LEVEL II PORTLAND CEMENT CONCRETE

2001-2002

TECHNICAL TRAINING & CERTIFICATION PROGRAM

Iowa Department
of Transportation

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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:

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 (I.M.)

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, which you should have already received in Level I PCC. The PCC Reference Book is a good tool for technicians and contains the I.M.s and Specifications needed to perform inspection and testing of Portland Cement Concrete. **NOTE:** I.M.s and Specifications are updated each spring and fall and the technician should always make sure the most current I.M.s and specifications are in the Reference Book.

Remember to check for I.M. and Specification changes each spring and fall to update your PCC Reference Manual

II. Certification Program for Certified Plant Technicians

I.M. 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!

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

D. Responsibilities

I.M. 213

The Certified Plant Technician shall:

- Sample
- Test
- Perform prescribed inspections
  All at the specified frequencies

The Project Engineer will:

- Be responsible for monitoring inspections
- Be responsible for Quality Control

UNSATISFACTORY PERFORMANCE NOTICE

Issued To: ______________________________ Date: ______________

____

____

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

____

____

____

____

____

____

____

____
District Materials Engineer

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

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 and 214, 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.

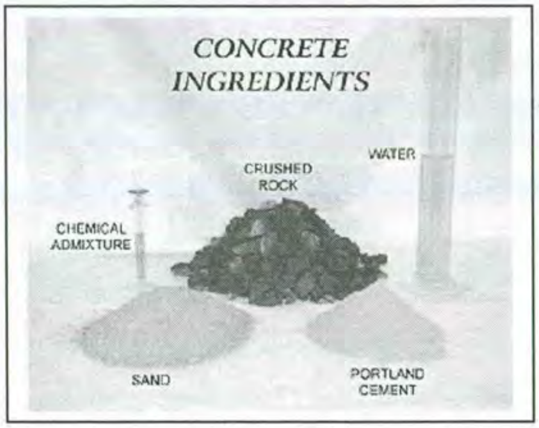
2521.04 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

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.

NOTE: This specification will be changed to take out the reference to I.M. 214.

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

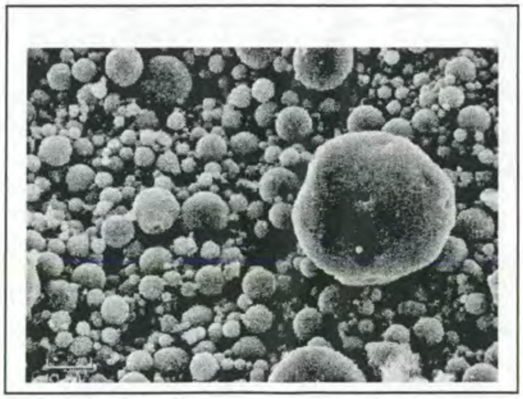
Type I used for most highway work and structures. Type II required on paving, except transit mix furnished less than 3000 m^2 (3600 yd^2). Type III ground finer than Type I cement. Blended cements may be furnished at Contractor's option when Type I or II is specified.

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

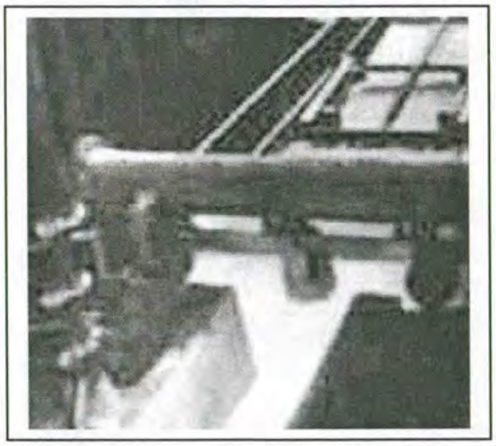
- Class C Fly Ash
  - Cementing
  - High Lime (CaO)
- Class F Fly Ash
  - Non-cementing
  - Low Lime (CaO)

Approved sources of each are listed in I.M. 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

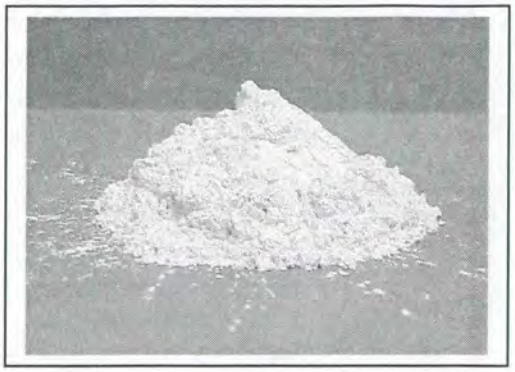
3. Ground Granulated Blast Furnace Slag (GGBFS) - Article 4108



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 I.M. 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

- I.M. T-203

5. Water - Article 4102

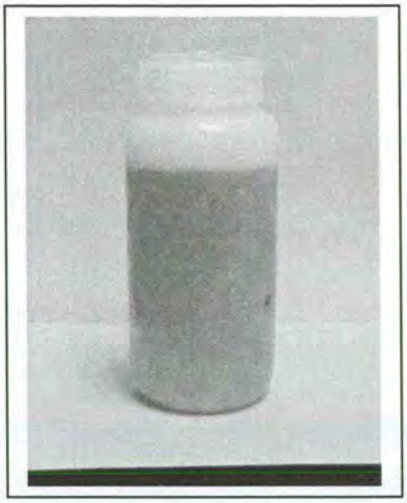
The water used in batching concrete can come from almost any source. Each source must be tested and approved if it is not potable. Often lakes or streams are used because they are close to the project. This water must meet hardness, alkalinity, and acidity requirements. During the summer, warm water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



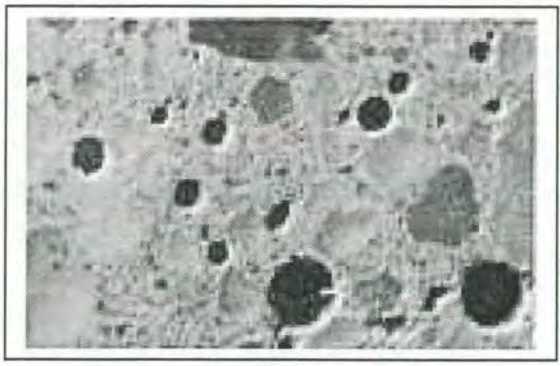
Reasons for using admixtures are:

- 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.

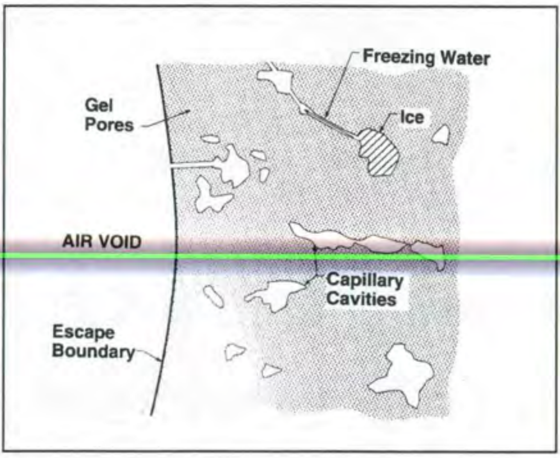


- Freeze Thaw Durability
- Increase Workability

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

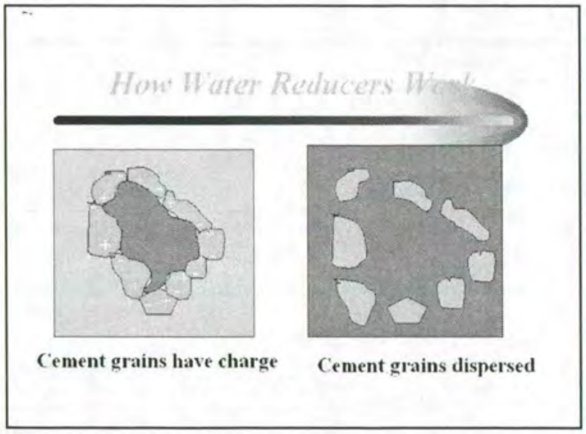
Without air voids, the repeated freezing and thawing will damage the concrete. This damage is increased with deicing salts.

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
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**

X 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**

X 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**

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

X Example: 10 square meters is 10 m^2

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

Example: 5 cubic meters is 5 m^3

4. **Product and Quotient**

X 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

X 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**

X 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 the 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.

Below 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)* mile (international) yard foot (U.S. Survey)* foot (international) inch	km km m m m mm	1.609347 1.609344** 0.9144** 0.3048006 0.3048** 25.4**
Area	square mile (U.S. Statute)* square mile (international) acre (U.S. Statute)* square yard square foot square inch	km^2 km^2 m^2 ha (10,000 m^2) m^2 m^2 mm^2	2.589998 2.589988 4046.873 0.4046873 0.83612736** 0.09290304** 645.16**
Volume	acre foot (U.S. Survey)* cubic yard cubic foot 100 board feet gallon cubic inch	m^3 m^3 m^3 cm L (1000 cm^3) m^3 L cm^3 mm^3	1233.489 0.76455486 0.02831685 28316.85 28.31685 0.2359737 3.785412 16.387064** 16387.064**
Mass	Pound kip (1000 pounds)	kg Mg (1000 kg)	0.45359237** 0.45359237**
Temperature	°F	°C	Formula: °C = (°F - 32))1.8**

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

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 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; - 1.3 yd;
1 m; - 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 $50 \text{ ft x } 0.3048 \frac{\text{m}}{\text{ft}} = 15.24 \text{ m}$

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 $30 \text{ ft5 x } 0.0929 \frac{m^2}{ft^2} = 2.79 \text{ m}^2$

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

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 $94\ lb \text{ x } 0.4536 \frac{kg}{lb} = 42.64\ kg$

Temperature:

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

To convert Farenheit to Centigrade: $°F = (°C \text{ x } 1.8) + 32$

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

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

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 = 8.34 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

I.M. 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 I.M. T-203 - determine
    1. Sample splitter
    2. Immerse (+ #4 sieve) in water for period of not less than 15 hours

I.M. 308 Free Moisture and Absorption of Aggregates

- Same as I.M. 307 except test sample is wet as received
- Needed to determine moisture content of aggregates

TEST FREQUENCY

Lot System

A. Paving Plant

1. One lot is one day's work

B. Ready Mix Plant

1. One lot is one day's run, 228.6m^2 (250 yd^2) or 1 weeks work whichever is greater)

Specific Gravity

A. Paving Plants

1. One sample (each aggregate) per day for the first 3 days
    a. It is a good idea to try to test each aggregate before the work begins.

1. 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

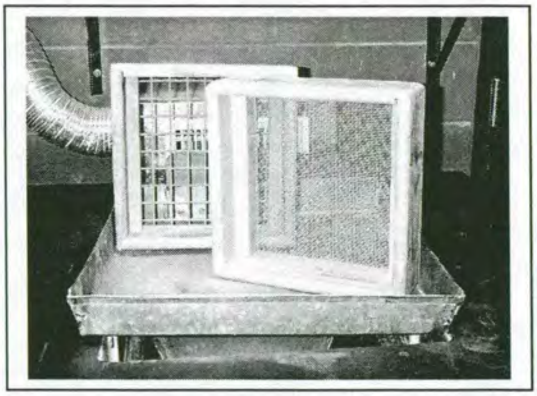
2. Moisture shall not vary, between batches by more than 0.5%

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

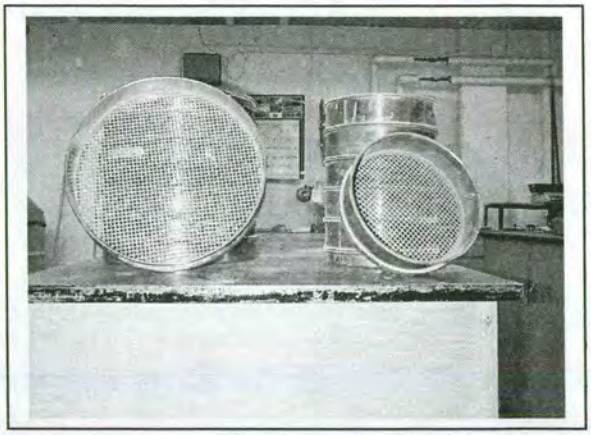


B. Test the first sample taken from each lot.

1. Split this sample. CPI tests half, the other half if to be bagged, identified on a 193 form, tagged and delivered promptly to the District Materials Laboratory.
    a. Samples should be put in a cloth bag or other approved container for delivery.

    b. The 193 form shall include the following information; contractor, project number, county, date sampled, material source, plant name, and gradation number.

    c. Tags shall be labeled with: contractor name, project number, county, and date sampled.



2. If a CPI sample fails, both backup samples must be tested.
    a. Split the backup samples and deliver half to the District Materials Laboratory; CPI tests the other half.

    b. Average the 3 gradations for advisory spec. compliance.

3. If a monitor sample fails, both backup samples must be tested.
    a. Split the backup samples and deliver half to the District Materials Laboratory; CPI tests the other half.

4. If the CPI sample passes, roll a die to determine if a backup sample needs to be tested.
    a. If the die number indicates the same day of the week the sample was taken, a backup sample must be tested.
        1. 1 =Monday, 2 = Tuesday, etc.

    b. Roll the die again to determine which backup sample to test.
        1. Even numbers indicate second sample, odd numbers indicate third sample.

    c. If a backup sample fails, test the other backup sample and average or advisory spec. compliance.

    c. All samples to be tested by the CPI must be split and half the sample delivered to the District Materials Laboratory.

5. A lot is accepted by the contracting authority's gradation results.
    - a. Must correlate with contracting agency – I.M. 216
    - b. CPI must keep all gradations until each lot is accepted.
    - c. Plant Monitor
        1. Witness sampling and splitting procedure on at least one of the first three samples tested of each aggregate.
        2. Witness a minimum of 10% of each aggregate thereafter.
        3. All witnessed samples are to be documented with the date and signature on the 193 form and a large W on the sample tag.
    - d. Contracting Authority
        1. Shall test the first three samples of each aggregate and a minimum of 10% of the remaining samples of each aggregate.
        2. Companion samples to failing process control samples shall be tested.
        3. If a monitor test fails, both backup samples shall be tested and the three tests averaged for spec.

compliance. When a sample is accepted, without question, by the contracting authority, all previous lots not tested are accepted.

    i. Samples representing accepted lots may be thrown out.

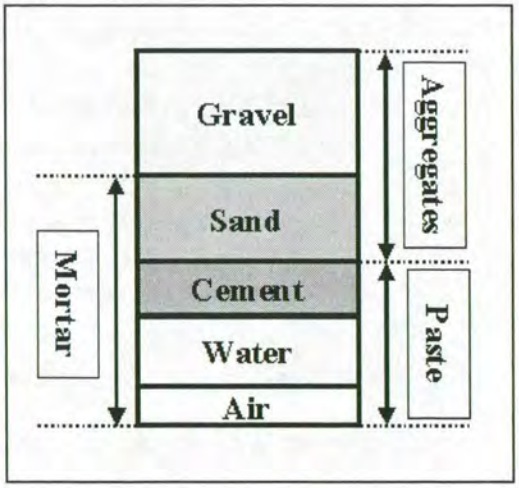
e. CPI be careful with gradations

    1. If a sample result is near the specification limits, the CPI should inform the contractor and the contracting authority so they can increase monitor frequency.

        a. If the contracting authority's sample fails, previous lots will be tested to determine penalty assessment.

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



I.M. 529

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

Source Information

To find specific gravities, source name, etc.

- I.M. 401 - Cement sources
- I.M. 491.14 - GGBFS sources
- I.M. 491.17 - Fly ash sources
- I.M. T-203 - Aggregate sources
- I.M. 403 - Admixtures

Type 1 cement 3.14

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

Cement Ground Fly ash & slag

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

- 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

p 6 of 7

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

Batch Weights - SSD

Cement weight = $0.108 \times 3.14 \times 62.4\ \text{lbs/ft}^3 \times 27\ \text{ft}^3/\text{yd}^3$ = 571 lbs. per cubic yard

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

Fine agg. = $0.309 \times 2.65 \times 62.4\ \text{lbs/ft}^3 \times 27\ \text{ft}^3/\text{yd}^3$ = 1380 lbs. per cubic yard

Coarse agg. = $0.377 \times 2.65 \times 62.4\ \text{lbs/ft}^3 \times 27\ \text{ft}^3/\text{yd}^3$ = 1683 lbs. per cubic yard

Maximum Water

= $0.489 \times 571\ \text{lbs./yd}^3 = 279\ \text{lbs./yd}^3$

Total water allowed including moisture in aggregates

Mineral Admixture Substitution

- Weight replacement (not volume)
- Pound for pound basis (1:1)
- Fly Ash – 15% maximum
- GGBFS – 35% Maximum - slag
- 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

p228 Fly Ash Std Spec 2001

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
15% fly ash substitution
Assume 2.59 Sp. G. for fly ash

carryout only 3 places

571 lbs. per cubic yard × 0.15 = 86 lbs. fly ash
571 – 86 = 485 lbs. cement

Abs. Vol. Cement = 485 ÷ 3.14 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/yd^3 = 0.0917
Abs. Vol. Fly Ash = 86 ÷ 2.59 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.0197

Weight Water = 0.43 × 571 = 245.53 lbs. per cubic yard
Abs. Vol. Water = 245 ÷ 1.00 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/yd^3 = 0.145
Abs. Vol. Air = 0.060

Abs. Vol. = 0.3164
1 – Subtotal = 0.6836

%Coarse = 0.55 × 0.6836 = 0.376
%Fine = 0.6836-0.376 = 0.3076

Fine agg. = 0.3076 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1373 lbs. per cubic yard
Coarse agg. = 0.376 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1679 lbs. per cubic yard

Check to make sure Absolute Volumes = 1.00

Cement	0.0917
Fly Ash	0.0197
Water	0.145
Air	0.060
Coarse	0.376
Fine	0.3076
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 = 0.0595
Abs. Vol. Fly Ash = 86 ÷ 2.59 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.0197
Abs. Vol, GGBFS = 170 ÷ 2.88 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/ yd^3 = 0.035

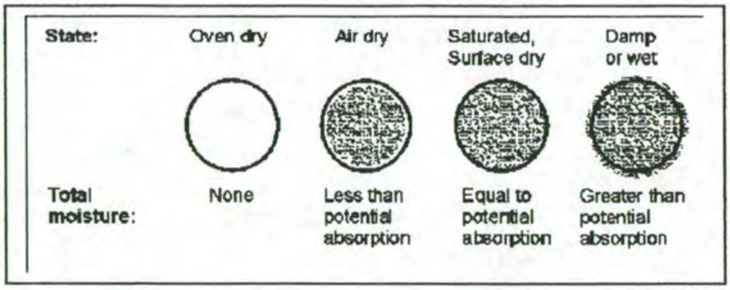
Weight Water = 0.43 × 571 = 245 lbs. per cubic yard
Abs. Vol. Water = 245 ÷ 1.00 ÷ 62.4 lbs/ft^3 ÷ 27 ft^3/yd^3 = 0.145
Abs. Vol. Air = 0.060

Abs. Vol. = 0.3192
1 – Subtotal = 0.6808

%Coarse = 0.55 × 0.6808 = 0.3744
%Fine = 0.6806-0.3744 = 0.3062

Fine agg. = 0.3062 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1367 lbs. per cubic yard
Coarse agg. = 0.3744 × 2.65 × 62.4 lbs/ft^3 × 27 ft^3/yd^3 = 1672 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. = 1652 lbs.
Fine Agg. = 1348 lbs.
Water = 259 lbs.

Assume

Coarse Aggregate Moisture = 0.3%
Fine Aggregate Moisture = 3.1%

Wet Batch Wt., Coarse

$$\frac{1652\ \text{lbs.}}{(100 - 0.3)} \times 100 = 1657\ \text{lbs.}$$

Wet Batch Wt., Fine

$$\frac{1348\ \text{lbs.}}{(100 - 3.1)} \times 100 = 1391\ \text{lbs.}$$

Adjust Water

Coarse
Wet Batch Weight – Dry batch weight
1657 – 1652 = 5 lbs.

Fine
1391 – 1348 = 43 lbs.

259 – 5 - 43 = 211 lbs.

Example 2 - SSD Batch Weights

Coarse Agg. = 1683 lbs.
Fine Agg. = 1380 lbs.
Water = 246 lbs.

Assume

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

Wet Batch Wt., Coarse

$\frac{1683 \text{ lbs.}}{(100 -(- 0.5)} \times 100 = 1674$ lbs.

Wet Batch Wt., Fine

$\frac{1380 \text{ lbs.}}{(100 - 3.1)} \times 100 = 1424$ lbs.

Adjust Water

Coarse
Wet Batch Weight – Dry batch weight
1674 – 1683 = -9 lbs.

Fine
1424 – 1380 = 44 lbs.

246 – (-9) + 44 = 211 lbs.

Alternate Method to Compute Wet Weights

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

Fine Aggregate:
1348 x 1.0319917 = 1391 lbs.
Coarse Aggregate:
1652 x 1.0030090 = 1657 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.

PROBLEM 1

basic 0.159 x 62.4 x 27 = 268 = 32.2 gal

basic H2O 0.536 = 263.7 = 31.6 gal

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

mix H2O 0.600
.6 x 492 = 295.2 = 35.4 gal

Specific Gravity
Cement 3.14 x 0.093 = 492
Fine Agg. 2.66 x 0.345 = 1546
Coarse Agg. 2.68 x 0.345 = 1558

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.

2952
54.0
241.2
8.333 = 28.9 max H

264 - 54 = 209.7
8.333 = 25.2 gal basic

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

1595 - 1546 = 49
1563 - 1558 = 5
54

C. Compute the wet batch weights using reciprocal tables. Use the aggregate moisture from Part B.

Note: Do not use the difference rows; they are for interpolation. Page 3 of 3 is for very dry aggregate in an absorptive condition. Water must be added to aggregate to reach saturated surface dry condition (SSD).

Water to nearest tenth

PROBLEM 2

EXAMPLE PROBLEM

FIGURE THE DRY BATCH WEIGHTS OF A C-4 –C15 MIX USING FORM 820150.

THE SOURCES ARE LISTED BELOW.

Continental Cement Co. Type I - 3.14

American Fly Ash - Louisa Generating Station 2.68

Coarse Aggregate - Kuhlman Const. - Gisleson Quarry - Clayton County 2.66

Fine Aggregate - Roverud Construction Co. - Bente Pit - Clayton County 2.66

FIGURE THE DRY BATCH WEIGHTS OF A C-4 MIX USING FORM 820150. THE SOURCES ARE THE SAME AS ABOVE ~~WITH THE EXCEPTION OF CEMENT~~.

C 3-C 10

Rev 02/01

Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

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

Mix No.: C4-C15 **Pounds Cement:** 624

1st Adjusted lbs. Cement: 0 118 **Source:** ______ **Sp. Gr.:** 3.14

I.M. 491.17 Fly Ash: ______ **Source:** ______ **Sp. Gr.:** 2.68

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

2nd Adjusted lbs. Cement: ______

Total Cementitious ______

I.M. T-203 Fine Aggregate Source: ______ **Sp. Gr.:** 2.66
I.M. T-203 Interm. Aggregate Source: ______ **Sp. Gr.:** —
I.M. T-203 Coarse Agregate Source: ______ **Sp. Gr.:** 2.66

Basic w/c 0.430 **Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** 268.3 = 32.2
Max w/c 0.488 **Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** 304.5 = 36.5

Absolute Volumes

Cement 530 **(lbs/cy) / (Sp. Gr. X 62.4 X 27) =** 0.100

Fly Ash 94 **(lbs/cy) / (Sp. Gr. X 62.4 X 27) =** 0.021

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

Water 268.3 **(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 (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 (0.330)

Aggregate Total = 0.660

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1479 (0.330)

Intermediate Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = — (0.330)

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)**

Distribution: ___ **Materials,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

Rev 02/01

Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____

County : ____

Mix No.: C 3 C10

Pounds Cement: 603

1st Adjusted lbs. Cement: 543 **Source:** ____ **Sp. Gr.:** 3.14

I.M. 491.17 **Fly Ash:** 60 **Source:** ____ **Sp. Gr.:** 2.68

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

2nd Adjusted lbs. Cement: ____

Total Cementitious ____

I.M. T-203 **Fine Aggregate Source:** ____ **Sp. Gr.:** 2.66
I.M. T-203 **Interm. Aggregate Source:** ____ **Sp. Gr.:** —
I.M. T-203 **Coarse Agregate Source:** ____ **Sp. Gr.:** 2.66

Basic w/c 0.430 **Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** 259.3 = 311
Max w/c 0.488 **Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** 294.3 = 353

Absolute Volumes

Cement ....543.... **(lbs/cy) / (Sp. Gr. X 62.4 X 27)** = 0.103

Fly Ash ....60.... **(lbs/cy) / (Sp. Gr. X 62.4 X 27)** = 0.013

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

Water ....259.... **(lbs/cy) / (1.00 X 62.4 X 27)** = 0.154

Air **0.060**

Subtotal = 0.330

1.000 - Subtotal = 0.670

Total = **1.000**

% FA Agg.: 45 **Fine Aggregate (1.000 - Subtotal) X % In Mix** = 0.301
% In. Agg.: ____ **Interm. Aggregate (1.000 - Subtotal) X % In Mix** = ____
% CA Agg.: 55 **Coarse Aggregate (1.000 - Subtotal) X % In Mix** = 0.369

Aggregate Total = 0.670

Aggregate Weights

Fine Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1349

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

Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1654

Summary

Cement 543 **(lbs/cy)**
Fly Ash 60 **(lbs/cy)**
Slag — **(lbs/cy)**
Water 259 **(lbs/cy)**
Fine Agg. 1349 **(lbs/cy)**
Interm. Agg. — **(lbs/cy)**
Coarse Agg. 1654 **(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 as the basis for you calculations given the following specific gravities.

SPECIFIC GRAVITIES

Cement 3.14 × 0.104 = 550
Fine Aggregate 2.66 × 0.306 = 1371
Coarse Aggregate 2.68 × 6.375 = 1693

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.

Desc - 0.474 × 550
260.7
31.3 gal

Assume Fine Aggregate moisture = 3.4% 1419 - 1371 = 48
Assume Coarse Aggregate moisture = 0.5% 1702 - 1693 = 9

57 lbs
8.333 = 68

max - 0.532
292.6
35.1 gal

$$\frac{\frac{292.6 - 57}{235.6}}{8.333} = 28.3 \text{ max } H_2O$$

$$\frac{\frac{260.7 - 57}{203.7}}{8.333} = 24.4 \text{ gals}$$

PROBLEM 4

PART 1

Compute the "dry" (saturated surface dry) batch weights for a C-4 one cubic yard mix using the following information:

Given: Absolute Volume for:

Cement	0.118
Water (basic)	0.159
Air	0.060
Fine Aggregate	0.331
Coarse Aggregate	0.332

Specific Gravity

Fine Aggregate	2.65
Coarse Aggregate	2.68

(The aggregate specific gravities are based on saturated surface dry conditions.)

PART 2

Now figure the actual or "wet" batch weights by correcting for aggregates free moisture.

Moistures:

Fine Aggregate	3.0%
Coarse Aggregate	0.7%

PART 3

Finally, determine the gallons of mixing water needed for a one cubic yard batch after deducting aggregate free moisture. Assume basic water, as computed in Part I, will meet your slump and consistency requirements.

Remember:

Weight of water per cubic foot = 62.4 lb
Weight of water per gallon = 8.33 lb
Cubic feet in a cubic yard = 27

PART 4

In addition, determine the maximum number of gallons of water that can now be added at the grade for a 7 cubic yard load.

Given:

(From Part 3) - 57 lb total free moisture in aggregate.
(From Part 3) - 211 lb mixing water
(C-4 Mix) maximum w/c ratio - 0.488

Remember:

Free water in materials	lb
(mixing water) water added at plant	lb
<u>water added at grade</u>	<u>+?</u>
Total Water	Total lb/yd^3

Cannot exceed....

Max w/c ratio = 0.488

or 0.488 x cement = maximum water lb

Suggested solution:

Work is lb/yd^3

Add free water in materials and mixing water together

Subtract total from maximum water (to nearest 0.1 lb)

Multiply by 7 (converts to lb/load)

Divide by 8.33 (converts to gallons/load)

PROBLEM 5

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	0.442 w/c
Free Water	5 gal/yd^3	
Added Water	27 gal/yd^3	
	32 = 266.66	

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

Cement	529 lb/yd^3	> 624
Fly Ash	95 lb/yd^3	= 0.481
Free Water	50 lb/yd^3	6 gal
Added Water	30 gal/yd^3	299.99

5. What is the minimum 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 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	0.442 w/c
Free Water	5 gal/yd^3	
Added Water	27 gal/yd^3	
	32 = 266.66	

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

Cement	529 lb/yd^3	> 624
Fly Ash	95 lb/yd^3	= 0.481
Free Water	50 lb/yd^3	6 gal
Added Water	30 gal/yd^3	299.99

5. **What is the minimum 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 6

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

2. **What is the total water per batch 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 7

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 batch when 23 gallons per 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 8

1. **Which weight is more, a cubic yard of B-4-C15 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.

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**

PROBLEM 9

Determine the absolute volume of a cement.

Given:

Sp.Gr. Cement	3.14
Batch size	5
Batch weight for cement	3130 lb batched

VII. Certified Plant Inspection

I.M. 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 I.M. 213
  - If test results indicate non-compliance, the Contractor is responsible for deciding corrective action, not the technician

B. Safety

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

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

C. Equipment

- Bins (Article 2001.06 and I.M. 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 I.M. 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

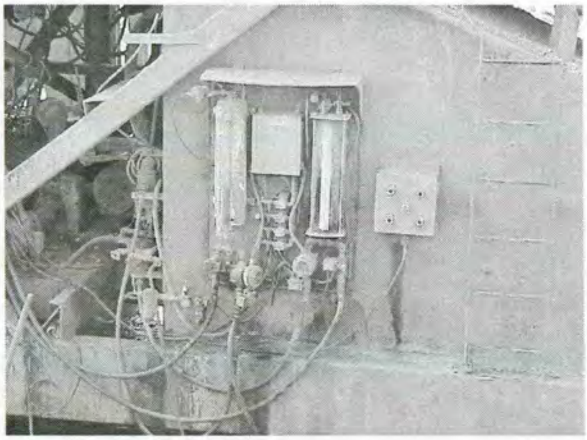
Proportioning equipment must be examined at least at 3-hour intervals for correctness of the amount being batched and for damage of the equipment

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 I.M. 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

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

- Transportation Vehicles (Article 2301.13 and I.M. 527)
  - Stationary Mixing
    - Concrete must be placed from non-agitating units within 30 minutes after discharge from mixer. If a retarding admixture is used, this time may be extended an additional 30 minutes
    - Concrete must be placed from agitating units within 90 minutes after the water and cement have made contact with each other
  - Truck Mixing
    - On truck-mounted transits with agitation, concrete must be placed within 90 minutes after the water and cement have made contact with each other. If no agitation is used, the time limit is 30 minutes

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 I.M. 403. Dosage rates are also included in this I.M. 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.

VII.Concrete paving Plant Inspection Checklist

paving

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. twice The scale sensitivity shall be checked at least ~~once~~ 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. Twice

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 meters (10,000 cubic yards) after the original determination made near the end of the first full day of production.

E. Check scale operation to determine aggregate delivery tolerance conformance at least ~~twice~~ once during a normal working day and document.

F. If water is measured with a scale, the delivery tolerance must be determined at least twice 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 - Three samples per lot. See Construction Department Instruction No. 3.22. Show sample number, name of sampler, and name of tester on lab work sheet.

N. One 508-mm (20-in.) long beam for each 1529 cubic meters (2000 cu. yd.) of concrete placed. Make flexural tests representing alternating 1529 cubic meters (2000 cu. yd.) placement units at 7 and 14 days.

O. At the plant, the plant inspector shall remove the specimens, clean the molds, oil and return the molds to the grade at the direction of the paving inspector. The plant inspector shall store the specimens until date of test. The storage space shall be a pit adequate for the project, and for normal projects it should be at least 1.2 m x 1.8 m x .46 m (4 ft. x 6 ft. x 18 in.). The specimens shall be wet at all times. If the temperature in the sand filled pit drops below 4.4°C (40°F), remove the specimens and place them under wetted burlap in a heated enclosure or in lime saturated water. See I.M. 328. **Note:** Lime-saturated water is prepared by mixing 30 ml (1 ounce) of hydrated lime with 4 L (1 gallon) of water.

P. 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

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.
- Suitable wind protection of scales

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.

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
  - Three samples per lot.
  - Day's run or 250 yd^3
  - Less than 250 yd^3 weekly
  - Bridge deck is one lot

- Small Quantities
  - Concrete placed at maximum rate of25 yd^3 per day and 75 yd^3 weekly
  - Accepted without gradation verifications, moisture tests, and specific gravities
  - Occasional air and slump tests
  - Certified Plant Inspector must certify the concrete meets specifications

- 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.

VIII. References

Instructional Memorandums

- Volume II
- Volume IV

PCC Reference Manual

- I.M.s 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-01001 – October 2001

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)

January 2001

Concrete Application	Type Conc.	Slump-In. Min.	Slump-In. Max.	Target	% Air Content Min.	% Air Content Max.	Specification Reference
Paving							
Slip Form	ABCF	N/A	N/A	See Specification			2301.04 B&C
Machine Finish	ABCF	1/2	21/2	7	6	8 1/2	2301.04 B&C
Hand Finish	ABCF	1/2	4	7	6	8 1/2	2301.04 B&C
Conc. Base (Machine Finish)	A	1/2	21/2	7	6	81/2	2301.04 & 2201
Conc. Base (Hand Finish)	A	1/2	4	7	6	81/2	2301.04 & 2201
Curb & Gutter	C		3	7	6	8	Applicable Spec. 2512.03
Sidewalk	C		4	7	6	8	2511.03
Intakes & Manholes	C	1	3	61/2	51/2	7 1/2	2403.03&2503.03D
REPAIR							
Patches With CaCl	M-4, M-V	1 3 prior to add. of CaCl	3	5	3	7	Applicable Spec. 2530.03 B& 2529
Patches Without CaCl	M or F	Target 1 to 3 Max. 4		61/2	5	8	Applicable Spec. 2530.03 B
Underseal & Grouting, Flowing Mortar				By Flow Cone			2539.03 & 2506
OVERLAYS							
Thin Bond PCC	C-4 WR, F-4 C-4 WR-C			Same as specified concrete			2310.02C
STRUCTURES							
Seal Coat	x	0	8		0	0	2405.05
Sub-Structure Super-Structure	C	Target 1 to 3 Max. 4		61/2	51/2	71/2	2403.03 A&B Applicable Spec.
Slope Protection	C	1	3	61/2	51/2	71/2	On the Plan Sheet
Piling Encased, Piling Brg. (Encased)	C	Target 1 to 3 Max. 4		61/2	51/2	71/2	2403-2501.04C-2501.19
Bridge Deck Overlay	O	Target 1/4 0 (2-4 min. delay)	1	61/2	51/2	71/2	2413.02A
Bridge Deck Class B Repair	O or D	1	3	61/2	51/2	71/2	2403.03 A&B, 2412 (2413.05)
Barrier Rail w/Overlay	D	1	3	61/2	51/2	71/2	2413.01 Applicable Spec. 2403.03B
Barrier Rail Slipform	D	0	2	61/2	51/2	71/2	Applicable Spec. 2414.02
Lightweight Conc.							In Special Prov. 2403.04
BARRIER RAIL							
RE 44ABCDE, RE 46	D	Target 1 Max. 4	3	61/2	51/2	71/2	2403.03 A&B Applicable Spec.
LIGHTING & HWY. SIGNING							
Foundation	C	Target 1 to 3 Max. 4		61/2	51/2	71/2	2403.03 A&B Applicable Spec.
END ANCHORS							
RE 26AB, RE 28	D	Target 1 to 3 Max. 4		61/2	51/2	71/2	2403.03 Applicable Spec.
RE 29A, RE 29B RE 33AB, RE 52, RE 53	C	Target 1 to 3 Max. 4			4	7	2403.03 & 2505.04B Applicable Spec.
Shot Crete							2424.01

CAUTION - Consult the applicable specifications for required air content and slump before using this chart.

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 (QMA)

The monitoring requirements listed in the appendices are intended to be the minimum for ACC 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 ACC projects, monitoring responsibilities are shared between the plant monitor, grade inspector, and materials personnel. Materials personnel will primarily monitor activities involved with ACC materials production process and quality such as plant calibration, QMA lab operation, contractor field process control, and, for QMA projects, will resolve discrepancies between the District 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 ACC 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.

The QMA specification can be considered an expansion of the certified plant program for ACC. In addition to normal certified plant inspection duties, under the QMA specification 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 QMA project, the plant monitor must be a certified ACC technician. This certification is obtained by attending the Level I ACC 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 QMA requirements.

The project documents will indicate if the requirements for QMA have been applied to the project. QMA will typically be applied to all interstate projects and to all other primary projects with more than 5000 tons of ACC. QMA requirements can be added by extra work order if the contractor requests and the DCE concurs. The District Materials Engineer should be consulted prior to adding QMA by extra work order. QMA can be added at a standard compensation rate of $.44 per Mg ($.40 per ton). If QMA is deleted by Change Order, the same rate should be applied as a credit to the project. For projects let under the QMA specification, the cost of QMA will be incidental to the price of the mix.

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

For duties performed by the certified ACC technician on QMA 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 ACC technician services to the contractor in cases of unexpected absences. If the contractor fails to provide certified ACC technicians as required by the specification, work covered by the QMA specification 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 person batching the concrete or 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.

Asphalt Cement Concrete Paving Plant Inspection

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, at a minimum, as frequently as required by *Appendix 3-4.* It is not specifically required that the monitor visit the plant daily. 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 be responsible for witnessing density core sampling and, on non-QMA projects, performing density tests.

For QMA projects, the field density tests will be performed by the contractor's certified ACC technician. The plant monitor should witness density testing on the first lot to ascertain that proper procedures have been followed. A minimum of 10% of density testing on subsequent lots should also be witnessed on a random basis. Additional witnessing may be advisable as dictated by field problems and the degree of competency displayed by the contractor's technician.

Plant Reports

The project engineer should make arrangements with the certified technician for timely distribution of plant reports. On QMA projects, the contractor shall FAX a copy of the daily plant report and QMA 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 the QMA specification 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 QMA 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 QMA projects related to specified moving averages will be noted on the certified ACC 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, ACC 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.

On QMA projects, the agency must check daily on correlation results between the Contractor's Lab and the District Materials Lab. Normally, this check will be performed by materials personnel. Results should correlate within the parameters specified in *Materials I.M.'s 208 and 216*. Testing discrepancies between the plant inspector and the monitor or DME will need to be resolved on an individual basis. Unsatisfactory correlation results between the contractor's lab and the District Materials Lab shall be considered serious and shall be immediately reported to the DME for investigation and appropriate action.

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 ACC 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. However, the plant monitor should carry a set of sieves to use for gradation analysis runs at the contractor's laboratory.

Samples

The plant inspector should indicate on the sample submittal form the field lab telephone number and hours they can be contacted for test results.

For QMA projects, the contractor is responsible for field sampling. The project inspector or monitor should witness sampling to the extent that they are assured samples are taken properly. Additional witnessing of obtaining, identifying, splitting, testing, and storing samples will be as directed by the QMA specification.

Samples obtained by the certified technician, but not tested, should not be split unless needed for further evaluation. They shall be retained at the plant until the lot has been accepted.

If required by contract documents, transportation of the split sample to the District Materials Lab will 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 and responsibilities and duties of all involved in the project. On small projects it may be possible to include a pre-concreting conference with 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.*

9.03 USE OF COMMERCIAL READY MIX CONCRETE ON PAVING PROJECTS

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

Required Information:

- For continuous mainline paving, Form 830212 must show plant name, contractor, project number, date, quantity, class, and time batched. Complete information regarding water in materials, water added, and total allowable water need only be shown at beginning of each run, and each time thereafter when moisture content changes or plant adjustments in mixing water are made.
- 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.

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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 project engineer. Equivalent materials include:

- 3 layers of Burlene
- 1 layer of Fast Track Blankets per *Specification 2301.19*
- 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

When cold weather protection is required, 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 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 below 1° 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 subgrade begins to freeze, the above provisions should be halted and specifications strictly enforced.

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. 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.

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.

9.64 CONCRETE VIBRATION AND CONSOLIDATION

Specification 2301.07.A.6.a requires vibration frequency to be maintained between 5000 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 projects, 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.

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.

9.70 PCC PATCHING

9.71 FULL DEPTH PCC PATCHES

Road Design Details 532-2 thru 532-10 show details for full depth patches for PCC pavement or resurfaced PCC pavement. Each of these details identify the required depth of the concrete for the patch.

These details also typically show pavement removal details. All patching details include both a full depth saw cut and a 37 mm (1 1/2 inch) saw cut. A full depth saw cut is usually performed with a wheel saw. These saw cuts are intended to sever pavement totally so existing pavement can be completely removed. The 37 mm (1 1/2 inch) saw cut is intended to create a smooth vertical face for ease of finishing and lower the chance of surface spalling at this final patch edge. The remaining portion of the concrete between these two saw cuts shall be entirely removed with hand tools. This breakout area should have an essentially vertical face with very minimal undercut. It is preferable to have a slight protrusion rather than any undercutting for this face. Care needs to be taken to ensure that a nice, vertical, clean edge is provided in this patching operation.

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.

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.

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 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

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 from the Office of Construction.

- 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.
- 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. Controlling the temperature of this large volume is important to reduce cracks and potential premature deterioration. 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.

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.

The water content required to obtain maximum flowability is very close to the maximum allowable for mix integrity. Once the allowable limit [about 446 L/m^3 (90 gals./cu yd.)] is exceeded, the sand will lose particle coating and separate. When this happens, the mix is no longer flowable and may take longer to become stable. Care must be taken to assure that the mix does not contain more water than necessary to achieve flowability and that no ponding occurs in the area.

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

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      ESTIMATING PROPOSAL  --  FOR FEDERAL AID CONTRACT             PAGE:  1
   To be valid for bidding, the Proposal Schedule of Prices form
   included with this Estimating Proposal or a computer generated EBS
   Schedule of Prices form must be included with a "BIDDING DOCUMENT"
   issued by the Iowa D.O.T. Office of Contracts.
**************************************************************************
*                                     Bid Order No.: 102                 *
* Proposal ID No.: 07-8155-034-A       Letting Date: January 11, 2000    *
*                                                    9:00 A.M.           *
*    Type of Work: PCC PAVEMENT - GRADE AND NEW                          *
*  Primary County: BLACK HAWK                    Design: ENGLISH         *
*       DBE Goal:  10.0 %                                1997 Std Spec   *
*  Pre-Qual Group: PCC PAVEMENT - RURAL                                  *
*                                                                        *
* Contracting Authority: CITY OF WATERLOO                                *
*     Proposal Guaranty: $ 375,000.00                                    *
* Tied Proposal Package: None assigned to, or allowed with this Bid Order. *
**************************************************************************

              This Proposal Includes The Following Project(s):
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

      Project: STP-U-8155(31)--70-07                     County: BLACK HAWK
    Work Type: PCC PAVEMENT - GRADE AND NEW               Plans: Yes
        Route: MLK JR DRIVE                              Design: ENGLISH
     Location: FROM IDAHO STREET, EASTERLY TO JUST EAST OF NORTHEAST DRIVE
               IN THE CITY OF WATERLOO.
  Road System: URBAN
       Length:   1.33 Miles
 Federal Aid - Predetermined Wages Are In Effect
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

      Project: STP-U-8155(34)--70-07                     County: BLACK HAWK
    Work Type: PCC PAVEMENT - GRADE AND NEW               Plans: Yes
        Route: MLK JR DRIVE                              Design: ENGLISH
     Location: FROM JUST EAST OF NORTHEAST DR., EAST TO NORTH ELK RUN ROAD
               AND SOUTH ON NORTHEAST DR. TO INDEPENDENCE AVE. IN WATERLOO.
  Road System: URBAN
       Length:   2.05 Miles
 Federal Aid - Predetermined Wages Are In Effect
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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*********************************************************************************
                                                Bid Order No.:  102
Proposal ID No.:  07-8155-034-A                  Letting Date:  January 11, 2000
                                                                9:00 A.M.
   Type of Work:  PCC PAVEMENT - GRADE AND NEW

---------------------------------------------------------------------------------
  Site     Contract Period/                            Working      Liquidated
 Number    Site Description                              Days        Damages
---------------------------------------------------------------------------------

CONTRACT   LATE START DATE:  04/03/00                    160      $  1,200.00

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PROPOSAL NOTES

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PROPOSAL SCHEDULE OF PRICES

Page: 1

Vendor No.: |__.__.__.__.__|
Proposal ID No.: 07-8155-034-A
Primary Work Type: PCC PAVEMENT - GRADE AND NEW
Primary County: BLACK HAWK

Bid Order No.: 102
Letting Date: January 11, 2000
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		Bid Amount	
			Dollars	Cts	Dollars	Cts
Section 0001	ROADWAY ITEMS FOR PHASE IV	STP-U-8155(31)--70-07				
0010	2101-0850001 CLEARING AND GRUBBING	4.720 ACRE	.		.	
0020	2101-0850002 CLEARING AND GRUBBING	37.800 UNIT	.		.	
0030	2102-0425070 SPECIAL BACKFILL	9,375.460 TON	.		.	
0040	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW	161,459.000 CY	.		.	
0050	2102-2710080 EXCAVATION, CLASS 10, UNSUITABLE OR UNSTABLE MATERIAL	650.000 CY	.		.	
0060	2102-2712015 EXCAVATION, CLASS 12, BOULDERS OR ROCK FRAGMENTS	130.000 CY	.		.	
0070	2102-4560000 LOCATING TILE LINES	11.500 STA	.		.	
0080	2104-2710020 EXCAVATION, CLASS 10, CHANNEL	4,803.000 CY	.		.	
0090	2105-8425011 TOPSOIL, SPREAD	2,400.000 CY	.		.	
0100	2105-8425015 TOPSOIL, STRIP, SALVAGE AND SPREAD	17,610.950 CY	.		.	

PROPOSAL SCHEDULE OF PRICES

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Line No	Item Number Item Description	Item Quantity and Unit	Unit Price		Bid Amount	
			Dollars	Cts	Dollars	Cts
0110	2105-8425020 TOPSOIL, STRIP AND STOCKPILE	22,819.980 CY	.		.	
0120	2111-8174100 GRANULAR SUBBASE	29,763.380 SY	.		.	
0130	2121-7425010 GRANULAR SHOULDERS, TYPE A	4,996.920 TON	.		.	
0140	2123-7450000 SHOULDER CONSTRUCTION, EARTH	142.570 STA	.		.	
0150	2213-6745500 REMOVAL OF CURB	3.150 STA	.		.	
0160	2301-0925025 INCIDENTAL CONCRETE	3.270 CY	.		.	
0170	2301-1032060 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 2 DURABILITY, 6 IN.	20.270 SY	.		.	
0180	2301-1033085 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 8.5 IN.	3,037.780 SY	.		.	
0190	2301-1033100 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 10 IN.	23,177.530 SY	.		.	

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Primary County: BLACK HAWK

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Line No	Item Number Item Description	Item Quantity and Unit	Unit Price		Bid Amount	
			Dollars	Cts	Dollars	Cts
0200	2301-4875006 MEDIAN, P.C. CONCRETE, 6 IN.	356.300 SY	.		.	
0210	2301-6911722 PORTLAND CEMENT CONCRETE PAVEMENT SAMPLES	LUMP	LUMP		.	
0220	2315-8275025 SURFACING, DRIVEWAY, CLASS A CRUSHED STONE	91.400 TON	.		.	
0230	2401-6745760 REMOVAL OF INTAKE	2.000 EACH	.		.	
0240	2401-6745910 REMOVAL OF SIGN	5.000 EACH	.		.	
0250	2402-0425031 GRANULAR BACKFILL	193.800 TON	.		.	
0260	2402-2720000 EXCAVATION, CLASS 20	1,899.000 CY	.		.	
0270	2402-2720100 EXCAVATION, CLASS 20, FOR ROADWAY PIPE CULVERT	304.000 CY	.		.	
0280	2403-0100020 STRUCTURAL CONCRETE (RCB CULVERT)	726.500 CY	.		.	
0290	2404-7775000 REINFORCING STEEL	93,714.000 LB	.		.	
0300	2416-0100015 APRONS, CONCRETE, 15 IN. DIA.	2.000 EACH	.		.	

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Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0310	2416-0100018 APRONS, CONCRETE, 18 IN. DIA.	2.000 EACH	.		.	
0320	2416-0100024 APRONS, CONCRETE, 24 IN. DIA.	6.000 EACH	.		.	
0330	2416-0100036 APRONS, CONCRETE, 36 IN. DIA.	4.000 EACH	.		.	
0340	2416-0100048 APRONS, CONCRETE, 48 IN. DIA.	10.000 EACH	.		.	
0350	2416-0101036 REMOVE AND REINSTALL CONCRETE PIPE APRONS LESS THAN OR EQUAL TO 36 IN.	1.000 EACH	.		.	
0360	2416-1160015 CULVERT, CONCRETE ENTRANCE PIPE, 15 IN. DIA.	58.000 LF	.		.	
0370	2416-1180018 CULVERT, CONCRETE ROADWAY PIPE, 18 IN. DIA.	150.000 LF	.		.	
0380	2416-1180024 CULVERT, CONCRETE ROADWAY PIPE, 24 IN. DIA.	408.000 LF	.		.	
0390	2416-1180036 CULVERT, CONCRETE ROADWAY PIPE, 36 IN. DIA.	276.000 LF	.		.	
0400	2416-1180048 CULVERT, CONCRETE ROADWAY PIPE, 48 IN. DIA.	780.000 LF	.		.	
0410	2502-2308100 TRENCH DRAIN	152.000 LF	.		.	

PROPOSAL SCHEDULE OF PRICES

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Vendor No.: |__.__.__.__.__|
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Primary County: BLACK HAWK

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Letting Date: January 11, 2000
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		Bid Amount	
			Dollars	Cts	Dollars	Cts
0420	2502-6745952 REMOVAL OF SUBDRAIN	265.000 LF	.		.	
0430	2502-8212034 SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	9,916.000 LF	.		.	
0440	2502-8212306 SUBDRAIN, STANDARD, PERFORATED, 6 IN., AS PER PLAN	1,645.000 LF	.		.	
0450	2502-8220105 SUBDRAIN OUTLET AS PER PLAN	3.000 EACH	.		.	
0460	2502-8220196 SUBDRAIN OUTLET, RF-19E	54.000 EACH	.		.	
0470	2503-4450080 INTAKE, RA-8	2.000 EACH	.		.	
0480	2503-7181036 REMOVE STORM SEWER PIPE LESS THAN OR EQUAL TO 36 IN.	8.000 LF	.		.	
0490	2503-7182036 REMOVE AND REINSTALL STORM SEWER PIPE LESS THAN OR EQUAL TO 36 IN.	102.000 LF	.		.	
0500	2503-7325015 SEWER PIPE, 2000D STORM, 15 IN. DIA.	14.000 LF	.		.	
0510	2503-8460020 UTILITY ACCESS, RA-2	1.000 EACH	.		.	
0520	2503-8462100 UTILITY ACCESS, CONVERT INTAKE TO	1.000 EACH	.		.	

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Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
0530	2504-4650006 MANHOLE, REBUILD SANITARY SEWER, TOP ONLY	3.000 EACH	.		.	
0540	2507-3250005 ENGINEERING FABRIC	196.300 SY	.		.	
0550	2507-6800060 REVETMENT, CLASS E, RIPRAP	133.300 TON	.		.	
0560	2510-6745850 REMOVAL OF PAVEMENT	1,126.380 SY	.		.	
0570	2511-7526004 SIDEWALK, P.C. CONCRETE, 4 IN.	15.200 SY	.		.	
0580	2511-7526005 SIDEWALK, P.C. CONCRETE, 5 IN.	7,846.260 SY	.		.	
0590	2512-1725306 CURB AND GUTTER, P.C. CONCRETE, 3.0 FT.	450.000 LF	.		.	
0600	2518-6890032 ROAD CLOSURE (URBAN), PERMANENT, RE-3B	1.000 EACH	.		.	
0610	2518-6910000 SAFETY CLOSURE	2.000 EACH	.		.	
0620	2519-3275031 FENCE, CHAIN LINK, AS PER PLAN	1.400 STA	.		.	
0630	2519-3325000 FENCE, TEMPORARY	18.600 STA	.		.	

Vendor No.: |__.__.__.__.__| Bid Order No.: 102
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Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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		Bid Amount	
			Dollars	Cts	Dollars	Cts
0640	2519-6745670 REMOVAL OF FIELD FENCE	19.650 STA	.		.	
0650	2520-3350010 FIELD LABORATORY	1.000 EACH	.		.	
0660	2524-6765010 REMOVE AND REINSTALL SIGN AS PER PLAN	2.000 EACH	.		.	
0670	2524-9275100 WOOD POSTS FOR TYPE A OR B SIGNS, 4 IN. X 4 IN.	596.000 LF	.		.	
0680	2524-9325001 TYPE A SIGNS, SHEET ALUMINUM	467.250 SF	.		.	
0690	2525-2638030 SILT FENCE	3,096.000 LF	.		.	
0700	2525-2638031 SILT FENCE FOR DITCH CHECKS	1,118.000 LF	.		.	
0710	2525-6745930 REMOVAL OF SILT FENCE	1,703.000 LF	.		.	
0720	2525-6745931 REMOVAL OF SILT FENCE FOR DITCH CHECK	178.000 LF	.		.	
0730	2527-9263007 PLOWABLE PAVEMENT MARKERS	266.000 EACH	.		.	
0740	2527-9263110 PAINTED PAVEMENT MARKING	444.640 STA	.		.	

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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	 Cts	Bid Amount Dollars	 Cts
0750	2527-9263140 PAINTED SYMBOLS AND LEGEND	12.000 EACH	.		.	
0760	2528-7575000 TRAFFIC CONTROL SIGNALS, FURNISH AND INSTALL	LUMP	LUMP		.	
0770	2528-8445110 TRAFFIC CONTROL	LUMP	LUMP		.	
0780	2533-4980005 MOBILIZATION	LUMP	LUMP		.	
0790	2599-9999005 ('EACH' ITEM) MONITORING WELL INSTALLATION	6.000 EACH	.		.	
0800	2601-2634100 MULCHING	42.770 ACRE	.		.	
0810	2601-2634500 OVERSEEDING AND FERTILIZING	25.970 ACRE	.		.	
0820	2601-2636016 NATIVE GRASS AND FORBS SEEDING	7.200 ACRE	.		.	
0830	2601-2636045 SEEDING SPECIAL AREAS	9.600 ACRE	.		.	
0840	2601-2638350 SLOPE PROTECTION, WOOD EXCELSIOR MAT	6.000 SQ	.		.	
0850	2601-2642100 STABILIZING CROP - SEEDING AND FERTILIZING	42.770 ACRE	.		.	

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Primary County: BLACK HAWK

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Line No	Item Number Item Description	Item Quantity and Unit	Unit Price Dollars	Unit Price Cts	Bid Amount Dollars	Bid Amount Cts
	SECTION 0001 TOTAL				.	
Section 0002 ROADWAY ITEMS FOR PHASE V		STP-U-8155(34)--70-07				
0860	2101-0850001 CLEARING AND GRUBBING	1.750 ACRE	.		.	
0870	2101-0850002 CLEARING AND GRUBBING	15.000 UNIT	.		.	
0880	2102-0425070 SPECIAL BACKFILL	14,642.620 TON	.		.	
0890	2102-2625000 EMBANKMENT-IN-PLACE	48,894.000 CY	.		.	
0900	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW	169,708.000 CY	.		.	
0910	2102-2710080 EXCAVATION, CLASS 10, UNSUITABLE OR UNSTABLE MATERIAL	1,000.000 CY	.		.	
0920	2102-2712015 EXCAVATION, CLASS 12, BOULDERS OR ROCK FRAGMENTS	200.000 CY	.		.	
0930	2102-4560000 LOCATING TILE LINES	6.500 STA	.		.	
0940	2105-8425015 TOPSOIL, STRIP, SALVAGE AND SPREAD	13,265.450 CY	.		.	
0950	2105-8425020 TOPSOIL, STRIP AND STOCKPILE	42,897.420 CY	.		.	

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Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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		Bid Amount	
			Dollars	Cts	Dollars	Cts
0960	2111-8174100 GRANULAR SUBBASE	45,718.580 SY	.		.	
0970	2121-7425010 GRANULAR SHOULDERS, TYPE A	7,719.150 TON	.		.	
0980	2123-7450000 SHOULDER CONSTRUCTION, EARTH	228.990 STA	.		.	
0990	2301-0925025 INCIDENTAL CONCRETE	6.480 CY	.		.	
1000	2301-1032060 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 2 DURABILITY, 6 IN.	344.490 SY	.		.	
1010	2301-1033080 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 8 IN.	2,040.570 SY	.		.	
1020	2301-1033085 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 8.5 IN.	12,484.030 SY	.		.	
1030	2301-1033090 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 9 IN.	2,454.890 SY	.		.	

Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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		Bid Amount	
			Dollars	Cts	Dollars	Cts
1040	2301-1033100 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 10 IN.	21,675.670 SY	.		.	
1050	2301-6911722 PORTLAND CEMENT CONCRETE PAVEMENT SAMPLES	LUMP	LUMP		.	
1060	2315-8275025 SURFACING, DRIVEWAY, CLASS A CRUSHED STONE	325.400 TON	.		.	
1070	2401-6745760 REMOVAL OF INTAKE	2.000 EACH	.		.	
1080	2401-6745910 REMOVAL OF SIGN	10.000 EACH	.		.	
1090	2402-2720000 EXCAVATION, CLASS 20	782.000 CY	.		.	
1100	2402-2720100 EXCAVATION, CLASS 20, FOR ROADWAY PIPE CULVERT	158.000 CY	.		.	
1110	2403-0100020 STRUCTURAL CONCRETE (RCB CULVERT)	521.200 CY	.		.	
1120	2404-7775000 REINFORCING STEEL	61,801.000 LB	.		.	
1130	2416-0100015 APRONS, CONCRETE, 15 IN. DIA.	8.000 EACH	.		.	

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Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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		Bid Amount	
			Dollars	Cts	Dollars	Cts
1140	2416-0100018 APRONS, CONCRETE, 18 IN. DIA.	2.000 EACH	.		.	
1150	2416-0100024 APRONS, CONCRETE, 24 IN. DIA.	3.000 EACH	.		.	
1160	2416-0102022 APRONS, CONCRETE ARCH, 22 IN. X 14 IN.	10.000 EACH	.		.	
1170	2416-0102029 APRONS, CONCRETE ARCH, 29 IN. X 18 IN.	6.000 EACH	.		.	
1180	2416-0102044 APRONS, CONCRETE ARCH, 44 IN. X 27 IN.	6.000 EACH	.		.	
1190	2416-1160015 CULVERT, CONCRETE ENTRANCE PIPE, 15 IN. DIA.	98.000 LF	.		.	
1200	2416-1180024 CULVERT, CONCRETE ROADWAY PIPE, 24 IN. DIA.	144.000 LF	.		.	
1210	2416-1200022 CULVERT, CONCRETE ARCH ROADWAY PIPE, 22 IN. X 14 IN.	428.000 LF	.		.	
1220	2416-1200029 CULVERT, CONCRETE ARCH ROADWAY PIPE, 29 IN. X 18 IN.	356.000 LF	.		.	
1230	2416-1200044 CULVERT, CONCRETE ARCH ROADWAY PIPE, 44 IN. X 27 IN.	186.000 LF	.		.	
1240	2502-8212034 SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	12,874.000 LF	.		.	

Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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
1250	2502-8212306 SUBDRAIN, STANDARD, PERFORATED, 6 IN., AS PER PLAN	1,245.000 LF	.		.	
1260	2502-8215012 SUBDRAIN, 2000D CONCRETE PIPE, 12 IN. DIA.	985.000 LF	.		.	
1270	2502-8215021 SUBDRAIN, 2000D CONCRETE PIPE, 21 IN. DIA.	470.000 LF	.		.	
1280	2502-8220105 SUBDRAIN OUTLET AS PER PLAN	6.000 EACH	.		.	
1290	2502-8220196 SUBDRAIN OUTLET, RF-19E	59.000 EACH	.		.	
1300	2503-4450030 INTAKE, RA-3	2.000 EACH	.		.	
1310	2503-4450080 INTAKE, RA-8	4.000 EACH	.		.	
1320	2503-7181036 REMOVE STORM SEWER PIPE LESS THAN OR EQUAL TO 36 IN.	8.000 LF	.		.	
1330	2503-7182036 REMOVE AND REINSTALL STORM SEWER PIPE LESS THAN OR EQUAL TO 36 IN.	142.000 LF	.		.	
1340	2503-7325015 SEWER PIPE, 2000D STORM, 15 IN. DIA.	361.600 LF	.		.	
1350	2503-7325024 SEWER PIPE, 2000D STORM, 24 IN. DIA.	187.900 LF	.		.	

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Vendor No.: |__.__.__.__.__|
Bid Order No.: 102
Proposal ID No.: 07-8155-034-A
Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW
9:00 A.M.
Primary County: BLACK HAWK

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
1360	2503-7380015 SEWER PIPE, 3750D STORM, 15 IN. DIA.	50.000 LF	.		.	
1370	2504-4650006 MANHOLE, REBUILD SANITARY SEWER, TOP ONLY	3.000 EACH	.		.	
1380	2505-4020250 GUARDRAIL, FORMED STEEL BEAM	50.000 LF	.		.	
1390	2505-4020251 GUARDRAIL, FORMED STEEL THRIE BEAM	125.000 LF	.		.	
1400	2505-4020400 GUARDRAIL, POSTS, BEAM	18.000 EACH	.		.	
1410	2505-4021332 GUARDRAIL, END ANCHORAGE, BEAM, RE-33B	4.000 EACH	.		.	
1420	2505-4021760 GUARDRAIL TERMINAL, BEAM, RE-76	4.000 EACH	.		.	
1430	2507-3250005 ENGINEERING FABRIC	348.000 SY	.		.	
1440	2507-6800060 REVETMENT, CLASS E, RIPRAP	303.800 TON	.		.	
1450	2510-6745850 REMOVAL OF PAVEMENT	1,073.040 SY	.		.	
1460	2511-7526004 SIDEWALK, P.C. CONCRETE, 4 IN.	7.600 SY	.		.	

Vendor No.: |__.__.__.__.__|
Proposal ID No.: 07-8155-034-A
Primary Work Type: PCC PAVEMENT - GRADE AND NEW
Primary County: BLACK HAWK

Bid Order No.: 102
Letting Date: January 11, 2000
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		Bid Amount	
			Dollars	Cts	Dollars	Cts
1470	2511-7526005 SIDEWALK, P.C. CONCRETE, 5 IN.	11,674.170 SY	.		.	
1480	2512-1725306 CURB AND GUTTER, P.C. CONCRETE, 3.0 FT.	85.000 LF	.		.	
1490	2515-2475006 DRIVEWAY, P.C. CONCRETE, 6 IN.	238.700 SY	.		.	
1500	2515-6745600 REMOVAL OF PAVED DRIVEWAY	148.000 SY	.		.	
1510	2519-3275031 FENCE, CHAIN LINK, AS PER PLAN	1.200 STA	.		.	
1520	2519-6745175 REMOVAL OF CHAIN LINK FENCE, AS PER PLAN	15.920 STA	.		.	
1530	2519-6745670 REMOVAL OF FIELD FENCE	33.290 STA	.		.	
1540	2523-0000100 LIGHTING POLES	5.000 EACH	.		.	
1550	2523-0000200 ELECTRICAL CIRCUITS	2,190.000 LF	.		.	
1560	2523-0000300 HANDHOLES	7.000 EACH	.		.	
1570	2524-6765010 REMOVE AND REINSTALL SIGN AS PER PLAN	2.000 EACH	.		.	

Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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		Bid Amount	
			Dollars	Cts	Dollars	Cts
1580	2524-9275100 WOOD POSTS FOR TYPE A OR B SIGNS, 4 IN. X 4 IN.	980.000 LF				
1590	2524-9325001 TYPE A SIGNS, SHEET ALUMINUM	515.000 SF				
1600	2525-2638030 SILT FENCE	5,254.000 LF				
1610	2525-2638031 SILT FENCE FOR DITCH CHECKS	800.000 LF				
1620	2527-9263007 PLOWABLE PAVEMENT MARKERS	240.000 EACH				
1630	2527-9263110 PAINTED PAVEMENT MARKING	600.840 STA				
1640	2527-9263130 REMOVABLE TAPE MARKING	96.900 STA				
1650	2527-9263140 PAINTED SYMBOLS AND LEGEND	28.000 EACH				
1660	2528-7575000 TRAFFIC CONTROL SIGNALS, FURNISH AND INSTALL	LUMP	LUMP			
1670	2528-8445110 TRAFFIC CONTROL	LUMP	LUMP			
1680	2529-5070110 PATCHES, FULL-DEPTH FINISH, BY AREA	54.400 SY				

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Vendor No.: |__.__.__.__.__| Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

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
1690	2529-5070120 PATCHES, FULL-DEPTH FINISH, BY COUNT	2.000 EACH	.		.	
1700	2533-4980005 MOBILIZATION	LUMP	LUMP		.	
1710	2538-8997010 SALVAGE AND REMOVAL OF BUILDINGS AS PER PLAN	LUMP	LUMP		.	
1720	2599-9999010 ('LUMP SUM' ITEM) RAILROAD CROSSING COORDINATION	LUMP	LUMP		.	
1730	2601-2634100 MULCHING	35.480 ACRE	.		.	
1740	2601-2634500 OVERSEEDING AND FERTILIZING	35.480 ACRE	.		.	
1750	2601-2642100 STABILIZING CROP - SEEDING AND FERTILIZING	35.480 ACRE	.		.	
	SECTION 0002 TOTAL				.	
	TOTAL BID				.	

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                                         Bid Order No.:  102
  Proposal ID No.:  07-8155-034-A         Letting Date:  January 11, 2000
Primary Work Type:  PCC PAVEMENT - GRADE AND NEW         9:00 A.M.
   Primary County:  BLACK HAWK
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Note Description

DBE-000111 January 11, 2000
DIRECTORY OF CERTIFIED DBE'S

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

GS-97006 October 26, 1999
GENERAL SUPPLEMENTAL SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION

IA99-1.1 July 30, 1999
PREDETERMINED WAGE RATES - GENERAL DECISION NUMBER IA990001 FOR HEAVY AND HIGHWAY CONSTRUCTION - STATEWIDE (EXCEPT SCOTT COUNTY)

*** ADDITIONAL REQUIREMENT ***

THE PRIME CONTRACTOR SHALL SUBMIT CERTIFIED PAYROLLS FOR ITSELF AND EACH APPROVED SUBCONTRACTOR 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-97335 January 11, 2000
SPECIAL PROVISIONS FOR WORK ON RAILROAD RIGHT OF WAY

*** INTENDED FOR: BLACK HAWK COUNTY STP-U-8155(34)--70-07 ***

SP-97343 January 11, 2000
SPECIAL PROVISIONS FOR TRAFFIC SIGNALIZATION

*** INTENDED FOR: BLACK HAWK COUNTY STP-U-8155(31)--70-07
BLACK HAWK COUNTY STP-U-8155(34)--70-07 ***

SP-97344 January 11, 2000
SPECIAL PROVISIONS FOR PLOWABLE PAVEMENT MARKERS

*** INTENDED FOR: BLACK HAWK COUNTY STP-U-8155(31)--70-07
BLACK HAWK COUNTY STP-U-8155(34)--70-07 ***

SS-97001 May 02, 1997
SUPPLEMENTAL SPECIFICATIONS FOR RAILROAD HIGHWAY INSURANCE PROTECTION REQUIRED OF CONTRACTORS

SS-97003 May 02, 1997
SUPPLEMENTAL SPECIFICATIONS FOR TRAFFIC SIGNALIZATION

Note	Description

SS-97003 (continued)

SS-97020 May 02, 1997
SUPPLEMENTAL SPECIFICATIONS FOR EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION REQUIREMENTS

SS-97021 May 02, 1997
SUPPLEMENTAL SPECIFICATIONS FOR SPECIFIC AFFIRMATIVE ACTION RESPONSIBILITIES (DISADVANTAGED BUSINESS ENTERPRISE) ON FEDERAL AID PROJECTS

SS-97027 July 15, 1997
SUPPLEMENTAL SPECIFICATIONS FOR METRICATION

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

SS-97035 January 12, 1999
SUPPLEMENTAL SPECIFICATIONS FOR FUEL ADJUSTMENT

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.

005.97020.01
*** REVISIONS TO SS-97020 ***

MAKE THE FOLLOWING REVISIONS TO SS-97020, 'SUPPLEMENTAL SPECIFICATIONS FOR EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION REQUIREMENTS';

ADD THE FOLLOWING SENTENCE TO SECTION 97020.05, PARAGRAPHS E (5) AND (7);

"THIS POSTER IS ONLY REQUIRED WHENEVER THERE ARE SPANISH SPEAKING EMPLOYEES, OR SPANISH SPEAKING APPLICANTS FOR EMPLOYMENT ARE LIKELY."

005.97021.01
*** REVISIONS TO SS-97021 ***

MAKE THE FOLLOWING REVISIONS TO SS-97021, 'SUPPLEMENTAL SPECIFICATIONS FOR SPECIFIC AFFIRMATIVE ACTION RESPONSIBILITIES (DISADVANTAGED BUSINESS ENTERPRISE) ON FEDERAL AID PROJECTS';

REPLACE THE FOURTH PARAGRAPH OF A[illegible]E 97021.05 B.1 WITH THE FOLLOWING:

Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

Note Description

005.97021.01 (continued)

"WHEN TWO OR MORE FEDERAL-AID PROJECTS ARE COMBINED ON THE SAME PROPOSAL, THE BIDDER'S DBE GOAL WILL BE CALCULATED USING THE SUM OF THE DBE COMMITMENTS ON THE FEDERALLY FUNDED ITEMS AND THE BID TOTAL. WHEN A FEDERAL-AID PROJECT (OR PROJECTS) IS COMBINED WITH A NON-FEDERAL-AID PROJECT (OR PROJECTS) ON THE SAME PROPOSAL, THE SUM OF THE DBE COMMITMENTS ON THE FEDERALLY FUNDED ITEMS AND THE BID TOTAL WILL BE USED FOR CALCULATING THE BIDDER'S DBE GOAL."

ADD THE FOLLOWING BETWEEN THE FIRST AND SECOND PARAGRAPH OF ARTICLE 97021.08, PARAGRAPH A.

THE CONTRACTOR SHALL SUBMIT A CERTIFICATION (FORM NO. 102116) LISTING ALL DBE FIRMS THAT WERE ENGAGED IN THE CONTRACT AND REPORT THE TOTAL DOLLAR AMOUNT PAID, OR WHICH WILL BE PAID, TO EACH. THIS CERTIFICATION MUST BE SUBMITTED TO THE ENGINEER AS PART OF THE FINAL PROJECT DOCUMENTS.

080.00

*** 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 "DIRECTORY OF CERTIFIED DBE'S" 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 PROJECT ENGINEER PRIOR TO THE PRECONSTRUCTION CONFERENCE TO DOCUMENT DBE SUBCONTRACTORS AND/OR SUPPLIERS TO BE USED. THE CONTRACTOR SHALL ATTACH A COMPLETED FORM 102117 FOR EACH DBE SUBCONTRACTOR AND/OR SUPPLIER LISTED ON THE CONTACTOR'S FORM 102115 THAT WAS SUBMITTED AT THE LETTING.

500.07.1999

*** WINTER WORK ***

WINTER WORK WILL BE ALLOWED DURING THE WINTER OF 1999/2000. NO WORKING DAYS WILL BE CHARGED BETWEEN NOVEMBER 15, 1999 AND APRIL 1, 2000.

500.2000

THE FREE TIME ALLOWED BETWEEN NOVEMBER 15 AND APRIL 1 WILL NOT BE

Bid Order No.: 102
Proposal ID No.: 07-8155-034-A Letting Date: January 11, 2000
Primary Work Type: PCC PAVEMENT - GRADE AND NEW 9:00 A.M.
Primary County: BLACK HAWK

Note Description

500.2000 (continued)

PERMITTED ON THIS PROJECT DURING THE WINTER OF 2000-2001. THE CONTRACTOR SHALL WORK DURING THE WINTER ON ALL WORKING DAYS AS DEFINED IN ARTICLE 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.

720.01

THIS PROPOSAL HAS AN ESTIMATING PROPOSAL ATTACHMENT FOR "RAILROAD DATA".

FA96 (Form 650019)
10-95

CONTRACT ID 07-8155-034-A

Letting Date: January 11, 2000 Bid Order No.: 102
County: BLACK HAWK Project Engineer: EARTH TECH, INC.
Cost Center: 849300 Object Code: 890
Contract Work Type: PCC PAVEMENT - GRADE/NEW

This agreement made and entered by and between the CITY OF WATERLOO CONTRACTING AUTHORITY,
AND
PETERSON CONTRACTORS INC. OF REINBECK, IA, (PE320), CONTRACTOR

It is agreed that the notice and instructions to bidders, the proposal filed by the Contractor, the specifications, the plan, if any, for project(s) listed below, together with Contractor's performance bond, are made a part hereof and together with this instrument constitute the contract. This contract contains all of the terms and conditions agreed upon by the parties hereto. A true copy of said plan is now on file in the office of the Contracting Authority under date of 01/06/2000.

PROJECT: STP-U-8155(31)--70-07 COUNTY: BLACK HAWK
WORK TYPE: PCC PAVEMENT - GRADE/NEW ACCOUNTING ID: 10261
ROUTE: MLK JR DRIVE LENGTH (MILES): 1.33
LOCATION: FROM IDAHO STREET, EASTERLY TO JUST EAST OF NORTHEAST DRIVE
IN THE CITY OF WATERLOO.
FEDERAL AID - PREDETERMINED WAGES ARE IN EFFECT
PROJECT AMOUNT:

PROJECT: STP-U-8155(34)--70-07 COUNTY: BLACK HAWK
WORK TYPE: PCC PAVEMENT - GRADE/NEW ACCOUNTING ID: 10262
ROUTE: MLK JR DRIVE LENGTH (MILES): 2.05
LOCATION: FROM JUST EAST OF NORTHEAST DR., EAST TO NORTH ELK RUN ROAD
AND SOUTH ON NORTHEAST DR. TO INDEPENDENCE AVE. IN WATERLOO.
FEDERAL AID - PREDETERMINED WAGES ARE IN EFFECT
PROJECT AMOUNT:

The specifications consist of the 1997 general specifications of the Iowa Department of Transportation plus the following supplemental specifications, special provisions, and addendums: DBE-000111, FHWA-1273.02, GS-97006, IA99-1.2, SP-97335, SP-97343, SP-97344, SS-97001, SS-97003, SS-97020, SS-97021, SS-97027, SS-97029, SS-97035, ADDENDUMS: 000001, 000002, 000003

Contractor, for and in considerations of $____________ payable as set forth in the specifications constituting a part of this contract, agrees to construct various items of work and/or provide various materials or supplies in accordance with the plans and specifications therefore, and in the locations designated in the Notice to Bidders.

Contractor certifies by signature on this contract, under pain of penalties for false certification, that the contractor has complied with Iowa Code Section 452A.17(8) as amended, if applicable, and Iowa Code Section 91C.5 (Public Registration Number), if applicable.

In consideration of the foregoing, Contracting authority hereby agrees to pay the Contractor promptly and according to the requirements of the specifications the amounts set forth, subject to the conditions as set forth in the specifications.

It is further understood and agreed that the above work shall also be commenced or completed in accordance with Page 1B of this Contract and assigned Proposal Notes.

Time is of the essence for this contract. To accomplish the purpose herein expressed, Contracting authority and Contractor have signed this and one other identical instrument as of the ______ day of ______________.

By____________________________
Contracting Authority

References 8-54

By____________________________
Contractor

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

Random Gradations
- Form E211 and M211

Beams Made and Tested
- Form E114 and M114

800240E - 04/00 computer

PCC Plant Report

Date of Placement		Location From	To
Mix 1	10/19/01	124+00	178+50
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: FM91(15)-55-91
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: 10/19/01
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	Water Grade	Avg w/c Ratio	Max w/c Ratio
C-3WR	1,011.50	105.2	3.3	2.65	1380				0.5	2.68	1702	571			1427		1711	56	175.0	—	0.405	0.489
C-3WR	425.00	106.9	3.0	2.65	1380				0.3	2.68	1702	571			1423		1707	48	173.0	—	0.387	0.489

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):	1436.5		
Cement (tons):	410.12		

Inter.	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/SIKA	3oz/100#	J60011P
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

Van Meter

	Source	T-203 A #	Grad. No.	
Coarse:	Halletts	A25512	3	2.68
Intermediate:			▨	
Fine:	Hallett Linn plant	A77524	1	2.65

Remarks

C.P.I.: John Doe SE000
Monitor: Mike Brown Se999

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

PROBLEM 10

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Form E820150E

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

Mix No.: C3WR **Pounds Cement:** 571

1st Adjusted lbs. Cement: 571 **Source:** ______ **Sp. Gr.:** 3.14

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

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

2nd Adjusted lbs. Cement: ______

Total Cementitious 571

I.M. T-203 **Fine Aggregate Source:** Hallett / University **Sp. Gr.:** 2.65
I.M. T-203 **Interm. Aggregate Source:** ______ **Sp. Gr.:** ______
I.M. T-203 **Coarse Agregate Source:** Hallett / Van Meter **Sp. Gr.:** 2.68

Basic w/c 0.430 245.5 **Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** ______
Max w/c 0.489 279 2 **Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** ______

Absolute Volumes

Cement 571	**(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 245.5	**(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

0.309 2.65
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 = —

0.377 2.68
Coarse Aggregate (abs vol.) X Sp. Gr. X 62.4 X 27 = 1702

Summary

Cement	603	**(lbs/cy)**
Fly Ash	—	**(lbs/cy)**
Slag	—	**(lbs/cy)**
Water	245	**(lbs/cy)**
Fine Agg.	1380	**(lbs/cy)**
Interm. Agg.		**(lbs/cy)**
Coarse Agg.	1702	**(lbs/cy)**

Distribution: ___ **Materials,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

434 | 48 479 | 55

PCC Plant Report

Date of Placement	Location		
		From	To
Mix 1	6/15/01	118+20	119+65
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: FN-63-1(26)-38-63
Plant Name: Manatt's - Hwy. H46
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: 06/18/01
Date Of Last Report: 06/17/01
Structures Des. No:

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

Mix	Batched	% Of Est.	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg	Max
																		Water				
	(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	In Agg.	Plant	Grade	w/c Ratio	w/c Ratio
C-4-C15	500.00	102.6	2.7						0.2										240.0			

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

Inter.	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//	3990334
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	1	3.14	Ash Grove
Fly Ash:	C		Louisa Generating Station
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:		A70002	3
Intermediate:			▨
Fine:		A90504	1

Remarks: Coarse Aggregate Beds 11-17

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

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

Problem 11

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

800240E - 04/00 computer

PCC Plant Report

		Location	
Date of Placement		From	To
Mix 1	8/6/01	199+00	199+70
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: BROS-66(122)10

Plant Name: American Concrete

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: 08/09/01

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)

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (In pounds)									Avg	Max
																		Water				
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	w/c Ratio	w/c Ratio
C-4	77.00	106.1	3.1						0.6										210.0	23.0		

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Batched		
Check One (X)	Today	Week	Total To Date
Concrete (CY):		77.00	
Cement (tons):		24.02	

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd.	3990334
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

	Type	Sp. Gr.	Source
Cement:	1	3.14	Ash Grove
Fly Ash:			
GGBFS:			

	Source	T-203 A #	Grad. No.
Coarse:		A76002	3
Intermediate:			▨
Fine:		A14514	1

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

Remarks

C.P.I.: John Doe SE000

Monitor: Mike Brown SE999

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

Problem 12

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**

PCC Plant Report

Date of Placement		Location From	To
Mix 1	9/17/01	309+40	780+00
Mix 2			
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: 09/17/01
Date Of Last Report: 09/16/01
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. (%)	T-203 Sp. G.	Wt. SSD (lbs)	Intermediate Aggregate Moist. (%)	T-203 Sp. G.	Wt. SSD (lbs)	Coarse Aggregate Moist. (%)	T-203 Sp. G.	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
C-3WR-C15	1,256.00	104.8	3.0						0.7										175.0			
C-3WR-C15	1,384.00	106.7	2.8						0.5										170.0			
M-4	14.00	102.0	2.8						0.5										221.0			

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

Inter.	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:	Plastocrete #161		5577882
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:	1	3.14	Continental
Fly Ash:	C		ISG 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

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

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

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**

Rev 02/01

Form E820150E

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

Project No.: ____________ **County :** ________

Mix No.: ________ **Pounds Cement:** 593

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 255 **Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** ________
Max w/c 290 **Max. Water (lbs/cy) = Design w/c (wt. cement + wt Fly Ash +Slag) =** ________

Absolute Volumes

Cement .... 504 **(lbs/cy) / (Sp. Gr. X 62.4 X 27)** **=** 0095
Fly Ash .... 89 **(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)** **=** 0.151
Air **0.060**

Subtotal **=** 326

1.000 - Subtotal **=** 0.674

Total **= 1.000**

% FA Agg.: ________ 50 **Fine Aggregate (1.000 - Subtotal) X % In Mix** **=** 0.337
% In. Agg.: ________ **Interm. Aggregate (1.000 - Subtotal) X % In Mix** **=** ________
% CA Agg.: ________ 50 **Coarse Aggregate (1.000 - Subtotal) X % In Mix** **=** 0.337

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 504 **(lbs/cy)**
Fly Ash 89 **(lbs/cy)**
Slag - **(lbs/cy)**
Water ________ **(lbs/cy)**
Fine Agg. 1510 **(lbs/cy)**
Interm. Agg. ________ **(lbs/cy)**
Coarse Agg. 1505 **(lbs/cy)**

Distribution: ___ **Materials,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

100 ± 1

PROBLEM 14

-Calculate the cement yield

-4096 lb cement in scale hopper from last cement yield check. 2.048 = 2.05

-4872 batches at 623 lb/batch 3,035,256 = 1517.628 = 1517.63

185.73

-615 batches at 604 lb/batch 371,460 = 185.730 = 27.16

-66 batches at 823 lb/batch 54,318 = 27.159 = 1.5

-3000 lb left in scale hopper

= 1.5

1732.017
− 2.048
1729.969

173202
− 2.05
172997

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

~~billed / batched~~ = ~~96.3%~~

batched / billed × 100 = 103.79%

1729.97 / 1666.67 × 100 =

= 103.8%

PROBLEM 15

Calculate the cement yield given the following

- **-2600 lb cement left in scale hopper from last yield check** 1.3
- **-1500 batches at 492 lb/batch** 738,000 = 369.00
- **-500 batches at 571 lb/batch** 285.500 = 142.75
- **-3000 lb cement left in hopper this check** 1.5
- **-Total billed weight is 512.05 Ton**
- **-Show your work in Tons (convert lb to ton)**

= 1.50

513.25

\- 1.30

$$\frac{511.95}{512.05} = 99.98\%$$

PROBLEM 16

Cement Yield

kg billed = 450709.1

Number of Batches = 1210

Batch size = 1 m^3

370.2 kg cement per m^3

Find cement yield in percent

PROBLEM 17

Cement yield

Tons Billed = 902.38

Number of batches = 3180

Batch Size = 1 yd;

571 lb cement per yd;

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
 CUSTOMER NO.:           1
 MASON CITY IA.

 JOB NO./ID.          1  #5
```

```
 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


 IDOT
 CUSTOMER NO.:           1
 MASON CITY IA.

 JOB NO./ID.          1  #5

  TICKET NO.:         20  PLANT ID.: 2495  DATE:11-24-98  TIME-11:20
 7.00 CY   FORMULA NO.:          1  C-3-WR-C 15%       TOLERANCE: 4
QTY ORD'D: 999999.00  QTY DEL'D:  16519.00  LOADS: 2364  REQ SLUMP:  0.00

 GATE  DESCRIP. TARGET ACTUAL      MC        GATE  DESCRIP. TARGET ACTUAL
---------------------------------------     --------------------------
```

Form 830212
10-95

READY MIX CONCRETE

______________________________ Plant

Truck No. ______________ Ticket No. ______________

Date ______________ Des. No. ______________

Proj. No. ______________________________

Mix No. ______________ Retarder/Water Reducer? ☐ Yes ☐ No

Conc. This Truck ______________________________ C.Y./m³

Air agent added this truck ______________________________ oz./mL

Time Batched ______________ Discharged ______________

Rev. Mixed *(Plant)* ______________ Grade ______________

in 7 yd load

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

In Aggregate	______________	gal./L	______________	lbs./kg
Added *(Plant)*	______________	gal./L	______________	lbs./kg
Subtotal	______________	gal./L	______________	lbs./kg
Added Grade	______________	gal./L	______________	lbs./kg
TOTAL WATER	______________	gal./L	______________	lbs./kg

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

Air ______________ Slump ______________

Plant Insp. ______________________________

Receiving Insp. ______________________________

Form 820917
11-94

Iowa Department of Transportation

PROJECT DEVELOPMENT DIVISION

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)

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 PCC Paving Plant book Index

Item Description	Form #	Page
Plant Information Sheet	Plantinf	
Portland Cement Concrete Form	E820150	
PCC Plant Report	E800240	
Portland Cement Shipment Yield Report	E820912	
Fly Ash Shipments	E203	
Aggregate Certifications (Coarse)	E204	
Aggregate Certifications (Fine)	E204	
Specific Gravities	E205	
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Daily Plant Check List	E212	
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Rev 01/98

Plantinf

Plant Information Sheet

Project No.:

Contract ID.:

Prime Contractor:

Plant Type:

Plant Location:

Pollution Control:

Storm Water Permit No.:

Date Calibrated:

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:

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**

Form 820912E
1/97

Iowa Department of Transportation

Portland Cement Shipment Yield Report

Report No.: ____________

Date Submitted: ____________

Contract ID: ____________

Source: ____________

Project No.: ____________

Contractor: ____________

County: ____________

Plant Location: ____________

Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type	Date	Invoice Number	Billed Tons	Type

Mix No.	Cement Per CY (lbs)	Batched (CY)		Cement Batched (Tons)
			…………	
			…………	
			…………	
			…………	
			…………	
Left In Scale (Tons)	This Check (+)			1.500
	Previous Yield Check (-)			2.048
	Total Weighed (Batch Scale)			

Total Billed Weight (Tons)	

Yield = ________ %

C.P.I.: ____________

Distribution: ____ TCME ____ RCE ____ Central Materials ____ Contractor ____ Inspector

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: ____________

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 (IM. 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: ____________

Rev 01/98 Form E206

Moistures by Pycnometer (IM 308)

Page No.: ____________

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

Date	Aggregate Type	W (Grams)	W 1 (Grams)	Diff. (Grams)	Moisture (%)	Remarks	By

Checked By: ____________

Audited By: ____________

Rev 01/98

Form E212

Daily Plant Check List

Page No.: ______________

Project No.: ______________________________

Contract ID.: ______________

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

Complies = Y

Discrepancy = D

Not Applicable = NA

Record actual Mixing Time & Placed Time

Refer To Daily Diary For Discrepancies.

Rev 01/98

Form E210

Plant Site Inspection List (PCC)

Page No.: ____________

Project No.: ______________________________

Contract ID.: ____________

Date Checked	Item	Complies		Remarks	By
		Yes	No		
	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 01/98

Form E211

Random Gradations

Page No.: ______________

Project No.: ______________________________

Contract ID.: ______________

Date	Day	Die Roll	Random Needed (Y / N)	2nd Roll	Sample Tested (2nd / 3rd)	Remarks	By
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						

Rev 01/98

PC Concrete Beam Record

Form E114

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

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 Ready Mix Plant Book Index

Form Description	Form #	Page
Plant Information Sheet	Plantinf	
Portland Cement Concrete Form	E820150	
PCC Plant Report	E800240	
Cement Shipments	E202	
Fly Ash Shipments	E203	
Aggregate Certifications (Coarse)	E204	
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Random Gradations	E211	
Beams Made & Tested (If Applicable)	E114	
Daily Diary	Daily 3 or 4	

Rev 01/98 Plantinf

Plant Information Sheet

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

Prime Contractor: ____________________

Plant Type: ____________________

Plant Location: ____________________

Pollution Control: ____________________

Storm Water Permit No.: ____________________

Date Calibrated: ____________________

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:** ____________________

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**

Rev 01/98

Form E202

Cement 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 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.: ______________

	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 (IM. 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: ____________________

Rev 01/98 Form E206

Moistures by Pycnometer (IM 308)

Page No.: ____________

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

Date	Aggregate Type	W (Grams)	W 1 (Grams)	Diff. (Grams)	Moisture (%)	Remarks	By

Checked By: ____________

Audited By: ____________

Rev 01/98

Form E208

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			

Rev 01/98

Form E209

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

Not Applicable = NA

Refer To Daily Diary For Discrepancies.

Rev 01/98

Form E210

Plant Site Inspection List (PCC)

Page No.: ________________

Project No.: ____________________________

Contract ID.: ________________

Date Checked	Item	Complies		Remarks	By
		Yes	No		
	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 01/98

Form E211

Random Gradations

Page No.: ____________

Project No.: ______________________________

Contract ID.: __________________

Date	Day	Die Roll	Random Needed (Y / N)	2nd Roll	Sample Tested (2nd / 3rd)	Remarks	By
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	1						
	2						
	3						
	4						
	5						
	6						
	7						

Rev 01/98

PC Concrete Beam Record

Form E114

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

Checked By:

Page No.: __________

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

Date: __________ **Sunrise:** __________ **High:** __________

Day: __________ **Sunset:** __________ **Low:** __________

Weather: ____________________

By: ____________________

Solution 1

PART A

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

PART B

Fine Aggregate Moisture

1.000 1546 lb = 1595 lb
- 0.031 0.969
0.969
1595 lb - 1546 lb = **49 lb excess water**

Coarse Aggregate Moisture

1.000 1558 lb = 1563 lb
-0.003 0.997
0.997
1563 lb - 1558 lb = **5 lb excess water**

Total Free Water = 54 lb

Alternate Method PART B

Using Reciprocal Tables

From T-214, page 1 of 3, find reciprocal for 3.1%

3.1%----1.0319917
1546 lb x 1.0319917 = 1595 lb

Fine Aggregates

1546 lb x 1.0319917 = **1595 lb**

Coarse Aggregates

1558 lb x 1.0030090 = **1563 lb**

To continue:

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;) 8.33 lb/gal = **25.3 gal/yd; of mix water**

Maximum water that can be added to the batch

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 = **295.2 lb maximum water per yd;**

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

295.2 lb - 54 lb = **241.2 lb/yd; Maximum allowable mixing water**

241.2 lb) 8.33 lb/gal = **29 gal/yd**

Maximum allowable water that may be added as mixing water.

Solution 2

Rev 02/01

Iowa Department Of Transportation
Office Of Materials
PORTLAND CEMENT CONCRETE

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 Cement Co. 1 **Sp. Gr.:** 3.14

I.M. 491.17 Fly Ash: 94 **Source:** Louisa Generating Station **Sp. Gr.:** 2.68

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

2nd Adjusted lbs. Cement: 530

Total Cementitious 624

I.M. T-203 Fine Aggregate Source: Roverud Const. **Sp. Gr.:** 2.66
I.M. T-203 Interm. Aggregate Source: ______ **Sp. Gr.:** ______
I.M. T-203 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)**

Distribution: ___ **Materials,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

Solution 4:English

Part 1:

Dry Batch Masses

Cement	$0.118\ \text{yd}^3 \cdot 3.14 \cdot 62.4\ \text{lb./ft.}^3 \cdot 27\ \text{ft.}^3/\text{yd}^3 =$	**624 lb.**
Water	$0.159\ \text{yd}^3 \cdot 1.00 \cdot 62.4\ \text{lb./ft.}^3 \cdot 27\ \text{ft.}^3/\text{yd}^3 =$	**268 lb.**
Fine Aggregate	$0.331\ \text{yd}^3 \cdot 2.65 \cdot 62.4\ \text{lb./ft.}^3 \cdot 27\ \text{ft.}^3/\text{yd}^3 =$	**1478 lb.**
Coarse Aggregate	$0.332\ \text{yd}^3 \cdot 2.68 \cdot 62.4\ \text{lb.ft.}^3 \cdot 27\ \text{ft.}^3/\text{yd}^3 =$	**1499 lb.**

Part 2:

Wet Batch Masses

Fine Aggregate

1.00 – 0.030 = 0.970

1478 lb. / 0.970 = **1524 lb. wet sand**

Coarse Aggregate

1.00 – 0.007 = 0.993

1499 lb. / 0.993 = **1510 lb. wet rock**

Part 3:

Mixing Water

Excess Moisture in Aggregate

1524 lb. – 1478 lb. = **46 lb. in fine aggregate**

1510 lb. – 1499 lb. = **11 lb. in coarse aggregate**

46 lb. + 11 lb. = **57 lb. total free moisture in aggregate**

Correct/Adjust Basic Water

268 lb. Basic Water

268 lb. – 57 lb. = **211 lb. mixing water**

211 lb. / 8.33 lb./gal = **25.3 gal/yd^3 mixing water**

Part 4:

Free Water in Materials + Water Added at the Plant = Basic Water

57 lb. + 211 lb. = **268 lb./yd^3**

Maximum Water

0.488 · 624 lb. = **304.5 lb.**

304.5 lb. – 268 lb. = **36.5 lb./yd³**

36.5 lb./yd³ · 7 yd³/load = **255.5 lb/load**

255.5 lb./load / 8.33 lb./gal = **30.7 gal**

Use 30 gallons maximum

Therefore, 30 gallons is the maximum water that can be added at the grade for this 7 yd³ load.

Solution 5: English

1. Maximum w/c = 0.488

   Maximum Water = 0.488 · 624 lb. = **304.5 lb./yd³**

   304.5 lb./yd³ / 8.33 lb./gal = **36.6 gal/yd³**

   Water Allowed = 36.6 · 5 = **183.0 gal**

2. Maximum w/c = 0.450

   Maximum Water = 0.450 · 709 lb. = **319 lb/yd³**

   319 lb./yd³ / 8.33 lb./gal = **38.3 gal/yd³**

   Water Allowed = 38.3 · 7 = **268.1 gal**

3. Total Water = [5 gal/yd³ · 8.33 lb./gal] + [27 gal/yd³ · 8.33 lb./gal]

   = 41.6 lb. + 224.9 lb.

   = 266.5 lb.

   w/c = 266.5 / 603

   = 0.422

4. Total Water = 50 lb.yd³ + [30 gal/yd³ · 8.33 gal/yd³]

   = 50 lb./yd³ + 249.9 lb./yd³

   =299.9 lb./yd³

   Total Cement = 529 lb./yd³ + 95 lb./yd³

   = 624 lb./yd³

   w/c = [299.9 lb./yd³] / [624 lb./yd³]

   = 0.481

5. Maximum w/c = **0.489**

   Maximum Water = 0.489 · 593 lb./yd³ = 290 lb./yd³

   = 34.8 gal/yd³

   Water Allowed = 34.8 gal/yd³ · 7 yd³ = **243.6 gal**

Total Water :

= 48 lb./yd³ + [24 gal/yd³ · 8.33 lb./gal]

= 48 lb./yd³ + 199 lb./yd³

= 247.9 lb./yd³

= 29.8 gal /yd³

29.8 gal/yd³ · 7 yd³ = **208.6 gal**

Amount of water that can be added at the paver:

243.6 gal – 208.6 gal = **35.0 gal**

Solution 6: English

1. Dry Batch Masses

Cement

$0.156 \cdot 3.14 \cdot 27 \cdot 62.4 =$ **825 lb.**

Fine Aggregate

$0.312 \cdot 2.67 \cdot 27 \cdot 62.4 =$ **1404 lb.**

Coarse Aggregate

$0.311 \cdot 2.65 \cdot 27 \cdot 62.4 =$ **1389 lb.**

Basic Water

$0.161 \cdot 1.00 \cdot 27 \cdot 62.4 =$ **217 lb. or 32.6 gal**

Actual Batch Masses

Fine Aggregate: $1404 \ / \ [1 - 0.028] =$ **1444 lb.**

Coarse Aggregate: $1389 \ / \ [1 - 0.006] =$ **1397 lb.**

2. Total Water

Water in the Materials

Fine Aggregate: $1444 - 1404 =$ **40 lb.**

Coarse Aggregate: $1397 - 1389 =$ **8 lb.**

Water added at the plant: $30 \cdot 8.33 =$ **250 lb.**

Water added at the grade: $[10/7] \cdot 8.33 =$ **$\underline{\text{12 lb.}}$**

310 lb.

3. Water/Cement Ratio

$310 \ / \ 825 =$ **0.376**

Solution 7: English

1. Dry Batch Masses

Cement

0.108 · 3.14 · 27 · 62.4 = **571 lb.**

Fine Aggregate

0.309 · 2.66 · 27 · 62.4 = **1385 lb.**

Coarse Aggregate

0.377 · 2.65 · 27 · 62.4 = **1683 lb.**

Basic Water

0.146 · 1.00 · 27 · 62.4 = **246 lb. or 29.5 gal**

Actual Batch Masses

Fine Aggregate

1385 / (1 – 0.030) = **1428 lb.**

Coarse Aggregate

1683 / (1-0.005) = **1691 lb.**

2. Total Water

Water in the Materials

Fine Aggregate: 1428 – 1385 = **43 lb.**

Coarse Aggregate: 1691 – 16 83 = **8 lb.**

Water Added at the Plant

23 · 8.33 = **192 lb.**

Water Added at the Grade

(15 / 7) · 8.33 = **18 lb.**

Total Water

192 + 18 + 43 + 8 = **261 lb.**

Solution 8

Rev 02/01

Form E820150E

Iowa Department Of Transportation
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

I.M. 491.17 **Fly Ash:** 74 **Source:** ______ **Sp. Gr.:** 2.65

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

2nd Adjusted lbs. Cement: 418

Total Cementitious 492

I.M. T-203 **Fine Aggregate Source:** ______ **Sp. Gr.:** 2.66
I.M. T-203 **Interm. Aggregate Source:** ______ **Sp. Gr.:** ______
I.M. T-203 **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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

Solution 8

Rev 02/01

Form E820150E

Iowa Department Of Transportation
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

I.M. 491.17 **Fly Ash:** 106 **Source:** ____________ **Sp. Gr.:** 2.65

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

2nd Adjusted lbs. Cement: 603

Total Cementitious 709

I.M. T-203 **Fine Aggregate Source:** ____________ **Sp. Gr.:** 2.66
I.M. T-203 **Interm. Aggregate Source:** ____________ **Sp. Gr.:** ____________
I.M. T-203 **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,** ___ **TC,** ___ **Proj. Engr.,** ___ **Contractor**

Solution 9

$3130 \text{ lb.} / 5 \text{ yd}^3 = \mathbf{626\ lb./yd^3}$

$(626) / (3.14) / (62.4) = \mathbf{3.195\ ft.^3 / yd^3}$

Absolute Volume = $(3.195 \text{ ft.}^3/\text{yd}^3) / (27 \text{ ft.}^3/\text{yd}^3) = \mathbf{0.118}$

800240E - 04/00 computer

PCC Plant Report

Date of Placement		Location From	Location To
Mix 1	10/19/01	124+00	178+50
Mix 2			
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: 10/19/01
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	Water Grade	Avg w/c Ratio	Max w/c Ratio
C-3WR	1,011.50	105.2	3.3	2.65	1,380				0.5	2.68	1,702	571			1,427		1,711	56	175.0		0.405	0.489
C-3WR	425.00	106.9	3.0	2.65	1,380				0.3	2.68	1,702	571			1,423		1,707	48	173.0		0.387	0.489

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			
Check One (X)	Today	Week	Total To Date
Concrete (CY):	1,436.50		
Cement (tons):	410.12		

Inter.	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/SIKA	3 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:		A77524	1

Remarks

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

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

Solution 10

800240E - 04/00 computer

PCC Plant Report

Date of Placement		Location From	To
Mix 1	6/15/01	118+20	119+65
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: FN-63-1(26)-38-63

Plant Name: Manatt's - Hwy. H46

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: 06/18/01

Date Of Last Report: 06/17/01

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	Water Grade	Avg w/c Ratio	Max w/c Ratio
C-4-C15	500.00	102.6	2.7	2.67	1,484				0.2	2.66	1,479	530	94		1,525		1,482	44	240.0		0.455	0.488

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

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

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

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

Check One (X)	Batched Today	Week	Total To Date
Concrete (CY):	500.00		
Cement (tons):	132.50		

	Brand / Source	Rate	Lot Number
Air Entraining:	Darex AEA	5.0 oz./yd//	3990334
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

	Type	Sp. Gr.	Source
Cement:	1	3.14	Ash Grove
Fly Ash:	C		Louisa Generating Station
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:		A70002	3
Intermediate:			
Fine:		A90504	1

Remarks: Coarse Aggregate Beds 11-17

C.P.I.: John Doe SE000

Monitor: Mike Brown SE999

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

Solution 11

800240E - 04/00 computer

PCC Plant Report

Date of Placement		Location From	To
Mix 1	8/6/01	199+00	199+70
Mix 2			
Mix 3			
Mix 4			
Mix 5			

Project No.: BROS-66(122)10
Plant Name: American Concrete
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: 08/09/01
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
C-4	77.00	106.1	3.1	2.66	1,488				0.6	2.64	1,472	624			1,536		1,481	57	210.0	23.0	0.465	0.488

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
Concrete (CY):		77.00	
Cement (tons):		24.02	

Inter.	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.	3990334
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:	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:		A76002	3
Intermediate:			
Fine:		A14514	1

Solution 12

Remarks

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

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

600240E - 04/00 computer

PCC Plant Report

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

Date of Placement		Location From	To
Mix 1	9/17/01	309+40	780+00
Mix 2			
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: 09/17/01
Date Of Last Report: 09/16/01
Structures Des. No:

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
C-3WR-C15	1,256.00	104.8	3.0	2.66	1,376				0.7	2.62	1,660	485	86		1,419		1,672	55	175.0		0.403	0.489
C-3WR-C15	1,384.00	106.7	2.8	2.66	1,376				0.5	2.62	1,660	485	86		1,416		1,668	48	170.0		0.382	0.489
M-4	14.00	102.0	2.8	2.66	1,394				0.5	2.62	1,377	825			1,434		1,384	47	221.0		0.325	

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 Check One (X)	Today	Week	Total To Date
Concrete (CY):	2,654.00		
Cement (tons):			

Inter.	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:	Plastocrete #161	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:	1	3.14	Continental
Fly Ash:	C		ISG 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

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

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

Solution 13

Solution 14

(4872 · 623 = 3, 035, 255 lb.) / 2000 = **1517.6 Ton**

(615 · 604 = 371,460 lb.) / 2000 = **185.7 Ton**

(66 · 823 = 54,318 lb.) / 2000 = **27.2 Ton**

Total: 3,461,033 lb. / 2000 = 1730.5 Ton

Left in scale hopper: 3000 lb. / 2000 = **1.5 Ton**

Left from last check: 4096 lb. / 2000 = **2.0 Ton**

1730.5 + 1.5 – 2.0 = **1730**

Total Billed : 3,333,333 / 2000 = 1666.7 Ton

(1730 / 1666.7) · 100 = **103.8%**

Remember:

1. Cement shipment yield determination must be made every 10,000 yd^3 after the original determination had 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

(1500 batches · 492 lb./batch = 738,000 lb.) / (2000 lb./Ton) = **369.00 Ton**

(500 batches · 571 lb./batch = 285,500 lb.) / (2000 lb./Ton) = **142.75 Ton**

Total Batched = 511.75 Ton

Left in scale:

Last check: 2600 / 2000 = **1.3 Ton**

This check: 3000/ 2000 = **1.5 Ton**

Total billed: (1,024,100 lb.) / 2000 = **512.05 Ton**

$$\frac{\textbf{(Tot.Cement Batched + Left in Scale This Check - Left in Scale Last Check)}}{\textbf{Total Cement Billed}} \cdot \mathbf{100} = \textbf{Cement Yield}$$

$$\frac{(511.75 + 1.5 - 1.3)}{512.05} \cdot 100 = \text{Cement Yield}$$

$$\frac{511.95}{512.05} \cdot 100 = \mathbf{99.8\%}$$

Solution 16

Given:

Cement yield

kg billed = 450,709.1

Number of Batches = 1210

370.2 kg cement per m^3

Solution and Answer:

Cement batched = 1210 · 370.2 = 447,942

$$\text{Cement Yield} = \frac{447{,}942 \text{ yd (batched)}}{450{,}709.1 \text{ yd (billed)}} \cdot 100 = \mathbf{99.38605}$$

$$= \mathbf{99.39\%}$$

Solution 17

Given:

Cement Yield

Tons Billed = 902.38

Number of Batches = 3180

571 lb. cement per yd^3

Solution and Answer:

Total Tons Batched = $\frac{3180 \cdot 571}{2000}$ = **907.89**

Cement Yield = $\frac{907.89 \text{ Tons (batched)}}{902.38 \text{ Tons (billed)}} \cdot 100 =$ **100.61%**

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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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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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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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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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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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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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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**

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**

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**

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**

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ____________ Contract ID: ____________ Report No.: ________

Plant Name: ____________ County: ____________ Date This Report: ________

Contractor: ____________ Temp. (°F) Min: ________ Date Of Last Report: ________

Weather: ____________ Temp. (°F) Max: ________ Structures Des. No: ________

Check Mix(x)	
Central	
Ready	

Check One(x)		SEND
Paving		(Daily)
Structure		(Weekly)
Incidental		(Weekly)
Patching		(Weekly)

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (In pounds)									Avg	Max
Mix	Batched	% Of Est.	Moist.	T-203	Wt. SSD	Moist.	T-203	Wt. SSD	Moist.	T-203	Wt. SSD							Water			w/c	w/c
	(CY)	Used	(%)	Sp. G.	(lbs)	(%)	Sp. G.	(lbs)	(%)	Sp. G.	(lbs)	Cement	Fly Ash	GGBFS	Fine	Inter.	Coarse	In Agg.	Plant	Grade	Ratio	Ratio

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			■
Fine:			

Remarks

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

C.P.I.: ______________________ ________

Monitor: ______________________ ________

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ______________ Contract ID: ______________

Plant Name: ______________ County: ______________

Contractor: ______________ Temp. (°F) Min: ________

Weather: ______________ Temp. (°F) Max: ________

Report No.: ________

Date This Report: ________

Date Of Last Report: ________

Structures Des. No: ________

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

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)										
																		Water			Avg	Max
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	w/c Ratio	w/c Ratio

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply
									Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			■
Fine:			

Remarks	

C.P.I.: ______________________ ________

Monitor: ______________________ ________

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

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ____________

Plant Name: ____________

Contractor: ____________

Weather: ____________

Contract ID: ____________

County: ____________

Temp. (°F) Min: ________

Temp. (°F) Max: ________

Report No.: ________

Date This Report: ________

Date Of Last Report: ________

Structures Des. No: ________

Check Mix(x)	
Central	
Ready	

Check One(x)		SEND
Paving		(Daily)
Structure		(Weekly)
Incidental		(Weekly)
Patching		(Weekly)

Mix	Batched (CY)	% Of Est. Used	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg w/c Ratio	Max w/c Ratio
																		Water				
			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		

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			▨
Fine:			

Remarks	

C.P.I.: ____________________ ________

Monitor: ____________________ ________

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

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ______________ Contract ID: ____________ Report No.: ________

Plant Name: ______________ County: ____________ Date This Report: ________

Contractor: ______________ Temp. (°F) Min: ________ Date Of Last Report: ________

Weather: ______________ Temp. (°F) Max: ________ Structures Des. No: ________

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

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg	Max
																		Water				
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	w/c Ratio	w/c Ratio

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

Remarks	

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Source	T-203 A #	Grad. No.
Coarse:			
Intermediate:			▨
Fine:			

C.P.I.: ______________________ ________

Monitor: ______________________ ________

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ____________ Contract ID: ____________ Report No.: ________

Plant Name: ____________ County: ____________ Date This Report: ________

Contractor: ____________ Temp. (°F) Min: ________ Date Of Last Report: ________

Weather: ____________ Temp. (°F) Max: ________ Structures Des. No: ________

Check Mix(x)	
Central	
Ready	

Check One(x)		SEND
Paving		(Daily)
Structure		(Weekly)
Incidental		(Weekly)
Patching		(Weekly)

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)									Avg	Max
																		Water				
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	w/c Ratio	w/c Ratio

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			▨
Fine:			

Remarks	

C.P.I.: ____________________ ________

Monitor: ____________________ ________

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

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ____________________

Plant Name: ____________________

Contractor: ____________________

Weather: ____________________

Contract ID: ______________

County: ______________

Temp. (°F) Min: ________

Temp. (°F) Max: ________

Report No.: ________

Date This Report: ________

Date Of Last Report: ________

Structures Des. No: ________

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

			Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (in pounds)										
																		Water				
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	Avg w/c Ratio	Max w/c Ratio

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			■
Fine:			

Remarks

C.P.I.: ______________________ ________

Monitor: ______________________ ________

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

800240E - 04/00 computer

PCC Plant Report

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

Project No.: ____________________

Plant Name: ____________________

Contractor: ____________________

Weather: ____________________

Contract ID: ______________

County: ______________

Temp. (°F) Min: ________

Temp. (°F) Max: ________

Report No.: _______

Date This Report: _______

Date Of Last Report: _______

Structures Des. No: _______

Check Mix(x)	
Central	
Ready	

Check One(x)		SEND
Paving		(Daily)
Structure		(Weekly)
Incidental		(Weekly)
Patching		(Weekly)

Mix	Batched (CY)	% Of Est. Used	Fine Aggregate			Intermediate Aggregate			Coarse Aggregate			Actual Quantities Used Per cy (In pounds)									Avg w/c Ratio	Max w/c Ratio
			Moist. (%)	T-203 Sp. G.	Wt. SSD (lbs)	Moist. (%)	T-203 Sp. G.	Wt. SSD (lbs)	Moist. (%)	T-203 Sp. G.	Wt. SSD (lbs)	Cement	Fly Ash	GGBFS	Fine	Inter.	Coarse	Water				
																		In Agg.	Plant	Grade		

Coarse	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200	Comply Y/N

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

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

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

	Brand / Source	Rate	Lot Number
Air Entraining:			
Water Reducer:			
Retarder:			
Calcium Chloride:			
Superplasticizer:			

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

	Type	Sp. Gr.	Source
Cement:			
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:			
Intermediate:			▨
Fine:			

Remarks	

C.P.I.: ______________________ ________

Monitor: ______________________ ________

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