Name: Carlson's - Hwy 218 & F62
Contractor: Fred Carlson Co.
Weather: Sunny-hot

Contract ID: 67592
County: Louisa
Temp. (°F) Min: 69
Temp. (°F) Max: 87

Report No.: 4
Date This Report: 09/17/06
Date Of Last Report: 09/16/06
Structures Des. No.:

Check Mix(x)		Check One(x)		SEND
Central	X	Paving	X	(Daily)
Ready		Structure		(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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-C20	1,256.00		3.1	2.66	1,380				0.7	2.62	1,664	451	113		1,424		1,676	56	175.0		0.409	0.489
2	C-3WR-C20	1,384.00		2.8	2.66	1,380				0.5	2.62	1,664	451	113		1,420		1,672	48	190.0		0.422	0.489
3																							
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Check One (X)	Batched Today X	Week	Total To Date
Concrete (CY):	2,640.00		
Cement (tons):	595.32		

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

	Brand / Source	Rate	Lot Number
Air Entraining:	Ad/Aire	5.0 oz./yd.	233998
Water Reducer:	Daratard 17	3 oz./100#	5577882
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	1SM	3.10	LaFarge
Fly Ash:	C	2.64	Council Bluffs#3
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													

	Source	T-203 A #	Grad. No.
Coarse:		A57004	3
Intermediate:			
Fine:		A58504	1

Remarks

Distribution: ____ DME ____ Proj. Eng. ____ Plant

C.P.I.: John Doe SE000
Monitor: Mike Brown SE999

SOLUTION #12

SOLUTION #12

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Office Of Materials

PORTLAND CEMENT CONCRETE

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

Mix No.: C-3WR-C20 Pounds Cement: 564

1st Adjusted lbs. Cement: 451 Source: LaFarge 1SM Sp. Gr.: 3.10

IM 491.17 Fly Ash: 113 Source: Council Bluffs#3 Sp. Gr.: 2.64

IM 491.14 Slag GGBFS: ____ Source: ____ Sp. Gr.: ____

2nd Adjusted lbs. Cement: 451

Total Cementitious 564

IM T203	Fine Aggregate Source:		Sp. Gr.: 2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:
IM T203	Coarse Agregate Source:		Sp. Gr.: 2.62

Basic w/c 0.430 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 243

Max w/c 0.489 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 276

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) / (1.00 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 Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1380
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1664

Summary

Cement	451	(lbs/cy)
Fly Ash	113	(lbs/cy)
Slag		(lbs/cy)
Water	243	(lbs/cy)
Fine Agg.	1380	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1664	(lbs/cy)

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

800240E computer VER 1-06

PCC Plant Report

Solution #14

Date of Placement		Location From	To
Mix 1	8/6/06		
Mix 2	8/6/06		
Mix 3	8/6/06		
Mix 4			
Mix 5			

Project No.: STP-53-4(15)--2C-53
Plant Name: Kirk Ready Mix
Contractor: Kirk Const.
Weather: Sunny/Warm

Contract ID: 4920
County: Jones
Temp. (°F) Min: 65
Temp. (°F) Max: 85

Report No.: 1
Date This Report: 08/06/06
Date Of Last Report:
Structures Des. No: 4920

Check Mix(x)		Check One(x)		SEND
Central		Paving		(Daily)
Ready	X	Structure	X	(Weekly)
		Incidental		(Weekly)
		Patching		(Weekly)

	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	Water Grade	Avg w/c Ratio	Max w/c Ratio
1	C-3WR-C15S35	182.00		3.7	2.66	1,376				0.7	2.66	1,681	315	86	170	1,429		1,693	65	175.0	19.0	0.453	0.489
2	C-4-C15	35.00		3.4	2.66	1,479				0.8	2.66	1,483	530	94		1,531		1,495	64	183.0	25.0	0.436	0.488
3	M-4	14.00		3.4	2.66	1,394				0.8	2.66	1,398	825			1,443		1,409	60	252.0	14.0	0.396	0.400
4																							
5																							

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
	100	95-100		25-60		0-10	0-5	0-1.5	Y/N

Conc. Treatment	(X)	lb / cy
Ice		
Heated Water		
Heated Materials		

Batched	Today	Week	Total
Check One (X)		X	To Date
Concrete (CY):		231.00	
Cement (tons):		43.72	

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

10-21

	Brand / Source	Rate	Lot Number
Air Entraining:	Daravair 1400	3 oz./yd.	AA9912
Water Reducer:	WRDA w/Hycol	3.0 oz/100#	AWR99915
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	II	3.14	LaFarge
Fly Ash:	C	2.79	Burlington
GGBFS:	120	2.93	NewCem

Adjusted % Passing Calculated Combined Gradation

	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	Within Target
Target													

	Source	T-203 A #	Grad. No.
Coarse:		A53004	3
Intermediate:			
Fine:		A53502	1

SOLUTION #13

Remarks

C.P.I.: John Doe NE000
Monitor: Jane Doe NE999

Distribution: ____ DME ____ Proj. Eng. ____ Plant

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Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: STP-53-4(15)--2C-53 County : Jones

Mix No.: C-3WR-C15S35 Pounds Cement: 571

	1st Adjusted lbs. Cement:	485	Source:	LaFarge II	Sp. Gr.:	3.14
IM 491.17	Fly Ash:	86	Source:	Burlington	Sp. Gr.:	2.79
IM 491.14	Slag GGBFS:	170	Source:	NewCem	Sp. Gr.:	2.93
	2nd Adjusted lbs. Cement:	315				
	Total Cementitious	571				
IM T203	Fine Aggregate Source:				Sp. Gr.:	2.66
IM T203	Interm. Aggregate Source:				Sp. Gr.:	
IM T203	Coarse Agregate Source:				Sp. Gr.:	2.66

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)	=	0.060
Fly Ash	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.018
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	0.034
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.146
Air			0.060
	Subtotal	=	0.318
	1.000 - Subtotal	=	0.682
	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	=	0.375
		Aggregate Total	=	0.682

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1376
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1681

Summary

Cement	315	(lbs/cy)
Fly Ash	86	(lbs/cy)
Slag	170	(lbs/cy)
Water	246	(lbs/cy)
Fine Agg.	1376	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1681	(lbs/cy)

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

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SOLUTION #13

Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: STP-53-4(15)-2C-53 County : Jones

Mix No.: C-4-C15 Pounds Cement: 624

	1st Adjusted lbs. Cement:	530	Source:	Sp. Gr.:	3.14
IM 491.17	Fly Ash:	94	Source:	Sp. Gr.:	2.79
IM 491.14	Slag GGBFS:		Source:	Sp. Gr.:	
	2nd Adjusted lbs. Cement:	530			
	Total Cementitious	624			

IM T203	Fine Aggregate Source:	Sp. Gr.:	2.66
IM T203	Interm. Aggregate Source:	Sp. Gr.:	
IM T203	Coarse Agregate Source:	Sp. Gr.:	2.66

Basic w/c 0.430 Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 268

Max w/c 0.488 Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) = 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)	=	0.020
Slag	(lbs/cy) / (Sp. Gr. X 62.4 X 27)	=	
Water	(lbs/cy) / (1.00 X 62.4 X 27)	=	0.159
Air			0.060
	Subtotal	=	0.339
	1.000 - Subtotal	=	0.661
	Total	=	1.000

% FA Agg.:	50	Fine Aggregate (1.000 - Subtotal) X % In Mix	=	0.330
% In. Agg.:		Interm. Aggregate (1.000 - Subtotal) X % In Mix	=	
% CA Agg.:	50	Coarse Aggregate (1.000 - Subtotal) X % In Mix	=	0.331
		Aggregate Total	=	0.661

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1479
Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1483

Summary

Cement	530	(lbs/cy)
Fly Ash	94	(lbs/cy)
Slag		(lbs/cy)
Water	268	(lbs/cy)
Fine Agg.	1479	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1483	(lbs/cy)

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

SOLUTION #13

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Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: STP-53-4(15)-2C-53 County : Jones

Mix No.: M-4 Pounds Cement: 825

	1st Adjusted lbs. Cement:	825	Source:		Sp. Gr.: 3.14
IM 491.17	Fly Ash:		Source:		Sp. Gr.:
IM 491.14	Slag GGBFS:		Source:		Sp. Gr.:
	2nd Adjusted lbs. Cement:	825			
	Total Cementitious				

IM T203	Fine Aggregate Source:		Sp. Gr.: 2.66
IM T203	Interm. Aggregate Source:		Sp. Gr.:
IM T203	Coarse Agregate Source:		Sp. Gr.: 2.66

Basic w/c	0.328	Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =	271
Max w/c	0.400	Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =	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) / (1.00 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 Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1394
	Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	
	Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27	=	1398

Summary

Cement	825	(lbs/cy)
Fly Ash		(lbs/cy)
Slag		(lbs/cy)
Water	271	(lbs/cy)
Fine Agg.	1394	(lbs/cy)
Interm. Agg.		(lbs/cy)
Coarse Agg.	1398	(lbs/cy)

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

Solution 14

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 15

1480 batches x 492 lb/batch = 728,160 lb ÷ 2000 lb/ton = **364.08 ton**

500 batches x 571 lb/batch = 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 = **1.50 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 16

Given:

Cement Yield

Tons Billed = 902.38

Number of Batches = 3180

571 lb cement per yd^3

Solution and Answer

Total Tons Batched = $\frac{3180 \times 571}{2000}$ = **907.89**

Cement Yield = $\frac{907.89 \text{ batched}}{902.38 \text{ billed}} \times 100 =$ **100.6%**

Iowa Department of Transportation
Technical Training and Certification Program

COURSE EVALUATION SHEET

In an effort to improve the Iowa DOT Technical Training and Certification Program, we ask that you fill out this evaluation form after you have taken the exam. Thank you for your cooperation.

Course: ______________________ Location: _____________________

Instructor: ____________________

1. What type of agency are you employed by?

 ____

2. Please rate the following portion of the course on a scale of 1-5. 1 = Poor, 5 = Excellent

 Facility: ________________

 Material: _______________

 Instructors: _____________

 Course Activities: _________
 (lectures, videos, demonstrations, etc.)

3. Are there any changes you would like to see made in the course?

 ____

 ____

REMARKS: