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CHAPTER 1

General Housekeeping

In this chapter you will find:

- Course Schedule
- SCDOT Website Navigation

Have Questions? People to Contact:

Robert VanRynn – Concrete (803) 737-6689

Caleb Gunter – Structural Materials Engineer (SME)

(803) 737-6694

SCDOT Concrete Technician Certification – Level 1 and 2

Instructors:

Eddie Deaver, Holcim (US) Inc.

SCDOT

UNIVERSITY OF South Carolina

SCHEDULE: DAY 1

8:30 – 8:45 AM	SCDOT Website Navigation
8:45 – 10 AM	Concrete 101
10AM – 10:30 AM	Qualified Product Listings
10:30 – 11 AM	SCDOT Specifications: Sec. 701 / Supplemental Specifications
11 – 11:30 AM	Moisture Corrections – Fine Aggregate and Mix Proportioning
11:30 – 12:30 PM	Form 700.04
	Break – Lunch
1:30 – 2:30 PM	Aggregate Sampling / Review Questions and Answers
2:30 – 3:30 PM	Construction Manual / SCDOT Specifications: Sec. 702 & Sec. 703
3:30 – 5:00 PM	Supplemental Information and Review

SCDOT

UNIVERSITY OF South Carolina

SCHEDULE: DAY 2

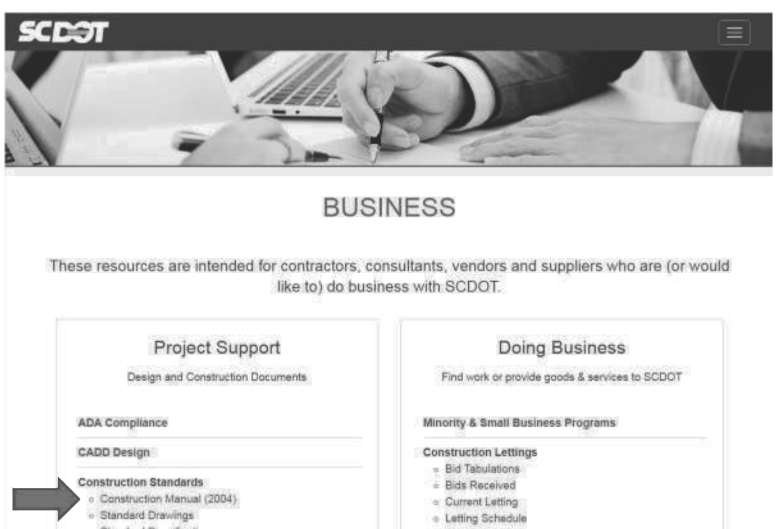
8:30 – 11:00 AM	Exam Level 1: Concrete Batching Technician
11 AM – 1:00 PM	Exam Level 2: Concrete Field Inspector Technician

INTERNET NAVIGATION: WHERE TO FIND WHAT YOU NEED

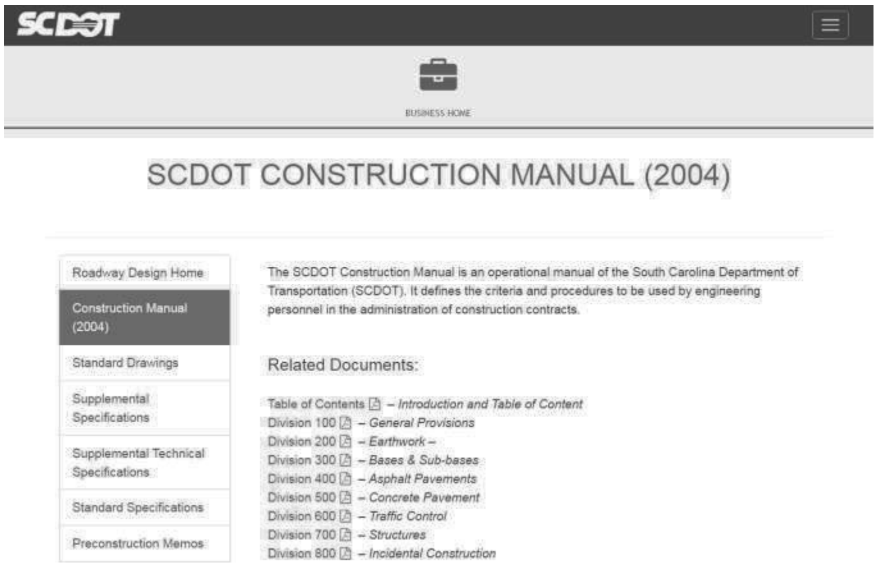
http://www.scdot.org

scdot.org

Construction Standards



Construction Manual

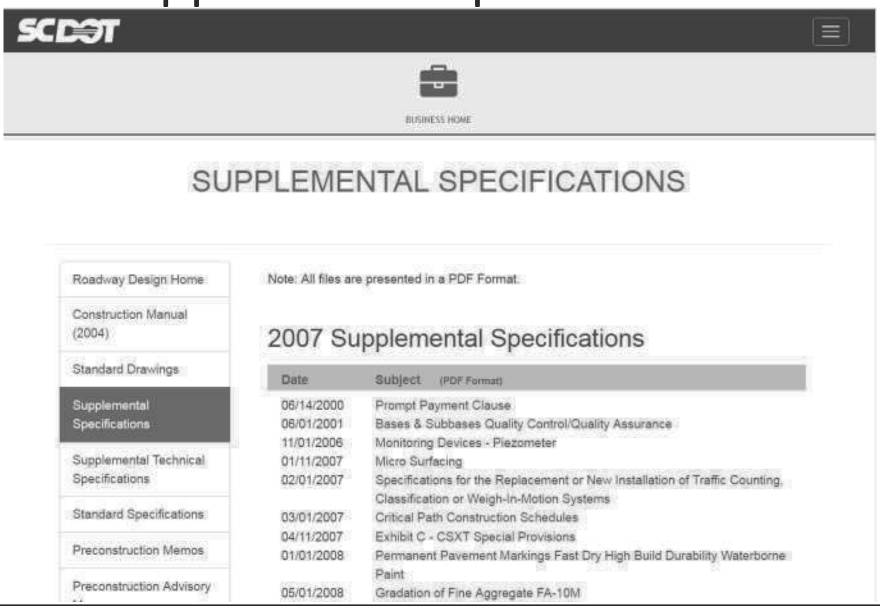


Standard Specifications

Standard Specifications

Supplemental Specifications

Supplemental Specifications



SCDOT

BUSINESS HOME

SUPPLEMENTAL SPECIFICATIONS

- Roadway Design Home
- Construction Manual (2004)
- Standard Drawings
- Supplemental Specifications
- Supplemental Technical Specifications
- Standard Specifications
- Preconstruction Memos
- Preconstruction Advisory M...

Note: All files are presented in a PDF Format.

2007 Supplemental Specifications

Date	Subject (PDF Format)
06/14/2000	Prompt Payment Clause
06/01/2001	Bases & Subbases Quality Control/Quality Assurance
11/01/2006	Monitoring Devices - Piezometer
01/11/2007	Micro Surfacing
02/01/2007	Specifications for the Replacement or New Installation of Traffic Counting, Classification or Weigh-In-Motion Systems
03/01/2007	Critical Path Construction Schedules
04/11/2007	Exhibit C - CSXT Special Provisions
01/01/2008	Permanent Pavement Markings Fast Dry High Build Durability Waterborne Paint
05/01/2008	Gradation of Fine Aggregate FA-10M

Supplemental Technical Specs

BUSINESS

These resources are intended for contractors, consultants, vendors and suppliers who are (or would like to) do business with SCDOT.

Project Support

Design and Construction Documents

ADA Compliance

CADD Design

Construction Standards
- Construction Manual (2004)
- Standard Drawings
- Standard Specifications
- Supplemental Specifications
- Supplemental Technical Specifications
- Preconstruction Design Memorandums
- Preconstruction Advisory Memorandums

Doing Business

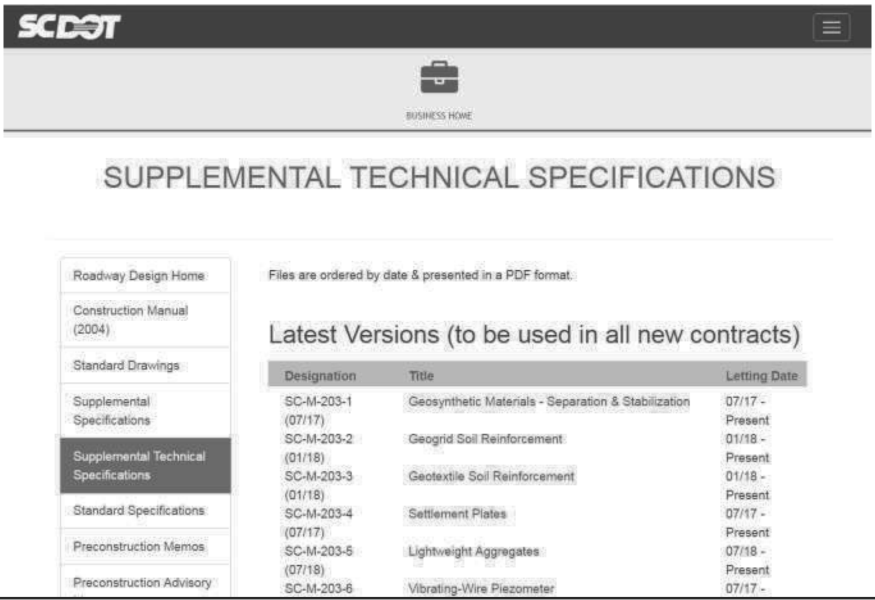
Find work or provide goods & services to SCDOT

Minority & Small Business Programs

Construction Lettings
- Bid Tabulations
- Bids Received
- Current Letting
- Letting Schedule
- Monthly Indexes
- Tentative Letting

Design-Build

Supplemental Technical Specs

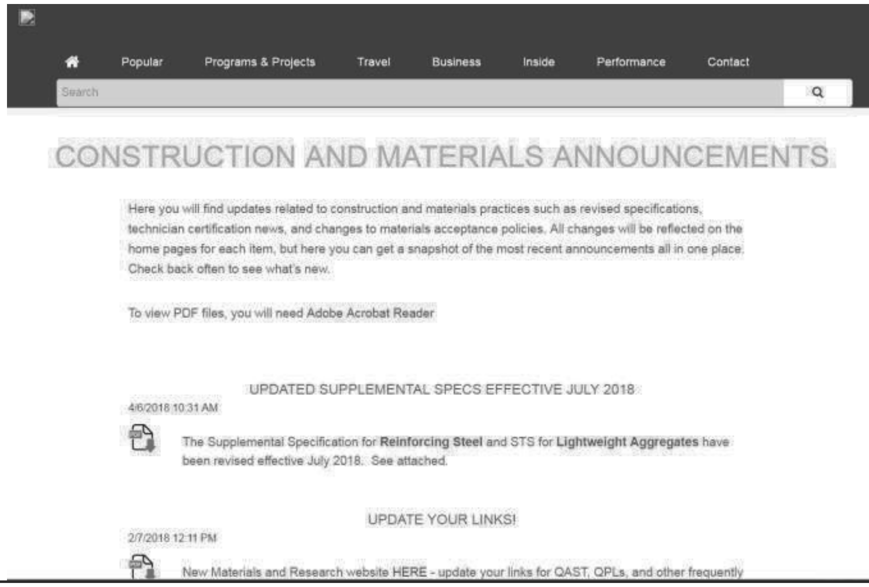


Still under **Business** ….

Materials and Research

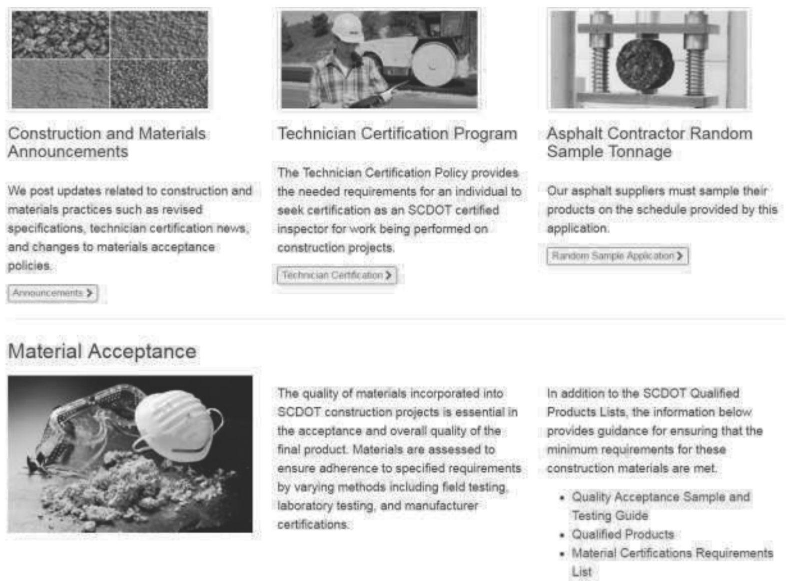
C and M Announcements

C and M Announcements

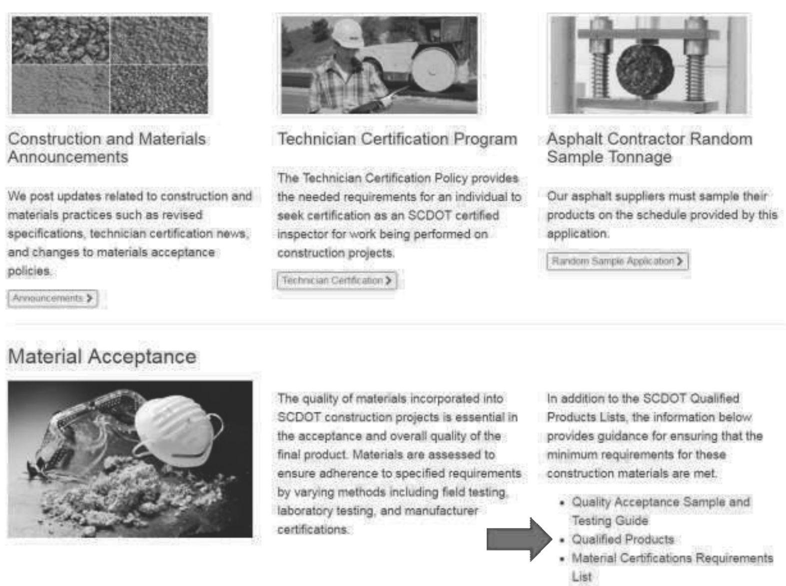


Technician Certification Programs

Materials and Research



Qualified Products



QPLs & QPPs

Popular | Programs & Projects | Travel | Business | Inside | Performance | Contact

Search

QUALIFIED PRODUCTS LISTINGS & POLICIES FOR CONSTRUCTION & MAINTENANCE MATERIALS

Qualified Products Listings (QPL) include pre-qualified materials that may be used on construction and maintenance projects as specified in the project proposal. The Qualified Products Policies (QPP) provide information to the manufacturer of the material to assist them in obtaining pre-qualified status. Each QPL and QPP indicates when the last revision occurred and a contact name in the event assistance is required.

Note: All forms are presented in a PDF Format. Items updated in the last 60 days are marked with (*).

To view PDF files, you will need Adobe Acrobat Reader

Show Only Changes in last 60 days

Number	Description	Policy	List
1	Fine Aggregate Source	8/4/2009	1/19/2018
2	Coarse Aggregate Sources	8/30/2012	1/17/2018
3	Fly Ash for use in Portland Cement Concrete	8/27/2014	12/20/2017
4	Sources of Coquina Base Materials	5/11/2007	1/4/2017
5	Air Entraining and Chemical Admixtures for Concrete	7/11/2017	3/21/2018*
6	Portland Cement and Non-steel Slag Manufacturers	8/24/2017	11/3/2017

QPL 1

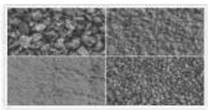
QUALIFIED PRODUCTS LIST 1
January 19, 2018
Page 1 of 7

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
QUALIFIED FINE AGGREGATE SOURCES

NOTICE: THE DATA PROVIDED HEREIN IS FOR INFORMATION ONLY. MATERIALS CHARACTERISTICS WILL VARY DURING PRODUCTION. USING SOURCES LISTED ON THIS QUALIFIED PRODUCTS LIST DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR PROVIDING MATERIALS THAT CONFORM TO THE APPLICABLE SPECIFICATIONS FOR END USE.

SUPPLIER	LOCATION NAME	SCDOT NO.	LOCATION	FINE MOD	ABSORP-TION, %	SPECIFIC GRAVITY, BULK SSD	SOUND. LOSS, %	NOTES
AMERICAN MATERIALS CO.	Pee Dee	SC506	BRITTONS NECK, SC	2.21	0.2	2.65	0.1	1,6,N,P,S,W
AMERICAN MATERIALS CO.	Plant # 240	SC507	JOHNSONVILLE, SC	2.68	0.3	2.644	4.7	1,6,D,N,P,S,W
AMERICAN MATERIALS COM.	Richardson Mine	SC625	BRITTONS NECK, SC	2.14	0.1	2.641	0.7	1,N,D,P,W,S
AMERICAN MATERIALS CO.	IVANHOE,NC	SC662	Wilmington,NC	2.53	0.4	2.636	2.53	3,6,B,N,P,S
American Matl's/Glasscock	Sumter,SC	SC545	SUMTER , SC	2.78	0.6	2.615	1.2	1,6,N,P,S,W
AMERICAN MATERIALS CO.	PEE DEE	SC506	Greshom,SC	2.06	0.4	2.639	0.1	1,6,N,P,S,W
AMERICAN MATERIALS COM.	Wade Plant	SC631	WADE, NC	2.75	0..6	2.64	0.8	1,6,N,P,W,S
AMERICAN MATERIALS CO.	Black Creek Sand M	SC595	MT. CROGHEN, SC	2.28	0.6	2.62	3.6	1,6,B,N,M
AMERICON SAND COMPANY	Lower Broad R.	SC647	MOORESBORO, NC	2.71	1.0	2.611	2.4	1,6,D,R,S,W
AMERICAN SAND CO.	Upper broad R. pit	SC657	Rutherforfton,NC	2.62	0.7	2.623	2.73	1,D,N,R,S,W
APAC MID-SOUTH	Warren Cty. Quarry	SC211	CAMAK, GA	2.99	0.4	2.63	1.2	1,M,W,S
AMERICAN SAND CO.	2[nd] Broad R. Pit	SC658	FOREST CITY,NC	2.78	0.5	2.639	3.53	1,D,P,R,S,W
ATLANTA SAND & SUPPLY CO.	Burke Plant	SC597	ROBERTA, GA	2.44	0.35*	2.626*	1.3	1,6,N,B,D,P,W,S, *GDOT Result
Aggregates Industries	Rappahannock Far.	SC656	Rappahannock Farms Sand & Gravel	2.82	0.8	2.637	1.49	1,M,P,S,W
AMERICAN SAND CO.	Baily Pit	SC578	BLACKSBURG, SC	2.27	0.4	2.621	2.0	1,6,D,R,W,S
BHC TRUCKING	Boling Sand Plant	SC638	WARE SHOALS, SC	2.83	0.8	2.603	1.29	1,4,D,N,P,S,W
BLANKINSHIP SAND COMPANY	Harbersham Plant	SC642	DEMOREST, GA	2.22	0.5	2.648	2.4	1,4,R,D,W,S
BLUEGRASS MATLS CO, LLC	Edmund	SC516	EDMUND, SC	2.86	0.4	2.640	1.5	1,6,B,N,S
BLUEGRASS MATLS CO, LLC	Calhoun Pit	SC613	GASTON, SC	2.67	0.9	2.611	1.3	1,6,B,N,S
BLUEGRASS MATLS CO, LLC	Old Charleston Hwy	SC581	GILBERT, SC	1.82	1.0	2.618	3.14	1,2,6,B,N,S
BLUE WATER INDUSTRIES	Elizabethtown, TN	SC665	Elizabethtown Quarry	4.06	1.9	2.555	5.52	1,2,P,M,S
BROAD RIVER MATERIALS	Askew Pit	SC624	LOCKHART, SC	2.68	0.7	2.615	2.1	1,R,D,P,W
BROAD RIVER MATERIALS	Cudd Pit	SC621	LOCKHART,SC	2.78	0.8	2.604	2.0	1,6,R,D,P,S
BROAD RIVER MATERIALS	Sloan Pit	SC641	LOCKHART, SC	2.05	0.7	2.62	2.5	1,6,D,P,R,S,

Sampling and Testing Guide



Construction and Materials Announcements

We post updates related to construction and materials practices such as revised specifications, technician certification news, and changes to materials acceptance policies.

Announcements >

Technician Certification Program

The Technician Certification Policy provides the needed requirements for an individual to seek certification as an SCDOT certified inspector for work being performed on construction projects.

Technician Certification >

Asphalt Contractor Random Sample Tonnage

Our asphalt suppliers must sample their products on the schedule provided by this application.

Random Sample Application >

Material Acceptance

The quality of materials incorporated into SCDOT construction projects is essential in the acceptance and overall quality of the final product. Materials are assessed to ensure adherence to specified requirements by varying methods including field testing, laboratory testing, and manufacturer certifications.

In addition to the SCDOT Qualified Products Lists, the information below provides guidance for ensuring that the minimum requirements for these construction materials are met.

- Quality Acceptance Sample and Testing Guide
- Qualified Products
- Material Certifications Requirements List

Sampling and Testing Guide

Revised: 02/07/18

SCDOT

South Carolina Department of Transportation

SCDOT Quality Acceptance Sampling and Testing Guide

This guide serves as an amendment to Figure 106B & 106C of the *SCDOT Construction Manual*. This guide should be used in conjunction with the Materials Certification Requirement List, Qualified Products Policies & Listings, Pretested Materials Policies & Listings, and all other applicable guidance, for quality acceptance of materials to be incorporated in the work of SCDOT projects.

Sampling and Testing Guide

Product	Material Description	SiteManager Material Code	Minimum Sample Frequency	Sample Size	Sampling Procedure	QPL	Office to Obtain Sample	RCE to test for (Test – Minimum Frequency)		Spec. Reference	Remarks
Aggregate, Coarse (Non-HMA)	Aggregate, # 1 Stone	Agg1	(1) per 500 Tons[f]	(1) 40 Lbs.	SC-T-1	QPL 2	RCE	-	-	S: 501, 701, 802, Appendix: A-2, A-3, A-4, A-6 STS: (7/17)	Sample requirement waived for: 1) Temporary applications used in CMRB Curing Method 4 2) Use in Non-structural Class 2500 concrete Small Quantity Acceptance
	Aggregate, # 4 Stone	Agg4									
	Aggregate, # 5 Stone	Agg5									
	Aggregate, # 56 Stone	Agg56									
	Aggregate, # 57 Stone	Agg57									
	Aggregate, # 67 Stone	Agg67									
	Aggregate, # 6M Stone	Agg6M									
	Aggregate, # 7 Stone	Agg7									
	Aggregate, # 78 Stone	Agg78									
	Aggregate, # 789 Stone	Agg789									
	Aggregate, # 89M Stone	Agg89M									
	Aggregate, # 8M Stone	Agg8M									
	Aggregate, Light Weight Stone	AggLightWeight									
	Aggregate, CR-14 Stone Crusher Run	AggCR-14									
Aggregate, Fine (Non-HMA)	Aggregate, FA-10	AggFA10	(1) per 500 Tons[f]	(1) 20 Lbs.	SC-T-2	QPL 1	RCE	-	-	S: 501, 701, 802, Appendix: A-2, A-3, A-5, A-6 SS: (5/1/08)	Sample requirement waived for: 1) Use in Non-structural Class 2500 concrete Small Quantity Acceptance
	Aggregate, FA-10 / Manufactured Sand	AggFA10M-701									
	Aggregate, FA-12	AggFA12									
	Aggregate, FA-13	AggFA13									
	Aggregate, Fine Agg. Blended	AggFABlend-701									
	Aggregate, Natural Sand used in Asphalt	AggNatSand401									
	Aggregate, Regular Screenings	AggScr									
	Aggregate, Washed Screenings	AggWScr									

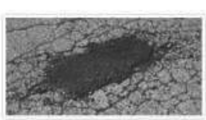
SCT Test Procedures

• Pretested Materials Policies & Listings

Research & New Products

The SCDOT Research Program Website is hosted by the Clemson University Transportation Technology Transfer Service, T3 Service. The T3 Service has been operated by Clemson University's Civil Engineering Department and sponsored by the SCDOT and the FHWA since 1985. Information that can be found on this website includes the structure of the SCDOT Research program, all active SCDOT sponsored research studies, recently completed SCDOT sponsored research studies, current and past electronic copies of the Research Development and Technology Transfer (RD&T) Newsletter, and an electronic copy of SCDOT research problem statement form and instructions.

Research Program Site › New Product Submission ›



Pavement Design

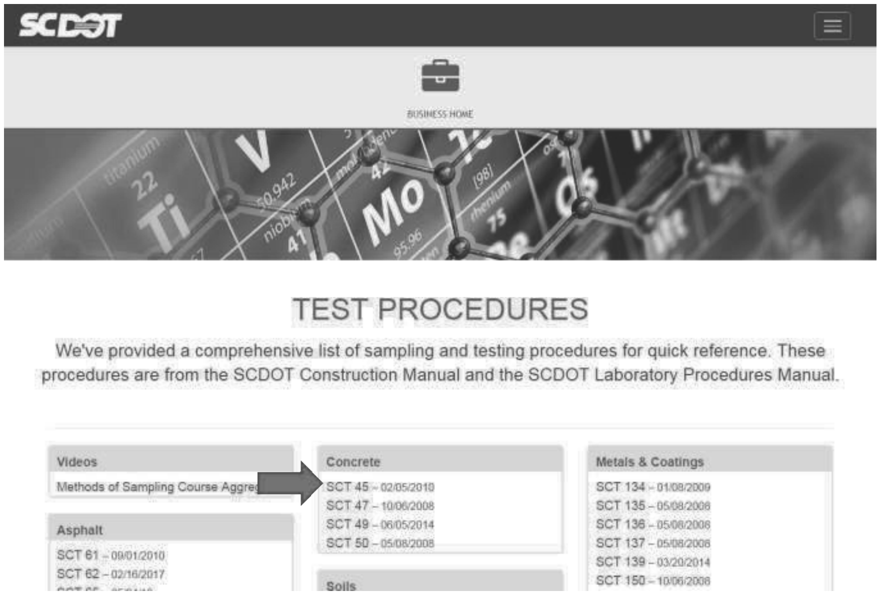
SCDOT Pavement Design Guidelines provide engineering guidance on converting traffic and soil data to determine a new pavement design that will provide adequate serviceability for the design period with acceptable reliability.

Test Procedures

View our quick reference for sampling and testing procedures from the SCDOT Construction Manual and the SCDOT Laboratory Procedures Manual.

Test Procedures ›

SCT Test Procedures



SC-T-45

Standard Method of Test for

Slump Loss of Portland Cement Concrete

SCDOT Designation: SC-T-45 (09/09)

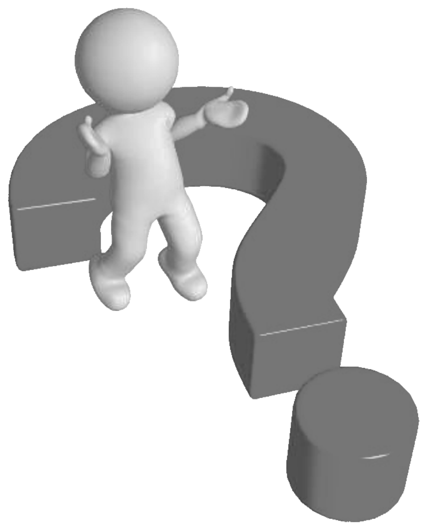
1. SCOPE

1.1. To determine the slump loss of freshly mixed Portland Cement Concrete over a period of time.

1.2. This method is typically used for drilled shaft concrete. It may also be applicable in special circumstances as deemed necessary by the RCE.

1.3. The purpose of this test is to ensure that drilled shaft concrete has a slump within the range specified in Subsection 701.2.12.3 of the 2007 edition of SCDOT's Standard Specifications For Highway Construction when placed and maintains a minimum slump as specified in Subsection 712.4.13.2 of the 2007 edition of SCDOT's Standard Specifications For Highway Construction.

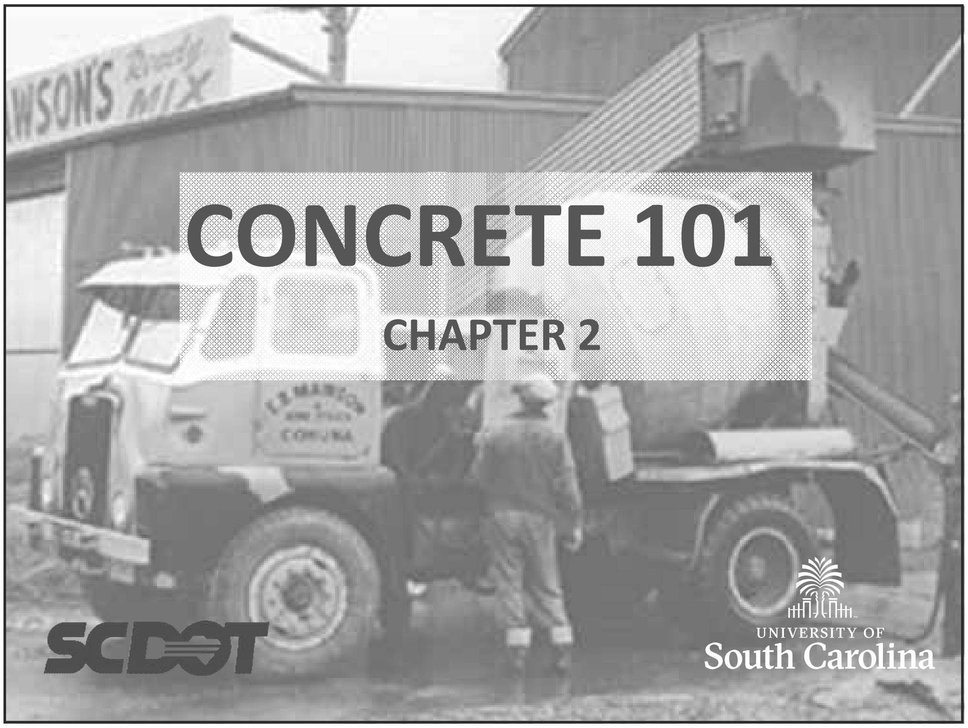
Questions



Chapter 2

SCDOT Concrete Technician Certification Course

- Concrete 101
- Concrete Materials



SCDOT PCC INSPECTOR:
WHAT ARE WE DOING HERE?

SCDOT Portland Cement Concrete Batching and Field Testing Technician Certification Requires:

ACI CONCRETE FIELD TESTING TECHNCIAN 1

SCDOT SUPPLEMENTAL MATERIAL

SCDOT

UNIVERSITY OF
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PC CONCRETE

Excellent building material used to counteract compressive stresses. It must be reinforced with steel when is subjected to tensile stresses, since concrete is weak in tension.

Concrete is a composite material:

- **Portland Cement**
- **Aggregate**
- **Water**
- **Admixtures (mineral and chemical)**

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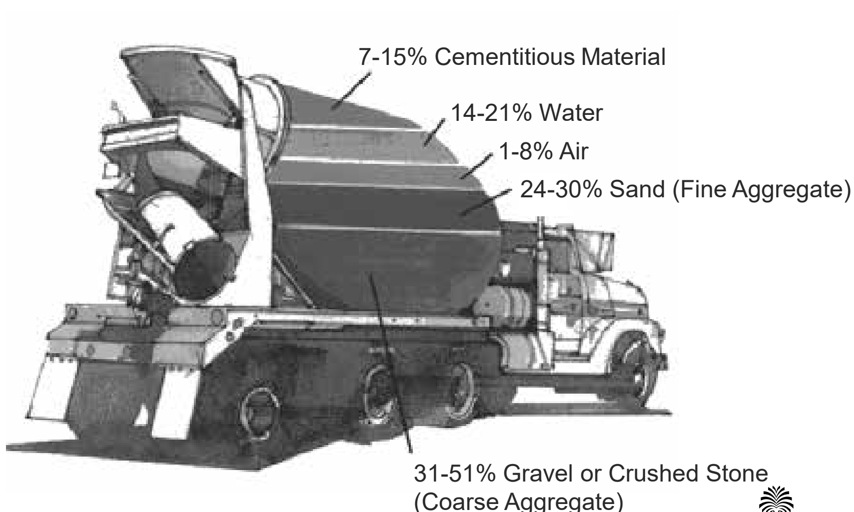
CONCRETE CONSTITUENTS



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PORTLAND CEMENTS

One of the most widely used construction material and the most important hydraulic cement.

Approximate proportions for portland cements:

- **Lime (CaO) : 60-65%**
- **Silica (SiO_2) : 20-25%**
- **Iron oxide and alumina (Fe_2O_3 and Al_2O_3) : 7-12%**

PROPERTIES OF MAJOR COMPOUNDS IN PORTLAND CEMENT

- The most desirable compound is that of **tricalcium silicate (C_3S)** because it hardens rapidly and accounts for the high early strength of the cement.
- **Dicalcium silicate (C_2S)** contributes largely to strength increase at ages beyond one week.
- **Tricalcium aluminate (C_3A)** liberates a large amount of heat during the first few days of hardening. It also contributes to early-strength development.
- **Tetracalcium aluminoferrite (C_4AF)** hydrates rather rapidly but contributes very little to strength.

TYPES OF PC

There are five standard types of portland cement

1. **ASTM Type I or Normal PC**
   - General purpose cement (not for severe climate).
2. **ASTM Type II Moderate Sulfate or Type II(MH) Moderate Heat**
   - Moderate sulfate resistance and moderate heat of hydration

   - Used for structures of considerable mass: piers, retaining walls or concretes in moderate sulfate environments.
3. **ASTM Type III or High-early Strength PC**
   - High strength in less than one week

   - Done with a finer grinding, better burning, such that the dicalcium silicate is less and the tricalcium silicate is greater.

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TYPES OF PC (Continued)

4. **ASTM Type IV or Low Heat of Hydration PC**
   - Develops strength at slower rate than Type I

   - Intended for mass structures, i.e. large gravity dams, where temperature on continuous pour is optimal

   - If temperature rise is not minimized, large cracks and flaws will appear
5. **ASTM Type V or Sulfate-resisting PC**
   - Used when concrete is to be exposed to severe sulfate action by soil or water

- The three types of Air-Entraining Cements

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AASHTO M240 &ASTM C595

Blended cements allowed by SCDOT:

IS(xx): Blended GGBFS Cement

IP(xx): Blended Fly Ash Cement

IL(xx): Blend Limestone Cement

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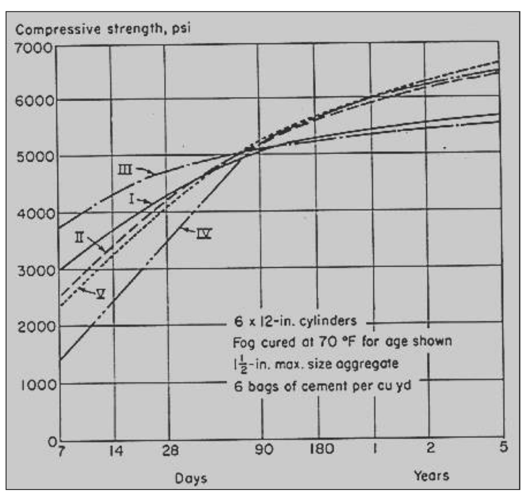
RATES OF COMPRESSIVE STRENGTH DEVELOPMENT
(PCA, Design and Control of Concrete Mixtures)



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PROPERTIES OF PC

- **The Specific Gravity of Portland cement is about 3.15** and it is the used in volume calculations when determining proportions in concrete mix designs.
- **The Specific Gravity of Class F Fly Ash is assumed to be 2.25 in mix designs**, though it varies to some degree, it is used as a default when the exact number is not known. This is the specific gravity that is used by SCDOT for mix design verification.

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WATER

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WATER

- Any drinkable water is good for concrete. Impurities, like dissolved chemicals, seawater, sugar, and algae, may cause problems:
    1. **Abnormal setting time**
    2. **Decreased strength**
    3. **Volume changes**
    4. **Efflorescence**
- Dissolved chemicals may accelerate or retard the set and can substantially reduce the concrete strength. Can also attack the cement-sand bond, leading to early disintegration of concrete.

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WATER

- Seawater containing less than 3% salt is acceptable for plain concrete but not for reinforced or prestressed concrete because of corrosion.
- Sugar, even in small amounts, can cause retarded setting.
- Algae can cause a reduction in the strength of concrete by increasing the amount of air captured in the paste and reducing the bond strength between the paste and the aggregate.

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AGGREGATE

- Mineral aggregate is a mass of mineral grains or fragments used in their natural state, or prepared by crushing, screening, washing, or blending of naturally occurring rock material, usually without chemical treatment of any kind (by-product like blast-furnace slag, may be used as mineral aggregates).
- It is very important of using the right type and quality of aggregates in concrete: fine and coarse aggregates occupy 55% to 75% of the concrete volume (70% to 85% by weight).

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TYPES OF MINERAL AGGREGATE

- **Natural products** (crushed stone, sand, gravel etc.) modified during their preparation only with reference to size, shape, surface texture, and the removal of foreign materials.
- **Artificial or synthetic products** (crushed furnace slag, burned clay, lightweight aggregates) prepared from natural materials whose physical properties have been changed in the course of their production.

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TYPES OF MINERAL AGGREGATE

- **Fine** → passing a 3/8 in. (9.5 mm) sieve and almost entirely passing a No. 4 (4.75 mm) sieve and predominantly retained on the No. 200 (75μm) sieve.
- **Coarse** → predominantly retained on the No. 4 (4.75 mm) sieve.

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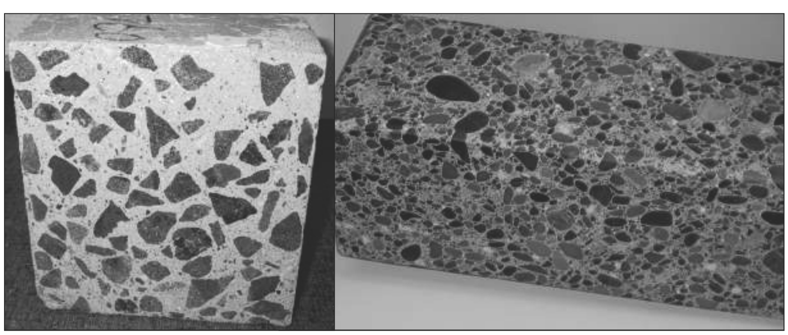
GRADATION & AGGREGATE BLENDING

Aggregate gradation affects the workability, strength, and cost of PC Concrete mixes.



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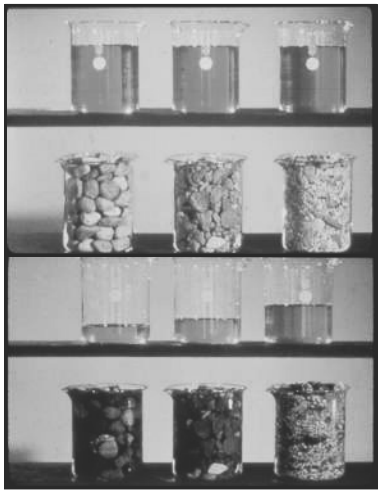
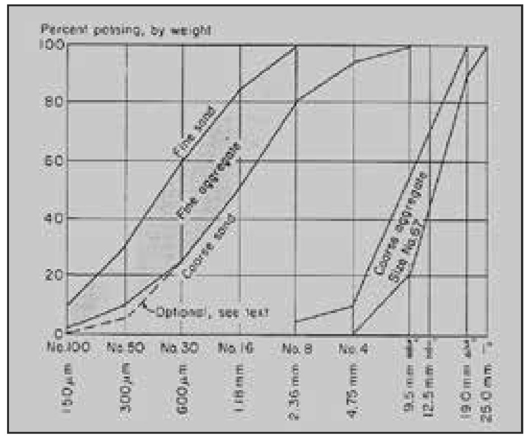
AGGREGATE BLENDING





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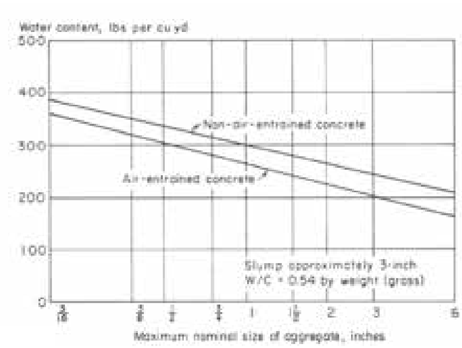
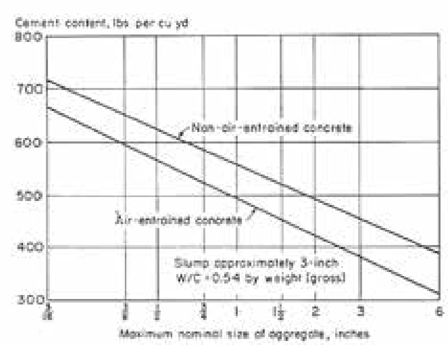
EFFECT OF AGGREGATE SIZE ON WATER & CEMENT AMOUNT

PCA, Design and Control of Concrete Mixtures





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CHEMICAL & MINERAL ADMIXTURES

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STANDARD SPECIFICATION FOR CHEMICAL ADMIXTURES FOR CONCRETE

ASTM C 494	
TYPE A	Water Reducing
TYPE B	Retarding
TYPE C	Accelerating
TYPE D	Water Reducing and Retarding
TYPE E	Water Reducing and Accelerating
TYPE F	Water Reducing, High Range
TYPE G	Water Reducing, High Range & Retarding
TYPE S	Special Use Admixtures (SRA, VMA, HSA)

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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.

They can be classified:

1. **Air-entraining**
2. **Water-reducing**
3. **Retarding**
4. **Accelerating**
5. **Superplasticizers**
6. **Finely divided mineral admixtures**
7. **Miscellaneous workability, bonding, dampproofing, coloring, corrosion inhibiting, etc.**

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REASONS FOR ADMIXTURES

1. To **reduce the cost** of concrete construction.
2. To **achieve certain properties in concrete more effectively** than by other means.
3. To ensure the **quality of concrete** during the stages of mixing, transporting, placing, and curing in hostile weather conditions.
4. To **overcome certain emergencies** during concreting operations.

No admixture can be considered a substitute for good concreting practice.

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1. AIR-ENTRAINING ADMIXTURES

- Air-entraining admixtures are used to entrain microscopic air bubbles in concrete. Air-entrainment will dramatically **improve the durability of concrete exposed to moisture during cycles of freezing and thawing and chemical deicers**. The workability of fresh concrete is also improved significantly. Segregation and bleeding are reduced or eliminated.
- Air-entrained concrete contains **small air-bubbles that are distributed "uniformly"** throughout the cement paste.
- Entrained air can be produced in concrete by use of air-entraining cement, admixture, or combination of both methods.

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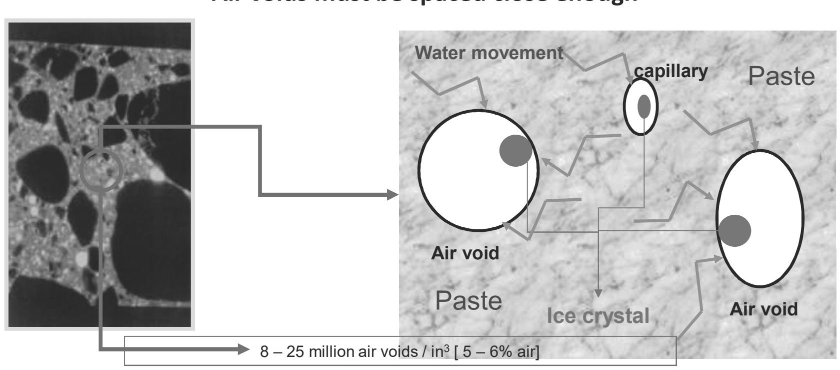
POSITIVE EFFECT OF AIR BUBBLES DURING F&T CYCLES

The pressure developed during freezing depends largely upon the distance the water must travel to the nearest air void for relief →

Air voids must be spaced close enough



Air-entrained concrete was not introduced until 1940.

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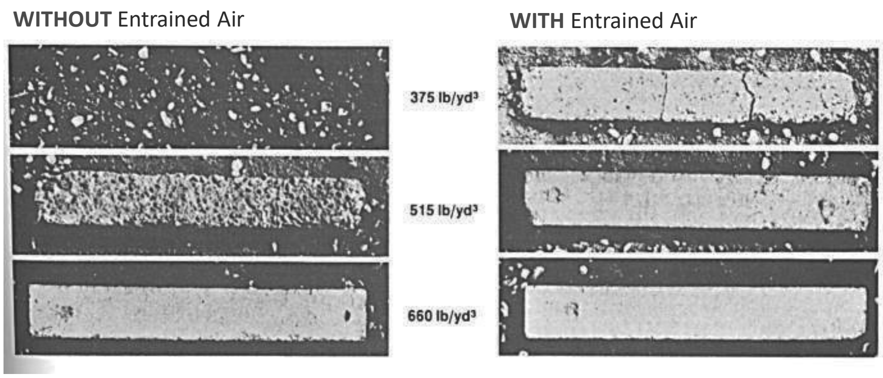
AIR-ENTRAINED CONCRETE

(PCA, Design and Control of Concrete Mixtures)



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2. WATER-REDUCING ADMIXTURES

- Reduce the quantity of mixing water.
- Typical water reducers → **5-10%**
- High-range water reducers "superplasticizers" → **12-30%**
- Increase of strength
- **PROBLEMS**
  - drying shrinkage
  - may retard the setting time

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3. RETARDING ADMIXTURES

- Retard the rate of setting of concrete, in cases like high temperature. A practical solution for that is to reduce the temperature of concrete by cooling the mixing water or the aggregates.
- Some reduction in strength and possible increased shrinkage at early ages can occur with the use of retarders.

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4. ACCELERATING ADMIXTURES

Accelerate the strength development of concrete at an early age.

Can also be achieved by:

1. **Use Type III high-early strength PC**
2. **Lowering the w/c ratio by adding cement**
3. **Curing at higher temperature**

Calcium Chloride ($CaCl_2$) is the material most commonly used in accelerating admixtures. **May cause** → drying shrinkage, potential reinforcement corrosion, discoloration (darkens concrete)

It is not recommended for:

1. **Prestressed Concrete – corrosion hazard**
2. **Hot weather**
3. **Massive concrete placements**

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5. SUPERPLASTICIZERS

(High-range water reducers)

It is added to concrete with a low-to-normal slump and water-cement ratio to make high-slump flowing concrete.

Flowing concrete can be used in:

1. **Thin section placements**
2. **Areas of closely spaced reinforcing steel**
3. **Underwater placements**
4. **Pumped concrete to reduce pump pressure**

Reduce also the w/c ratio (12-30%) that can produce concretes with:

1. Ultimate Strength Compressive Strength in excess of 10,000 psi
2. Increase early strength, etc.

The effect of superplasticizers in increasing workability is short-lived, 30 to 60 minutes; it is added at the jobsite.

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6. FINELY DIVIDED MINERAL ADMIXTURES

Improve or change some of the plastic or hardened properties of portland cement concrete.

Based on their chemical or physical properties they are classified as:

- **Cementitious materials (ground granulated blast-furnace slag, natural cement etc.)**
- **Pozzolans (fly ash and silica fume)**
- **Pozzolanic and Cementitious materials.**

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FLY ASH

- **Fly ash is a pozzolan** - a siliceous or aluminosiliceous material that in itself possesses limited or no cementitious value but will react with the calcium hydroxide released by the hydration of pc to form a compound possessing cementitious properties.
- It is a **byproduct of coal-fired electric** generating plants.
- Fly ash particles are generally spherical and similar in size to pc: typical particle size under 20 μm.
- W/C: water/cementitious materials ratio

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EFFECTS OF FLY ASH

PROS	CONS
Strength Gain	Decreases Air Entraining Ability
Improves Workability	Decreases Early Strength
Reduces Bleeding	Seasonal Limitations
Reduces Heat of Hydration	
Reduces Permeability	
Increases Resistance to Sulfate Attack	
Lowers Costs	

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SILICA FUME

- It is a result of the manufacture of silicon or ferrosilicon alloy in an electric arc furnace.
- It has spherical shape extremely fine particles with less than 1μm in diameter. They are about 100 times smaller than average portland cement particles.

EFFECTS OF FRESHLY MIXED CONCRETE

1. Requires more water
2. Decreases air content
3. Reduces workability
4. Decreases segregation and bleeding
5. Retards setting time of concrete
6. Requires longer period of curing

EFFECTS ON HARDENED CONCRETE

1.	Increases strength
2.	Increases early strength
3.	Reduces permeability
4.	Improves the resistance to sulfate or seawater attack
5.	Reduces corrosion by reducing permeability
6.	Slightly increases carbonation
7.	Improves freeze-thaw resistance

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CORROSION INHIBITORS

- Concrete protects embedded steel from corrosion through its highly alkaline nature. The high pH causes a passive and noncorroding protective oxide film to form on steel. Carbonation or the presence of chloride ions from deicers or seawater can destroy or penetrate the film→ **CORROSION**.
- Calcium nitrite, the most commonly used liquid corrosion inhibitor, blocks the corrosion reaction of the chloride ions by chemically reinforcing and stabilizing the passive film. A certain amount of calcium nitrite can stop corrosion up to a certain a threshold of chloride ions.
- Calcium nitrite is an accelerator and affects other properties of concrete (air entraining).

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CONCRETE MIXING

Concrete should be mixed thoroughly until it is uniform in appearance with all ingredients evenly distributed.

Ready Mixed
Concrete Methods:

- Central Mixed
- Shrink Mixed
- Truck Mixed

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IT'S NOT CONCRETE, IF IT'S NOT MIXED

The concrete was batched out of a dry-batch plant, then taken to the jobsite with the mixer in agitate speed (4 rpm). The concrete was mixed at the jobsite 20, 40, 50, and 70 total revolutions at mixing speed (12 rpm). Tests were taken at various stages of the mixing.

	Number	of	Revs.						
Test No.	@ 4 RPM (Agitate)	@ 12 RPM (Mix)	Total Revs.	7 Day PSI	28 Day PSI	WT. Cu. ft.	Total Air %	Slump INCH.	Yield Cu. Ft. / Yard
1	84	0	84	1920	2400	146.5	2.9	1.00	26.08
2	84	20	104	2080	2800	145.7	3.2	1.25	26.22
3	84	40	124	2270	3000	145.0	3.5	1.75	26.34
4	84	50	134	2420	3210	143.8	4.4	2.50	26.56
5	84	70	154	3200	4010	141.0	6.0	4.00	27.09

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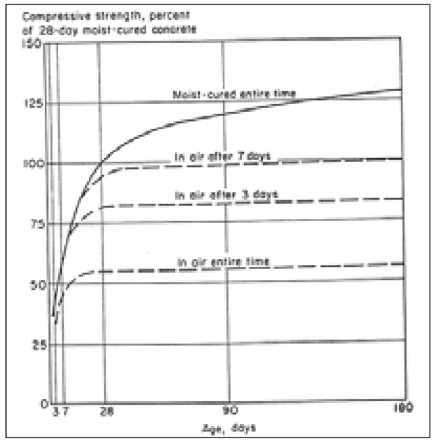
CURING

(PCA, Design and Control of Concrete Mixtures)



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PRINCIPAL REQUIREMENTS

Three Principal Requirements:

1. QUALITY

2. WORKABILITY

2. ECONOMY

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2. CONCRETE MATERIALS 101

Material presented in boxes is more technical in nature and corresponds to the initial portion of the review course presentation**. These materials are not components of the SCDOT specifications, they represent general guidelines only**! SCDOT policies, procedures, and reference values will be located in subsequent sections.

2.1 What is Concrete?

In its simplest form, concrete is a mixture of paste and aggregate (sand & rock). The paste, composed of cement and water, coats the surface of the fine (sand) and coarse aggregate (rocks) and binds them together into a rock-like mass known as concrete.

Within this process lies the key to a remarkable trait of concrete: it's plastic and can be molded or formed into any shape when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks, and superhighways, houses and dams.

The key to achieving a strong, durable concrete rests on the careful proportioning and mixing of the ingredients. A concrete mixture that does not have enough paste to fill all the voids between the aggregate will be difficult to place and will produce rough, honeycombed surfaces and porous concrete. A mixture with an excess of cement paste will be easy to place and will produce a smooth surface; however, the resulting concrete will be more likely to crack and be uneconomical.

A properly designed concrete mixture will possess the desired workability for the fresh concrete and the required durability and strength for the hardened concrete. Typically, a mix is by volume about 10 to 15 percent cement, 60 to 75 percent aggregate and 15 to 20 percent water. Entrained air bubbles in many concrete mixtures may also take up another 5 to 8 percent.

History of Portland Cement Concrete There are several milestones in the development of PC concrete including:

1 Portland cement was patented by J. Aspdin in 1824. Aspdin selected this name for his powdery material because it resembled a natural limestone quarried on the Isle of Portland in England.

2 J. Monier, a Parisian gardener, is considered as the inventor of reinforced concrete due to a patent he received in 1865 for making flower tubs.

3 T.P. Hyatt tested and published a series of tests on reinforced concrete conducted in London between 1870 and 1875.

4 The first Portland cement in the U.S. was produced by D. Saylor at Coplay, Pennsylvania in 1875.

5 The first U.S. reinforced concrete home was built by W. Ward at Port Chester, New York in 1875. Several newspaper reporters were close by to report the collapse, as they expected, of the new structure made out of a "strange" material called reinforced concrete. The structure is still standing, safe and strong.

6 D. Abrams established a rational basis for proportioning concrete mixes in 1910. The effect of the water/cement ratio (0.3-0.6) was, for the first time, quantified.

7 Prestressed concrete was introduced by E. Freyssinet in 1928. This was possible due to the development of high strength steel wire for prestressing.

8 Air-entrained concrete was introduced in 1940 and from 1960 we have an explosive growth of admixtures.

2.1.1 Portland Cement and other Cementitious Materials

There is a common misunderstanding that cement and concrete are one and the same. Portland cement is the active ingredient in concrete and usually makes up 10 to 20 percent of the weight of a concrete mix. Cement is manufactured by fusing several minerals together in a large kiln and grinding the resultant cement clinker into a fine powder. When Portland cement contacts water, a chemical reaction, called hydration, takes place, leading to the formation of a new, hard compound. In the production of concrete, Portland cement is frequently blended with fly ash, slag cement or other cementitious materials.

Cements

Cements are materials that exhibit characteristic properties of setting and hardening when mixed with water. They can be classified:

1. Hydraulic: they set and harden under water i.e. hydraulic limes, natural cements, Portland cement etc.
2. Non-hydraulic: they require air to harden, i.e. lime.

Portland Cement (PC)

It is one of the most widely used materials in construction and the most important hydraulic cement. The essential constituents of pc are lime, silica, alumina, and iron oxide. Lime does not occur in nature but is found in materials like limestone, chalk or oyster shells. Silica and alumina are found free in nature in the form of shale, clay, and blast furnace slag. A small amount of gypsum is added during the production of pc to retard its setting. Four major compounds are found in pc:

1. Tricalcium silicate $3CaO\ SiO_2$ (C_3S) 45-60%: The most desirable compound because it hardens rapidly and accounts for the high early strength of pc concrete.
2. Dicalcium silicate $2CaO\ SiO_2$ (C_2S) 15-30%: It contributes largely to strength increase at ages beyond one week.
3. Tricalcium aluminate $3CaO\ Al_2O_3$ (C_3A) 6-12%: It is responsible for the large amount of heat liberated during the first few days of hardening. It also contributes to the early-strength development.
4. Tetracalcium aluminoferrite $4CaO\ Al_2O_3\ Fe_2O_3$ (C_4AF) 6-8%: It hydrates rather rapidly but contributes very little to strength.

There are five standard types of pc (excluding the 3 air-entrained) as follows:

- ASTM Type I or normal pc: It is the general-purpose cement.
- ASTM Type II or moderate pc: It is recommended for moderate sulfate resistance and moderate heat of hydration. It is used for structures of considerable mass such as piers and retaining walls.
- ASTM Type III or high early strength pc: It is used when a high early strength pc concrete is required. This is done with a finer grinding, better burning, such that the dicalcium silicate is less and the tricalcium silicate is greater.
- ASTM Type IV or low heat of hydration pc: It develops strength at slower rate than does Type I. It is intended for mass structures such as large gravity dams where the temperature rise on the continuous pour is great. If the temperature rise is not minimized large cracks and flaws would appear.
- ASTM Type V or sulfate-resisting pc: It is used when concrete is to be exposed to severe sulfate action by soil or water.

The character of concrete is determined by the quality of the paste. The strength of the paste, in turn, depends on the ratio of water to cement. The water-cement ratio is the weight of the mixing water divided by the weight of all cementitous material (including cement, fly ash and silica fume). High-quality concrete is produced by lowering the water-cement ratio as much as possible without sacrificing the workability of fresh concrete. Generally, using less water produces a higher quality concrete provided the concrete is properly placed, consolidated and cured.

Properties of PC

There are several specifications regarding the chemical composition and physical properties of pc. Such physical properties include:

1. Fineness (90% of pc particles are less than 45 μm): It affects the rate of hydration. The greater the fineness the greater the rate of hydration and hence the greater the strength development during the first seven days.
2. Soundness of hardened cement paste: It is a measure of the ability to retain its volume after setting. Lack of soundness leads to expansive forces.
3. Time of setting: The length of time that concrete remains plastic is dependent upon the chemical composition, fineness, water content, and temperature.
4. Compressive strength: It is determined by mixing the cement specimen with uniform silica sand and water in prescribed proportions and molding the mixture into 2in. x 2in. x 2in cubes.
5. Heat of hydration: Heat generated when water and cement react. It depends on the chemical composition, fineness of the cement, and the temperature during curing.
6. Loss of ignition: It is determined by heating a cement sample of known weight to a full red heat of 1,652 °F until a constant weight is obtained. The loss of weight is determined. This is an indication of pre-hydration and carbonation, which may be caused by improper or prolonged storage.
7. Specific gravity: It is about 3.15 and is not an indication of cement's quality.

Besides Portland Cement, concrete may contain other cementitious materials including fly ash, a waste product from coal burning electric power plants; ground slag, a byproduct of iron and steel manufacturing; and silica fume, a waste product from the manufacture of silicon or ferro-silicon metal. Some of these cementitious materials are similar to the volcanic ashes the Romans mixed with lime to obtain their cement binder. Some of these Roman structures still exist today! The concrete industry uses these materials, which would normally have to be disposed in land-fill sites, to the advantage of concrete. The materials participate in the hydration reaction and significantly improve the strength, permeability and durability of concrete.

Admixtures for PC Concrete

Admixtures are those ingredients in concrete other than Portland cement, water, and aggregates that are added to the mixture immediately before or during mixing. They can be classified:

1 Air-entraining
2 Water-reducing
3 Retarding
4 Accelerating
5 Superplasticizers
6 Finely divided mineral admixtures
7 Miscellaneous: workability, bonding, damp-proofing, coloring, corrosion inhibiting etc.

Concrete should be workable, finishable, strong, durable, watertight, and wear resistant. These qualities can often be obtained easily and economically by the selection of suitable materials (except air-entraining admixtures when needed). The major reasons of using admixtures are:

1. To reduce the cost of concrete construction.
2. To achieve certain properties in concrete more effectively than by other means.
3. To ensure the quality of concrete during the stages of mixing, transporting, placing, and curing in hostile weather conditions.
4. To overcome certain emergencies during concreting operations.

No admixture can be considered a substitute for good concreting practice.

1. Air-Entraining Admixtures (mid-1930's)
   Air-entraining admixtures are used to entrain microscopic air bubbles in concrete. Air-entrainment will dramatically improve the durability of concrete exposed to moisture during cycles of freezing and thawing and chemical deicers. The workability of fresh concrete is also improved significantly. Segregation and bleeding are reduced or eliminated. Air-entrained concrete contains small air-bubbles that are distributed "uniformly" throughout the cement paste. Entrained air can be produced in concrete by use of air-entraining cement, admixture, or combination of both methods.

2. Water-Reducing Admixtures
   They are used to reduce the quantity of mixing water by 5 to 10%. High-range water reducers ("superplasticizers") can be used to reduce the amount of water by 12 to 30%. The major benefit of reducing the mixing water is the increase of the strength of pc concrete. A retard of the setting time and an increase of drying shrinkage may be caused by these kind of admixtures.

3. Retarding Admixtures
   They retard the rate of setting of concrete in cases like concrete exposed to high temperature during placement. A practical solution for that is to reduce the temperature of concrete by cooling the mixing water or the aggregates. Some reduction in strength at early ages accompanies the use of retarders.

4. Accelerating Admixtures
   They can be used to accelerate the strength development of concrete at an early age. This, however, can be also achieved by: (a) use Type III high-early strength Portland cement, (b) lowering the w/c ratio by adding cement, and (c) curing at higher temperature. Calcium chloride (CaCl) is the material most commonly used in accelerating admixtures. It may cause some problems such as drying shrinkage, corrosion, and discoloration (darkens concrete).It is not recommended for prestressed concrete, hot weather, and massive concrete placements.

5. Superplasticizers (High-range water reducers)
   It is added to concrete with a low-to-normal slump and water-cement ratio to make high-slump flowing concrete. Flowing concrete can be used in thin section placements, in areas of closely spaced reinforcing steel, underwater placements, and in pumped concrete to reduce pump pressure. Reduction of w/c ratio (12-30%) can produce concretes with ultimate compressive strength in excess of 10,000 psi and higher early strength etc. The effect of superplasticizers in increasing workability is short-lived, 30 to 60 minutes, and so it should be added at the jobsite.

6. Finely Divided Mineral Admixtures
   They improve or change some of the plastic or hardened properties of Portland cement concrete. Based on their chemical or physical properties they are classified as: (a) cementitious materials (ground granulated blast-furnace slag, natural cement etc.), (b) pozzolans (fly ash and silica fume), and (c) pozzolanic and cementitious materials.

   Fly Ash is a pozzolan, meaning is a siliceous or aluminosiliceous material that possesses limited or no cementitious values but will react with the calcium hydroxide released by the hydration of pc to form a compound possessing cementitious properties. It is a byproduct of coal-fired electric generating plans. Fly ash particles are generally spherical and similar in size to pc. Typical particle size is less than 20 μm. Fly ash may affect positively the produced concrete by increasing the strength, improving workability, reducing bleeding, reducing heat of hydration, reducing permeability, increasing resistance to sulfate attack, increasing resistance to alkali-silica reactivity, and reducing the cost. It may affect, however, negatively the produced concrete by decreasing air entraining ability and decreasing early strength.

   Silica Fume is a result of the manufacture of silicon or ferrosilicon alloy in an electric arc furnace. It has spherical shape extremely fine particles with less than 1μm in diameter. The particles are about 100 times smaller than the average pc particles. It has some significant effects on freshly mixed concrete including: a) requires more water, b) decreases air content, c) reduces workability, d) decreases segregation and bleeding, e) retards setting time of concrete, and f) requires longer period curing. It affects also the hardened concrete including: a) increases the strength, b) increases early strength, c) reduces permeability, d) improves the resistance to sulfate or seawater attack, e) reduces corrosion by reducing permeability, f) increases slightly carbonation, and g) improves freeze-thaw resistance.

7. Corrosion Inhibitors Concrete protects embedded steel from corrosion through its highly alkaline nature. The high pH causes a passive and non-corroding protective oxide film to form on steel. Carbonation or the presence of chloride ions from deicers or seawater can destroy or penetrate the film and initiate corrosion.

Calcium nitrite, the most commonly used liquid corrosion inhibitor, blocks the corrosion reaction of the chloride ions by chemically reinforcing and stabilizing the passive film. A certain amount of calcium nitrite can stop corrosion up to a certain threshold of chloride ions. Calcium nitrite, however, is also an accelerator and affects other properties of concrete.

2.1.2 Aggregate

Aggregate for concrete is chosen carefully. Aggregate comprises 60 to 75 percent of the total volume of concrete. The type and size of the aggregate mixture depends on the thickness and purpose of the final concrete product. Relatively thin building sections can require small coarse aggregates, though aggregate up to six inches (150 mm) in diameter have been used in large dams. A continuous gradation of particle sizes is desirable for efficient use of the paste. In addition, aggregate should be clean and free from any matter that might affect the quality of the concrete.

Aggregate
Mineral aggregate is a mass of mineral grains or fragments used in their natural state, or prepared by crushing, screening, washing, or bleeding of natural occurring rock material, usually without chemical treatment of any kind (by-product like blast-furnace slag, may be used as mineral aggregates).

It is very important to use the right type and quantity of aggregates in concrete since fine and course aggregates occupy 55% to 75% of the pc concrete volume (70% to 85% by weight). Aggregates may be classified as natural of artificial products. Natural aggregates (crushed stone, sand, gravel etc.) are modified during their preparation only with reference to size, shape, surface, texture, and removal of foreign materials. Artificial aggregates (crushed furnace slag, burned clay, lightweight aggregates etc.) are prepared from natural materials whose physical properties have been changed in the course of their production. Aggregates may further classified as fine and coarse. Fine aggregates pass a 3/8 in. (9.5 mm) sieve and almost entirely pass a No.4 (4.75 mm) sieve and predominantly retained on a No.200 (75 µm) sieve. Coarse aggregates are predominantly retained on a No. 4 (4.75 mm) sieve.

2.1.3 Water

Almost any natural water that is drinkable (potable) and has no pronounced taste or odor may be used as mixing water for concrete. Occasionally, some waters that are not fit for drinking may be suitable for concrete.

Excessive impurities in mixing water may not only affect curing time and concrete strength, but also may cause efflorescence, staining, corrosion of reinforcement, volume instability and reduced durability.

Specifications usually set limits on chlorides, sulfates, alkalis, and solids in mixing water unless tests indicate that the water will not negatively impact concrete properties.

All water to be used for concrete must be tested except that supplied by a public water system.

2.1.4 Hydration

After the aggregate, water, and the cement are combined, the mixture remains in a plastic condition for about four to six hours which permits transporting, placing and finishing in its final location, then the mixture starts to harden. All Portland cements set and harden through a chemical reaction with water. During this reaction, called hydration, a node forms on the surface of each cement particle. The node grows and expands until it links up with nodes from other cement particles or adheres to adjacent aggregates. The building up process results in progressive stiffening, hardening, and strength development.

Once the concrete is thoroughly mixed and workable it should be placed in forms before the mixture becomes too stiff. During placement, the concrete is consolidated to compact it within the forms and to eliminate potential flaws, such as honeycombing and air voids.

2.2 What Is Ready Mixed Concrete?

Ready mixed concrete refers to concrete that is delivered to the customer in a freshly mixed and unhardened state. Due to its durability, low cost and its ability to be customized for different applications, ready-mixed concrete is one of the world's most versatile and popular building materials.

Principal Requirements for PC Concrete

There are three principal requirements that should be considered for designing pc concrete mixtures:

1. Quality
2. Workability
3. Economy

Quality

It is measured by pc concrete's strength and durability. The strength (compressive, flexural etc.) should provide the ability to a structure to carry safely the applied loads. It depends (assuming sound aggregate) on water/cement ratio and the extent to which hydration has progressed. Hydration is a chemical reaction between water and cement while concrete is hardening and responsible for the unique properties of concrete. Durability of concrete is the ability to resist the forces of disintegration due to freezing and thawing and chemical attach.

Workability

It is the characteristic indicating the ease with which the mass of the plastic material may be deposited in its final place. It depends on the size and gradation of the aggregate, the amount of mixing water, the time of mixing, etc. It is difficult to be measured. Slump tests (measure of consistency) are used to assess workability. It is usually between 2-4 in. with min 1 in., and it increases by 1 in. by adding 10 lb of water per cubic yard of concrete.

Economy

Effective use of materials, effective operation, and ease of handling gives good quality and economical pc concrete mixtures.

2.2.1 Ordering Information

The purchaser determines the concrete quality (in terms of its properties or composition) and quantity or volume required for the particular application.

2.2.1.1 Quality

Three model formats for ordering ready mixed concrete are suggested by the ASTM C 94, *Standard Specification for Ready Mixed Concrete*. These formats are:

Performance format: Purchaser specifies aggregate size, slump, air content, and strength. Sometimes, the purchaser can specify the strength level and intended use of concrete such as driveway or basement walls. This is the best way to order ready mixed concrete because the ready mixed concrete (RMC) producer, who is an expert in this field, would design an economical mix with the desired properties. The RMC producer accepts responsibility for the design of the mixture.

Prescription format: Purchaser specifies aggregate size, slump, air content, cement content or weight of cement per cubic yard of concrete, maximum water content and admixtures required. In this case, the purchaser accepts responsibility for concrete strength and performance.

Mixed format: Purchaser specifies aggregate size, slump, and air content, required strength, minimum cement content, and admixtures. This format is generally discouraged as the performance requirements may conflict with the prescriptive parameters.

Where the purchaser's specifications differ from these three model formats, the purchaser's specifications govern.

2.2.1.2 Quantity

Concrete is bought and sold by volume in a freshly mixed and unhardened state. The most frequently used unit measure is the cubic yard or cubic meter. A cubic yard is 27 cubic feet of volume, that is 3 feet in length, width, and height. One cubic yard of concrete weighs about 4000 lb. (2 short tons). One cubic meter is approximately 1.3 cubic yards and weighs about 2400 kg (2.4 metric tons).

When ordering concrete, make sure that you order 4% to 10% more concrete than is estimated from a volumetric calculation of the plan dimensions. This will account for the following:

- Waste or spillage
- Over-excavation
- Spreading of forms
- Some loss of entrained air
- Settlement of wet mixture
- Change in volume – dry concrete volume is 1% to 2% less than fresh concrete volume

It is important that you do not order too much concrete. The processing and disposal of returned concrete is an expensive proposition for the ready mixed concrete producer, who has to comply with various environmental regulations. Be environmentally friendly! Towards the end of a large job, reevaluate the additional volume of concrete you need and communicate this to your concrete supplier.

2.3 Production of Ready Mixed Concrete

2.3.1 Proportioning

The proportioning of a concrete mix design should result in an economical and practical combination of materials to produce concrete with the properties desired for its intended use, such as workability, strength, durability and appearance.

The ready mixed concrete producer may independently select the material proportions to provide the performance you need or may receive instructions through the job specifications, such as minimum cement content, air content, slump, maximum size of aggregate, strength, and others. The RMC producer is the expert in selecting the proportions based on previously developed guidelines and experience.

Regardless of the source of instructions, there are established methods for selecting the proportions for concrete for each batch. The *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete* (ACI 211.1-91) published by the American Concrete Institute Committee 211 is often referenced for selecting concrete proportions.

Here are the basics of a good concrete mix:

Portland cement and water combine chemically to bind the sand and aggregate together. Fly ash or other cementitious materials, which enhance concrete properties, may supplement some of the cement. The key to quality concrete is to use the least amount of water that can result in a mixture that can be easily placed, consolidated and finished.

Fine and coarse aggregate make up about 70% of the concrete volume and impart volume stability to the concrete. Concrete aggregates are required to meet appropriate specifications and in general should be clean, strong and durable.

Admixtures are generally products used in relatively small quantities to improve the properties of fresh and hardened concrete. They are used to modify the rate of setting and strength development of concrete, especially during hot and cold weather. The most common is an air-entraining agent that develops millions of tiny air bubbles in concrete, which imparts durability to concrete in freezing and thawing exposure. Water reducing admixtures enable concrete to be placed at the required consistency while minimizing the water used in the mixture, thereby increasing strength and improving durability. A variety of fibers are incorporated in concrete to control cracking or improve abrasion and impact resistance.

2.3.2 Production

2.3.2.1 Transit Mixed (or "truck-mixed") Concrete

In transit-mixed concrete, also called truck mixed or dry-batched, all of the raw ingredients are charged directly in the truck mixer. Most or all water is usually batched at the plant. The mixer drum is turned at charging (fast) speed during the loading of the materials. There are three options for truck mixed concrete:

Concrete mixed at the job site. While traveling to the job site the drum is turned at agitating speed (slow speed). After arriving at the job site, the concrete is completely mixed. The drum is then turned for 70 to 100 revolutions, or about five minutes, at mixing speed.

Concrete mixed in the yard. The drum is turned at high speed or 12-15 rpm for 50 revolutions. This allows a quick check of the batch. The concrete is then agitated slowly while driving to the job site.

Concrete mixed in transit. The drum is turned at medium speed or about 8 rpm for 70 revolutions while driving to the job site. The drum is then slowed to agitating speed.

2.3.2.2 Shrink Mixed Concrete

Concrete that is partially mixed in a plant mixer and then discharged into the drum of the truck mixer for completion of the mixing is called shrink mixed concrete.

Central mixing plants that include a stationary, plant-mounted mixer are often actually used to shrink mix, or partially mix the concrete. The amount of mixing that is needed in the truck mixer varies in these applications and should be determined via mixer uniformity tests. Generally, about thirty turns in the truck drum, or about two minutes at mixing speed, is sufficient to completely mix shrink-mixed concrete.

2.3.2.3 Central Mixed Concrete

Central-mixing concrete batch plants include a stationary, plant-mounted mixer that mixes the concrete before it is discharged into a truck mixer. Central-mix plants are sometimes referred to as wet batch or pre-mix plants. The truck mixer is used primarily as an agitating haul unit at a central mix operation. Dump trucks or other non-agitating units are sometimes be used for low slump and mass concrete pours supplied by central mix plants. About 20% of the concrete plants in the US use a central mixer. Principal advantages include:

Faster production capability than a transit-mix plant,
Improved concrete quality control and consistency, and
Reduced wear on the truck mixer drums.

There are several types of plant mixers, including:

Tilt drum mixer
Horizontal shaft paddle mixer
Dual shaft paddle mixer
Pan mixer
Slurry mixer

The tilting drum mixer is the most common American central mixing unit. Many central-mix drums can accommodate up to 12 yd^3 and can mix in excess of 200 yd^3 per hour. They are fast and efficient, but can be maintenance-intensive since they include several moving parts that are subjected to a heavy load.

Horizontal shaft mixers have a stationary shell and rotating central shaft with blades or paddles. They have either one or two mixing shafts that impart significantly higher horsepower in mixing than the typical drum mixer. The intensity of the mixing action is somewhat greater than that of the tilt drum mixer. This high energy is reported to produce higher strength concrete via to thoroughly blending the ingredients and more uniformly coating the aggregate particles with cement paste. Because of the horsepower required to mix and the short mixing cycle required to complete mixing, many of these mixers are 4 or 5 yd^3 units and two batches may be needed to load a standard truck or agitator.

Pan mixers are generally lower capacity mixers at about 4 to 5 yd^3 and are used at precast concrete plants.

The slurry mixer is a relative newcomer to concrete mixing technology. It can be added onto a dry-batch plant and works by mixing cement and water that is then loaded as slurry into a truck mixer along with the aggregates. It is reported to benefit from high-energy mixing. Another advantage is that the slurry mixer reduces the amount of cement dust that escapes into the air.

2.3.2.4 "Mix Mobiles" - Mobile Volumetric Proportioning Plants

"Mix Mobile" are truck-mounted, volumetric batching and continuous mixing units. These "plants-on-wheels" often supply small-volume or specialty pours and offer the convenience of freshly mixed concrete in fairly precise quantities. The unit consists of a truck with bins of sand, coarse aggregate, cement, water, and admixtures. The aggregate bins have longitudinal belts at the bottom of the sand, and as well as coarse aggregate bins that drag the aggregate to separate adjustable gates at the rear of the bin. The speed of the belts is connected to a feeder in a cement bin, and all three materials drop down into a mixer. Flow meters control the introduction of water and admixtures.

2.3.2.5 Batch Plants Styles

Concrete batch plants come in a variety of styles and configurations designed to accommodate a variety of markets, technical and environmental considerations.

Portable Plants have a cement silo and an overhead bin for sand or one or two coarse aggregate types.

Permanent Plants operate from same location for a relatively long period of time. Large quantities of materials of greater variety are stored at the plant. The plant will tend to have larger overhead storage and may have two lanes to permit batching two trucks at the same time. Plants may be also classified as:

> ***High profile*** – the traditional stack up plant is a tall plant that has aggregate and cement storage bins that feed into batchers or weigh hoppers by gravity.
>
> ***Low profile*** – the aggregate weigh hoppers are near the ground with belts to elevate the aggregate to load the mixer.

2.3.3 Delivery

2.3.3.1 The Truck Mixer

While ready mixed concrete can be delivered to the point of placement in a variety of ways, the overwhelming majority of it is brought to the construction site in truck-mounted, rotating drum mixers. Truck mixers have a revolving drum with the axis inclined to the horizontal. Inside the shell of the mixer drum are a pair of blades or fins that wrap in a helical (spiral) configuration from the head to the opening of the drum. This configuration enables the concrete to mix when the drum spins in one direction and causes it to discharge when the direction is reversed.

To load, or charge, raw materials from a transit mix plant or centrally mixed concrete into the truck, the drum must be turned very fast in the charging direction. After the concrete is loaded and mixed, it is normally hauled to the job site with the drum turning at a speed of less than 2 rpm.

Since its inception in the mid-1920's, the traditional truck-mixer has discharged concrete at the rear of the truck. Front discharge units, however, are rapidly becoming more popular with contractors. The driver of the front discharge truck can drive directly onto the site and can mechanically control the positioning of the discharge chute without the help of contractor personnel.

Currently, because of weight laws, the typical truck mixer is a 9 to 11 yd^3 unit. The drums are designed with a rated maximum capacity of 63% of the gross drum volume as a mixer and 80% of the drum volume as an agitator. Generally, ready mixed concrete producers load their trucks with a quantity at or near the rated mixer capacity.

Fresh concrete is a perishable product that may undergo slump loss depending on temperature, time to the delivery point on the job site, and other factors. Water should not to be added to the mix unless the slump is less than that which is specified. If water is added, it should be added all at once and the drum of the truck mixer should be turned a minimum of 25 revolutions, or about two minutes, at mixing speed.

In certain situations, air-entraining, water reducing, set-retarding or high-range water reducing admixtures may need to be added to concrete prior to discharge to compensate for loss of air, high temperatures or long delivery times. The ready mixed concrete producer will assist the purchaser in such circumstances.

2.3.4 Inspection and Testing

Concrete is a manufactured product. Specific control tests and evaluations are required during the manufacturing process to produce predictable high-quality concrete. The customer may want to verify that concrete meets specifications. Some of the important properties of concrete that are measured by basic quality control tests are strength, temperature, slump, air content, and unit weight. In general concrete is tested at a frequency of 1 in 150 cubic yards. Concrete should also be tested for each structural element placed, such as footings, columns and caps.

Each test helps to determine the quality of concrete and it should be performed in accordance with American Society for Testing and Materials (ASTM) standards. A SCDOT certified Portland Cement Technician must make the tests.

When there are no formal job specifications, such as with a homeowner or small contractor, it is important for the concrete producer to agree to furnish concrete in accordance with ASTM C 94 or at least certain critical sections of ASTM C 94. This reference should also be included on the delivery ticket.

ASTM C 94 includes a number of things that should be a part of any agreement between the producer and a purchaser. Some of them are:

Define the basis of purchase, cubic yards, and how it is measured.
Define acceptable material specifications and acceptable industry practice and tolerances.
Define strength testing procedures and acceptance criteria.
Set laboratory personnel qualifications. The testing laboratory must comply with ASTM C 1077, which is required in ASTM C 94.

Strength of PC Concrete
Strength of concrete, in compression, tension, shear, or combination of these, is, in most cases, directly related to load-carrying capacity of plain and reinforced concrete. Strength properties can usually be determined more easily than all the other properties of hardened concrete. Strength tests can be also used as a qualitative indication of other important properties of hardened concrete. It is important for the safety of the structure to check the strength of concrete. Adjustments can be made in case of low strength.

Compressive Strength
Concrete exhibits its best strength characteristics when subjected to compressive loading. Compressive strength is the most important property of concrete. Other strength properties can be estimated based on the compressive strength. Tensile strength, for example, can be taken as 10-12% of the compressive strength. Flexural strength, as measured by modulus of rupture, is about 15 to 20% of the compressive strength. The compressive strength of concrete depends primarily on the w/c ratio but also on the character of the cement, conditions of mixing, character and grading of aggregates, size of aggregates, curing and aging, temperature, and moisture content. The principal effect of changing the aggregate grading is to change the amount of cement and water needed to make the mixture workable. The surface roughness and texture of aggregates have greater effect on the flexural strength than on the compressive strength of concrete.

2.4 Inspecting a Ready Mix Plant

What do you look for when inspecting a ready mix plant for SCDoT?

Ensure that the plant is listed on the QPL28.
Plants are certified through a third-party (NRMCA & CRMCA) per QPP28.

Chapter 3

Select SCDOT Qualified Product Policies

The most current versions of the SCDOT Qualified Product Polices are available online:
http://info.scdot.org/Construction_D/SitePages/QualifiedProducts3.aspx

Policy Number	Topic	Page Number
1	Fine Aggregate	9
2	Coarse Aggregate	13
3	Fly Ash	16
5	Air Entraining Agents and Chemical Admixtures	18
6	Portland Cement and Slag	20
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10	Bridge Deck Waterproofing Membrane Type 1	24
11	Cold Applied Sealants for Bridge Joints	25
18	Type IS Portland Blast-furnace Slag Cement	27
22	Rapid Patch Material for Concrete Pavement	28
28	Ready Mix Concrete Plants	30
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33	Curing Compounds for Concrete Structures	33
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69	Reinforced Concrete Pipe	44
73	Mechanical Couplers for Reinforcing Steel	46
81	Preformed Rubber Joint Filler	48
86	Type IL Portland-Limestone Cement	49

QPL & QPP

(Chapter 3)

MATERIAL SPECIFICATIONS

The vendors who provide materials:

Qualified Materials List

QUALIFIED PRODUCTS LISTINGS

- **The QP Policies and Listings are numbered concurrently**
  - EX. Policy 1 explains how to become a vendor of fine aggregate and Listing 1 provides a register of who is currently eligible to sell fine aggregate for SCDOT work.
- **The QP Listings are updated Frequently on the SCDOT Website.**

SCDOT

UNIVERSITY OF South Carolina

RELEVANT POLICIES & LISTINGS

1. Fine Aggregate
2. Course Aggregate
3. Fly Ash
5. Air Entraining Agents & Chemical Admixtures
6. Portland Cement & Slag
7. Surface Coatings
10. Bridge Deck Waterproofing Membrane I
11. Cold Applied Sealants for Bridge Joints
18. Type I Slag Modified Portland Cement
22. Rapid Patch Materials for Concrete Pavement

SCDOT

UNIVERSITY OF South Carolina

RELEVANT POLICIES & LISTINGS

28. Ready-mix Concrete Plants
32. Stabilizing Agents & Mixer Drum Wash Water
33. Curing Compounds
53. Corrosion Inhibitors for Concrete
54. Temporary Concrete Barrier Products
60. Reinforcing Steel
69. Reinforced Concrete Pipe
73. Mechanical Couplers for Reinforcing Steel
81. Preformed Rubber Joint Filler
86. Type IL Portland Limestone Cement

QUALIFIED PRODUCTS LISTINGS

Find QP Listing 1 for Fine Aggregate (Ch.3 Page 2)

Look at the top row of the table

– The Supplier, Location Name and Location are all given

Physical data is given for each product

** Always pay special attention to the **NOTES** –
In the right-most column

QP LISTING NOTES

There will be a notes key and/or a legend along with an explanation for any relevant notes located at the end of each QP Listing.

The Notes Key →qualifiers on the use of a product.

The Legend Key → material source and preparation.

EXAMPLE

Does the fine aggregate produced by Buckhorn Materials at its Lynches River Quarry located in Jefferson, SC meet the FA-10 Gradation?

ANSWER:
According to the QPL page header it does NOT.

Note 2 does allow for blending as long as it meets gradation requirements for FA-10M (M=Manufactured) Purposes.

QUALIFIED PRODUCTS LISTINGS

You will know to use the QP Listings in Ch. 3 to answer **ANY** question that relates to a **SPECIFIC PRODUCT**.

1. What is the minimum cure time for the spray on surface coating Triko-Plex sold by Proko Industries?

ANSWER:

2. What is the application rate for sprayed final finish coatings applied to the underside of bridges?

ANSWER:

Do you see the difference in the question type?

QUALIFIED PRODUCTS LISTINGS

(Formerly Approval Policies)

- Outline the criteria governing material and vendor suitability for any/all materials used in SCDOT work.
- Verified compliance with any approval policy is required to become a SCDOT vendor.
- Upon verification, the vendor will be listed on the appropriate Qualified Products Listing.

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
QUALIFIED FINE AGGREGATE SOURCES

NOTICE: THE DATA PROVIDED HEREIN IS FOR INFORMATION ONLY. MATERIALS CHARACTERISTICS WILL VARY DURING PRODUCTION. USING SOURCES LISTED ON THIS QUALIFIED PRODUCTS LIST DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR PROVIDING MATERIALS THAT CONFORM TO THE APPLICABLE SPECIFICATIONS FOR END USE.

SUPPLIER	LOCATION NAME	SCDOT NO.	LOCATION	FINE- NESS MODU- LUS	ABSORP- TION, %	SPECIFIC GRAVITY, BULK SSD	SOUND- NESS LOSS, %	NOTES
AGGREGTES USA	Dogwood Q.	SC146	GROVETOWN, GA.	3.23	0.2	2.66	0.1	1,6,M,W,S
ALABAMA SAND & GRAVEL		SC612	BILLINGSLEY, AL	2.62	0.2	2.65	1.4	1,N,B,P,W,S
AMERICAN MATERIALS COM.	Clark Pit	SC575	WADE, NC	2.34	0.4	2.64	5.8	1,6,N,P,W,S
AMERICAN MATERIALS COM.	Richardson Mine	SC625	BRITTONS NECK, SC	2.56	0.2	2.64	1.7	1,6,N,D,P,W,S
AMERICAN MATERIALS COM.	Wade Plant	SC631	WADE, NC	2.41	0.2	2.65	0.8	1,6,N,P,W,S
ATLANTA SAND & SUPPLY CO.	Burke Plant	SC597	ROBERTA, GA	2.34	0.4	2.65	1.3	1,6,N,B,D,P,W,S
AZALEA UTILITIES, INC	Shoo Fly Mine	SC598	SUMMERVILLE, SC	2.57	0.4	2.57	1.9	1,6,N,B,P,W,S
BAILEY SAND COMPANY	Baily Pit	SC578	BLACKSBURG, SC	2.89	0.3	2.63	3.3	1,6,D,R,W,S
B & B SAND COMPANY	Saluda River	SC563	MARIETTA, SC	2.74	1.5	2.56	3.0	1,6,R,D,W,S
BHC TRUCKING	Boling Sand Plant	SC638	WARE SHOALS, SC	2.74	0.3	2.62	1.2	1,D,R,S,W
B & T SAND COM.	Edmund	SC516	EDMUND, SC	2.91	0.1	2.65	1.5	1,6,B,N,S
B & T SAND COM.	Old Charleston Hwy	SC581	GILBERT, SC	2.10	0.9	2.60	0.5	1,6,B,N,S
BROWN SAND	Tyger River Pit	SC585	UNION, SC	3.03	0.8	2.60	0.2	1,6,D,R,S,W
BROWN BROTHERS SAND		SC555	JUNCTION CITY, GA	2.62	0.1	2.65	6.8	1,N,P,W
BROWN & WATSON	Butler Sand	SC566	BUTLER, GA.	2.30	0.3	2.63	1.2	1,6,N,B,W
B. V. HEDRICK GRAVEL & SAND	Lilesville	SC505	LILESVILLE, NC	2.78	0.8	2.63	0.8	1,6,N,P,S,W
CAROLINA SAND, INC.	Pee Dee	SC506	BRITTONS NECK, SC	2.94	0.1	2.65	0.1	1,N,P,S,W
CAROLINA SAND, INC.	Plant # 240	SC507	JOHNSONVILLE, SC	2.54	0.1	2.65	4.7	1,6,D,N,P,S,W
C B SAND COMPANY	Plant # 2	SC576	GUYTON, GA	2.42	0.1	2.65	0.0	1,6,N,D,P,S,W
C B SAND COMPANY	Plant # 3	SC618	GUYTON, GA	2.62	0.1	2.65	2.8	1,6,N,D,P,S,W
CEMEX	Deerfield	SC544	RIDGELAND, SC	2.47	0.1	2.65	2.0	1,6,N,P,S
CEMEX	Union Sand Mine	SC594	LUDOWICI, GA	2.67	0.2	2.64	2.4	1,6,N,P,W
CLARK ENOREE SAND		SC600	WHITMIRE, SC	2.84	0.6	2.63	2.1	1, R,D,S
COLLETON SAND		SC603	WALTERBORO, SC	2.33	0.1	2.66	2.0	1,6,B,P,W,S
COLUMBIA SILICA	Dixiana (unwashed)	SC520	PINERIDGE, SC	2.33	0.6	2.61	1.0	1,6, N,B,S,P
COLUMBIA SILICA	Dixiana (washed)	SC520	PINERIDGE, SC	2.20	0.2	2.62	0.6	1,6,N,B,W,S,P
CONSTRUTION MATERIALS G.	Black Creek Sand	SC595	MT. CROGHEN, SC	2.53	0.3	2.64	0.4	1,6,N & M
COOPER SAND	Saluda River	SC583	EASLEY, SC	2.45	0.4	2.62	1.7	1,4,6,R
COOPER SAND	Holiday Circle	SC521	EASLEY, SC	2.91	1.2	2.59	3.2	1,6,D,R
COASTAL SAND, INC.		SC629	GUYTON, GA.	2.30	0.2	2.64	4.6	1,6,N,D,P,W,S
DECK SAND COM. INC	B. R. Harris Pit	SC523	RUTHERFORDTON, NC	2.54	0.7	2.62	2.3	1,D,W,R,S
FLORIDA ROCK INDUSTRIES		SC553	GRANDIN, FLA.	2.40	0.2	2.64	0.6	1,6,N,W,S
FLORIDA ROCK INDUSTRIES		SC572	WEIRDALE, FLA.	2.18	0.4	2.64	0.3	1,6,N,B,W,S
GLENN SAND COMPANY	Ellis Ferry Road Pit	SC528	SHELBY, NC	2.19	0.3	2.64	1.7	1,6,D ,R,W,S
GRAND STRAND AGG.	Goretown Mine	SC101	LORIS, SC	2.97	1.8	2.59	1.8	1,6,M,P,S,W
G S MATERIALS	Emery Pit	SC580	JACKSON SPRINGS, NC	2.63	0.2	2.65	0.7	1,6,N,W,S

The following sources did not meet gradation requirements for FA-10 and are qualified only for blending with other sands to achieve a composite blend that meets gradation requirements.

SUPPLIER	LOCATION NAME	SCDOT NO.	LOCATION	FINE- NESS MODU- LUS	ABSORP- TION, %	SPECIFIC GRAVITY, BULK SSD	SOUND- NESS LOSS, %	NOTES
AGGREGATES USA	Hitchcock Q.	SC171	MACON, GA.	3.46	0.3	2.71	0.7	2,6,M,W
B & T SAND	Calhoun Pit	SC613	GASTON, SC	1.47	0.1	2.66	1.3	2,6,B,N,S
BUCKHORN MATERIALS	Lynches River	SC191	JEFFERSON, SC	3.40	0.5	2.65	0.6	2,6,M,W, N&M
CAROLINA STALITE COMPANY	Gold Hill	SC103	SALISBURY, NC	3.06	1.2	1.89	0.3	2,6,L,M
CAROLINA STALITE COMPANY	Aquadale	SC102	ALBEMARLE, NC	3.28	0.8	2.01	1.4	2,6,L,M
CHARLESTON MILL SERVICE	Nucor, Huger Plant	SC178	HUGER, SC	3.94	0.4	2.80	2.1	2,M,S,P
COLUMBIA SILICA	Tindal Mine	SC519	EDMUND, SC	1.84	0.6	2.62	2.5	2,6,B,N
COLUMBIA SILICA	Princeton Mine	SC518	S. CONGAREE, SC	1.89	0.8	2.62	1.1	2,6,N,B
DECK SAND	Broad River Pit	SC522	CLIFFSIDE, SC	3.34	0.2	2.63	2.8	2,D,R,S,W
HANSON AGG.		SC173	ATHENS, GA	3.36	0.2	2.69	3.6	2,6,M,W
HANSON AGG.	Monroe Q.	SC197	BOLINGBROKE, GA.	2.74	0.1	2.81	4.2	2,6,M,W
HANSON AGGR.	Lowrys Q.	SC112	McCONNELLS, SC	3.21	0.4	2.64	1.1	2,6,M,P,W
MARTIN MARIETTA AGG	Appling	SC120	APPLING, GA.	3.52	0.2	2.65	0.7	2,6,M,W
MARTIN MARIETTA AGG	Augusta	SC134	AUGUSTA, GA.	3.60	0.7	2.65	1.1	2,M,W
MARTIN MARIETTA AGG	Bakers	SC136	MONROE, NC	3.33	0.7	2.74	1.1	2,6,M,W
MARTIN MARIETTA AGG.	Berkeley	SC125	EUTAWVILLE, SC	3.33	4.8	2.44	15.7	2,M,S,W
MARTIN MARIETTA AGG.		SC128	HICKORY, NC	2.21	0.3	2.74	3.1	2,6,M,P,W
MARTIN MARIETTA AGG.	Georgetown II Q.	SC129	JAMESTOWN, SC	3.61	2.3	2.61	5.8	2,6,M,W
MARTIN MARIETTA AGG.	Chesterfield Q.	SC130	JEFFERSON, SC	3.42	0.5	2.62	0.9	2,6,M,S,P,W
MARTIN MARIETTA AGG.	Jefferson Quarry	SC586	JEFFERSON, GA.	2.83	0.1	2.70	0.2	2,6,M,W
MARTIN MARIETTA AGG.		SC144	STATESVILLE, NC	2.42	0.1	2.88	0.3	2,6,M,W,S
VULCAN MATERIALS CO.		SC149	BLAIR, SC	2.25	0.3	2.68	1.2	2,6,M,W
VULCAN MATERIALS CO.	Cabarrus	SC152	CONORD, NC	3.27	0.5	2.78	1.0	2,6,M,P,S,W
VULCAN MATERIALS CO.		SC157	HENDERSONVILLE, NC	2.97	0.1	2.68	0.5	2,M,P,W
VULCAN MATERIALS CO.		SC160	LYMAN, SC	2.25	0.5	2.77	0.5	2,6,M,W
VULCAN MATERIIALS CO.	Jack Q.	SC202	PETERSBURG, VA.	3.61	0.5	2.65	1.0	2,M,W
VULCAN MATERIALS CO.		SC185	PISGAH FOREST, NC	3.46	0.4	2.65	2.3	2,6,M,P,W
VULCAN MATERIALS CO.	North Quarry	SC187	WINSTON-SALEM, NC	3.13	0.4	2.85	0.9	2,6,M,P,W
WILSON SAND CO.	Frick (unwashed)	SC636	Batesburg-Leesville, SC	1.96	0.1	2.65	1.1	2,6,B,N,S

The following NATURAL SAND sources are qualified for use in asphalt mixes.

SUPPLIER	LOCATION NAME	SCDOT NO.	LOCATION			% Silt	% Clay	% Total Sand	
AMERICAN MATERIALS	Richardson Mine	SC625	BRITTONS NECK, SC			0.1	0.3	100	000
ANDREWS SAND		SC607	ANDREWS, SC			1.1	1.4	98	
AZALEA UTILITIES	Shoo Fly Mine	SC598	GIVHANS, SC			0.6	1.3	98	
B & B SAND CO.	Saluda River Pit	SC563	MARIETTA, SC			0.4	0.2	99	
B & T SAND	Calhoun Pit	SC613	GASTON, SC			0.9	1.7	97	
B & T SAND	Old Charleston Rd.	SC581	GILBERT, SC			2.4	5.1	93	000
BAILEY SAND	Bailey Pit	SC578	BLACKSBURG, SC			0.3	0.4	99	
BHC TRUCKING	Boling Pit	SC638	WARE SHOALS, SC			0.9	1.1	98	000
BROWN SAND CO.	Tyger River Pit	SC585	UNION, SC			0.3	0.3	99	000
CAROLINA SAND	Pee Dee	SC506	BRITTONS NECK, SC			0.1	0.3	100	000
CEMEX	Deerfield	SC544	TILLMAN, SC			0.9	0.5	99	
CLARK ENOREE SAND		SC600	WHITMIRE, SC			0.3	0.1	100	000
Construction Materials Group	Black Creek Sand Mine	SC595	MT, CROGHEN, SC			1.6	4.9	94	000
COOPER SAND Co.	Saluda Lake Pit	SC583	EASLEY, SC			0.1	0.3	100	
COOPER SAND Co.	H\W Place Pit	SC521	WARE PLACE, SC			0.5	0.4	99	
DECK SAND CO.	Harris Pit	SC523	RUTHERFORDTON, SC			0.3	0.1	100	
DECK SAND CO.	Broad River Pit	SC522	CLIFFSIDE, NC			0.5	0.3	99	
GLOVER SAND		SC577	RIDGELAND, SC			0.9	3.1	96	
COLUMBIA SILICA	Dixiana Mine	SC520	PINERIDGE, SC			1.0	2.3	97	
GLENN SAND	Ellis Ferry Rd. Pit	SC528	SHELBY, NC			0.3	0.3	99	000
HANSON AGGREGATES	Brewer	SC529	PAGELAND, SC			1.3	4.4	94	
HANSON AGGREGATES	Marlboro	SC106	BENNETTSVILLE, SC			0.3	5.1	95	
HEDRICK INDUSTRIES	Piedmont Sand	SC541	PAGELAND, SC			1.4	2.9	96	000
H. R. COFFIN & SONS	HR Coffin Mine	SC617	CONWAY, SC			0.0	0.4	100	
INMAN STONE	Pacolet River	SC513	CONVERSE, SC			0.3	0.5	99	
INMAN STONE	Slater Pit	SC509	LANDRUM, SC			0.3	0.3	99	
INMAN STONE	Deaton Pit	SC561	SPARTANBURG, SC			0.4	0.3	99	
INMAN STONE	Theo Pit	SC571	ENOREE, SC			0.4	0.3	99	000
LANIER SAND		SC589	COLUMBIA, SC			0.3	2.0	98	
LOVELESS& LOVELESS		SC537	PONTIAC, SC			0.5	1.0	99	000
MARTIN MARIETTA AGG.	Kershaw Sand	SC626	BETHUNE, SC			1.7	3.4	95	000
McINTYRE SAND CO.	Askew Site	SC624	LOCKHART,SC			0.7	0.4	99	000
McINTYRE SAND CO.	Cudd Pit	SC621	LOCKHART,SC			0.4	0.0	100	000
MURRY MINES	Principal Mine	SC593	RIDGEVILLE, SC			0.0	0.1	100	000
NEWBERRY SAND		SC627	NEWBERRY, SC			0.5	0.3	99	000
PAGELAND SAND		SC640	MT. CROGHAN, SC			1.3	4.7	94	000

The following NATURAL SAND sources are qualified for use in asphalt mixes.

SUPPLIER	LOCATION NAME	SCDOT NO.	LOCATION			% Silt	% Clay	% Total Sand	
PALMETTO SAND	Pine Bluff Mine	SC601	RIDGEVILLE, SC			0.6	2.1	97	000
PALMETTO AGGREGATES	Saluda River Pit # 1	SC559	PIEDMONT, SC			0.4	0.1	100	
PALMETTO AGGREGATES	Saluda River Pit # 2	SC620	PIEDMONT, SC			0.4	0.5	99	
PALMETTO AGGREGATES	Saluda River Pit # 3	SC637	PIEDMONT, SC			0.1	0.3	100	
REA CONTRACTING	First Broad River Pit	SC615	SHELBY, NC			1.3	1.2	98	
REA CONTRACTING	Buffalo Creek Pit	SC622	GROVER, NC			0.4	0.2	99	
REA CONTRACTING	Ocain Sand	SC604	ORANGEBURG, SC			3.2	4.4	92	
REA CONTRACTING	Ulmer Pit	SC605	ULMER, SC			0.9	4.0	95	000
REA CONTRACTING	SF RIVER PIT	SC623	DALLAS, NC			1.1	0.5	98	
SUPERIOR SAND		SC546	NICHOLS, SC			0.1	0.1	100	000
STARRETTE TRUCKING	Starrette Pit	SC616	AUGUSTA, GA			0.8	2.9	96	
SUMTER COUNTY SAND	Glasscock	SC545	SUMTER, SC			0.0	0.7	99	
THOMAS SAND		SC547	BLACKSBURG, SC			0.7	0.3	99	
WILLIAMS C&D LANDFILL		SC610	GRANITEVILLE, SC			0.4	2.1	97	

NOTES

NOTE 1: THIS QUALIFICATION IS NOT INTENDED TO ELIMINATE GRADATION CONTROL AND/OR CONTAMINATION CONTROL AT THE JOBSITE.
NOTE 2: BLENDING OF SANDS IS APPROVED ONLY IF THE COMPOSITE BLEND OF THE SANDS MEETS GRADATION REQUIREMENTS. ANY COMBINATION OF THE QUALIFIED SAND IS APPROVED AS LONG AS GRADATION REQUIREMENTS ARE MET AND THE CONCRETE DISPLAYS SATISFACTORY WORKABILITY, ETC. ANY QUESTIONS REGARDING BLENDING SHOULD BE DIRECTED TO THE SCDOT OFFICE OF MATERIALS AND RESEARCH.
NOTE 3: COLORIMETRIC TEST EXCEEDING COLOR PLATE 3 HAS BEEN TESTED AND SHALL NOT BE USED FROM THIS SOURCE.
NOTE 4: COLORIMETRIC TEST OF COLOR PLATE 4 HAS BEEN TESTED AND QUALIFIED FROM THIS SOURCE.
NOTE 5: COLORIMETRIC TEST OF COLOR PLATE 5 HAS BEEN TESTED AND QUALIFIED FROM THIS SOURCE.
NOTE 6: SOUNDNESS RESULTS ARE MADE ON ALTERNATE YEARS. THESE RESULTS ARE BASED ON PREVIOUS YEAR'S TESTS.
NOTE 7: DOES NOT MEET FA-10 GRADATION BUT MEETS FA-10M GRADATION FOR MANUFACTURED SAND.

LEGEND

B	BANKED	M	MANUFACTURED	R	RIVER
D	DREDGED	N	NATURAL	S	SCREENED
L	LIGHTWEIGHT	P	PROCESSED	W	WASHED

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
QUALIFIED COARSE AGGREGATE SOURCES

NOTICE: THE DATA PROVIDED HEREIN IS FOR INFORMATION ONLY. MATERIALS CHARACTERISTICS WILL VARY DURING PRODUCTION. USING SOURCES LISTED ON THIS QUALIFIED PRODUCTS LIST DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR PROVIDING MATERIALS THAT CONFORM TO THE APPLICABLE SPECIFICATIONS FOR END USE.

SUPPLIER (SOURCE NAME) LOCATION	SCDOT NO.	LA ABRA LOSS %		ABSORPTION %	SPECIFIC GRAVITY			SOUNDESS % LOSS at 5 CYCLES			SAND EQUIV ALENT	NOTES
		B	C		BLK. DRY	BLK. SSD	APP ARE NT	1 1\2 to 3\4	3\4 TO 3\8	3\8 TO #4		
AGGREGATE USA												
Appling, Ga. (Dogwood Quarry)	SC146	42	46	0.7	2.61	2.63	2.67	0.5	0.3	0.3	75	C,Gr
Macon, Ga. (Hitchcock Quarry)	SC171	19	24	0.6	2.67	2.68	2.71	0.1	0.2	0.6	59	1,C,Gr
Sparta, Ga.	SC210	45	47	0.6	2.59	2.61	2.64	0.3	0.2	0.3	72	4,C,Gr
Savannah, Ga. (Savannah Vending Yard)	SC213	Transfer Stockpiles from Aggregates USA Macon Quarry										
Springfield, Ga. (Springfield Sales Yard)	SC193	Transfer Stockpiles from Aggregates USA Macon Quarry										
APAC MID-SOUTH												
Warren County Quarry	SC211	35	42	1.1	2.62	2.65	2.69	1.5	0.8	0.8	66	C,Gr
ATLANTIC COAST MATERIALS												
ACM, Bayside, Canada (information only)	-	15	20	0.6	2.70	2.71	2.74	-	0.2	0.4	-	C,Gr.
ATLANTIC COAST MATERIALS												
Savannah, Ga. (East Coast Terminal)	SC212	Transfer Stockpiles from Atlantic Coast Materials, Bayside, NB, Canada										
BLUEGRASS MATERIALS COMPANY,LLC												
Trenton, SC (Edgefield Quarry)	SC216	48	51	1.3	2.55	2.59	2.64	1.1	0.9	1.07	76	C,Gr
BUCKHORN MATERIALS, LLC												
Jefferson, SC (Lynches River Q)	SC191	43	42	0.8	2.61	2.63	2.66	0.1	0.9	4.2	96	1,C,Gr
CAROLINA STALITE COMPANY												
Albemarle, NC (Aquadale)	SC102	32	28	4.8	1.38	1.44	1.48	0.4	0.0	3.7	--	1,Lw
Salisbury, NC (Gold Hill)	SC103	32	27	4.2	1.37	1.43	1.46	0.1	0.2	0.2	--	1,Lw
CHARLESTON MILL SERVICE												
Huger, SC	SC178	17	17	1.2	3.61	3.66	3.78	0.4	2.3	3.3	82	2,5,MFG-SS
CONRAD YELVINGTON DIST, INC												
Hardeeville, SC	SC196	Transfer stockpiles from Martin Marietta Augusta and Camak Quarries.										
HANSON AGGREGATES												
Anderson, SC	SC105	46	53	0.8	2.65	2.67	2.70	0.1	0.1	0.1	61	1,C,Gr
Athens, Ga.	SC173	46	49	0.8	2.66	2.68	2.72	0.4	0.4	0.9	75	1,C,Gr-Gn
Bennettsville, SC (Marlboro)	SC106	56	51	0.6	2.61	2.62	2.65	0.3	0.1	0.3	--	1,G,Q

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
QUALIFIED COARSE AGGREGATE SOURCES

SUPPLIER (SOURCE NAME) LOCATION	SCDOT NO.	LA ABRA LOSS %		ABSORPTION %	SPECIFIC GRAVITY			SOUNDESS % LOSS at 5 CYCLES			SAND EQUIV ALENT	NOTES
		B	C		BLK. DRY	BLK. SSD	APPARENT	1 1\2 To 3\4	3\4 To 3\8	3\8 To #4		
The following sources are qualified only for use in Non-Reinforced Concrete, Graded Aggregate Base Course, Asphalt Aggregate Base Course, Asphalt Intermediate Course, Asphalt Surface Type C and Type D Course and Pipe Bed Material.												
GRAND STRAND AGGREGATES												
Loris, SC (Goretown Mine)	SC101	35	48	4.2	2.31	2.41	2.56	2.4	4.1	3.1	55	1,C,ML
MARTIN MARIETTA AGGREGATES												
Georgetown, SC (Terminal)	**SC127**	**Transfer Stockpile from Bahamas (BA 348) Quarry**										
Jamestown, SC (Georgetown II)	SC129	33	32	4.0	2.37	2.46	2.62	4.1	4.9	2.5	--	1,C,ML
Bahamas Islands (BA 348) (information only) **		32	34	3.8	2.32	2.41	2.55		12.8	19.6	--	1,4, C,ML
WAKE STONE CORPORATION												
Longs, SC	SC170	51	50	3.2	2.38	2.46	2.58	2.4	2.5	2.6	74	1,C,ML
The following sources are qualified only for use in Graded Aggregate Base Course, Asphalt Aggregate Base Course, Asphalt Intermediate Course and Asphalt Surface Type D Course.												
MARTIN MARIETTA AGGREGATES												
Eutawville, SC (Berkeley)	SC125	46	43	8.3	2.11	2.29	2.56	60.4	38.5	41.5	--	1,C,ML
The following sources are qualified only for use in Graded Aggregate Base , Pipe Bed Material and Rip Rap												
INMAN STONE, INC.												
Inman, SC	SC115	50	45	0.8	2.71	2.73	2.77	0.2	0.5	1.4	72	1,C,Gr
OCONEE COUNTY ROCK												
Walhalla, SC (Oconee Cty. Rock Quarry)	SC186	64	66	0.8	2.59	2.61	2.64	0.5	0.2	0.5	74	1,CGr

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
QUALIFIED COARSE AGGREGATE SOURCES

The following sources are qualified only for use as riprap stone

HANSON AGGREGATES												
Greer, SC (Pelham)	SC168	79	80	1.6	2.60	2.64	2.72	1.2	0.5	0.5	--	1,7,C,Gr

NOTES*

NOTE 1: Soundness tests are made on alternate years. These results are based on previous year's tests.
NOTE 2: Qualified only for use in Graded Aggregate Base.
NOTE 3: Qualified for use in Class B Concrete, Graded Aggregate Base Course, Asphalt Aggregate Base Course, Asphalt Concrete Intermediate Course and Asphalt Surface Type D.
NOTE 4: Stone from this source may be loaded from yards other than the quarry.
NOTE 5: Qualified on a job to job basis per Standard Specification Subsection 401.03(d).
NOTE 6: Qualified only for use in aggregate courses that will be exposed and not overlaid with additional pavement course.
NOTE 7: Qualified only for use as riprap stone.
NOTE 8: Sources will not be permitted in Asphalt Surface Types A and B Courses, Asphalt Intermediate Type A Course and Open Graded Friction Course.

* If no restrictive numerical notes are listed in note column, the aggregate may be used in all applications if not restricted by these notes, special provisions, plans and/or specifications.

** Materials from quarries with no SCDOT no. or marked for information only, are to be used from sales yard or terminals only.

LEGEND

C	Crushed	L	Limestone	Q	Quartzite
ML	Marine Limestone	LW	Lightweight Aggregate	Sch	Schist
G	Gravel	M	Marble	Sh	Shale
Gn	Gneiss	MFG	Manufactured	SS	Steel Slag
Gr	Granite	NSS	Non-Steel Slag		

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For class purposes only

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Product List for Fly Ash for Use in Portland Cement Concrete

Supplier	Type	Source Location	Producer Code
Ash Venture, LLC 188 Somerfield Ct., Suite 101 Roanoke, VA 24019 Bryan Mckenzie 601-299-2459	F	Central Power and Light 1514 Dunnaway Rd Roxboro, NC 27573	PCCFA035
	F	Cliffside Steam Station Cliffside, NC	PCCFA037
Boral Materials Technologies, Inc. 45 NE Loop 410 Suite 700 San Antonio, TX 78216 Melissa Garcia 1-210-348-4069	F	Georgia Power Bowen Plant Taylorsville, GA	PCCFA038
	F	Sandow Mine Power Plant Rockdale, TX “MICRON 3”	PCCFA039
	C	Scherer Plant Juliette, GA	PCCFA040
	F	JEA St. John River Park Plant 11201 New Berlin RD Jacksonville, FL 32226	PCCFA041
	F	Georgia Power Plant Wansley Franklin, GA	PCCFA042
The SEFA Group 217 Cedar Rd. Lexington, SC 29073 Bert Nunn / Gary Sheaff 803-520-9001 bnunn@sefagroup.com	F	Santee-Cooper Cross Station Pineville, SC	PCCFA043
	F	Santee-Cooper Winyah Station Georgetown, SC	PCCFA044
	F	SCE&G McMeekin Station Columbia, SC	PCCFA045
	F	Buck Station STAR 1555 Dukeville Rd Salisbury, NC 28146	PCCFA056
	F	HF Lee Station STAR 1594 Blackjack Church Rd Goldsboro, NC 27530	PCCFA057
	F	Cape Fear Fly Ash 2220 Corinth Rd Moncure, NC	PCCFA058
	F	Duke Power Belews Creek Station Belews Creek, NC	PCCFA059
	F	Dominion Energy Williams Station 2242 Bushy Park Rd Goose Creek, SC 29445	PCCFA061
Headwaters Resources 10701 S. River Front Pkwy., Suite 300 South Jordan, UT 84095 Doug Gruber 1-850-582-7324	C	Source MR-205 Labadie Power Plant Labadie, MO	PCCFA046
	C	Source MR-267 Rush Island Plant Festus, MO	PCCFA047

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Headwaters Resources – *Continued*	C	Miller Power Plant Units 3 & 4 Birmingham, AL	PCCFA048
Mineral Resource Technologies MRT A CEMEX Company 929 Gessner Rd, Suite 1900 Houston, TX 77024 Oscar Jaramillo 1-713-722-6088	C	Source MR-47 Grand River Dam Authority GRDA Coal Fired Generating Station Chouteau, OK	PCCFA049
	F	Eren Enerji Elektrik Uretim A.S. Catalagzi, Zonguldak, Turkey	PCCFA050
Charah, LLC 12601 Plantside Dr. Louisville, KY 40299 David Weber 1-502-377-6570 dweber@charah.com	F	Source MR-267 Petersburg Generating Station Boilers 3 & 4 Petersburg, IN	PCCFA051
Separation Technologies, LLC (Titan America Business) 11000 NW 121st Way Medley, FL 33178 Jorge Tercero 305-588-9591	F	Separation Technologies, LLC 1400 Wago Rd. York Haven, PA 17370	PCCFA052
	F	Separation Technologies, LLC 1000 Brandon Shores Rd Baltimore, MD 21226	PCCFA053
Spartan Materials 5221 Creek Rd. Cincinnati, OH 45242 Geoffrey Mather 513-800-7690 1-513-266-8882 gmather@spartanmaterials.com	F	Adani Power Plant Gujarat, India	PCCFA054
Waste Management / Fly Ash Direct 4228 Airport Rd Cincinnati, OH 45228 Doug Burry 1-216-401-7266 dburry@wm.com	F	AEP John Amos Power Plant 1350 Winfield Rd. Winfield, WV 26213	PCCFA055
JSW Energy Limited Village Nandiwade, Post Jaigad Maharashtra 415614, India Ashish Musale 91 2357 242501-505 Ext. 1572 ashish.musale@jsw.in	F	JSW Energy Limited Jaigarh Village, Ratnagiri District Maharashtra, India	PCCFA060

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South Carolina
Department of Transportation
Qualified Air Entraining and Chemical Admixtures for Concrete

PRODUCER	TRADE NAME	TYPE	CODE	RECOMMENDED DOSAGE RATE	NTPEP NUMBER	NOTE
Axim Concrete Technologies	Catexol AE 260	AEA	AEA	0.1 to 6	CADD(2009)-15	
P. O. Box 234	Catexol AE 360	AEA	AEA	0.1 to 6	CADD(2009)-16	
8282 Middlebranch Road	Catexol 800N	A	WRA	2 to 6	CADD(2009)-12	
Middlebranch, Ohio 44652	Catexol 1000N	A	WRA	1.5 to 5	CADD(2009)-13	
Nate Artman	Catexol 3000GP	A	WRA/WRA-MR	2 to 20	CADD(2009)-21	
Nathaniel.artman@essroc.com	Catexol 3500 N	A	WRA/WRA-MR	3 to 20	CADD(2009)-20	
330-966-0444 ext. 2021	Catexol Hydrosense	A & F	WRA/WRA-HR	2 to 15	CADD(2009)-22	
	Superflux 2100 PC	A & F	WRA/WRA-HR	3 to 30	CADD(2009)-33	
	Catexol 2000Ni	A & G	WRA/WRAR-HR	3 to 24	CADD(2009)-19	
	Allegro 122	A & F	WRA/WRA-HR	4 to 30	CADD(2009)-26	
	Duraflux 33	A & F	WRA/WRA-HR	1 to 8	CADD(2009)-27	
	Duraflux 66	A & F	WRA/WRA-HR	1 to 8	CADD(2009)-30	
	Duraflux 77	A & F	WRA/WRA-HR	1 to 6	CADD(2009)-31	
	SuperFlux 2000 PC	A & F	WRA-WRA-HR	3 to 30	CADD(2009)-32	
	Catexol 2000 RHE	C & E	A/WRA-A	5 to 60	CADD(2009)-25	
	Catexol 1000R	D	WRA-R	1.5 to 4	CADD(2009)-14	
	Catexol 1000 SP-MN	F	WRA-HR	10 to 40	CADD(2009)-23	
Euclid Chemical Company	Plastol 341	A & F	WRA/WRA-HR	2 to 10	CADD(2010)-02-040	
19218 Redwood Road	Accelguard 80	C & E	A/WRA-A	12 to 90	CADD(2010)-01-024	
Cleveland Ohio 44110	Accelguard NCA	C & E	A/WRA-A	12 to 75	CADD(2010)-01-022	
1-216-692-8381	Eucon Air 30	AEA	AEA	0.5 to 1	CADD(2010)-01-047	1
Attn. Christopher Balsat	Eucon Air 40	AEA	AEA	0.5 to 1	CADD(2010)-01-048	1
Email address:	Eucon LR	A	WRA	3 to 10	CADD(2010)-01-026	
cbalsat@euclidchemical.com	Eucon LW	A	WRA	3 to 6	CADD(2010)-01-028	
	Eucon NW	A	WRA	2 to 6	CADD(2010)-01-020	
	Eucon NR	A & D	WRA/WRA-R	3 to 5	CADD(2010)-01-049	
	Eucon SPC	A & F	WRA-WRA-HR	3 to 12	CADD(2010)-01-016	9
	Eucon SPJ	A & F	WRA/WRA-HR	4 to 7	CADD(2010)-01-015	9
	Eucon X15	A & F	WRA/WRA-HR	3 to 10	CADD(2010)-01-030	
	Eucon X20	A & F	WRA/WRA-MR	3 to 15	CADD-2011-01-018	
	Eucon AcN	C & E	A/WRA-A	20 to 60	CADD-2010-01-029	14
	Eucon AcN 200	C & E	A/WRA-A	10 to 60	CADD-2011-01-020	14
	Eucon LR	D	WRA-R	3 to 10	CADD(2010)-01-026	
	Eucon TR	D	WRA-R	3 to 6	CADD-2011-01-021	
	Eucon W.O.	D	WRA-R	4 to 16	CADD-2011-01-017	
	Eucon SP	F	WRA-HR	12	CADD-2011-01-016	2 & 7
	Eucon RD-2	G	WRAR-HR	6 to 10	CADD-2011-01-014	2 & 7
	Euco Air-Mix	AEA	AEA	0.5 to 1	CADD-2011-01-012	1, 6
	Eucon AEA-92	AEA	AEA	0.5 to 1	CADD(2010)-01-021	1
	Eucon AEA 92S	AEA	AEA	0.5 to 2	CADD(2010)-01-034	
	Euco Air-Mix 200	AEA	AEA	0.5 to 1	CADD(2008)-10	1
	Euco Air-Mix 250	AEA	AEA	0.75 to 1.5	CADD(2008)-11	1
	Eucon A+	A	WRA	3 to 8	CADD-2011-01-015	
	Eucon Pro-Finish	A	WRA	3 to 10	CADD(2009)-01	
	Eucon MR	A	WRA	4 to 10	CADD(2008)-13	
	Eucon WR	A	WRA	4	CADD(2010)-01-027	
	Eucon WR-75	A	WRA	2 to 3	CADD(2010)-01-014	
	Eucon WR-91	A	WRA	3.5 to 6	CADD(2010)-01-031	
	Eucon MRX	A & F	WRA/WRA-HR	3 to 12	CADD(2009)-02	
	Eucon 37	A & F	WRA/WRA-HR	10 to 16	CADD(2010)-01-019	2
	Plastol Ultra 109	A & F	WRA/WRA-HR	2 to 12	CADD(2010)-02-043	
	Plastol 341S	A & F	WRA/WRA-HR	2 to 10	CADD(2008)16	
	Plastol 6200 EXT	A & F	WRA/WRA-HR	3 to 12	CADD(2010)-01-046	
	Euco Accelguard 80	C & E	A/WRA-A	16 to 32	CADD(2010)-01-024	
	Eucon DS	D	WRA-R	4 to 16	CADD(2010)-01-050	
	Eucon Retarder 75	D	WRA-R	3 to 5	CADD(2010)-01-017	
	Eucon Retarder 100	D	WRA-R	2 to 6	CADD(2010)-01-045	
	Eucon WR	D	WRA-R	12	CADD(2010)-01-027	
	Eucon 1037	F	WRA-HR	6 to 25	CADD(2010)-01-018	2, 7
	Plastol 5000	F	WRA-HR	3 to 10	CADD-2011-01-022	
	Plastol 5500	F	WRA-HR	3 to 8	CADD(2010)-01-023	

Type	Code	Description
Type A	WRA	Normal Water Reducer
Type C	A	Accelerator
Type D	WRA-R	Water Reducer Retarder
Type E	WRA-A	Water Reducer Accelerator
Type F	WRA-HR	High Range Water Reducer
Type G	WRAR-HR	High Range Water Reducer Retarder

NOTES

Dosage rates refer to either one bag or 100 lbs of cementitious material
All dosages shown are producer's recommended dosage rates.

Note 1: Adjustment should be made in the recommended dosage rates to obtain the desired amount of entrained air (4.5% +- 1.5%). The amount required must be determined by test.
Note 2: This agent may be used with a Type A or Type D admixture if approved by the producer, at a rate to obtain the desired concrete workability and slump. Also, it may be added a second or third time to return the concrete to a workable slump.
Note 3: Normally as an air entraining agent, only a neutralized vinsol resin should be used with this product.
Note 4: 2oz/100 lbs below 65 degrees Fahrenheit, 3oz/100 lbs 65 degrees Fahrenheit to 85 degrees Fahrenheit, 4oz/100 lbs above 85 degrees Fahrenheit.
Note 5: This is a dry weight and not a liquid measurement and is non-chloride.
Note 6: This is a known neutralized vinsol resin.
Note 7: This agent may be re-dosed twice. The amount may be varied to get the desired results.
Note 8: This agent may be used with Type C or E admixture, if approved by the manufacturer.
Note 9: The agent to be remixed after long storage periods.
Note 10: Shelf life is one year.
Note 11: Shelf life is nine months.
Note 12: Approved by Policy 32 as a Mixer Wash Water Stabilizer.
Note 13: This product contains calcium chloride.
Note 14: Where water reduction is not required, less amounts may be used to aid in acceleration as required for job situations.
Note 15: Mid range Water Reducer.

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Portland Cement and Non-Steel Slag Manufacturers

The following is a list of Portland Cement Manufacturers who have satisfied the requirements established in the Department's "Policy for Portland Cement and Non-Steel Slag Manufacturers." All Trade Names are registered Trademarks of the appropriate company.

Sales Office	Trade Name	Type	Mill and Transfer Silo Terminals
Argos Cement USA P.O. Box 326 Harleyville, SC 29448 800-845-2771	Magnolia (bulk) (bagged)	I II III I	Harleyville Plant at Harleyville, SC
	Asia Cement Corp.	I	Hualien Plant at Hsin-Cheng, Taiwan Terminal Charleston, SC
 ***Bruce Walker** **(803) 238-7705**	Titan Cement (bulk)	I	Kamari, Plant at Eleuis, Greece Lafarge Terminal Charleston, SC
	Heracles (bulk)	I	Mylaki Plant, Greece Lafarge Terminal Charleston, SC
	Cementos Del Caribe (bulk)	I	Barranquilla Plant & Cartagena Plant Colombia, S.A. Port Royal Terminal Port Royal, SC
	Vencemos (bulk)	I II	Vencemos Plant at Venezuela, S.A.
Argos Cement USA 2520 Paul Street Atlanta, GA 30318	Magnolia (bulk) (bagged)	I III I	Atlanta Plant at Atlanta, GA Lafarge Terminal Charleston, SC
Argos Cement USA PO Box 182 Calera, AL	Magnolia (bulk) (bagged)	 I, II I, II	Roberta Plant at Calera, AL.

***Bruce Walker is the contact person for all locations.**

Port Royal Cement 2200 Burnett Blvd Wilmington, NC 28402 Telephone: 912-238-3108 Fax: 912-238-0511 Ivan Radi Cell: 912-659-2419	I	Barranquilla Plant & Cartagena Plant Colombia, SA Terminal Silos at Savannah, GA Terminal Silos at Wilmington, NC

Notes:

(1) All trade names are registered trademarks of the appropriate company.

(2) This qualified product list is for general product qualification and does not guarantee performance of a particular shipment.

(3) All pre-qualified sources (manufacturers) must continue to comply with the policy for Portland Cement Inspections. The delivery of cement used in SCDOT projects must be accompanied with a delivery ticket and certification stating that the cement is guaranteed to meet SCDOT specifications.

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Spray-On/Brush-On Surface Coatings for Concrete Finish

SPRAY-ON
Non-Cementitious

Solventborne

Spray-on Coatings must meet South Carolina Department of Transportation Standard Specification for Highway Construction.

Vinyl Toluene Acrylate Copolymer

Source	Trade Name	Note
Textured Coatings of America, Inc. 2422 East 15th Street Panama City, Florida 32405 Sales: 1-800-454-0340 1-904-769-0347 Mr. Richard Barnes	XL-70 Bridge-Coat Curing Compound	Note 1 Note 5
Proko Industries 501 S. Foote Street Cambridge City, IN 47327 1-800-423-8341 - Ext. 31 Ms. Ilene A. Waite	Triko-Plex Curing Compound	Note 4 Lower pH $\leq$ 7 for surface alkalinity
Sherwin-Williams 1415 East Bessemer Ave Greensboro, NC 27405 Mr. Sid Oakes Cell: (336) 324-0614 Email: sid.oakes@sherwin.com	*H & C Silicone Acrylic Concrete Stain **UltraCrete	Note 3 Note 2
VEXCOM Chemicals 7240 State Road Philadelphia, PA 19135 Telephone: (888)-VEXCON1 (839-2661) Mr. Clifford platt	Certi-Vex Enviosmooth VOC	Note 1

*Also under the name “Concrete Sealer, B97-Series”.

**Also under the name “DOT Solvent Texture Coating, B97-Series”.

NOTES:

1. Concrete does not have to be cured beyond the set time before applying the coating. The finish coat may be used in lieu of concrete wet cure or a curing compound. For delayed application of coating see Note 5.

2. Concrete must cure a minimum of 7 days before application.

3. Concrete must cure a minimum of 14 days before application.

4. Concrete must cure a minimum of 28 days before application.

5. For waiting periods as required by Notes 2, 3, and 4, or delay of coating application (Note 1) at option of the Contractor, the concrete shall be cured for at least 4 days by wet cure methods as described in Section 702.4.11 of the Standard Specifications or by means of a dissipating membrane curing compound that is clear (with or without fugitive dye) and restricted to resin (non-wax), known as AASHTO M 148 Type 1D, Class B.

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Qualified Product Listing for:

Bridge Deck Waterproofing Membrane Type I
for use under HMA overlays

Source	Product
Carlisle Coatings & Waterproofing 900 Hensley Lane Wylie, TX 75098 972-442-6545 phone 800-527-7092 toll free Fax 972-442-0076	CCW-711-70 Primer CCW-702 (When pavement surface is 40 degrees F and rising)
Crafco Inc. 6165 W. Detroit St. Chandler, AZ 85226 (602)276-0476	Pave Prep
Polyguard Products, Inc. PO Box 755 Ennis, TX 75120 (800)541-4994	Polyguard 665 Primer: 650 RC - 650 Mastic Polyguard NW-75 Primer: 650 RC - 650 Mastic
W.R. Meadows, Inc. PO Box 543 Elgin, IL 60121 (330)896-5900	MELDEK Waterproofing Membrane

SCDOT Contact:

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Cold Applied Sealants for Bridge Joints

Polymeric Elastomeric Two Component Sealant

Manufacturer	Product
W. R. Meadows of Georgia 100 Riverside Drive Cartersville, GA 30120 1-770-386-6440 1-800-342-5976 Jim Nelson	SOF-SEAL 224 No Primer Necessary
Lion Oil Company Protective Coatings Department El Dorado Refinery 1000 McHenry (Physical Address) El Dorado, AR 71730 1-800-643-1506	 Elastomeric Sealant Lion D200 (Summer Grade) Lion D200 (Winter Grade)
Lion Oil Company Protective Coatings Department El Dorado Refinery PO Box 7005 (Mailing Address) El Dorado, AR 71731-7005 1-800-643-1506	
Sika Corporation 3778 La Vista Road Suite 300 Tucker, GA 30084 1-800-933-SIKS FAX: (404) 315-0117	Sikaflex-2C/SL Color - Precast Gray
Pecora Corporation 165 Wambold Road Harleysville, PA 19438 1-215-799-7557 1-267-816-7720 Glen Murphy FAX: (215) 721-0286 www.pecora.com	 NR 200 Primer 200

BASF Corporation
Master Builders Solutions
889 Valley Park Drive
Shakopee, MN 55379
1-800-433-9517
Zach Duggan – Brian Spencer
www.master-builders-solutions.basf.us

MasterSeal NP 2
MasterSeal SL2

Manufacturer	Product

Silicone Sealant

Dow Corning Corporation
1225 Northmeadow Parkway
Suite 104
Roswell, GA 30076
Telephone: (770) 751-7979
FAX: (770) 343-8015

902 RCS (Self-Level)

BASF
WATSON BOWMAN ACME
95 Pineview Drive
Amherst, NY 14228
1-800-677-4922 ext 5458
Cell: 716-316-6022
Fax: 1-716-691-9239
Michael Ferro

Wabo Crete SiliconeSeal System

Pecora Corporation
165 Wambold Road
Harleysville, PA 19438
1-215-799-7557
1-267-816-7720
Glen Murphy
FAX: (215) 721-0286
www.pecora.com

Pecora 322 FC Faster Cure
SiliconeSeal

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

AUTHORIZED SUPPLIERS OF TYPE I(SM) SLAG-MODIFIED PORTLAND CEMENT

The following is a list of Type I(SM) Slag-Modified Portland Cement Suppliers who have satisfied the requirements established by the SCDOT as defined by Qualified Product Policy 18. Both cement and slag constituents in slag-modified cement must be from qualified sources listed on SCDOT qualified product list #6, "Authorized Portland Cement and Non-Steel Slag Manufacturers." All trade names are registered trademarks of the appropriate companies.

Manufacturer	Trade Name	Type	Mill and Transfer Silo Terminals
Holcim (US) Inc. 1501 Main Street Suite 725 Columbia, SC 29201 Tel: (803) 252-5428 Fax: (803) 252-3862 Eddie Deaver edward.deaver@holcim.com	HolCem	I(SM)	Holly Hill Plant, Holly Hill, SC

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
Rapid Patch Material for Concrete Pavement

Brand	Source
Fast Set Cement Mix ProSpec Rapid Patch VR ProSpec Magna 100 ProSpec VO Repair Mortar	ProSpec American 8201 Arrowridge Blvd. Charlotte, NC 28273 (800) 738-1621 Michael Boenisch (704) 529-4272
SonoPatch 100	New south Construction Supply 951 Harbor Road West Columbia, SC 29169 (803) 791-8700
Futura Patching Mix	W. R. Meadows of GA. PO Box 280 Austell, Georgia 30001 (800) 342-5976 Fax: (770) 941-5058
Sikaset (1) SikaQuick 2500 (2) Roadway Patch 2000	Sika Corporation 201 Polito Ave Lyndhurst, NJ 07071 (704) 905-5836 Jim Hadley
Road Patch II (with Acryl 60)	Thoro Systems Products 7800 NW 38th Street Miami, Florida 33166-6599 (803) 776-3363
Hilti RM 800 PC	Hilti PO Box 21148 Tulsa, OK 74121 (800) 727-3427 Ext 7533
Emaco T 415 and Emaco S88-CA ThoRoc 10-60 Rapid Mortar SET 45	*BASF Building Systems, Inc. 23700 Chagrin Boulevard Cleveland, Ohio 44122 Brian Spencer 803-356-4952 803-873-2156 cell www.basf-buildingsystems.com

*Formerly Degussa (as of 7-1-06)

Brand	Source
Elephant Armor DOT	GST International 3579 Westwind Blvd. Santa Rosa, CA 95403 707-291-0808; Fax 707-527-6522 Thomas Martin
Unique High Performance Fast Set	Unique Paving Materials Corp. 3993 E. 93rd Street Cleveland, OH 44105-4096 216-978-0504; Fax 216-341-8514 Josh Pemberton

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South Carolina Department of Transportation
Qualified Ready Mix Concrete Plants

Plant names that appear on this list are qualified to furnish concrete to the department projects at the time of inspection.
The Project Engineer should assure the plant is in compliance to furnish the type concrete needed when contractor orders concrete. Plants that DID NOT comply with department's specifications at the time of inspection ARE NOT listed.
**Note: NRMCA CERTIFICATIONS MUST BE CURRENT AT THE TIME OF PROVIDING SERVICES TO SCDOT PROJECTS.

COUNTY/ STATE	COMPANY ADDRESS	LOCATION	CONTACT/ PHONE NUMBER	** EXPIRATION DATE	NRMCA ID Number	SITE MANAGER P/S CODE
02	Argos Ready Mix, LLC 201 Laney Walker Blvd. Augusta, GA 30901	Aiken Plant 371	John Fleischauer 706-823-4470	10/13/2013	13669	RMCP192
02	Argos Ready Mix LLC 201 Laney Walker Blvd. Augusta, GA 30901	Jackson Plant 377	John Fleishauer 706-823-4470	10/28/2012	12453	RMCP193
02	Argos Ready Mix LLC 201 Laney Walker Blvd. Augusta, GA 30901	Jackson Portable Plant 381-2	John Fleishauer 706-823-4470	2/14/2013	12725	RMCP194
04	American Concrete & Precast P. O. Box 4026 Anderson, SC 29622	Anderson	Jamie Boulware 864-222-6868	7/29/2013	13459	RMCP161
04	Thomas Concrete 124 Moats Fowler Rd. Anderson, SC 29626	Anderson Plant #4000	Steve Tanner 864-225-1070	11/3/2012	12332	RMCP004
04	Cemex Old Pearman Dairy Rd. Anderson, SC	Anderson Plant 4644	864-224-8722	11/21/2013	13805	RMCP131
04	Century Concrete, LLC P. O. Box 2524 Greer, SC 29652	Piedmont Plant 2	Joey Stone 864-848-5545	6/11/2013	13200	RMCP048
05	Orangeburg Redi-Mix Co. PO Box 1683 Orangeburg, SC 29116	Bamberg Plant 2	J. C. Till 803-245-5363	9/29/2013	13682	RMCP006

COUNTY/ STATE	COMPANY ADDRESS	LOCATION	CONTACT/ PHONE NUMBER	** EXPIRATION DATE	NRMCA ID Number	SITE MANAGER P/S CODE
NC	Southern Concrete Materials PO Box 33038 Charlotte, NC 28283	South Plant 32 Near prestress plt.	Joseph Leotaud 704-588-1641	8/20/2012	12238	RMCP047
NC	Thomas Concrete Co. 3701 North Graham St. Charlotte, NC 28206	Gastonia Plant 514	Vincent Washington 704-634-2534	5/14/2013	13117	RMCP130

S.C.D.O.T. CONTACT PERSON:

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FAX: (803) 737-6649
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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Stabilizer Agents for Mixer Drum Wash Water

These products are qualified for holding a concrete truck overnight after it is empty and is not intended to hold concrete overnight.

Source	Product
Master Builders, Inc. 23700 Chagrin Blvd. Cleveland, Ohio 44122 Sales: (704) 845-2020	Delvo (Product #1)
Cormix Construction Materials 471 Sessions St. Marietta, GA 30060 Sales: 1-800-777-5645	ConSave (Product #2)
Fritz Chemical Company 500 Sam Huston Mesquite, TX 75149 1-800-955-1323 Fax: 1-972-289-8756	Fritz-Pak (Product #3)

Qualified Product #1

Delvo Stabilizer by Master Builders Inc. methods:

1. Add 115 liters of water to the ready-mix drum that has been emptied of all plastic concrete.

2. Turn drum in the direction to back up the wash water to the rear of the drum.

3. (a.) Dispense one liter of Delvo Stabilizer into the concrete wash water for overnight stabilization; or (b.) Dispense 2 liters of Delvo Stabilizer into the concrete wash water for over the weekend stabilization.

4. Turn drum in the direction to return stabilized concrete wash water to the front of the drum and mix at high speed for one (1) minute.

5. Turn drum in the direction to back up the stabilized wash water quickly to the rear of the drum for maximum fine cleaning.

6. Turn drum in the direction to return the stabilized concrete wash water to the front of the drum and mix at high speed for (1) minute and stop.

7. If the drum is a truck mixer, park the truck for the night or weekend and cover the drum opening with a tarp to prevent addition of rain water, etc.
8. The next day or after a weekend, batch the first concrete mix into the drum with 115 liters less mix water and proceed with normal concrete making and delivery procedures. This is necessary because the 115 liters of stabilized concrete wash water is used as mix water and is already in the mixer. It is necessary to subtract 115 liters from the water required by the batch chart to maintain the water-cement ratio and slump of the concrete for each mixer drum that was stabilized.

9. A Batchman Log Sheet for each mixer shall be maintained and signed by responsible ready mix plant personnel indicating that the above methods have been strictly adhered to. A proper Batchman Log Sheet is the form "Delvo-5" by Master Builders. A copy of this form is attached at the approval policy.

Qualified Product #2

ConSave Stabilizer by Cormix Construction Materials:

Use the 9 methods exactly as shown for qualified product #1 above.

Qualified Product #3

Fritz-Pak Mini Delayed Set by Fritz Chemical Company

1. After discharging all plastic concrete, wash down rear drum fins and chutes. (Do not add water to drum).

2. Remove protective outer bag and add one container of Fritz-Pak Mini Delayed Set for each 16 hours of wash water stabilization required.

3. Add 115 to 190 liters of water to the mixer.

4. Mix wash water and Mini Delayed Set at high speed for 2 1/2 minutes.

5. Reverse drum to coat rear fin assembly. DO NOT DISCHARGE WASH WATER.

6. Mix wash water at high speed for an additional 2 1/2 minutes. (5 minutes total).

7. If mixer drum is truck mounted, park the truck and cover the drum opening in order to prevent the addition of rain water.

8. The next time concrete is batched, subtract the (actual gallons) added wash water and proceed with normal mixing procedures.

9. Maintain a Mixer Batch Log Sheet.

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Curing Compound for Concrete Structures

Curing Compounds on this qualified product list comply with Subsection 702.04 of the Standard Specifications.

The Resident Construction Engineer will accept shipment of curing compound by receiving the manufacturer's certificate of analysis and performance test results for products shown on this list.

SOURCE	TRADE NAME	NTPEP Code #
W.R. Meadows of Georgia, Inc. 100 Riverside Drive Carterville GA 301220 Sales: (800) 342-5976 Fax: (770) 941-5058 Mr. Jim Nelson	SEALTIGHT 1600 Type 2 Class A Wax Base	CCC-2011-02-003
	SEALTIGHT 1100/1150 Type 1 Class B Resin Base	CCC-2011-01-007
Hunt Process Corp. Southern PO Box 688 Ridgeland, Mississippi 39158 Sales: (601) 856-8811 Fax: (601) 856-0723 Mr. Rick Largent	Hunt Process White Pigmented Type 2 Class A WS Wax Base	CCC-2005-06
Kaufman Products Inc. 3811 Curtis Avenue Baltimore, Maryland Sales: (800) 637-6372 Fax: (601) 856-0723 Mr. Alex Kaufman	Thinfilm 450 Type 2 class B Resin Base	CCC-2009-06
	Thinfilm 445 Type 2 Class A Wax Base	CCC-2005-03
	Thinfilm 420 Type 1 Class B Resin Base	CCC-2009-05

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SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Qualified Corrosion Inhibitors for Concrete

Producer	Trade Name	Recommended Dosage
W.R. Grace and Company 62 Whittermore Avenue Cambridge, MA 02140 Tel: 617-876-1400 Denise Preston denise.i.preston@grace.com	Calcium Nitrite DCI	2 gal/ c.y.
BASF Corporation 23700 Chagrin Blvd. Cleveland, OH 44122 1-800-451-5833 Richard Morrow dmorrow@mbt.com	Reocrete 222 *Reocrete CNI *NTPEP #: CADD-2011-01-041	1 gal/c.y. 1-6 gal/c.y.
The Euclid Chemical Company 19218 Redwood Road Cleveland, OH 44110 Tel: 216-692-8360 1-800-321-7628 Fax: 216-531-9399 Bob Bucheral bob@euclidchemical.com	CIA	1 gal/c.y.
Cortec Corporation 4119 White Bear Pkwy St. Paul, MN 55110 Tel: 651-429-1100 Fax: 651-429-1122 1-800-4-cortec Jessi Jackson Meyer jessij@cortecvci.com	MCI 2000 MCI 2005	1 pint/c.y. 1 pint/c.y.
Sika Corporation 201 Polito Avenue Lyndhurst, NJ 07071 Tel: 201-508-6656 Cell: 717-821-3721 Paul (pj) Jordan jordan.paul@sika-corp.com	Sika CNI	3 gal/ c.y.
Goulson Technologies, Inc. 700 N. Johnson St. Monroe, NC 28110 Cell: 706-614-3052 John Howell jhowell@goulston.com	Chupol CI	2-6 gal/ c.y.

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South Carolina Department of Transportation
Temporary Concrete Barrier Producers

PRODUCER	STANDARD DRAWINGS	CODE	APPROVAL DATE	EXPIRATION DATE
Utility Precast, Inc. 939 West Craighead Road Charlotte, NC 28206 1-800-280-5085 Contact: Mr. Chip Harris	**605-210-01** **605-210-02** **605-210-03** **605-210-04**	UP	05/11	05/13
Curtin P. O. Box 38220 Charlotte, NC 28278 1-704-588-7899 Contact: Mr. Clyde Hopkins 1-704-588-7055	**605-210-01** **605-210-02** **605-210-03** **605-210-04**	CT	05/11	05/13
TIC P.O. Box 9207 Savannah, GA 31412 1-912-235-4872 ext 1765 Contact: David Maher	**605-210-01**	TIC	08/13	08/15
Seminole Precast Manufacturing, Inc. P. O. Box 3177 Macon, GA 31205 1-478-781-2090 Contact: Daniel Moody	**605-205-01** **605-205-02** **605-205-03**	SPI	08/11	08/13

Contact: All questions and correspondence regarding this qualified product list should be directed to:

Caleb Gunter
Structural Materials Engineer
SCDOT Office of Materials and Research
PO Box 191
Columbia, SC 29201
Telephone: (803) 737-6694
Email: guntercb@scdot.org

For Class Purposes Only

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Suppliers of Reinforcing Steel

These Producers are qualified in accordance with SCDOT Qualified Product Policy 60. Trade names are registered trademarks of the appropriate company.

SCDOT PRODUCER CODE	Producer	Contact /Telephone
SteelRebarCo005 (CMCCSC)	CMC Steel South Carolina 310 New State Road Cayce, SC 29033	Clyde Ditolla (803) 936-3867 Clyde.ditolla@cmc.com
SteelRebarCo029 (CMCDOK)	CMC Steel Oklahoma 584 Old Highway 70 Durant, OK 74702	Robbie Booth (480) 396-7127 Robert.booth@cmc.com
SteelRebarCo002 (CMCJFL)	CMC Steel Florida 16770 Rebar Road Jacksonville, FL 32234	Alex Renosto (904) 266-1468 alexander.renosto@cmc.com
SteelRebarCo003 (CMCKTN)	CMC Steel Tennessee 1919 Tennessee Avenue Knoxville, TN 37921	Jim Hall (865) 202-5972 James.Hall@cmc.com
SteelRebarCo033 (CMCMAZ)	CMC Steel Mesa 11444 East Germann Road Mesa, AZ 85242	Jacob Selzer (480) 396-7101 Jacob.Selzer@cmc.com
SteelRebarCo017 (CMCSNJ)	CMC Steel New Jersey 1 North Crossman Road Sayreville, NJ 08872	Joe Homic (800) 721-8047 Joseph.Homic@cmc.com
SteelRebarCo022 (CMCSTX)	CMC Steel Texas 1 Steel Mill Drive Seguin, Texas 78155	Jason Dinscore (830) 372-8746 Jason.dinscore@cmc.com
SteelRebarCo023 (CMCRCCA)	CMC Steel California 12459-B Arrow Road Rancho Cucamonga, CA 91739	Michael Mayer (909) 646-7886 Michael.Mayer@cmc.com
SteelRebarCo021 (EVRAZCO)	Evraz Rocky Mountain Steel 2100 South Freeway Pueblo, CO 81004	Billy Byrd (719) 561-6426 Billy.byrd@evrazna.com
SteelRebarCo001 (GACNC)	Gerdau Ameristeel (Charlotte Mill) 6601 Lakeview Road Charlotte, NC 28269	Rachel Warren (704) 596-0361 Ext. 3039 Rachel.Webster@gerdau.com
SteelRebarCo019 (LSPIL)	Liberty Steel 7000 S.W. Adams Street Peoria, IL 61641-0002	Tyler Higgins (309) 697-7173 tyler.higgins@libertysteel.us
SteelRebarCo034 (NSAFL)	Nucor Steel (Florida) 22 Nucor Drive Avon Park, FL 33843	Tad Nowlin (863) 546-5796 Tad.nowlin@!nucor.com
SteelRebarCo024 (NSANY)	Nucor Steel (Auburn) 25 Quarry Road Auburn, NY 13021	Rachel Palmer (315) 258-4207 Rachel.Palmer@nucor.com
SteelRebarCo013 (NSBAL)	Nucor Steel (Alabama) 2301 F.L. Shuttlesworth Drive Birmingham, AL 35234	George Miljus (205) 250-7417 george.miljus@nucor.com
SteelRebarCo014 (NSBIL)	Nucor Steel (Illinois) 1 Nucor Way Bourbonnais, IL 60914	Jason Rivera (815) 929-3524 Jason.rivera@nucor.com

SteelRebarCo016 (NSKAZ)	Nucor Steel (Arizona) 3000 West Old Highway 66 Kingman, AZ 86413	Vijay M. Choksi (928) 718-7035 Ext. 217 Vijay.Choksi@nucor.com
SteelRebarCo025 (NSMOH)	Nucor Steel (Ohio) 912 Cheney Avenue Marion, OH 43302	Justin Spitzer (704) 383-9651 Justin.spitzer@nucor.com
SteelRebarCo027 (NSPUT)	Nucor Steel (Utah) 7285 W 2100 N West Cemetery Road Plymouth, UT 84330	Brenda Porath (435) 458-9208 brenda.porath@nucor.com
SteelRebarCo031 (NSSMO)	Nucor Steel (Sedalia) 500 Rebar Road Sedalia, MO 65301	Karan Bajwa (660) 951-1732 Karan.bajwa@nucor.com
SteelRebarCo008 (NSSWA)	Nucor Steel (Washington) 2424 SW Andover Street Seattle, Washington 98106	Erik Nissen (206) 724-4727 Erik.Nissen@Nucor.com
SteelRebarCo012 (NSWCT)	Nucor Steel (Connecticut) 35 Toelles Road. Wallingford, CT 06492	John Brasell (203) 949-6848 John.brasell@nucor.com
SteelRebarCo010 (OSVTX)	Optimus Steel 100 Old Highway 90 West Vidor, TX 77704	Leonardo Radicchi (409) 769-1086 leonardo.radicchi @optimus-steelusa.com
SteelRebarCo032 (SDICCIN)	Steel Dynamics, Inc. 2601 South County Road 700 East Columbia City, IN 46725	Kimberly Lickey (260) 625-8460 Kimberly.Lickey@steeldynamics.com
SteelRebarCo028 (SDIPIN)	Steel Dynamics, Inc. 8000 N County Road 225 E Pittsboro, IN 46167	Brandon Dugan (317) 892-7166 Brandon.Dugan2@steeldynamics.com
SteelRebarCo030 (SDIRVA)	Steel Dynamics, Inc. 102 Westside Boulevard NW Roanoke, VA 24017	Lewis Leftwich (540) 510-3185 Lewis.leftwich@steeldynamics.com

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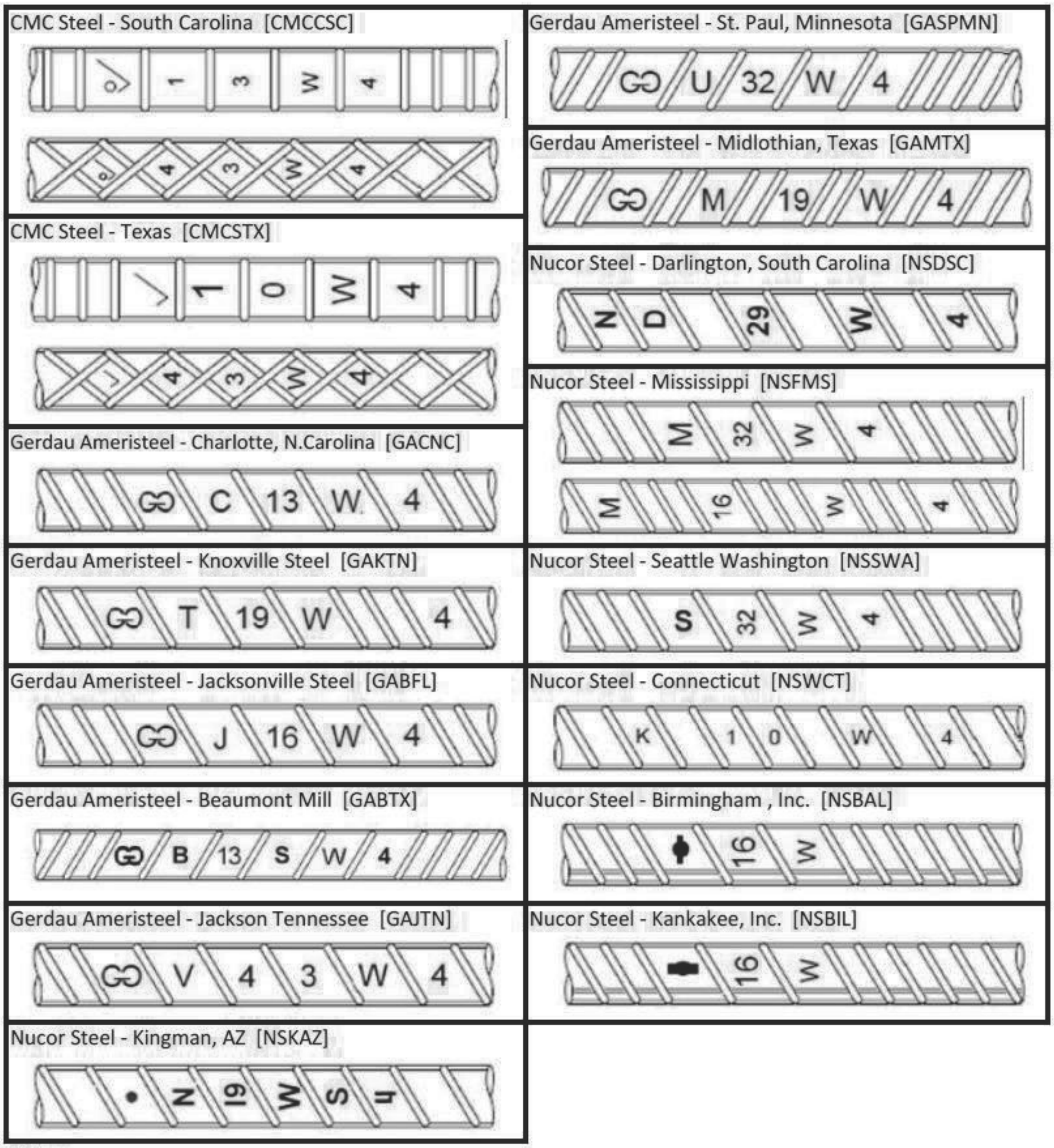
Current Acceptable Rebar Mill Markings



Notes:

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Authorized Producers of Reinforced Concrete Pipe (RCP)

The following is a list of Reinforced Concrete Pipe (RCP) producers who have satisfied the requirements established by the SCDOT as defined by Qualified Product Policy 69.

		Reinforced Concrete Pipe Using Flexible Sealants (FS)			Reinforced Concrete Pipe Using Rubber Gaskets (RG)			
Producers	**Plant Certification Expiration Period**	**Pipe Size**	**Sealant Size**	**Flexible Sealant Manufacturer**	**Pipe Size**	**Rubber Gasket Size**	**Rubber Gasket Manufacture r**	**Notes**
**CP & P, LLC 2750 Azalea Drive Charleston, SC 29405 Tel: 1-843-744-5376 Fax: 1-843-566-7956 Michael Troan	ACPA Q-Cast Jan 1, 2016 Through Jan 1, 2018	12"-36" 42"-72"	¾ " 1 ¼"	Concrete Sealants Materials, New Carlisle, Ohio	12" – 36 " 42" – 72"	158-4G 210-4G	Press-Seal Gasket Corporation Fort Wayne IN	Profile Style Joint
Concrete Designs, LLC P.O. Box 15164 Surfside Beach, SC 29587 Tel: 1-843-650-0099 Jimmy Kid	*NPCA Dec 31, 2017	15" – 36" 48" – 60"	1" 1 ¼"	Concrete Sealants Materials' New Carlisle, Ohio				

Diamond Concrete, LLC P.O. Box 1370 Rincon, GA 31326 Tel: 1-912-728-9485 Alan Zipperer	*NPCA Dec 31, 2016	15” – 36” 42” – 60”	1” 1 ¼”	Concrete Sealants Materials’ New Carlisle, Ohio	15” – 60” 15” – 60” 15” – 36” 15” – 36” 42” – 72”	155– 4G CR023 3 SOCL TSS135 7SOCL	Press-Seal Gasket Corporation Fort Wayne IN Universal Polymer Ravenna, OH Hamilton Kent LLC Toronto, Ontario Winchester, TN	
Foley Products Company 1291 Hardigree Road Winder, GA 30680 Tel: 1-770-868-0118 Fax: 1-770-307-5918 Mbl: 1-404-787-1367 Dennis Morrissey	ACPA Q-Cast Jan 1, 2015 Through Jan 1, 2017				15” – 36” 42” – 96” 15” – 36” 42” – 72” 84” – 96” 15” – 36” 42” – 96”	155-4G 260-4F CR147 CR066 CR023 BN3RCP BN7RCP	Press-Seal Gasket Universal Polymer C - Tech C – Tech	Profile Style Joint
Foltz Concrete Pipe 11875 North NC Hwy 150 Winston Salem, NC 27127 Tel: 1-336-764-0341 Doug Shell	*NPCA Dec 31, 2016	15” – 18” 24” – 30” 36” – 42” 48” – 72”	¾” 1” 1 ¼” 1 ½”	Concrete Sealants Materials’ New Carlisle, Ohio	15” – 36” 42” – 72”	158-4G 210-4G	Press-Seal Gasket Corporation Fort Wayne IN	Profile Style
Gossett Concrete Pipe P.O. Box 3683 Greenville, SC 29608 Tel: 1-864-242-3593 Fax: 1-864-244-4720 Plant:: 1-864-244-0370	ACPA Q-Cast Oct 1, 2015 Through Oct 1, 2017	12”-24” (1) 30”-36” (1) 42”-48” (1)	¾ “ 1” 1 ¼ ”	Concrete Sealants Materials, New Carlisle, Ohio Multiseal, Inc	15” – 36” 42” – 72” 15” – 36”	V-0168 .326AS V-0166 .446AS 3 SOCL	Vertex Inc. Mogadore, OH Hamilton	(1)Tongue & Groove Style Joint (2). Profile Style Joint

Notes:
a. RG: AASHTO M 315 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (13-psi. in straight alignment and 10-psi. in deflected alignment in plant hydrostatic test).
b. FS: AASHTO M 198 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Section Using Preformed Flexible Sealants (10-psi. in plant hydrostatic test).
c. For the following counties: Berkeley, Beaufort, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper, provide pipe joints meeting AASHTO M 315 *(13 psi), for all other counties, either M 190 (10 psi) or M 315 may be used unless noted otherwise in the plans or special provision*.

*NPCA performs their audits on the specific date listed above – ACPA performs their audits through the expiration period without any announcement.

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Products List of Mechanical Couplers for Reinforcing Steel

Mechanical Couplers for Reinforcing Steel on this qualified product list comply with Subsection 703 of the Standard Specifications. This table was prepared to provide a reference source for rebar splicing systems currently authorized for use by SCDOT.

Splice Company	Coupler Model	Authorized Service Splice (Bar Sizes)	Authorized Ultimate Splice (Bar Sizes)
Headed Reinforcement Corp. (HRC) 11200 Condor Ave Fountain Valley, CA 92708 Jeremy Maldonado 714-852-1333	HRC 410/420 Standard Coupler Xtender 500/510 Standard Coupler	#8 through #18 #4 through #14	#8 through #18 #4 through #14
Erico Products, Inc. 34600 Solon Road Cleveland, OH 44139 Craig Guy 843-340-5420	Lenton A-2 Standard Coupler Lenton P Position Coupler Lenton D6 Terminator Coupler	#4 through #18 #4 through #18 #4 through #18	#4 through #18 #4 through #18 #4 through #18
Dayton Superior Corporation 1125 Byers Road Miamisburg, OH. 45342 Timothy Fondelier 412-812-4848 Ben Rivera 978-994-0477	Barlock SCA Series Barlock L Series	#4 through #18 #4 through #18	#4 through #18 #4 through #18
Barsplice Products, Inc. 4900 Webster St. Dayton, OH 45414 Jon Bonner 937-275-8700 EX-243	Bargrip XL Barsplicer XP Taper Threaded Grip Twist Taper Threaded Grip Twist Position Zap Screwlok Type 2	 #5 through #18 #4 through #18	#5 through #18 #4 through #11 #3 through #18

Barsplice Products, Inc. 4900 Webster St. Dayton, OH 45414 Jon Bonner 937-275-8700 EX-243	Zap Screwlok Epoxy Zap Screwlok SL Double Barrel Zap Screwlok	#4 through #18 #4 through #18 #4 through #18	

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Qualified Products List
for
Preformed Rubber Joint Filler Materials

The following products are preformed rubber joint filler materials that have been qualified by the Office of Materials and Research and comply with SCDOT specifications.

Products	**Manufacturer**
Sponge Rubber Expansion Joint *(Black Material)*	Right Pointe/**J &K P.O. Box 467 234 Harvestore Drive DeKalb, IL 60115-8604 (815) 754-5700
Sponge Rubber Expansion Joint *(Black Material)*	Bob Warner, Inc. 477 Pine Glen Rd. Karthaus, PA 16845 814-430-2161
Sponge Rubber Expansion Joint *(Gray Material)*	W.R. Meadows 100 Riverside Drive Cartersville, GA 30120 (770) 586-6440

**J &K Foam Fabricating, Inc.
66 Robinson Street
Pottstown, PA 19464
877-823-1059

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

AUTHORIZED SUPPLIERS OF TYPE IL PORTLAND-LIMESTONE CEMENT

The following is a list of Type IL Portland-Limestone Cement Suppliers who have satisfied the requirements established by the SCDOT as defined by Qualified Product Policy 86. Cement must be from a qualified source listed on SCDOT qualified product list 6, “Authorized Portland Cement and Non-Steel Slag Manufacturers.” All trade names are registered trademarks of the appropriate companies.

Manufacturer	Trade Name	Type	Mill and Transfer Silo Terminals
Holcim (US) Inc. 9624 Bailey Road Suite 275 Charlotte, NC 29201 Tel: (800) 845-1120 Fax: (704) 895-5961 Eddie Deaver edward.deaver@holcim.com		IL(10)	Holly Hill Plant, Holly Hill, SC

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CHAPTER 4

SCDOT 2007 Standard Specifications for Highway Construction

Section 701: Portland Cement and Portland Cement Concrete

- Chapter 4 Presentation
- Concrete Materials

SCDOT PCC SPECIFICATIONS

(Chapter 4)

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SOURCES OF SPECIFICATIONS

Specifications can come from:

1. AASHTO
2. Instructions from the RCE
3. Project Proposal
4. Project Plan & SCDOT Standard Drawings
5. SCDOT Standard Specifications
6. SCDOT Construction Manual
7. SCDOT Material Approval

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SCDOT ORGANIZATION

Resident Construction Engineer

- Ultimate authority on the Project
- Maintains a weekly diary compiled from inspectors diaries
- Provides monthly estimates and updates of work completed

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SCDOT ORGANIZATION

Portland Cement Concrete Inspector

*****Could be You*****

- Observes contractor and performs testing
- Tracks quantities
- Maintains a diary of quantities and observations

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WHAT DO THE SPECS PERTAIN TO?

→ Materials

→ Building Processes

→ Construction Supervision

SCDOT Specs begin with the building materials.

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STANDARD SPECIFICATIONS

SCDOT 2007 Standard Specs for Highway Construction [Black Book]

701 Portland Cement and PCC

702 Concrete Structures

703 Reinforcing Steel

Written with the Contractor's point of view as the primary concern.

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STANDARD SPECIFICATIONS

SCDOT Abbreviations

BCE	Bridge Construction Engineer
BDE	Bridge Design Engineer
OMR	Office of Materials & Research
RCE	Resident Construction Engineer
SME	Structural Materials Engineer

Taken from the list of abbreviations – 2007 Standard Specifications

STANDARD SPECIFICATIONS

701 Portland Cement and PCC

701.2 Materials

Portland Cement (701.2.1)
Fly Ash (701.2.2)

Silica Fume (701.2.4)

Air Entrainment (701.2.5)

Admixture Policy (701.2.6-8)

Aggregates (701.2.9-10)

Water (701.2.11)

STANDARD SPECIFICATIONS
701 Portland Cement and PCC

701.2.12 Concrete Mix Design

Covers Mix Design Principles

Contains the Structural Concrete Table

- Probably the most important table in the book for PCC Structures [Chapter 4, Pages 22-24]
- Based on Class and Course Aggregate Type
- Min. cement content, aggregate ratio, max water: cement ratio as well as 28 day design strength

Non-Conforming Concrete

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STANDARD SPECIFICATIONS
701 Portland Cement and PCC

701.3 Equipment (Production)

Weighing Equipment (701.3.2)

Central Mix Plants (701.3.3)

Truck Mixers (701.3.4)

701.4 Construction

Material Storage (701.4.1-3)

Batching and Mixing (701.4.4)

Consistency (701.4.5)

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WHERE SHOULD CONCRETE MIX DESIGN BE SUBMITTED?

WHO APPROVES THE MIX DESIGN?

ANSWER:

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What Happens When Concrete Cylinders Don't Meet Strength Requirements

Cylinder Test Results:	Price Reduction per cubic yard (Percent) X (Contract Unit Price)	
Percentage of Minimum Strength	With Contract Unit Price	Without Contract Unit Price*
98.0 - 100.0	0%	0%
95.0 - 97.9	5%	25%
90.0 - 94.9	10%	50%

* If there is no contract unit price for concrete, use (percent reduction) x (supplier's invoice unit cost).

The BCE may approve use of concrete test method **SC-T-49** to determine the accepted strength if the concrete test cylinders have been considered non-conforming.

The total amount of the price reduction will not be less than $500.00.

2 If any cylinder test result is below 90%, take cores in the presence of the BCE or RCE from the concrete in the structure that is represented by the non-conforming test cylinders in order to evaluate the strength of the concrete in place. Ensure that test cores are taken, conditioned, and tested in accordance with the requirements of **Subsection 701.2.12.4.2.2**.

701.2.12.4.2 Procedure for Testing Non-conforming Concrete

701.2.12.4.2.1 Limits of Questionable Concrete

1 The limit of questionable concrete is determined by using concrete test method **SC-T-49**. Acceptance is solely based on the compressive strength of the cores removed from the in-place concrete, unless authorized otherwise by the BCE.

Cores or SC-T-49 (ASTM C805)

701.2.12.4.2.4 Acceptance of Concrete

1 Acceptance of the concrete from which the cores are taken is based on the core test results. If access to the concrete is not practical for obtaining cores or the taking of cores would result in irreversible damage to the structure, the BCE may approve concrete test method **SC-T-49** to determine the strength of the concrete.

2 If the **SC-T-49** test results or the core test results are below 90%, but are equal to or greater than 85% of the design strength, obtain a design analysis based on the reduced strength from the Designer-of-Record. Based on the design analysis, the BCE will determine if the concrete can remain in place. If the concrete test results are less than 85% of the design strength, remove the concrete unless authorized otherwise in writing by the BCE.

3 If non-conforming concrete is allowed to remain in-place, a price reduction on the quantity of concrete in question is determined by the following table.

Price Reduction for Non-conforming Concrete Left In-Place		
Core Test Results: *	Price Reduction per cubic yard (Percent) X (Contract Unit Price)	
Percent of Minimum Strength	With Contract Unit Price	Without Contract Unit Price**
98.0 -100.0	0%	0%
95.0 - 97.9	5%	25%
90.0 - 94.9	10%	50%
85.0 - 89.9	15%***	80%

* Or **SC-T-49** if approved by the BCE.

** If there is no contract unit price for concrete, use (percentage) x (supplier's invoice unit cost).

*** Use 15% of contract unit price or 80% of supplier's invoice unit cost, whichever is greater.

The total amount of the Price Reduction will not be less than $500.00.

Hot & Cold Weather Concrete

*****See Chapter 5 for New Supplemental Specifications regarding new Hot & Cold Weather Plans for jobs Let 7/1/2018 and after.**

SLUMP ADJUSTMENTS
701.4.6 ADDING WATER

In the event additional water is required to obtain the specified slump at the work site, the RCE may approve adding water from an acceptable water supply at the rate of 1 gallon per cubic yard per inch of desired slump, but not to exceed the maximum water to cementitious material ratio shown in the table in **Subsection 701.2.12.2**. When additional water is added, make certain that the truck mixer drum turns a minimum of 25 revolutions at mixing speed before discharge of the concrete.

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SLUMP ADJUSTMENTS
701.4.7 CHEMICAL ADMIXTURES

Type F or Type G admixtures may be added to concrete to increase workability and/or to reduce the water to cementitious material ratio. Type F is a HRWR, and Type G is a High Range Water Reducer-Retarder. If these admixtures are used, add them at the work site just before discharge, and mix concrete for a minimum of 30 seconds per cubic yard of concrete in the mixer after each addition of an admixture. Measure the slump of the concrete before the addition of the high-range admixture, and make certain not to exceed the maximum slump limits indicated above. Discontinue or avoid the use of admixtures when there is any indication of excessive flow, bleeding, or segregation. The admixture may be added a second or third time to re-establish mixture flow if the maximum time for placing the concrete after the mix water.

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STANDARD SPECIFICATIONS

701 Portland Cement and PCC

701.4 Construction (continued)

Slump (701.4.6)

Use of Water Reducers & Water Reducer-Retarders (701.4.7-8)

Fly Ash and Water-Granulated Blast Furnace Slage (701.4.9)

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FLY ASH REPLACEMENT

701.4.9 Fly Ash & Water-Granulated Blast-Furnace Slag

The addition of fly ash or water granulated blast-furnace slag is allowed in the concrete mix if the following requirements are met when using these materials:

A. Fly ash or water-granulated blast-furnace slag may replace allowable percentages of Type I, Type II, or Type III Portland cement. Do not use fly ash or slag replacement for mixes using Type I (SM) or any other blended cement.

B. Remove forms in accordance with **Subsection 702.4.5.**

C. When fly ash is used to replace the Portland cement, replace at a ratio of not less than 1.2:1 by weight, and do not replace more than 20% of the cement originally called for in the mixture.

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RELATIONSHIP OF CONSTRUCTION MANUAL AND STANDARD SPECIFCATIONS

Labeled concurrently with Standard Specifications of Chapters 4 & 10 (2007 Black Book)

TOPIC	CONSTRUCTION MANUAL CHAPTER 9	STANDARD SPECIFICATIONS CHAPTER 4 & 10
Aggregates	**701.2.4.3**	**701.2.9 & 701.2.10**

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SCDOT PCC SUPPLEMENTAL SPECIFICATIONS AND DEPARTMENT MEMOS

(Chapter 5)

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DIVISION 700

STRUCTURES

SECTION 701

PORTLAND CEMENT AND PORTLAND CEMENT CONCRETE

701.1 Description

1 This section contains specifications for the materials, construction, measurement, and payment for furnishing, storing, and handling of the materials; and the proportioning, mixing, and delivery of Portland cement concrete for structures.

701.1.1 Classes of Concrete

1 Classes of concrete typically used by the Department are listed in the Structural Concrete Table in **Subsection 701.2.12.2**. The numerical portion of the Class is the minimum 28-day mix design strength based on ASTM C 39.

701.2 Materials

701.2.1 Portland Cement

701.2.1.1 General

1 Use Portland cement conforming to the requirements of the following specifications for the type required or permitted and obtained from a source listed on the most recent edition of *SCDOT Qualified Product List 6* with the additional requirements stated hereafter.

2 Use Portland cement concrete for structures composed of Portland cement, fine aggregate, coarse aggregate, water, air-entraining admixture, and other permitted or required admixtures. Fly ash, water granulated blast-furnace slag, and silica fume may be added or used as a replacement for a portion of the Portland cement and is considered as cement in the water-cementitious material ratio unless otherwise designated. Ensure that the materials conform to the requirements hereinafter specified. Prepare and deliver the mixture in accordance with these specifications.

3 Comply with compressive strength requirements and meet the requirements for low-alkali cement (0.6 maximum).

4 Except for cement in RC pipe and prestressed or precast products, use cement complying with the maximum limits of fineness of grind in AASHTO M 85 controlled as follows:

A. Ensure that the cement in the mill test reports furnished by the manufacturer complies with the maximum fineness (air permeability test) values stated in AASHTO M 85.

B. Take job control samples at random at the project site and submit them to the OMR for testing. Make certain that the maximum fineness limit (air permeability test) is in conformance with the requirements of AASHTO M 85 with allowance for variations in sampling, presence of moisture in the sample, age of the cement production, and multi-laboratory coefficient of variation.

5 Type I (SM) slag-modified Portland cement may be used instead of Type I and Type II cement. If used, furnish Type I (SM) cement conforming to the requirements of AASHTO M 240 and obtain from the sources listed on the most recent edition of *SCDOT Qualified Product List 18*. Provide an intimate and uniform blend of Portland cement and granulated blast-furnace slag. In any case, make certain that the slag constituent is less than 25% of the total weight of the slag-modified Portland cement.

6 Furnish certified mill test reports to the RCE as outlined in the most recent edition of *SCDOT Qualified Product Policy 6*.

7 Do not store incompatible brands of cement or different types of cement in the same cement storage bin or silo and do not use them together in any continuous pour.

8 Have the weighing and handling procedures of bulk cement approved by the OMR before its use. Protect cement shipments at all times. Inspect, sample, and test questionable cement before its use. Do not use cement that is lumpy, caked, or from open or otherwise damaged bags.

9 Measure cement by weight or by the bag as packed by the manufacturer. Unless another weight is indicated on the bag, use 94 pounds as the weight of one bag of cement.

10 Whenever it is determined by subsequent laboratory testing of mill or job control samples that a cement shipment does not comply with these specifications, discontinue use of the cement from that cement mill until testing reveals that the problem has been corrected. The Contractor is responsible for replacing or otherwise making satisfactory the concrete in which any defective cement is used.

701.2.2 Fly Ash

1 Use fly ash (Type C or Type F) conforming to the requirements of AASHTO M 295, except for the supplementary optional physical requirements. Use fly ash from sources listed on the most recent edition of *SCDOT Qualified Product List 3.*

701.2.3 Water Granulated Blast-Furnace Slag

1 If slag is used, use water granulated blast-furnace slag Class 100 or higher conforming to the requirements of ASTM C 989.

701.2.4 Silica Fume

1 Use silica fume meeting the general requirements of ASTM C 1240. Make certain that the raw silica fume meets the chemical requirements of Table 1 and Table 2 and the physical requirements of Table 3 in ASTM C 1240. Furnish the manufacturer's certification stating the results of tests made on samples of silica fume during production and that the applicable requirements of ASTM C 1240 have been met. Provide certification for each lot of each shipment to the RCE and to the OMR.

2 Silica fume may be added to the mix in either a dry (densified) form or a wet (slurry) form. The dry form is usually supplied in 50-pound bags. When a dry form is used, adjust the mix design to use whole bags of silica fume, i.e. do not use partial bag(s). Whole bags of silica fume in excess of the normal 50-pound bag and whole bags as small as 40 pounds are permitted only if approved by the RCE. Make certain that the guidelines of OSHA regulations for worker protection are followed.

3 When a wet (slurry) form is used, compute the water contained in the slurry and count it as part of the total water in the mix. Ensure that this data is in accordance with the manufacturer's certified quality test report for the lots of silica fume being used in the mix.

701.2.5 Air Entrained Concrete

1 Unless otherwise specified, use a design mix for air-entrained concrete based on 4.5% (± 1.5%) entrained air, except for prestressed concrete. If the concrete is pumped, then the entrained air will be acceptable at 5.5% (± 1.5%) measured at the truck.

2 Do not use air entrainment exceeding the maximum limits specified in the paragraph above. Air entrainment for Class 10000 concrete is left to the judgment of the Contractor and approval of the OMR.

3 Use air entrained concrete in all bridge columns, bent or pier caps, decks, sidewalks, parapets, barrier walls, and other structural elements on the bridge deck regardless of the class of concrete used.

4 When air-entrainment is used, vary the proportions of water, fine aggregate, and coarse aggregate from those specified herein to maintain the specified strength of the concrete. Use approved admixture specified in **Subsection 701.2.5.1** to obtain the required air entrainment.

701.2.5.1 Air-Entraining Admixtures

1 When air entrainment is required, use air-entraining admixtures complying with AASHTO M 154. Submit an affidavit to the RCE and the OMR to show that the admixture conforms to the requirements of AASHTO M 154. Use admixtures from sources appearing on the most recent edition of *SCDOT Qualified Product List 5.*

701.2.6 Accelerating, Retarding, and Water-Reducing Admixtures

1 If the use of a chemical admixture to facilitate concrete placement in adverse conditions is desired, the use of an admixture complying with AASHTO M 194 must be approved by the RCE before its use. The RCE may direct the use of an admixture due to adverse placement conditions.

2 When a retarding admixture is desired and approved, use a Type G high range water reducing-retarding admixture or a Type D water reducer-retarder combined with a Type F high range water reducer as provided in **Subsections 701.4.7** and **701.4.8**. Do not use a Type B retarding admixture. Furnish the RCE with an affidavit showing that the admixtures conform to the requirements of AASHTO M 194. Use admixtures from sources appearing on the most recent edition of *SCDOT Qualified Product List 5*.

701.2.7 Corrosion Inhibitor

1 When a corrosion inhibitor is required in a concrete mix, add the corrosion inhibitor to the concrete while batching. Use the corrosion inhibitors that appear on the most recent edition of *SCDOT Qualified Product List 53*. Adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation, and method of mixing. Add the corrosion inhibitor to the mix by a dispenser meeting the requirements of **Subsection 701.4.3.4**.

2 Furnish the RCE a copy of the manufacturer's certified test report showing the composition of the corrosion inhibitor and the percent of solids.

701.2.8 Calcium Chloride

1 If calcium chloride is approved by the RCE for use in non-reinforced concrete during cold weather work, do not exceed a rate of 2% by weight of cementitious material. Use calcium chloride complying with the requirements of AASHTO M 144 for Type S or Type L. In any case, do not use calcium chloride in reinforced concrete structures.

701.2.9 Fine Aggregate for Portland Cement Concrete

701.2.9.1 General

1 Submit the fine aggregate in the concrete mix designs for approval by the OMR. Use natural sand, manufactured sand, or a combination of natural and manufactured sand meeting the requirements of **Subsections 701.2.9.2** through **701.2.9.8** below. Do not use marine limestone aggregate in reinforced concrete.

701.2.9.2 Natural Sand

1 Use natural sand, FA-10, composed of clean, hard, durable, and uncoated grains that is free of lumps or flaky particles, organic matter, loam, or other deleterious substances.

701.2.9.3 Manufactured Sand

1 Use manufactured sand, FA-10M, made from stone meeting all the quality requirements for coarse aggregates.

701.2.9.4 Mixtures of Sand

1 When a blend of sands is approved, store and batch the two materials separately unless otherwise approved in writing by the OMR.

701.2.9.5 Organic Impurities

1 Make certain that fine aggregate is free of injurious amounts of organic impurities. Do not use fine aggregates, which when subjected to the colorimetric test, AASHTO T 21 for organic impurities, produces a color darker than 3, unless the following criteria is met:

- Fine aggregate with the color darker than 3 may be used if the relative strength at 7 and 28 days is not less than 95% when tested in accordance with AASHTO T 71 as revised herein.

2 Comply with Section 4.2 of AASHTO T 71 revised as follows:

- Mix one batch of mortar with the aggregate treated in sodium hydroxide and one batch with untreated aggregate on the same day. Mold six 2-inch cubes from each batch. Test three of the cubes from each batch at 7 days and 28 days.

701.2.9.6 Soundness

1 Use fine aggregate that has a weighted loss not exceeding 10% by weight when subjected to five alternations of the sodium sulfate soundness test conducted according to AASHTO T 104.

701.2.9.7 Approved Sources

1 Use sand from sources that appear on the most recent edition of *SCDOT Qualified Product List 1.*

701.2.9.8 Gradation of Fine Aggregate

1 Use fine aggregate for all classes of Portland cement concrete and concrete pavement conforming to the following gradations of FA-10 or FA-10M as indicated in Gradation of Fine Aggregate table in the Appendix of these specifications.

701.2.10 Coarse Aggregate

701.2.10.1 General

1 Use coarse aggregate that is clean, tough, durable crushed gravel or crushed stone. Make certain that it is free from soft, thin, elongated, or laminated pieces and sufficiently washed during production to produce a clean aggregate free from lumps or coatings of clay, disintegrated particles, vegetation, or deleterious substances. Adherent coatings are considered injurious. Do not use coarse aggregate with a Los Angeles Abrasion Loss exceeding 60% as determined by AASHTO T 96. Use coarse aggregate that has a

weighted loss not exceeding 15% when subjected to five alternations of the sodium sulfate soundness test conducted according to AASHTO T 104. Use coarse aggregate for Portland cement concrete conforming to the requirements in **Subsections 701.2.10.2** through **701.2.10.4**.

2 Use aggregate from marine limestone quarries only in applications of non-reinforced concrete. Use marine limestone coarse aggregate that has a weighted loss not exceeding 25% when subjected to five alternations of the sodium sulfate soundness test conducted according to AASHTO T 104. When marine limestone aggregate is used, use a sprinkler system to produce a saturated aggregate during concrete batching.

701.2.10.2 Slag

1 Use crushed slag or other inert materials having similar characteristics and approved in writing by the OMR, consisting of clean, tough, durable pieces of approved slag or other inert materials, is reasonably uniform in density and quality, and is reasonably free of thin or elongated pieces. Ensure that the slag or other inert material is air-cooled and has a weight of not less than 75 pounds per cubic foot. Do not use crushed slag with a Los Angeles Abrasion Loss exceeding 40% as determined by AASHTO T 96. Do not use slag containing free lime in deleterious quantities as determined by laboratory tests and containing more than 15% by weight of glassy pieces.

701.2.10.3 Approved Sources

1 Use coarse aggregate from sources listed on the most recent edition of *SCDOT Qualified Product List 2* and approved for use with Portland cement concrete.

701.2.10.4 Gradation of Coarse Aggregate

1 Use Aggregate No. 56, No. 57, or No. 67 as coarse aggregate for Portland cement concrete. Aggregate No. 78 may be used in thin sections and prestressed panels when approved in writing by the OMR. Use only Aggregate No. 67 in prestressed concrete. Do not use blends of aggregate other than Aggregate No. 67, except when approved in writing by the OMR. Use gradation requirements for Aggregate No. 56, No. 57, No. 67, and No. 789 as indicated in the table entitled Gradation of Coarse Aggregates, in the Appendix of these specifications.

701.2.11 Water

701.2.11.1 General

1 Make certain that water used in mixing, fogging, or curing of Portland cement concrete is free of salt, oil, acid, alkali, organic matter, sewage, or other substances injurious to the finished product. The RCE in consultation with the SME will be the sole judge in determining whether the water used in mixing, fogging, or curing of Portland cement concrete is reasonably free of salt, oil, acid, alkali, organic matter, sewage, or other substances injurious to the finished product. If at any time, the water is found to be unacceptable by the RCE, discontinue its

use and provide approved water at no additional cost to the Department.

2 Conduct tests using the services of a laboratory that has an equipment calibration and verification system, technician training, and an evaluation process in conformance with AASHTO R 18 or, for Chemical Testing, has otherwise been approved by the SCDHEC for the tests being conducted. Supply AASHTO R 18 documentation to the SME for review and acceptance before using a non-SCDHEC approved laboratory. Keep all laboratory test results on file at the concrete plant, and ensure that all reports are readily available to the RCE and the SME. Conduct testing at no additional cost to the Department.

701.2.11.2 Water from a Public Water Supply

1 Water from a public water supply may be accepted and approved without being tested.

701.2.11.3 Water from Sources Other than a Public Water Supply

1 Do not use water from sources other than a public water supply until tested and approved by the RCE. Do not use wash water in structural concrete or other applications using reinforcing steel.

2 For water sources of questionable water quality, except for wash water recycling sources, make a comparison of the water with distilled or other satisfactory water by means of the standard cement test for soundness, time of setting, and 1:3 mortar strength with standard sand conforming to ASTM C 778 using the same cement with each water. Reject the water being tested if there is any indication of unsoundness, change in time of setting of ± 30 minutes, or a reduction of more than 10% in strength from 7 day test results obtained with mixtures containing satisfactory water.

3 When required by the SME, determine the acidity or alkalinity of the water in accordance with AASHTO T 26. In the event an approved water source reservoir is relatively shallow, enclose the intake pipe and elevate it to exclude silt, mud, grass, or other foreign matter.

4 Water from washout operations or is a blend of concrete wash water and other acceptable water sources is certified by the concrete producer as complying with the requirements of AASHTO M 157, Table 2 (Level 3 – conventionally reinforced concrete in a moist environment, but not exposed to chloride) and either AASHTO M 157, Table 1 (using mortar) or the table below entitled Acceptance Criteria for Questionable Water Supplies (Using Concrete), may be used as mix water. Wash water from mixer washout may be used only with RCE approval. When wash water is permitted, provide satisfactory proof or data that no detrimental effects if potentially reactive aggregates are used. Discontinue use of wash water if undesirable reaction with admixtures or aggregates occurs. Test the wash water or blended water weekly for 4 weeks for compliance with the chemical and physical requirements indicated above. Conduct subsequent tests on the water every month with records of test results provided upon request by the RCE or the OMR.

5 In addition, do not allow the specific gravity of the mixing water sampled from the discharge line to exceed 1.03 at any time concrete is being produced for the Department. Check the specific gravity by acceptable means and document the value before commencing the batching operation for use in work for the Department.

6 Use the following table to determine acceptance of water.

Acceptance Criteria for Questionable Water Supplies (Using Concrete)		
Criteria	**Limits**	**Test Method [1]**
Compressive Strength, min. percent Control at 7 days	90	AASHTO T 22 (ASTM C 39)
Time of Set, Deviation from Control	From 1:00 hr. earlier to 1:30 hr later	AASHTO T 197 (ASTM C 403)
[1] Base comparison on fixed proportions and the same volume of test water compared to control mix using public water or distilled water.		

701.2.12 Concrete Mix Design

701.2.12.1 General

1 Design the concrete mix and determine the proportions of cementitious material, fine aggregate, coarse aggregate, water, air-entraining admixture, and water-reducing or water-reducing set retarding admixture (when used) that produces a workable concrete mix. Meet the criteria for the typical classes of concrete shown in the Structural Concrete Table in **Subsection 701.2.12.2**. Consider the amount of air-entrainment that is incidentally afforded by the use of water-reducing or water-reducing/retarding admixtures. Determine the proportions of ingredients in accordance with requirements for the particular type of work and with consideration of the specific gravities of the materials to provide the desired workability and consistency.

2 At its own expense, the Contractor may retain an independent testing laboratory accredited by the AASHTO Accreditation Program to design the mix for the class of concrete specified, or use a mix design previously reviewed and used by the Department.

3 Submit all design mixes to the OMR for review using standard forms approved by the SME. After successful review by the OMR, provide a copy of all concrete designs to the RCE.

4 For the water-cementitious material ratio, use the ratio of water to cementitious materials by weight.

5 Design the concrete mix using Department approved ingredients intended for use in the project and make all trial batches using such materials. Test trial mixes for complete conformance with the Specifications by the approved laboratory engaged by the Contractor.

6 Base mix designs on the air entrainment specifications in **Subsection 701.2.5**.

7 Base the total water content of the mix on the weight of cement, fly ash, and silica fume multiplied by the water-cementitious ratio. Do not include the absorbed water in the aggregate as mix water.

8 Base mix designs on specific gravities and saturated surface dry moisture contents of aggregate obtained from a source on the most recent edition of *SCDOT Qualified Product List 2*.

9 Base the sand to stone ratio on volume. Vary the ratio to obtain good workability.

10 No separate payment is made for the cost of the laboratory engaged by the Contractor, the materials furnished and used for trial batches, the preparation and testing of trial batches either by the Contractor or its laboratory, or furnishing the OMR with the mix data, the results of the cylinder tests, and yield to be tested. These costs are considered incidental to the work of the applicable item. Include the cost in the unit prices for the applicable pay items in the Contract.

11 After successful review of a design mix by OMR, do not change the mix proportions for concrete of that class unless modifications are necessary and are approved in advance.

701.2.12.2 Structural Concrete Table

1 Unless otherwise noted or directed, make certain that the properties of the various classes of concrete incorporated into the work conform to the following Structural Concrete Table. Compressive strength is based on ASTM C 39.

Structural Concrete Table					
Aggregate Type	**Minimum Cement Content (lbs./CY)**	**Other Cementitious Material (lbs./CY)**	**Min. 28 Day Mix Design (psi)**	**Percent Fine to Coarse Aggregate Ratio**	**Max. Water to Cementitious Material Ratio**
Class 2500 (Non Structural)					
Crushed stone	494	--	2500	36:64	0.54
Gravel	494	--	2500	35:65	0.52
Marine Limestone	494	--	2500	40:60	0.56

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Structural Concrete Table					
Aggregate Type	Minimum Cement Content (lbs./CY)	Other Cementitious Material (lbs./CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cementitious Material Ratio
Class 3000					
Crushed stone	588	--	3000	35:65	0.46
Gravel	588	--	3000	34:66	0.44
Marine Limestone	588	--	3000	39:61	0.47
Class 4000					
Crushed stone	611	--	4000	35:65	0.40
Gravel	611	--	4000	34:66	0.40
Class 4000S					
Crushed stone	682	--	4000	38:62	0.45
Gravel	682	--	4000	38:62	0.45
Class 4000DS (See Notes 2 & 4)					
Crushed stone	625	--	4000	40:60	0.44
Gravel	625	--	4000	39:61	0.43
Class 4000P (See Note 5)					
Crushed stone	682	--	4000	34:66	0.43
Gravel	682	--	4000	33:67	0.38
Class 5000					
Crushed stone	705	--	5000	35:65	0.46
Gravel	705	--	5000	34:66	0.42

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Structural Concrete Table					
Aggregate Type	**Minimum Cement Content (lbs./CY)**	**Other Cementitious Material (lbs./CY)**	**Min. 28 Day Mix Design (psi)**	**Percent Fine to Coarse Aggregate Ratio**	**Max. Water to Cementitious Material Ratio**
Class 6000					
Crushed stone	750	--	6000	34:66	0.44
Gravel	750	--	6000	33:67	0.39
Class 6500 (See Notes 1 & 3)					
Crushed stone	500	CF35, FA140	4000	37:63	0.37
Gravel	500	CF35, FA140	4000	38.62	0.37
Class 7000					
Crushed stone	800	---	7000	35:65	0.37
Gravel	800	---	7000	34:66	0.37
Class 8000					
Crushed Stone	840	---	8000	34:66	0.30
Gravel	840	---	8000	34:66	0.30
Class 10000					
Crushed stone, or Gravel	800	Silica Fume: 74 & Fly Ash, Type F: 100	10000	34:66	0.25

701.2.12.3 Structural Concrete Table Notes

1 **Note 1**:

Provide a mix design that yields a 56-day minimum laboratory strength of 6500 psi. Acceptance of in-place concrete is based on a minimum strength of 4000 psi compression strength at a maximum of 28 days or 6500 psi at 56 days.

2 **Note 2**:

Use Type G or Type D admixture.

3 **Note 3**:

Use the following proportions for Class 6500 concrete mix per cubic yard:

Cement (min.)……………………………….....500 lbs.
Fly Ash……………………………………...…140 lbs.
Silica Fume…………………………………….35 lbs.
Corrosion Inhibitor…………………………..….(see **Subsection 701.2.7**)
Entrained Air (Range)…………………….….4.5 (± 1.5)%
Water-Cementitious Material Ratio (max.)…0.37
High Range Water Reducer……………..…..Required
Aggregates…………………………………….Variable

4 If a Type A or Type D admixture is used, demonstrate that the admixture is compatible, does not adversely extend normal setting time, and does not cause excessive bleeding.

5 The slump of the concrete at time of placement in the forms may be increased by the use of a High Range Water Reducer, either Type F or Type G in accordance with the requirements of **Subsection 701.2.6**.

6 If silica fume slurry is used, add it at a point that produces an acceptable mix.

7 Add a High Range Water Reducer at the job site. Limit additional mixing to the minimum specified in accordance with **Subsection 701.4.7**, but it may be increased in order to obtain the necessary air entrainment.

8 Concrete Temperature: Do not allow the temperature of Class 6500 concrete to exceed the maximum permitted in **Subsection 701.4.4.3**.

9 Mix Design Review: Submit to the OMR a proposed sequence of mixing and a proposed concrete mix design based on trial mixes by the concrete supplier. Perform the laboratory mix design with the observation and assistance from the OMR. There is no separate payment for this mix design.

10 Class 6500 Trial Mix: Before placing Class 6500 concrete in the deck, place one or more small batches of Class 6500 concrete in a part of the structure as directed by the RCE. Test air content, slump, unit weight, temperature, cylinder for 28-day compressive strength, and time of set. Repeat the trial batch procedure until all desired mix properties are achieved.

11 No payment is made for the trial batches. The Class 6500 concrete used in trial batches may be substituted for another class of concrete elsewhere in the project if it meets proper strength requirements, and in which case, it is paid for at the contract unit price of the concrete for which it is being substituted.

12 Mixing Sequence: Develop a proposed mixing sequence for review that ensures breakup and distribution of the dry densified silica fume. (Generally, the addition of part of the water, aggregates, and silica fume at mixing speed adequately disperses the silica fume. The remaining ingredients may then be added in a sequence to produce a desirable mix.)

13 Include both silica fume and fly ash as part of the cementitious material.

14 **Note 4**:

Use Class 4000DS concrete for drilled shaft construction.

15 Design the mix for drilled shaft concrete and determine the proportions of cement, fine aggregate, coarse aggregate, water, and water reducing/retarding admixture that produces a workable concrete mix meeting the following criteria:

Minimum cement per cubic yard…………..625 lbs.
Slump…………………………………………7-9 inches
Max. water/cementitious ratio……………..(see Table)
28-day minimum compressive strength…..4000 psi
Air entraining admixture…………………….not required
Nominal coarse aggregate size…………… ¾ inch
No. 67 aggregate gradation………………..as required

16 Design concrete mix using approved ingredients intended for use on the project. Test trial mix for complete conformance with the Specifications.

17 Submit the proposed mix with test results showing full compliance with the Specifications to the OMR for review.

18 A Type G High-Range Water Reducing/Retarding admixture or a Type D Water Reducer-Retarder combined with a Type F High-Range Water Reducer may be used.

19 **Note 5**:

Minimum Class 4000P concrete is preferred in non-prestressed precast items.

CONCRETE ENTRAINED AIR AND SLUMP PROPERTIES

701.2.12.3.1 Entrained Air and Slump Tests

Prior to discharge into forms, entrained air content (as determined by ASTM C231 or ASTM C173) and slump (as determined by ASTM C143) tests will be performed by the Department's representative on the first concrete truck to arrive at the site for every pour to ensure specification compliance. If the first truck arrives with material that is out of tolerance, a retest will be performed after elected steps as outlined below have been taken to correct out of tolerance loads of concrete. Subsequent trucks will be tested, corrected as outlined below, and retested upon arrival until the material meets Department specifications. Once test results show consistently acceptable results, future entrained air and slump testing will be at the discretion of the Department's representative and when making concrete test specimens for compressive strength testing.

Secure the sample for testing after one cubic yard of concrete has been discharged from the delivery vehicle. The one cubic yard can be used in the work provided that it meets Department specifications and is placed into equipment such as a concrete bucket and crane that conveys the concrete without introducing contamination or segregation. The Department will then obtain at least two cubic feet of concrete from the delivery vehicle in a sampling receptacle that conforms to the requirements of ASTM C31.

If either the entrained air content or slump testing yields a test result that is outside of the allowable range, the Department's representative will perform one retest on a different sample of the load in question. Before the retest, the contractor and/or ready mixed concrete producer may elect to take steps to bring the mix within specifications such as adding additional air entraining admixture, adding water that was held back at the plant, etc. When taking these corrective steps, ensure that all other specifications such as allowable time, required number of additional mixing revolutions, and maximum water/cementitious material ratio are in compliance with Department specifications. If the results of the retest are still outside of the allowable range, the load will be rejected and the Contractor's representative will be immediately informed of the test results. Ensure that the producer is immediately notified of the test results through a pre-established means of communication. If the results of the retest indicate passing properties then the concrete will be permitted to be used in the work.

Ensure that no additional cement is added to loads of concrete previously rejected for excessive water content or slump, with the exception of Class 2500 non-structural concrete, as indicated in **Subsection 701.4.6.**

Acceptance or rejection will be based on the results obtained from these tests. Sampling, fabrication, and curing of cylinders to be used for compressive strength testing will be performed as required per ASTM Standards and the Standard Specifications.

701.2.12.4 Non-conforming Concrete

701.2.12.4.1 Price Reduction

1 If the 28-day compressive strength or tensile strength of the concrete test cylinders falls below the expected design strengths, but is at least 90% of the design strength, a price reduction is applied on the quantity of concrete represented by the non-conforming cylinders determined from the following table. (This subsection does not apply to prestressed concrete, which due to complex design criteria is handled on a case-by-case basis.)

Cylinder Test Results:	**Price Reduction per cubic yard (Percent) X (Contract Unit Price)**	
Percentage of Minimum Strength	**With Contract Unit Price**	**Without Contract Unit Price***
98.0 - 100.0	0%	0%
95.0 - 97.9	5%	25%
90.0 - 94.9	10%	50%

* If there is no contract unit price for concrete, use (percent reduction) x (supplier's invoice unit cost).

The BCE may approve use of concrete test method **SC-T-49** to determine the accepted strength if the concrete test cylinders have been considered non- conforming.

The total amount of the price reduction will not be less than $500.00.

2 If any cylinder test result is below 90%, take cores in the presence of the BCE or RCE from the concrete in the structure that is represented by the non- conforming test cylinders in order to evaluate the strength of the concrete in place. Ensure that test cores are taken, conditioned, and tested in accordance with the requirements of **Subsection 701.2.12.4.2.2**.

701.2.12.4.2 Procedure for Testing Non-conforming Concrete

701.2.12.4.2.1 Limits of Questionable Concrete

1 The limit of questionable concrete is determined by using concrete test method **SC-T-49**. Acceptance is solely based on the compressive strength of the cores removed from the in-place concrete, unless authorized otherwise by the BCE.

701.2.12.4.2.2 Obtaining Cores

1 Have the OMR or an independent firm, accredited by AASHTO**,** remove the cores from the structure in the presence of representatives of all affected par- ties. The BCE will determine the location(s) of the test cores that best represent the concrete in question. Take three cores (3 to 4 inches in diameter), sized to match the testing equipment used, from each area of concrete that produced a test cylinder with test strength less than 90% of the required strength. Take care to avoid damaging reinforcing steel. Properly label cores before shipment. Obtain and test cores at no expense to the Department.

701.2.12.4.2.3 Conditioning and Testing Cores

1 Deliver cores to the OMR or an independent testing laboratory accredited by AASHTO.

2 Have cores tested in accordance with AASHTO T 24. Provide a written report on the laboratory test results to all affected parties.

701.2.12.4.2.4 Acceptance of Concrete

1 Acceptance of the concrete from which the cores are taken is based on the core test results. If access to the concrete is not practical for obtaining cores or the taking of cores would result in irreversible damage to the structure, the BCE may approve concrete test method **SC-T-49** to determine the strength of the concrete.

2 If the **SC-T-49** test results or the core test results are below 90%, but are equal to or greater than 85% of the design strength, obtain a design analysis based on the reduced strength from the Designer-of-Record. Based on the design analysis, the BCE will determine if the concrete can remain in place. If the concrete test results are less than 85% of the design strength, remove the concrete unless authorized otherwise in writing by the BCE.

3 If non-conforming concrete is allowed to remain in-place, a price reduction on the quantity of concrete in question is determined by the following table.

Price Reduction for Non-conforming Concrete Left In-Place		
Core Test Results: *	**Price Reduction per cubic yard (Percent) X (Contract Unit Price)**	
Percent of Minimum Strength	**With Contract Unit Price**	**Without Contract Unit Price****
98.0 -100.0	0%	0%
95.0 - 97.9	5%	25%
90.0 - 94.9	10%	50%
85.0 - 89.9	15%***	80%

* Or **SC-T-49** if approved by the BCE.

** If there is no contract unit price for concrete, use (percentage) x (supplier's invoice unit cost).

*** Use 15% of contract unit price or 80% of supplier's invoice unit cost, whichever is greater.

The total amount of the Price Reduction will not be less than $500.00.

701.2.12.5 Changes in Mix Design

1 When changes are made in the mix design, furnish the new proportioning values for batching purposes to the OMR for review.

701.3 Equipment

701.3.1 Equipment, Inspection, and Approval

1 Have all equipment specified herein inspected and approved before use.
Schedule such inspections at least annually and at other times considered necessary by the RCE.

701.3.2 Weighing Equipment

1 At all batch plants, provide equipment with a positive means of weighing ingredients in each batch of concrete.

2 Weigh individual cementitious material to not less than 99% of the required weights.

3 Ensure that the weight of individual aggregates is within ± 2% of the required weight and the total weight of aggregate is within ± 2% of the total required weight. Use beam, springless-dial, or load cell scales for weighing aggregates and cement. Make certain that scales are accurate to within 0.5% when used for cement and to within 1.0% when used for aggregate under operating conditions throughout the range of use. When beam scales are used, provide a device such as a "tell-tale" dial for indicating when the load in the weighing hopper is approaching the required weight. Use poises de- signed to lock in any position to prevent accidental change of position.

4 Provide dust tight enclosure for dial scales. Ensure that the chart is made from a durable material and has good readability.

5 Periodically have scales used in batching Portland cement concrete checked for accuracy by the Division of Weights and Measures of the State Department of Agriculture or by other qualified scale service agents. Post on the scales or in the batching room a statement certifying as to their accuracy with the date of inspection. Do not allow the interval between inspections to exceed 12 months.

6 Ensure that the cement weighing hopper is properly sealed and vented to preclude dusting during weighing operations.

701.3.3 Central Mixing Plant

1 Thoroughly mix concrete in a batch mixer of an approved size and type that ensures a uniform distribution of the materials throughout the batch. Use plants that are listed on the most recent edition of *SCDOT Qualified Product List 28.*

2 Ensure that there is adequate water storage. Make certain that the mixer is equipped with a device to accurately weigh or measure and automatic control the quantity of water used in each batch. Ensure that the device used is ac- curate, and so calibrated that under all operating conditions, it is accurate to within 1% of the quantity of water required for the batch. Furnish the Department's inspector with facilities for checking the water measuring equipment whenever deemed necessary by the RCE. Clearly mark scales or other means used to measure water to accurately show the quantity of water used. Ensure that there is no loss of water from the time it is measured until it is deposited in the mixer drum. Make certain that the water supply is automatically shutoff while the water is being discharged into the mixer. Use a mixer with an acceptable timing device capable of being locked and that does not permit the batch to be discharged until the specified mixing time has elapsed.

3 Maintain mixers in good working condition. Repair mixers when necessary to ensure that the concrete is of uniform quality. Examine mixers for change in condition due to accumulation of hard concrete or mortar and for wear of the blades. Replace the pick-up and throw-over blades when any part or section is worn 1 inch or more below the original height of the manufacturer's design. If requested by the OMR, provide a copy of the manufacturer's de- sign, showing dimensions and arrangements of blades.

4 Use mixers equipped with a separate dispenser for each type of admixture.

The dispensers may operate either automatically or manually, but regardless of which type is used, make certain that they are capable of measuring and placing exactly and consistently the desired amount of admixtures in each batch.

701.3.4 Truck Mixers

1 Make certain that all truck mixers are pre-approved by the SCDOT or NRMCA and display a valid approved inspection sticker.

2 Ensure that the manufacturer's rating plate is attached on all truck mixers and the mixing speed and agitating speed are clearly visible and legible on the plate. If the speeds are not legible or if truck mixer does not have a rating plate, provide the OMR a written document from the truck mixer manufacturer stating the mixing and agitating speeds.

3 Use truck mixers capable of combining the ingredients of the concrete within the specified number of mixing revolutions into a thoroughly mixed and uniform mass and discharging the concrete with a degree of uniformity satisfactory to the RCE.

4 Do not exceed the manufacturer's rating for the volume of mixed concrete permitted in the drum of truck mixer indicated on the capacity plate. Ensure that the National Ready Mixed Concrete Association (NRMCA) plate is accessible, clear, and legible at all times. Ensure agitators are capable of producing concrete with a degree of uniformity to the satisfaction of the RCE.

5 If the equipment does not have an attached rating plate with maximum capacities. The approved capacity as a mixer and as an agitator will be assumed from the following table.

Maximum Gross Volume of Drum (cubic feet)	Maximum Capacity (cubic yards)	
	As Mixer	As Agitator
261	6.0	7.75
306	7.0	9.25
329	7.5	9.75
352	8.0	10.50

(table continued on the next page)

(table continued from the previous page)

Maximum Gross Volume of Drum (cubic feet)	Maximum Capacity (cubic yards)	
	As Mixer	As Agitator
376	8.5	11.25
399	9.0	12.00
423	9.5	12.75
446	10.0	13.25
493	11.0	14.75
540	12.0	16.00
587	13.0	17.50
634	14.0	19.00
681	15.0	20.25

6 If the volumes are determined using the table above, provide with each truck the proper documentation to be used instead of the manufacturer's rating plate showing the maximum mixing and agitating capacity.

7 Use truck mixers equipped with a water system and measuring device. Make certain that the device permits ready access and can accurately deter- mine the quantity of water used. Use a water-measuring device that can accurately measure water in the tank to within 1.0% when the truck mixer is stationary and essentially level.

8 Ensure that truck mixers and agitators of the revolving drum type are equipped with a hatch in the periphery of the drum shell that will permit access to the inside of the drum for inspection, cleaning, and repair of the drum and blades.

9 Use truck mixers that have an electrically or mechanically actuated revolution counter that can be reset to zero. Make certain that this counter is mounted in a position such that it can be read from the ground.

10 Maintain truck mixers in good working condition. Repair when necessary to ensure that the concrete is of uniform quality. Replace blades when any part or section is worn 1 inch or more below the original design. If requested by the OMR, provide a copy of the manufacturer's design, showing dimensions and arrangements of blades.

701.4 Construction

701.4.1 Care and Storage of Concrete Aggregates

1 Handle and store concrete aggregates in a manner that prevents intermixing, segregation, and contamination by foreign materials. Handle and stockpile each aggregate component from a different source or grading separately. Clear vegetation and other extraneous matter from stockpile sites, so that they have natural ground bottoms, and ensure that they are generally smooth, firm, and well drained.

2 Do not use the bottom 1-foot of any stockpile with a natural ground bottom except under direct supervision of the RCE. If excessive segregation is likely because of the stockpiling of an aggregate, construct the stockpile in layers not to exceed 3 feet in depth.

701.4.2 Storage of Cement

1 Store bulk cement in weatherproof bins or silos that protect the cement from dampness and provide for the free flow of the cement. If the OMR authorizes the use of bagged cement, store it in weatherproof buildings or temporary store it in the open on a raised platform with ample waterproof flooring and covering.

2 At a batching plant with two or more silos in which different types of cement or cementitious materials is stored, place a sign at each fill inlet indicating the type of cement stored therein. Make the sign from a durable material with raised, indented, or cut letters a minimum of 2 inches high and ¼ inch thick or deep. Ensure that the sign clearly identifies the material that is in the silo.

3 If concrete is to be proportioned at the work site and is only for the Department's use, keep accurate records of the deliveries of cement and of its use in the work. Provide copies of these records to the RCE and OMR in such form as they may require.

701.4.3 Measuring Materials

701.4.3.1 Portland Cement

1 Measure Portland cement and other cementitious materials by weight unless otherwise specified. Weigh the cementitious materials on scales meeting the requirements of **Subsection 701.3.2** and are not used to weigh other materials. If bagged cement is authorized, measure it in bags packed by the manufacturer. From time to time, weigh full bags as a check on the net weight. Prepare batches that do not require fractional bags of cement unless all the cement for each batch is weighed.

701.4.3.2 Water

1 Measure water by volume or by weight through an approved measuring system. Use a measuring system with a metering or weighing device capable of incorporating into the batch the predetermined quantity of water with an accuracy of 1.0% of the quantity of water required for the batch. Assume water to weigh 8.33 pounds per gallon.

701.4.3.3 Fine and Coarse Aggregate

1 Measure fine and coarse aggregates separately by weight on scales meeting the requirements of **Subsection 701.3.2**. In measuring aggregates, make allowance for water in the aggregates. For determinations of the moisture content of aggregates, use automatic sensing devices if available; otherwise, take representative samples and investigate individually or combined in a composite sample.

701.4.3.4 Admixtures

1 Dispense admixtures into the batch as a solution of uniform concentration and in the amounts recommended by the manufacturer. Use properly equipped sight-tube dispensers with a graduation strip or strips that are labeled in terms of ounces or ounces per hundred pounds of cement. Identify graduated strips as to the rate at which the admixture is being measured for the particular diameter of the tube being used.

2 Calibrate meter and timing dispensers by obtaining a metered sample and checking the accuracy of the system. Have the equipment checked and approved

during the annual inspection and at other times when deemed necessary or as directed by the RCE.

3 Maintain the accuracy of all systems to within ± 3%. Discharge the admixture into the stream of water entering the mixer drum or into the pre-measured or pre-weighed water for each batch. Take precautions to prevent the dilution of the admixture in storage by rain and condensation. For actual control, measure the air content with air meters only. Add additional admixtures at any time to achieve the proper amount of entrained air.

4 When adding Types A, C, D, or E admixtures, ensure that the dispensing equipment and procedure adds the admixture after the dispensing of the air entraining agent is complete and some mixing of the concrete has occurred. When adding Types F or G admixture, do not add the admixture agent until after all of the materials are in the mixer and have been mixed for 1 minute if in a truck mixer, for 15 seconds if in a central-mix mixer, or at approximately the midpoint of the primary mixing portion of the auger mixing chamber on a mobile concrete mixer unit.

701.4.4 Concrete Batching and Mixing

701.4.4.1 General

1 When concrete is furnished by a transit or central-mix plant, use batching equipment that is sufficient to weigh a load of the required size in less than 15 minutes.

2 Make certain that an SCDOT-certified concrete field technician is present at the plant when concrete is being produced for SCDOT work. The SCDOT-certified concrete field technician may be an employee of the Contractor, the concrete supplier, or an independent testing laboratory. While concrete is being produced for SCDOT work, ensure that the SCDOT-certified concrete field technician's sole, full- time responsibility is to maintain quality control records and conduct physical testing of concrete and its constituent materials.

3 Ensure that an SCDOT-certified concrete field technician completes and signs Form 700.04 for the first load of each class of concrete delivered to the job site each day. After the completion of Form 700.04 for the first delivered load, subsequent loads of each class of concrete will require Form 700.04 or an OMR pre-approved batch ticket containing the appropriate information. A batch ticket may be pre-approved for use in SCDOT work through the Structural Materials Engineer if the batch ticket format contains at a minimum: date and time batched, load size, ticket number, aggregate moistures, amount of free water in aggregates, design target weights or measures for all materials, batched variances from targets listed as a percentage for all materials, designed water/cementitious materials ratio, batched water/cementitious materials ratio, designed batch water in gallons, actual batch water in gallons, and water in gallons held back from target value at the plant that can be added at the job site.

701.4.4.2 Batching and Mixing in Cold Weather

1 Before starting work on the project, submit a written *Cold Weather Batching and Mixing Plan* developed in conjunction with the concrete supplier and to be used when the atmospheric temperature is below 35ºF (determined by the RCE).

2 At a minimum, include in the plan the methods and equipment employed to meet the following requirements and restrictions:

- Do not batch concrete with aggregates that contain frozen particles.
- Do not heat mixing water to a temperature exceeding 170ºF at dis- charge into the mixer.
- Heat aggregates by either steam or dry heat.
- Use heating apparatus to heat the aggregates uniformly and avoid hot spots.
- Make certain that the temperature of the batched concrete is at least 50ºF when placed in the forms.

The RCE may add other requirements to the plan if deemed necessary.

3 Batch concrete only after the plan has been accepted, and the RCE has specifically authorized the batching.

701.4.4.3 Batching and Mixing in Hot Weather

1 Before starting work on the project, submit a written *Hot Weather Batching and Mixing Plan* developed in conjunction with the concrete supplier to prevent the concrete mix temperature from exceeding 90ºF measured before placement in the forms, unless specified otherwise. For Class 2500 concrete, do not allow the temperature of the concrete to exceed 95ºF. For mass concrete pours, do not allow the mix temperature to exceed 80ºF as measured at discharge into the forms. This requirement does not apply to concrete used in precast/prestressed members.

2 The plan may include the following methods and equipment to meet the mix temperature requirements:

- Use Type II cement.
- Sprinkle coarse aggregate with water to cool by evaporation.
- Use chilled mixing water or shaved ice to replace part of the mixing water.

3 Ensure that the plan conforms to the applicable requirements of ACI 305R, *Hot Weather Concreting*.

701.4.4.4 Central Plant Mixing

1 Thoroughly mix concrete in a central mixer of an approved plant. Ensure that the period of mixing after all materials including water are in the drum exceeds 1½ minutes. During the mixing period, operate the drum at speeds specified by the mixer manufacturer and shown on the nameplate on the ma- chine.

2 Mix concrete only in quantities required for immediate use. Transport the mixed concrete to the work site in a truck mixer operating at agitating speed.

701.4.4.5 Truck Mixing

1 After all materials, including water, have been placed in a truck mixer, rotate drum for not less than 70 revolutions at the mixing speed designated by the truck mixer manufacturer and shown on the rating plate. Mix concrete at the batching plant or at the job site. After mixing or while in transit between the plant and the work site, rotate the drum at agitating speed of 2 to 6 rpm or at the speed designated for agitation by the manufacturer.

701.4.4.6 Wash Water Stabilizers

1 Ready mix concrete producers may use mixer drum wash water stabilizer agents in truck and central mix drums. Use products that appear on the most recent edition of *SCDOT Qualified Product List 32*. Make certain that the stabilizing agents are used in accordance with the most recent edition of SCDOT *Qualified Product Policy 32*.

2 The RCE or the OMR may disallow the use of mixer drum wash water stabilizers if the Department's policy is not strictly adhered to or technical problems are encountered because of using a stabilizer.

701.4.4.7 Mobile Concrete Mixing Plants

1 Use a truck mounted mobile Portland cement concrete plant designed for automatic volume proportioning of the concrete materials and for mixing the concrete for immediate use at the work site for incidental construction and only when authorized by the OMR. If authorized, ensure that the plant pro- vides a satisfactory rate of production and is capable of combining the concrete ingredients into a thoroughly mixed and uniform mass and of discharging the concrete without segregation.

701.4.5 Consistency

1 Provide compatible pozzolans and/or admixtures as necessary to obtain the appropriate workability and consistency at no additional cost to the Department. Provide the RCE and the OMR with written documentation from the concrete supplier stating that all products in the concrete mix are compatible.

701.4.6 Slump

1 Except for Class 2500 concrete and unless otherwise specified, provide concrete that has a maximum slump of 4 inches when measured in accordance with ASTM C 143. In any case, do not exceed the water to cementitious material ratio for the appropriate class of concrete shown in the Structural Concrete Table in **Subsection 701.2.12.2**.

2 For pumped concrete, the slump is measured at the truck.

3 In the event additional water is required to obtain the specified slump at the work site, the RCE may approve adding water from an acceptable water sup- ply at the rate of 1 gallon per cubic yard per inch of desired slump, but not to exceed the maximum water to cementitious material ratio shown in the table in **Subsection 701.2.12.2**. When additional water is added, make certain that the truck mixer drum turns a minimum of 25 revolutions at mixing speed be- fore discharge of the concrete.

4 For Class 2500 concrete with an initial slump between 4 to 6 inches, additional cement may be added at the work site at the rate of 20 pounds of cement per cubic yard of concrete per inch of slump over 4 inches to attempt to bring the slump down to the maximum of 4 inches. Batches of Class 2500 concrete with slumps greater than 4 inches after the allowable addition of cement will not be accepted for Department use, unless otherwise permitted by these specifications or the Special Provisions.

701.4.7 Water Reducers

1 A water reducer may be used to increase the slump of concrete. A Mid- Range Water Reducer (MRWR) may be used to increase the slump to a maximum of 6 inches. A High-Range Water Reducer (HRWR) may be used to increase the slump to a maximum of 9 inches.

In any case, do not allow the slump to exceed the maximum slump for the following items:

- Maximum 6" slump for concrete in bridge decks.
- Maximum 9" slump for seal concrete and in drilled shaft concrete.
- Maximum 9" slump for prestressed concrete.

2 Use MRWR or HRWR admixtures listed on the most recent edition of *SCDOT Qualified Product List 5*. Provide to the RCE for prior approval the admixture manufacturer's product data sheet that clearly states the product is intended for use as a MRWR or a HRWR. Use MRWR and HRWR admixtures strictly in accordance with the manufacturer's recommendations and the limitations specified in this subsection.

3 Type F or Type G admixtures may be added to concrete to increase workability and/or to reduce the water to cementitious material ratio. Type F is a HRWR, and Type G is a High Range Water Reducer-Retarder. If these admixtures are used, add them at the work site just before discharge, and mix concrete for a minimum of 30 seconds per cubic yard of concrete in the mixer after each addition of an admixture. Measure the slump of the concrete before the addition of the high-range admixture, and make certain not to exceed the maximum slump limits indicated above. Discontinue or avoid the use of admixtures when there is any indication of excessive flow, bleeding, or segregation. The admixture may be added a second or third time to re-establish mixture flow if the maximum time for placing the concrete after the mix water is added has not expired.

701.4.8 Water Reducer-Retarders

1 A water reducer-retarder admixture may be added to concrete mixes to reduce the water content and shrinkage in the concrete, improve its workability, retard the initial set of the concrete, and/or reduce the rate of internal heat development in concrete pours without sacrificing quality or strength.

2 Use a water reducer-retarder, Type D or Type G complying with **Subsection 701.2.6** in concrete deposited underwater, and also in concrete that is not likely to reach its final position in the forms before initial set takes place. Ensure that proportioning and dispensing of the admixture is in accordance with **Subsection 701.2.6**.

701.4.9 Fly Ash and Water-Granulated Blast-Furnace Slag

1 The addition of fly ash or water granulated blast-furnace slag is allowed in the concrete mix if the following requirements are met when using these materials:

A. Fly ash or water-granulated blast-furnace slag may replace allowable percentages of Type I, Type II, or Type III Portland cement. Do not use fly ash or slag replacement for mixes using Type I (SM) or any other blended cement.

B. Remove forms in accordance with **Subsection 702.4.5**.

C. When fly ash is used to replace the Portland cement, replace at a ratio of not less than 1.2:1 by weight, and do not replace more than 20% of the cement originally called for in the mixture.

D. When water-granulated blast-furnace slag is used to replace Port- land cement, replace at a ratio of 1:1 by weight, and do not replace more than 50% of the cement originally called for in the mixture.

E. Submit a mix design to the OMR for review a minimum of 7 calendar days in advance of batching. Indicate in the submittal the amount of cement to be removed, the material that will replace it, and compressive strength results of the mix.

F. After batching begins and as concrete is delivered to the work site, make certain that the concrete contains the specified entrained air content at the time it is discharged from the transit mixer. Do not use concrete with non-conforming air content.

G. To ensure accurate batching, provide separate storage bins, conveying devices, weighing equipment, and weighing procedures for each material (fly ash or slag) used.

H. Provide fly ash from sources that appear on the most recent edition of *SCDOT Qualified Product List 3*. Furnish certified mill test reports and shipping tickets from the supplier for each shipment.

I. Provide slag from sources that appear on the most recent edition of *SCDOT Qualified Product List 6*.

701.5 Measurement

1 The quantity for the pay item Concrete for Structures - Class (as specified) is the volume of specified concrete within the neat lines of the structure as shown on the Plans or as revised by the RCE (excluding precast/prestressed members, bridge barrier parapet, bridge barrier parapet transitions, and drilled shaft concrete) and is measured by the cubic yard (CY) of concrete, complete, and accepted. Deductions are made for the volume of embedded items, except for reinforcing steel; however, no deduction is made for edge chamfers of ¾ inch or smaller.

2 Measurement for the quantity of concrete in bridge slabs is computed from the neat line dimensions shown on the Plans with no allowance for form de- flection. No additional payment is made for extra concrete required by the use of permanent steel bridge deck forms or for the SIP forms themselves.

3 The costs for concrete used in precast/prestressed members, bridge barrier parapet, bridge barrier parapet transitions, and drilled shafts, including the cost of designing the mix, testing, engaging the testing laboratory, and furnishing materials for testing is included in the contract unit bid price for the applicable pay item.

701.6 Payment

1 Payment for the accepted quantity of Concrete for Structures - Class (as specified), measured in conformance with **Subsection 701.5**, is determined using the contract unit bid price for each pay item. Payment is full compensation for furnishing and placing the Class of concrete as specified or directed and includes costs of the mix design, sampling, and testing; furnishing, storing, batching, mixing, and transporting concrete materials; admixtures; false- work and forms (including SIP forms); surface finishing and curing; quality control personnel and equipment; and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.

2 Concrete is paid for at 100% of the contract unit bid price upon completion of the Initial Surface Finish.

3 Unless otherwise specified, payment for concrete includes the cost of pipe drains, French drains, weep holes, expansion joints, expansion joint materials, flashing, pipes, conduits, anchors, and other similar material. Payment for concrete also includes the cost of removing and disposing of portions of existing structures designated on the Plans to be widened or reconstructed and the costs of drilling for dowels or expansion bolts.

4 Payment for the item Concrete for Structures includes all direct and indirect costs and expenses required to complete the work.

5 Pay items under this section include the following:

Item No.	Pay Item	Unit
7011100	Concrete for Structures – Class 3000 (Roadway)	CY
7011105	Concrete for Structures – Class 3000 (Retaining Wall)	CY
7011200	Concrete for Structures – Class 3000 (Bridge)	CY
7011300	Concrete for Structures – Class 2500	CY
7011400	Concrete for Structures – Class 4000	CY
7011400	Concrete for Structures – Class 4000	CY
7011401	Concrete for Structures – Class 4000 (Retaining Wall)	CY
7011402	Concrete for Structures – Class 4000 (Culvert)	CY
7011403	Concrete for Structures – Class 4000 (Roadway)	CY
7011500	Concrete for Structures – Class 4000S	CY
7011501	Concrete for Structures – Class 4000P	CY
7011510	Concrete for Structures – Class 4000DS For Drilled Shafts	CY
7011600	Concrete for Structures – Class 5000	CY
7011630	Concrete for Structures – Class 6500	CY
7011640	Concrete for Structures – Class 7000	CY

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Gradation of Coarse Aggregates

Percentage by Weight Passing Sieves Having Square Openings

Sieve Designation	Aggregate No.									
	CR-14	**5**	**56**	**57**	**67**	**6M**	**8M**	**78**	**789**	**89M**
2-inch	100	--	--	--	--	--	--	--	--	--
1½-inch	95 - 100	100	100	100	--	--	--	--	--	--
1-inch	70 - 100	90 - 100	90 - 100	95 - 100	100	100	--	--	--	--
¾-inch	--	20 - 55	40 - 85	--	90 - 100	90 - 100	100	100	100	--
½-inch	35 - 65	0 - 10	10 - 40	25 - 60	--	--	95 - 100	90 - 100	95 - 100	100
⅜-inch	--	0 - 5	0 - 15	--	20 - 55	0 - 20	75 - 100	40 - 75	80 - 100	98 - 100
No. 4	10 - 40	--	0 - 5	0 - 10	0 - 10	0 - 5	10 - 35	5 - 25	20 - 50	20 - 70
No. 8	--	--	--	0 - 5	0 - 5	--	--	--	--	2 - 20
No. 16	--	--	--	--	--	--	0 - 5	0 - 5	0 - 6	--
No. 100	--	--	--	--	--	--	0 - 2	--	0 - 2	0 - 3

Gradation of Fine Aggregates				
Percentage by Weight Passing Sieves Having Square Openings				
Sieve Designation	**Aggregate No.**			
	FA-10	**FA-10M**	**FA-12**	**FA-13**
½-inch	--	--	--	--
⅜-inch	100	100	100	100
No. 4	96 - 100	95 - 100	90 - 100	90 -100
No. 8	75 - 100	84 - 100	--	--
No. 16	55 - 98	45 - 95	50 - 86	40 - 80
No. 30	25 - 75	25 - 75	--	--
No. 50	5 - 30	8 - 35	2 - 20	0 - 10
No. 100	0 - 9	0.5 - 20	0 - 5	0 - 3
No. 200	0 - 3	0 – 10*	--	--

* Dust of fracture essentially free from clay or shale, final job site testing only.

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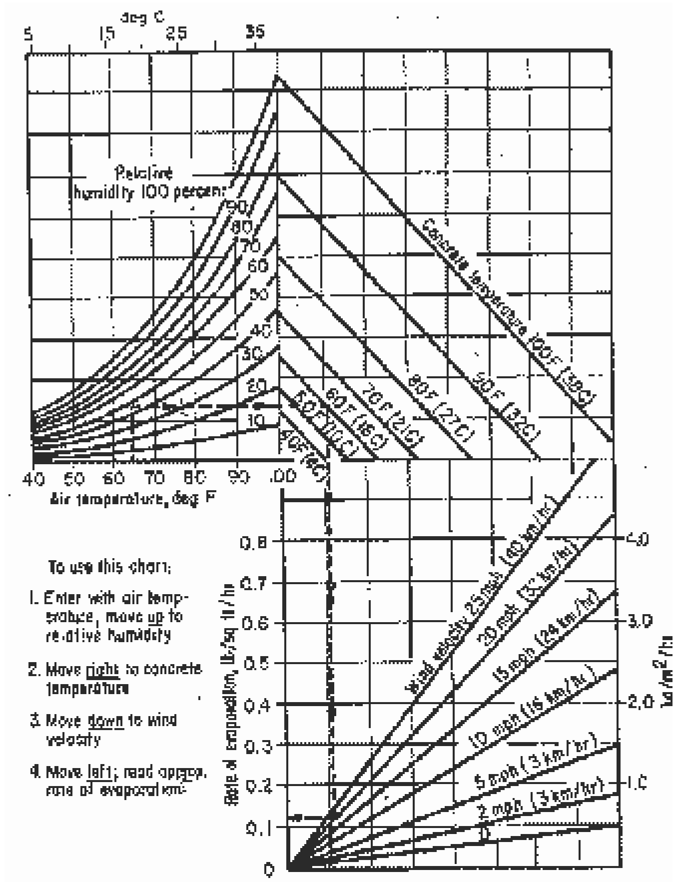

Nomograph for Determining Rate of Evaporation

This chart provides a graphic method of estimating the loss of surface moisture due to concrete and air temperatures, relative humidity, and wind velocity. To use the chart, follow the four steps outlined. If the rate of evaporation approaches 0.2 lbs. /ft.^{2}/hr., precautions against plastic shrinkage cracking are necessary.

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Chapter 5

Supplemental Specifications, Department Memos, and Changes

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Supplemental Technical Specification for **April 8, 2008**

Surface Smoothness of Bridge Decks and Approach Slabs

SCDOT Designation: SC-M-701 (04/08)

1. SCOPE

1.1. This standard describes the smoothness requirements for bridge decks. The riding surfaces subject to this standard include all traffic lanes, all full-width acceleration and deceleration lanes, and lanes planned for future use on both bridge decks and approach slabs.

2. REFERENCED DOCUMENTS

2.1. **SC-T-124,** Operation of the Cox Model C8200 Electronic Profilograph for Surface Measurement

3. DEFINITIONS

3.1. *Profile Index* – Inches per Mile of total roughness in excess of the blanking band.

3.2. *Blanking Band* – A band of uniform height with its longitudinal center positioned optimally between the highs and lows of the surface record depicting at least 100 feet of pavement.

4. PREPARATION OF THE TESTING SURFACE

4.1. Provide a surface clean of all debris such as sand and aggregate and make the site accessible to SCDOT's Office of Materials and Research (OMR) personnel performing the test prior to their arrival. Remove any materials stored or blocking the areas to be tested.

5. REQUEST FOR TESTING

5.1. When needed, schedule smoothness testing through the Resident Construction Engineer (RCE), who will then make arrangements with the Pavement Evaluation Unit within OMR. If OMR personnel arrive at the scheduled testing time and find the site is not suitably prepared for testing as given in Subsection 4, above, correct the deficiency within 60 minutes. After 60 minutes, the testing must be rescheduled and the Contractor will reimburse the Department in the amount of $500 for the additional site visit.

6. TESTING

6.1. The Pavement Evaluation Unit of OMR will determine a Profile Index for each wheelpath for nominal 300-foot test sections. Partial sections will be analyzed and reported as given in **SC-T-124**. Sections that contain individual bumps in excess of the maximum values given herein will also be noted. The RCE and the Contractor will receive copies of the profile chart and test results.

7. REQUIREMENTS FOR SMOOTHNESS

7.1. The maximum allowable Profile Index value for acceptable smoothness for any individual wheelpath is 10 inches per mile utilizing the 0.2-inch blanking band for each 300-foot nominal test section. All individual bumps and depressions exceeding a cutoff height of 0.3 inches from a chord of 25 feet must be corrected regardless of Profile Index. In addition to these requirements for longitudinal smoothness, the surface will have deviations no greater than 0.25 inches in 10 feet when measured using a 10-foot straightedge placed transversely across any lane.

8. CORRECTIVE ACTION

8.1. When any measured surfaces fail to meet the criteria given in Subsection 7, above, take corrective action at no expense to the Department. Submit a written plan of corrective action to the RCE and receive approval from the RCE prior to taking any corrective action. However, approval of any corrective plan in no way relieves any responsibility for meeting these smoothness requirements. Any corrective plan that reduces the concrete cover by more than 0.50 inches from that shown in the Plans is not acceptable.

8.2. After corrective action, the surface will be retested by the Department to determine if the rideability requirements have been met. If the surface is tested and reported more than three times, including the initial rideability test, the Contractor shall reimburse the Department for each additional test in the amount of $500.

9. GROOVED SURFACE FINISH

9.1. When a grooved surface finish is required, do not apply it until all requirements for rideability have been met.

April 5, 2010

CONCRETE BATCHING AND MIXING

Delete subsection 701.4.4.1 Concrete Batching and Mixing – General, of the Standard Specifications in its entirety and replace it with the following:

701.4.4 Concrete Batching and Mixing

701.4.4.1 General

1 When concrete is furnished by a transit or central-mix plant, use batching equipment that is sufficient to weigh a load of the required size in less than 15 minutes.

2 Make certain that an SCDOT-certified concrete field technician is present at the plant when concrete is being produced for SCDOT work. The SCDOT-certified concrete field technician may be an employee of the Contractor, the concrete supplier, or an independent testing laboratory. While concrete is being produced for SCDOT work, ensure that the SCDOT-certified concrete field technician's sole, full-time responsibility is to maintain quality control records and conduct physical testing of concrete and its constituent materials.

3 Ensure that an SCDOT-certified concrete field technician completes and signs *Form 700.04* for the first load of each class of concrete delivered to the job site each day. After the completion of *Form 700.04* for the first delivered load, subsequent loads of each class of concrete will require *Form 700.04* or an OMR pre-approved batch ticket containing the appropriate information. A batch ticket may be pre-approved for use in SCDOT work through the Structural Materials Engineer if the batch ticket format contains at a minimum: date and time batched, load size, ticket number, aggregate moistures, amount of free water in aggregates, design target weights or measures for all materials, actual batch weights or measures for all materials, batched variances from targets listed as a percentage for all materials, designed water/cementitious materials ratio, batched water/cementitious materials ratios, designed batch water in gallons, actual batch water in gallons, and water in gallons held back from target value at the plant that can be added at the job site.

4 Except for Class 2500 concrete, prestressed concrete, and precast concrete, the Department will not accept concrete unless a completed *Form 700.04* or preapproved batch ticket that is signed and certified by the SCDOT-certified concrete technician, accompanies the delivery of the concrete. If a pre-approved batch ticket is being used and conditions warrant that the use of a batch ticket is unacceptable to the RCE, the SCDOT-certified concrete technician will discontinue using the batch ticket for acceptance and return to the use of *Form 700.04* until such time that the deficiencies of the batch ticket have been resolved and accepted by the RCE.

5 Provide sufficient advance notification to the RCE as to the name of the plant supplying the concrete in order to permit time to make the necessary arrangements for inspection of equipment at the plant.

Concrete Structures –
Preformed Joint Filler

Delete Subsection 702.2.2.1 of the Standard Specifications in its entirety and replace it with the following:

702.2.2.1 Preformed Joint Filler

Use preformed joint material that meets AASHTO M 153 or AASHTO M 213 with the following exceptions:

1. Use only materials manufactured from rubber.
2. Use materials that require a load of not less than 340 kPa or greater than 5200 kPa to compress to 50% of its thickness when tested in accordance with AASHTO T 42.
3. Use materials that have a recovery of at least 70% when tested in accordance with AASHTO T 42.

Use preformed joint material that is listed on QPL 81.

Provide a manufacturer's certification that states that the material conforms to SCDOT specifications.

May 5, 2014

PORTLAND CEMENT AND PORTLAND CEMENT CONCRETE

Subsection 701.2.1.1 Materials – Portland Cement - General, of the 2007 Standard Specifications is amended to add the use of Type IL Portland-limestone cement in addition to the materials given.

Add the following to Subsection 701.2.1.1 Materials – Portland Cement- General:

> Type IL Portland-limestone cement may be used instead of Type I and Type II cement. If used, furnish Type IL cement conforming to the requirements of AASHTO M 240 and obtain from sources listed on the most recent edition of SCDOT Qualified Products 86. Provide an intimate and uniform blend of Portland cement and limestone. In any case, make certain that the limestone constituent is less than 15% of the total weight of the Portland-limestone cement.

Delete Subsection 701.4.9 – Construction – Fly Ash and Water-Granulated Blast-Furnace Slag - Items A and C of the 2007 Standard Specifications in their entirety and replace with the following:

A. Fly ash or water-granulated blast furnace slag may replace allowable percentages of Type I, Type II, or Type III Portland cement or Type IL Portland-limestone cement. Do not use fly ash or slag replacement for mixes using Type I (SM) or Type IP blended cements.

C. When fly ash is used to replace the Portland and Type IL Portland-limestone cement, replace at a ratio of not less than 1.2:1 by weight, and do not replace more than 20% of the cement originally called for in the mixture.

Class 5000 Structural Concrete

Subsection 701.2.12.2 Materials – Concrete Mix Design – Structural Concrete Table, of the 2007 Standard Specifications is amended to add Note 6 below to the Class 5000 Concrete shown in the Structural Concrete Table.

Note 6:

The maximum water to cementitious material ratio for Class 5000 concrete regardless of coarse aggregate type is 0.40 when air entrainment is required per 2007 Standard Specification Subsection 701.2.5 – Air Entrained Concrete.

February 1, 2015

CONCRETE ENTRAINED AIR AND SLUMP PROPERTIES

Insert the following into the Standard Specifications:

701.2.12.3.1 Entrained Air and Slump Tests

Prior to discharge into forms, entrained air content (as determined by ASTM C231 or ASTM C173) and slump (as determined by ASTM C143) tests will be performed by the Department's representative on the first concrete truck to arrive at the site for every pour to ensure specification compliance. If the first truck arrives with material that is out of tolerance, a retest will be performed after elected steps as outlined below have been taken to correct out of tolerance loads of concrete. Subsequent trucks will be tested, corrected as outlined below, and retested upon arrival until the material meets Department specifications. Once test results show consistently acceptable results, future entrained air and slump testing will be at the discretion of the Department's representative and when making concrete test specimens for compressive strength testing.

Secure the sample for testing after one cubic yard of concrete has been discharged from the delivery vehicle. The one cubic yard can be used in the work provided that it meets Department specifications and is placed into equipment such as a concrete bucket and crane that conveys the concrete without introducing contamination or segregation. The Department will then obtain at least two cubic feet of concrete from the delivery vehicle in a sampling receptacle that conforms to the requirements of ASTM C31.

If either the entrained air content or slump testing yields a test result that is outside of the allowable range, the Department's representative will perform one retest on a different sample of the load in question. Before the retest, the contractor and/or ready mixed concrete producer may elect to take steps to bring the mix within specifications such as adding additional air entraining admixture, adding water that was held back at the plant, etc. When taking these corrective steps, ensure that all other specifications such as allowable time, required number of additional mixing revolutions, and maximum water/cementitious material ratio are in compliance with Department specifications. If the results of the retest are still outside of the allowable range, the load will be rejected and the Contractor's representative will be immediately informed of the test results. Ensure that the producer is immediately notified of the test results through a pre-established means of communication. If the results of the retest indicate passing properties then the concrete will be permitted to be used in the work.

Ensure that no additional cement is added to loads of concrete previously rejected for excessive water content or slump, with the exception of Class 2500 non-structural concrete, as indicated in **Subsection 701.4.6**.

Acceptance or rejection will be based on the results obtained from these tests. Sampling, fabrication, and curing of cylinders to be used for compressive strength testing will be performed as required per ASTM Standards and the Standard Specifications.

SECTION 703
REINFORCING STEEL

Delete Subsections 703.2.4 and 703.2.5 in their entirety and replace them with the following:

703.2.4 Mechanical Couplers for Reinforcing Steel

703.2.4.1 General

Use mechanical coupler components that are compatible with the reinforcing bars specified in **Section 703** and manufacture all splices with the mechanical couplers as specified and detailed on the Plans. In selecting a coupler, consider the clearance requirements for correct installation and proper alignment of the reinforcing after installation. Use mechanical couplers from a manufacturer listed on the most recent edition of SCDOT Qualified Product List (QPL 73).

703.2.4.2 Quality Control Manager

Designate in writing, to the RCE, a Quality Control Manager (QCM) for all mechanical couplers. The QCM is responsible for the quality of the mechanical coupler splicing, including the inspection of materials and workmanship and for submitting correspondence, required submittals, and reports to the RCE. The QCM may be an employee of the Contractor.

703.2.4.3 Materials

703.2.4.3.1 General

A lot of mechanical couplers is defined as 150, or fraction thereof, of the same type of mechanical couplers used for each bar size and each bar deformation pattern that is used in the work. For ultimate mechanical couplers, the length of the coupler must be less than 10 times the nominal bar diameter. Use service couplers only in locations indicated on the design drawings. Ensure that mechanical couplers meet the following specifications:

a. Cyclic and Fatigue tests when required (current version of Caltrans Test 670).
b. Tensile test (ASTM A 370) - For ultimate mechanical couplers, a minimum tensile strength of 80 ksi or 125% of the actual yield strength of the reinforcing bar, whichever is greater. For service couplers, at least 125% of the specified minimum yield strength of the reinforcing bar.
c. Slip test - according to the table listed in Section 52-6.02B of Caltrans Standard Specification.

703.2.4.3.2 Manufacturer's Certification

Provide to the RCE a certified statement from the manufacturer of each type of mechanical coupler used that includes the following information:

- a description of the device, including dimensions, designations, and material specifications
- a description of the method of packaging and identification
- a statement that the product meets **Section 703** of SCDOT specifications
- detailed installation instructions

703.2.4.4 Manufacturer's Quality Control Testing Facility and Reports

703.2.4.4.1 General

Ensure that all manufacturer quality control testing is performed in a laboratory that has been reviewed and accepted by the Structural Materials Engineer (SME) or has been accredited by AASHTO for all applicable tests. Ensure that the qualified laboratory used to perform the manufacturer's quality control testing of all splices meets and complies with the requirements of **Subsections 703.2.4.4.2** through **703.2.4.4.4**.

703.2.4.4.2 Facilities

Ensure that the qualified laboratory has a tensile testing machine capable of breaking the largest bar requiring testing in accordance with ASTM A 370 and applicable equipment needed for Caltrans Test 670.

703.2.4.4.3 Operators

Ensure that the machine operators have received formal training and are certified to perform the testing in conformance with ASTM A 370 and Caltrans Test 670.

703.2.4.4.4 Calibration

Ensure that the qualified laboratory has a record of annual calibration of testing equipment as outlined in AASHTO R-18, performed by an independent third party that has standards that are traceable to the National Institute of Standards and Technology (NIST) and has a formal reporting procedure, including published test reports.

703.2.4.4.5 Test Reports

Ensure that the following information is included in all test reports:

- Sampling procedures used,
- Test specimen preparation procedures if applicable,
- Test procedures used,
- Results of the tests listed in **Subsection 703.2.4.3.1**

703.2.4.5 Quality Control (QC) Test Requirements

For each lot of each bar size to be used, test two pre-job sample splices in conformance with these specifications and the requirements of ASTM A 370 in tension to ensure conformity with the requirements of Subsection 703.2.4.3.1. Upon completion of testing of each lot, provide the RCE with a written statement from the QCM stating that all couplers in this lot conform to the specifications.

703.2.4.6 Quality Assurance (QA) Sample Requirements

For each lot (as defined in **Subsection 703.2.4.3.1**) of each splice size, two complete samples of mechanical couplers with reinforcing bars of the same heat numbers that are being used in the work will be randomly obtained at the project site by the RCE and submitted to the OMR for testing. Ensure that samples of complete reinforcing bars with coupler splice meet the requirements of **Subsection 703.2.5.4.2**. In the event one sample fails, submit two check samples of couplers from the same lot for testing.

703.2.4.7 Handling and Storage

Protect exposed threaded bars on staged work by installing the threaded coupler on the in-place bar and capping the open end of the coupler per the manufacturer's instructions. Immediately before installation, check the threads and ease of rotation of any threaded parts of couplers to detect contamination that could cause binding. Regardless of the method of mechanical coupling used, prevent damage to or contamination of the reinforcing or coupling devices that will inhibit or negatively affect the certified behavior of the device. If in the opinion of the RCE, such damage or contamination exists, replace the reinforcing, couplers, or both, or remove the contamination to the satisfaction of the RCE at no additional time or cost to the Department.

703.2.5 Ultimate Butt-Welded Splices (UBWS)

703.2.5.1 Material

Use UBWS containing steel that conforms to the requirements of **Subsection 703.2.**

703.2.5.2 Manufacturer's Quality Control Testing Facility

Ensure that all manufacturer quality control testing is performed in a laboratory that has been reviewed and accepted by the SME representative or has been accredited by AASHTO for all applicable tests. Ensure that the qualified laboratory used to perform the manufacturer's quality control testing of all splices meets and complies with the requirements of **Subsections 703.2.4.4.2** through **703.2.4.4.4**.

703.2.5.3 Fabricator Pre-job Test Requirements

Before incorporation into the work, ensure that Ultimate Butt Welded Splices are fabricated in conformance with the following pre-job test requirements:

A. Notify the SME at least 14 calendar days before beginning production for the project so that a source visit can be arranged. The SME will make random visits to the fabricator during production.

B. Obtain 4 pre-job sample splices for each bar size for UBWS that will be used in the work.

C. Fabricate the sample splices using the same splice materials, position, operators, location, and equipment, and following the same procedures that will be used to make the splices in the work.

D. Perform all fabricator pre-job testing in a laboratory that has been reviewed and accepted by the SME and meets the requirements of **Subsection 703.2.5.2**.

E. Ensure that all UBWS from each pre-job test conform to the test criteria specified herein. Obtain a pre-job test report prepared by the laboratory performing the tests. Have the quality control manager, who represents the laboratory and accepts the responsibility for the report's contents, sign the report. Ensure that the report contains, as a minimum, the following information for each sample:

a. SCDOT Contract Number,
b. SC Project ID,
c. Bar size,
d. Type of splice,
e. Physical condition of test sample splice,
f. Any notable defects,
g. Limits of heat affected zone,
h. Location of visible necking area,
i. Ultimate strength of each splice.

F. Submit the pre-job test report to the SME for review and the RCE for acceptance.

703.2.5.4 Quality Assurance (QA) Test Requirements

703.2.5.4.1 General

A UBWS lot is defined as a shipment of the same type of UBWS used for each bar size and each heat number that is used in the work. Two test samples will be randomly selected by the RCE at the project site for each size and shipment of material for the work and submitted to the OMR for testing.

703.2.5.4.2 Test Sample Requirements

Each sample must meet the following requirements:

- A minimum of 30 inches in length with the splice located at mid-point,
- Accompanied by a Certified Mill Test Report for that bar's heat number, and
- Suitably identified before shipment with weatherproof markings.

Ensure that all sample test results are satisfactory before encasing any splices in concrete. If any splices are encased before receiving notification from the RCE, it is expressly understood that any material not conforming to these specifications will be subject to rejection, and the replacement of removed material will be at no expense to the Department and is not grounds for an extension of contract time.

703.2.5.4.3 Test Criteria

The Office of Materials and Research will test the tensile strength of the sample splice in conformance with the requirements of ASTM A 370 to ensure that the UBWS achieves at least 100 percent of the specified ultimate tensile strength of the reinforcing bar. Visible necking of the bar at rupture must occur outside of the heat affected zone which is defined as the region of the parent metal which has not been melted during welding and is typically measured to be one bar diameter from either side of the center of the weld. Brittle failure at points where leads have been connected will be cause of rejection.

In the event that one or both of the samples fail, submit two check samples from the same lot for testing by OMR. Any material not conforming to the requirements herein will be subject to rejection. If the sample splice fails to conform to these provisions, all splices in the lot represented by the QA tests will be rejected.

Do not mix or combine the lots of UBWS being tested before the successful completion of the QA tests.

703.2.5.4.4 Corrective Action

Whenever a lot of UBWS is rejected, fulfill the following requirements before using additional UBWS in the work:

A. Perform a complete review of the producer's quality control process for these splices.
B. Submit a written report to the SME describing the cause of failure for the splices in this lot and provisions for correcting the failure in future lots.
C. Ensure that the SME has provided the RCE notification that the report is acceptable. The SME will have at least 10 calendar days to review the report and notify the RCE of the report's status. The RCE will have at least 5 calendar days after notification to determine the course of action for the project.

If a QA test for any lot fails, replace all reinforcing bars representing failing sample splices before the RCE selects additional splices from the replacement for further testing.

When sampled bars are repaired with a pre-qualified Ultimate Mechanical Coupler as described in **Subsection 703.2.4,** QA tests are not required on the repaired splices.

Add the following sentence to ***Subsection 703.4.3****:*

Do not tack weld reinforcing bars.

APPROVED: JUNE 4, 2018
Division Administrator
By:
FEDERAL HIGHWAY ADMINISTRATION

SUPPLEMENTAL SPECIFICATION

July 1, 2018

Concrete Placement in Cold and Hot Weather

Delete Subsection 702.4.2.8.1 and 702.4.2.8.2 in their entirety and replace with the following:

702.4.2.8.1 Concreting in Cold Weather

Do not place concrete when the air temperature measured at the location of the concreting operation is below 35°F as determined by the RCE unless authorized by the RCE.

When concreting in cold weather above 35°F or with RCE authorization below 35°F, make available and implement measures utilizing suitable equipment and materials as necessary to protect the uncured concrete when air temperatures are anticipated to drop below 50°F at any time within 96 hours following concrete placement. Implemented measures shall maintain the air temperature surrounding the concrete between 50°F and 100°F. Place Hi-Lo thermometers on the concrete surface at locations directed by the RCE. Monitor concrete temperatures for a period of 4 days after the concrete is placed. Additional monitoring locations may be added by the contractor if deemed appropriate to ensure concrete protection.

Prior to placing concrete in cold weather, have a contingency plan and provisions in place to quickly and adequately address sudden temperature changes below those forecasted during the curing period. Check concrete temperatures before leaving for the day to determine if additional protection measures are needed when overnight temperatures are forecasted to drop below 35°F.

Implemented measures to protect concrete placed during cold weather may include but are not limited to the following:

A. Curing blankets conforming to the requirements found in Subsection 702.3.4. If used, curing blankets are to remain in place for a minimum of 4 days.

B. Heating equipment such as stoves, salamanders, or steam equipment deemed necessary to protect the concrete. Dry heat may be used provided a system to maintain adequate moisture is used to maintain the concrete in a wet condition during the curing period.

C. Windbreaks or heated enclosures.

Before placing concrete, remove all ice and frost from all materials and surfaces in contact with the concrete.

Do not implement alternate measures to those listed above without prior approval by the RCE.

Recommendations provided in ACI 306R, Guide to Cold Weather Concreting may be used to meet the requirements of this subsection with RCE approval.

The contractor retains the responsibility for maintaining the temperature of the air surrounding the curing concrete within specified limits and for placing concrete that meets the requirements of the plan, specifications, and special provisions.

702.4.2.8.2 Concreting in Hot Weather

When concreting in hot weather, the contractor is required to implement measures to prevent a reduction in concrete workability, losses from cement hydration, evaporation, drying, or elevated concrete temperatures. Implement measures to maintain the temperature of concrete below 90°F when measured at the point of discharge from the delivery unit, with the exceptions of Class 2500 concrete and mass concrete pours. Cool steel forms and reinforcing steel exceeding 120°F prior to concrete placement.

Implemented measures to protect concrete placed during hot weather may include but are not limited to the following:

A. Scheduling work so that the concrete can be placed with the least possible delay.

B. Scheduling work so that the concrete can be placed during a cooler part of the day.

C. Reducing loss of water through absorption by pre-wetting the sub-grade or forms just prior to concrete placement so that they will not absorb water from mix.

D. Spraying forms and reinforcing steel with cool fresh water just before placement of concrete.

E. Erecting windbreakers to prevent wind from drying exposed concrete surfaces while they are being finished.

F. Using water-curing methods to provide evaporative cooling.

G. Screed and float concrete as it is placed, and start curing procedures immediately.

H. Applying liquid curing compound in accordance with Subsection 702.2.2.11 to all exposed surfaces as finishing is completed.

Do not allow the concrete temperature for Class 2500 concrete to exceed 95°F at discharge. Do not allow mass concrete mix temperature measured at discharge into the forms to exceed 80°F.

Do not implement alternate measures to those listed above without prior approval by the RCE.

Recommendations provided in ACI 305R, Guide to Hot Weather Concreting may be used to meet the requirements of this subsection with RCE approval.

The contractor retains the responsibility for placing concrete that meets the requirements of the plan, specifications, and special provisions.

APPROVED: JUNE 4, 2018
Division Administrator
By: [signature]
FEDERAL HIGHWAY ADMINISTRATION

July 1, 2018

Concrete Batching and Mixing in Cold and Hot Weather

Delete Subsections 701.4.4.2 and 701.4.4.3 in their entirety and replace them with the following:

701.4.4.2 Batching and Mixing in Cold Weather

When batching and mixing concrete at atmospheric temperatures below 50ºF as determined by the RCE, ensure measures are implemented to provide batched concrete with a temperature of at least 50ºF when placed in the forms. Batch and mix concrete at atmospheric temperatures below 35ºF only when permitted by the RCE. Implemented measures may include but are not limited to the following:

A. Replacing a portion of the design mix water with heated water not exceeding 170ºF at discharge into the mixer.

B. Heating aggregates by steam, dry heat, or placing in heated mixing water. Any aggregate heating method or apparatus used shall heat the aggregates uniformly without creating hot spots.

Aggregates that contain ice, frost, or frozen particles shall not be used in the concrete mix. When either aggregates or water are heated above 100ºF, combine aggregate and a portion of the water prior to adding cement to avoid flash set. Cement may be added with water or with a mixture of water and aggregate having a temperature less than 100ºF.

Do not implement alternate measures to those listed above without prior approval by the RCE.

Recommendations provided in ACI 306R, Guide to Cold Weather Concreting maybe used to meet the requirements of this subsection with RCE approval.

The contractor retains the responsibility for producing concrete that meets the requirements of the plans, specifications, and special provisions.

701.4.4.3 Batching and Mixing in Hot Weather

When batching and mixing concrete in hot weather, ensure measures are implemented to prevent the concrete mix temperature from exceeding 90ºF measured before placement in the forms, unless specified otherwise. For Class 2500, do not allow the concrete mix temperature to exceed 95ºF. For mass concrete pours, do not allow the concrete mix temperature to exceed 80ºF as measured at discharge into the forms. This requirement does not apply to concrete used in precast/prestressed members.

Implemented measures to meet mix temperature requirements may include but are not limited to the following:

A. Using Type II cement.
B. Sprinkling coarse aggregate with water to cool by evaporation.
C. Using chilled mixing water or cubed/crushed ice to replace part of the mixing water. If using ice, ensure the ice melts before batch is discharged from mixing unit.
D. Scheduling pours during cooler portions of the day.

Do not implement alternate measures to those listed above without prior approval by the RCE.

Recommendations provided in ACI 305R, Guide to Hot Weather Concreting may be used to meet the requirements of this subsection with RCE approval.

The contractor retains the responsibility for producing concrete that meets the requirements of the plans, specifications, and special provisions.

Concrete Structures –
Preformed Joint Filler

Delete Subsection 702.2.2.1 of the Standard Specifications in its entirety and replace it with the following:

702.2.2.1 Preformed Joint Filler

Use either sponge rubber (Type I) or polyurethane-bonded recycled rubber (Type IV) preformed joint material that meets AASHTO M 153 specifications or Semi-Rigid, Closed-Cell Polypropylene Foam that meets ASTM D 8139 specifications. Other materials such as Polyvinyl Chloride (PVC) may be used, provided it meets recovery, compression and extrusion requirements as listed in either AASHTO M 153 or ASTM D 8139. Do not use non-extruding and resilient bituminous (AASHTO M 213) types of preformed joint filler.

Use only approved preformed joint material that is listed on QPL 81.

Provide a manufacturer's certification to the RCE that states that the material conforms to SCDOT specifications.

APPROVED: NOVEMBER 9, 2018
Division Administrator
By:
FEDERAL HIGHWAY ADMINISTRATION

July 1, 2019

APPROVED:
Division Administrator

By: ______________________
FEDERAL HIGHWAY ADMINISTRATION

Fine and Coarse Aggregate for Portland Cement Concrete

Delete Subsection **701.2.9.1** of the Standard Specifications in its entirety and replace it with the following:

701.2.9.1 General

Submit the fine aggregate in the concrete mix design for approval to the OMR. Use natural sand, manufactured sand, or a combination of natural and manufactured sand meeting the requirements of **Subsection 701.2.9.1** through **701.2.9.8**. Use marine limestone fine aggregate only if the water soluble chloride content of the aggregate, when tested in accordance with ASTM C 1218, is less than 200 ppm.

Delete Subsection **701.2.10.1** of the Standard Specifications in its entirety and replace it with the following:

701.2.10.1 General

Use coarse aggregate that is clean, tough, durable crushed gravel or crushed stone. Make sure that it is free from soft, thin, elongated, or laminated pieces and sufficiently washed during production to produce a clean aggregate free from lumps or coatings of clay, disintegrated particles, vegetation, or deleterious substances. Adherent coatings are considered injurious. Do not use coarse aggregate with a Los Angeles Abrasion loss exceeding 60% as determined by AASHTO T 96. Use coarse aggregate that has a weighted loss not exceeding 15% when subjected to five alternations of the sodium sulfate soundness test determined by AASHTO T 104. Use coarse aggregate for Portland cement concrete conforming to the requirements in **Subsection 701.2.10.1** through **701.2.10.4**.

Use marine limestone coarse aggregate in reinforced concrete only if the water soluble chloride content of the aggregate, when tested in accordance with ASTM C 1218, is less than 200 ppm. For non-reinforced concrete applications, use marine limestone coarse aggregate that has a weighted loss not exceeding 25% when subjected to five alternations of the sodium sulfate soundness test conducted according to AASHTO T 104. When a marine limestone aggregate is used, use a sprinkler system to produce a saturated aggregate during concrete batching.

Delete Section **701.4.4.7 Mobile Concrete Mixing Plants** and replace it with the following:

701.4.4.7 Volumetric Concrete Mixers

Provide volumetric mixers with rating plates indicating that the performance of the mixer is in accordance with the Volumetric Mixer Manufacturer Bureau (VMMB). Ensure that mixers comply with ASTM C685. Unless otherwise specified, ensure that all mixing operations are in strict accordance with the manufacturer's recommended procedures. Provide such procedures to the RCE for review upon request.

Ensure that the concrete mixing truck is an auger-type continuous mixer used in conjunction with volumetric proportioning. Ensure that the mixer produces concrete, uniform in color and appearance, with homogeneous distribution of the material throughout the mixture. Establish the mixing time necessary to produce uniform concrete and comply with other requirements of these specifications. Only acceptable equipment capable of producing uniform results will be permitted.

Continuous volumetric concrete mixers may be used, with the approval of the RCE and State Materials Engineer, for non-structural concrete. Ensure that mix designs meet the requirements of Section 701.2.12.2 and all materials used meet the requirements of Section 701. Ensure that continuous volumetric concrete mixers are capable of combining aggregate, cement and/or fly ash, water and admixtures, into a uniform mixture within the specified mixing period. Ensure that all materials used are listed on the appropriate QPL (for example, fine aggregates, coarse aggregates, cement, fly ash, and admixtures).

Ensure that continuous volumetric concrete mixers meet the following additional requirements:

- A capacity to carry (in separate compartments for each ingredient) enough of each individual ingredient to produce a minimum of 6 cubic yards of concrete,
- A recording meter capable of measuring the cement as it is introduced into the mixture,
- An adjustable flow control valve capable of controlling the flow of water and admixture as they are introduced into the mixture,
- A water flow meter capable of indicating to the nearest 0.10 gallons, the quantity of gallons used,
- The capability of being calibrated to automatically proportion and blend all components of the concrete mixture on a continuous or intermittent basis, as required,
- Equipped with an onboard ticketing system that will electronically produce a record of all material used and their respective weights and total volume of concrete placed. Ensure that tickets also identify the following information at a minimum:
    - Contractor Name
    - SCDOT Project ID
    - Date
    - Truck No.

- Ticket No.
- Time start/end of pour
- Mix ID and description
- Aggregate moisture before mixing

Calibrate the continuous volumetric concrete mixer according to the manufacturer's recommendations. Provide the RCE with the means to verify the calibration of the continuous volumetric concrete mixer.

The RCE will allow operation of the continuous volumetric concrete mixer provided the concrete produced is within the limits of the specifications.

Tolerances in proportioning the various ingredients are as follows:

Cement, fly ash, mass %	0 to +4
Fine aggregate, mass %	±2
Coarse aggregate, mass %	±2
Admixtures, mass or volume %	±3
Water, mass or volume %	±1

Perform the calibration process of each volumetric mixer at least once every 12 months or any time materials change.

Upon written request, the use of volumetric mixers may be allowed on small quantities of structural concrete on case by case basis upon approval by the RCE (or RME as applicable), DOC office and State Materials Engineer.

SCDOT
South Carolina
Department of Transportation

MEMORANDUM

TO: District Engineering Administrators
District Construction Engineers

FROM: Robert E. Isgett III, P.E. Director of Construction

DATE: April 20, 2020

RE: Temporary Revision to 2007 Standard Specification for Highway Construction, Section 701.4.4.1, Paragraph 2 – "Contactless" Weigh Ticket Protocol for COVID 19

In response to CDC guidelines related to COVID-19 and to ensure the safety of SCDOT, contractor, and consultant personnel, a "Contactless" Weigh Ticket Protocol has been created. This protocol is to be implemented immediately for all **Concrete Mixer Deliveries**. This temporary revision to Section 701.4.4.1 of the Standard Specifications will remain in effect until further notice.

Contactless Weigh Ticket Protocol

1. SCDOT will provide email for RCE (or designee) to the Contractor to then provide to the Concrete Producer.

2. Concrete Producer will provide truck driver with a copy of the batch ticket AND an *unsigned* copy of the 700.04 form (Class 3000 and above) to deliver on-site. Truck driver will securely post the batch ticket and 700.04 form at a location where both are fully visible to the inspector and contractor, while maintaining Social Distancing.
   a. The batch ticket and 700.04 form will remain onsite. The inspector will not take possession of this paperwork. The contractor will dispose of these documents as job site trash once the inspector has gathered the needed information from it.

3. **For Class 3000 and above:** Inspector will gather information from the *unsigned* 700.04 form to populate the highlighted columns of the "700.04 Summary Log" (provided with this guidance). The remainder of the information on the 700.04 Summary Log will be completed on site following testing and placement of the concrete.
   a. Proper care should be taken by Concrete Producers to ensure the accuracy of Plant Water Held on the 700.04 to ensure that Water / Cement Ratios will not be exceeded.

4. SCDOT Inspectors will sanitize their hands before AND after touching the water hose on the back of the concrete truck. Other disposable PPE may be used in place of sanitizer.

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5. No later than 12:00 p.m. the next business day, the Concrete Producer will email, in PDF format (one form or ticket per page): 1) copies of all batch tickets and 2) copies of all *signed* 700.04 forms (if applicable).
    a. The 700.04 Summary Log will be signed by the inspector and placed in the project file with the signed 700.04 forms from the Concrete Producer. The 700.04 Summary Log attached to the 700.04 forms (as received) will become the complete document and no additional notes on the 700.04 are required.

If you have any questions regarding this temporary revision, please contact Clay Richter at (803) 315-5330.

REI:cwr
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Merritt Vann, Quality Program Manager
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FEDERAL HIGHWAY ADMINISTRATION

July 1, 2020

REINFORCING STEEL

The 2007 SCDOT Standard Specifications is amended as follows:

Delete every occurrence of "ASTM A 706" and replace with "AASHTO M 31, Type W."

Delete Subsection 703.2.1 in its entirety and replace it with the following:

703.2.1 Reinforcing Bars

Provide reinforcing bars (rebar) and dowels that meet the requirement of AASHTO M 31, Type W with a minimum single yield strength level of 60,000 psi, designated as Grade 60 and are from a source listed on the most recent edition of SCDOT Qualified Product List 60.

Each shipment of rebar delivered to the project must be accompanied by the manufacturer's mill test report for each heat included in the delivery. The mill test report must include the following:

a. Producer information
b. Heat number and size of rebar represented by the report
c. The grade for which the steel qualifies
d. Tensile test results including yield strength, tensile strength and elongation
e. Statement ensuring that the steel was melted and manufactured in the United States

703.2.1.1 Quality Assurance (QA) Sample Requirements

Acceptance or rejection of all reinforcing steel, with the exception of those described in **Subsection 703.2.1.3**, is based on samples taken in the field by the SCDOT inspector or observed being taken in field by the SCDOT inspector and tested in conformance with the requirements of AASHTO T 244 by the OMR or an OMR authorized AASHTO accredited testing laboratory. Each sample must include one complete set of the bar's mill markings and must be accompanied by the sample heat's mill test report.

Once a rebar sample is obtained, the sample must remain in the custody of the SCDOT inspector until delivery to the OMR or OMR authorized AASHTO accredited testing laboratory. Samples delivered to the OMR by the contractor will not be accepted.

Any samples failing to meet the requirements of **Subsection 703.2.1** require two check samples of the same heat and rebar size. If either of the check samples fails, the heat represented is not to be used in the work and a sample must be taken from every size of every shipment of rebar produced by the same rebar producer for the remainder of the project.

703.2.1.2 Coiled Rebar

With the exception of Ultimate Butt-Welded Splices and bars included in **Subsection 703.2.1.3**, all rebar shipped in a coiled state from the producer listed on the most recent edition of SCDOT

Qualified Product List 60 must be sampled after mechanical straightening as used in the project. These samples must meet all specifications of AASHTO M 31, Type W as shipped to the project.

703.2.1.3 Reinforcing Bars Exempt from Acceptance Sampling and Testing

With the exception of Ultimate Butt-Welded Splices, reinforcing bars bent prior to shipment to the project that have no straight lengths 5-ft or longer will be accepted based upon a manufacturer's certified mill test report from a rebar producer listed on the most recent edition of Qualified Products List 60.

Delete Subsection 703.2.2 in its entirety and replace it with the following:

703.2.2 Wire and Wire Fabric

703.2.2.1 General

Provide wire and welded wire fabric for concrete reinforcement, either as such or in fabricated form conforming to the requirements of AASHTO M 336.

703.2.2.2 Wire (Non-welded) for Concrete Reinforcement

703.2.2.2.1 Quality Assurance (QA) Sample Requirements

Acceptance or rejection of wire (non-welded) for concrete reinforcement is based on samples taken in the field by the SCDOT inspector or observed being taken in field by the SCDOT inspector and tested in conformance with the requirements of AASHTO T 244 by the OMR or an OMR authorized AASHTO accredited testing laboratory. Each sample must be accompanied by the manufacturer's representative material certification and test report.

Once a wire sample is obtained, the sample must remain in the custody of the SCDOT inspector until delivery to the OMR or OMR authorized AASHTO accredited testing laboratory. Samples delivered to the OMR by the contractor will not be accepted.

Any samples failing to meet the requirements of **Subsection 703.2.1** require two check samples of the same shipment, producer and size. If either of the check samples fails, that size of wire from that producer from that shipment is rejected and not to be used in the work.

703.2.2.3 Welded Wire Fabric for Concrete Reinforcement

703.2.2.3.1 General

Any welded wire fabric provided for use on SCDOT projects must be produced by a manufacturer included on the most recent edition of QPL 85.

703.2.2.3.2 Acceptance Requirements

Acceptance of welded wire fabric for concrete reinforcement will be based upon the manufacturer's material certification and test report. The material certification and test report should indicate if the wires are deformed and the sizes of the wires in both directions. It should also contain the manufacturer's test results demonstrating that the welded wire meets the requirements of AASHTO M 336 and the strength requirements shown in the plans. The report must also indicate that the steel was melted and manufactured in America.

Delete Subsections 703.2.4 and 703.2.5 in their entirety and replace them with the following:

703.2.4 Mechanical Couplers for Reinforcing Steel

703.2.4.1 General

Use mechanical coupler components that are compatible with the reinforcing bars specified in **Section 703** and manufacture all splices with the mechanical couplers as specified and detailed on the Plans. In selecting a coupler, consider the clearance requirements for correct installation and proper alignment of the reinforcing after installation. Use mechanical couplers listed on the most recent edition of SCDOT Qualified Product List 73 for the category of coupler required.

703.2.4.2 Materials

703.2.4.2.1 General

A LOT of mechanical couplers is defined as 150, or fraction thereof, of the same type of mechanical coupler used for each bar size and each bar deformation pattern that is used in the work. For ultimate mechanical couplers, the length of the coupler must be less than 10 times the nominal bar diameter. Use service couplers only in locations indicated on the design drawings. Ensure that mechanical couplers meet the following specifications when tested with AASHTO M 31, Type W rebar:

a. Cyclic and Fatigue tests (current version of Caltrans Test 670)
b. Tensile test (AASHTO T 244) – For ultimate mechanical couplers, a minimum tensile strength of 80 ksi, or 125% of the actual yield strength of the reinforcing bar, whichever is greater. For service couplers, at least 125% of the specified minimum yield strength of the reinforcing bar.
c. Slip test – according to the table listed in Section 52-6.02B of the 2015 edition of Caltrans Standard Specifications.

703.2.4.2.2 Manufacturer's Certification

Provide to the RCE a certified statement from the manufacturer of each type of mechanical coupler used that includes the following information:

a. A description of the device, including dimensions, designations, material specifications, and the specific model name.
b. A description of the method of packaging and identification
c. A statement that the product meets the requirements of **Section 703** of SCDOT specifications
d. Detailed installation instructions

703.2.4.3 Quality Assurance (QA) Sample Requirements

Acceptance or rejection of mechanical couplers will be based upon random samples assembled by the contractor using reinforcing bars of the same heat numbers used in the work. Sample assemblies will be obtained at the project site by the RCE prior to being incorporated into the work and submitted to the OMR or OMR authorized AASHTO accredited testing laboratory for testing. If the sample fails, two check samples of coupler assemblies using couplers from the same LOT for testing are required.

If one or both of the check samples fail, the LOT of couplers is rejected and should not be used in the work.

When the lot of failing couplers is tapered and threaded bar type couplers, both the couplers and corresponding tapered and threaded rebar are rejected. If it is demonstrated to the satisfaction of the RCE that the tapering and threading on the rebar is correct, the rebar may be used with another lot of couplers, provided that a passing sample coupler assembly is obtained using the new lot of couplers. Alternatively, if it can be demonstrated to the satisfaction of the RCE that the rebar tapering and threading is incorrect and the couplers themselves are acceptable, the couplers may be used with another shipment of rebar, provided that a passing sample coupler assembly is obtained using the new shipment of tapered and threaded rebar.

Once a coupler assembly sample is obtained, the sample must remain in the custody of the SCDOT inspector until delivery to the OMR or OMR authorized AASHTO accredited testing laboratory. Samples delivered to the OMR by the contractor will not be accepted.

703.2.4.3.1 Test Criteria

The OMR will test the tensile strength of sample coupler assemblies in conformance with the requirements of AASHTO T 244 to ensure that the splice achieves an ultimate strength of at least:

a. 75,000 psi for service splices
b. 80,000 psi for ultimate splices

703.2.4.4 Handling and Storage

Protect exposed threaded bars on staged work by installing the threaded coupler on the in-place bar and capping the open end of the coupler per the manufacturer’s instructions. Immediately before installation, check the threads and ease of rotation of any threaded parts of couplers to detect contamination that could cause binding. Regardless of the method of mechanical coupling used, prevent damage to or contamination of the reinforcing or coupling devices that will inhibit or negatively affect the certified behavior of the device. If in the opinion of the RCE, such damage or contamination exists, replace the reinforcing, couplers, or both, or remove the contamination to the satisfaction of the RCE at no additional time or cost to the Department.

703.2.5 Ultimate Butt-Welded Splices (UBWS)

703.2.5.1 Material

Use UBWS containing steel that conforms to the requirements of **Subsection 703.2.1.** Use only UBWS produced utilizing a resistance (flash) welding process by a fabricator listed on Qualified Product List 103 for the hoop diameter and bar size required.

703.2.5.2 Quality Assurance (QA) Test Requirements

703.2.5.2.1 General

A UBWS LOT is defined as a shipment of the same type of UBWS used for each bar size and each heat number that is used in the work. Acceptance or rejection will be based upon sample welded splices used in the work randomly selected by the RCE at the project site and submitted to the OMR or an OMR authorized AASHTO accredited laboratory for testing.

Once a UBWS sample is obtained, the sample must remain in the custody of the SCDOT inspector until delivery to the OMR or OMR authorized AASHTO accredited testing laboratory. Samples delivered to the OMR by the contractor will not be accepted.

Ensure that all sample test results are satisfactory before encasing any splices in concrete. If any splices are encased before receiving notification from the RCE, it is expressly understood that any material not conforming to these specifications will be subject to rejection, and the replacement of removed material shall be done at no additional time or cost to the Department.

703.2.5.2.2 Test Criteria

The OMR will test the tensile strength of the sample splice in conformance with the requirements of AASHTO T 244 to ensure that the UBWS achieves at least 100 percent of the specified ultimate tensile strength of the reinforcing bar.

If a sample fails, two check samples from the same LOT for testing by OMR are required. Any material not conforming to the requirements herein will be subject to rejection. If the sample splice fails to conform to these provisions, all splices in the LOT represented by the QA tests will be rejected.

Do not mix or combine the LOTS of UBWS being tested before the successful completion of the QA tests.

703.2.5.2.3 Corrective Action

Whenever a LOT of UBWS is rejected, fulfill the following requirements before using additional UBWS in the work:

a. Perform a complete review of the producer’s quality control process for these splices.
b. Submit a written report to the SCDOT Structural Materials Engineer describing the cause of failure for the splices in this LOT and provisions for correcting the failure in future LOTS.
c. Ensure that the Structural Materials Engineer has provided the RCE notification that the report is acceptable. The Structural Materials Engineer will have 15 business days to review the report and notify the RCE of the report’s status. The RCE will have 10 business days after notification to determine the course of action for the project.

If a QA test for any LOT fails, replace all reinforcing bars representing failing sample splices before the RCE selects additional splices from the replacement for further testing.

When sampled bars are repaired with a pre-qualified Ultimate Mechanical Coupler as described in **Subsection 703.2.4,** QA tests are not required on the repaired splices.

Delete **Subsection 703.4.3; Paragraph 2** and replace it with the following:

(2) Hold the reinforcement together by tie wire at all intersections except where the spacing is 12 inches or less in each direction, in which case tie alternate intersections. Hold bars projecting beyond a construction joint in place by templates during concreting to ensure proper position. Do not tack weld reinforcing bars.

APPROVED:
Division Administrator

By: ____________________________
FEDERAL HIGHWAY ADMINISTRATION

January 1, 2021

Concrete Mix Design

Subsection 701.2.12 of the SCDOT Standard Specifications is amended as follows:

Delete **Subsection 701.2.12.1** and replace with the following:

701.2.12.1 General

1 Design the concrete mix and determine the proportions of cementitious material, fine aggregate, coarse aggregate, and admixtures (when used) that produce a workable concrete mix. Meet the criteria for the typical classes of concrete shown in the Structural Concrete Table in **Subsection 701.2.12.2**. Consider the amount of air-entrainment that is incidentally afforded by the use of water-reducing or water-reducing/retarding admixtures. Determine the proportions of ingredients in accordance with requirements for the particular type of work and with consideration of the specific gravities of the materials to provide the desired workability and consistency.

2 At its own expense, the Contractor may retain an independent testing laboratory accredited by the AASHTO Accreditation Program to design the mix for the class of concrete specified, or use a mix design previously reviewed and used by the Department.

3 Submit all mix designs to the OMR for review a minimum of 12 business days prior to use in SCDOT projects. Submit the mixes on the appropriate OMR form approved by the SME. After successful review by the OMR, provide a copy of the mix design showing OMR's stamp to the RCE before supplying that mix to the project.

4 Once a mix has been reviewed by the OMR, that mix is valid for a period of three years provided that the mix ingredients or proportions are not changed. The mix may be supplied to any SCDOT project requiring that class of concrete during that period.

5 For the water-cementitious material ratio, use the ratio of water to cementitious materials by weight. When a mix design is reviewed by the OMR using a water-cementitious ratio lower than the maximum allowed in the Structural Concrete Table in **Subsection 701.2.12.2**, the lower water-cementitious ratio as reviewed by the OMR becomes the maximum allowable for that mix.

6 Design the concrete mix using Department qualified ingredients intended for use in the project and make any trial batches using such materials. Test trial mixes for complete conformance with the Specifications by the approved laboratory engaged by the Contractor.

7 Base mix designs on the air entrainment specifications in **Subsection 701.2.5**.

8 Base total water content of the mix on the weight of cement, fly ash, and silica fume multiplied by the water-cementitious ratio. Do not include the absorbed water in the aggregate as mix water.

9 Base mix designs on specific gravities and saturated surface dry moisture contents of coarse aggregate obtained from a source on the most recent edition of *SCDOT Qualified Product List 2* and fine aggregate obtained from a source on the most recent edition of *SCDOT Qualified Product List 1*. Include the SCDOT Number as shown on *SCDOT Qualified Product Lists 1 and 2* for all aggregate sources on the mix design form.

10 Base the Percent Fine to Coarse Aggregate Ratio on volume. Values of this ratio shown in the Structural Concrete Table in **Subsection 701.2.12.2** are general guidelines for the classes of concrete shown. Vary this ratio to obtain the desired workability.

11 No separate payment is made for the cost of the laboratory engaged by the Contractor, the materials furnished and used for trial batches, the preparation and testing of trial batches either by the Contractor or its laboratory, or furnishing the OMR with the mix data, the results of the cylinder tests, and yield to be tested. These costs are considered incidental to the work of the applicable item. Include the cost in the unit prices for the applicable pay items in the Contract.

12 After successful review of a mix design by the OMR, do not change the mix proportions or the sources of the individual mix ingredients with the exception of the fly ash source. Fly ash sources can be changed if needed due to supply issues (except for mass concrete mixes), provided that the alternate source is listed in *SCDOT Qualified Product List 3* and meets any other specification requirements. If modifications are necessary (other than the fly ash source), submit a new mix design for review by the OMR.

January 1, 2021

APPROVED:
Division Administrator

By: ______________________________
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Section 702 Falsework/Forming Systems

Delete and replace Subsection 702.4.1.2 Design of the Standard Specifications in its entirety and replace with the following:

702.4.1.2 Design

1 Design falsework/form systems to handle all vertical and horizontal loading that may be placed upon it and with sufficient redundancy to prevent failure of the system because of the failure of any individual element. Include the sum of all anticipated vertical dead and live loads and real and assumed horizontal loads. Include the weight of the concrete, reinforcing steel and other encased items, equipment, personnel, forms, and falsework. For the weight of concrete, do not use less than 150 pounds per cubic foot for normal concrete and not less than 120 pounds per cubic foot for lightweight concrete.

2 For live loads, use the actual weight of any equipment and personnel to be supported by falsework applied as concentrated loads at the points of contact plus a uniform load of not less than 20 pounds per square foot applied over the area supported, plus 75 pounds per linear foot applied at the outside edge of deck overhangs.

3 For horizontal loads, use actual horizontal loads due to equipment and personnel, construction sequence, or other causes, plus an assumed horizontal wind load of not less than 50 pounds per square foot of horizontal surface area or 2% of the total dead and live load, whichever is greater.

4 Erect falsework with sufficient camber and/or adjustment to compensate for deflection and settlement under the weight of concrete so that the completed structure or part thereof has the alignment and curvature shown in the Plans. When footing type foundations are used for falsework support, determine the bearing value of the soil and show the values assumed in the design on the Working Drawings. Consider the effects of differential settlement. Limit settlement and support of falsework to 1 inch or less.

5 When falsework is to be placed adjacent to public roads, consider the effects of vibrations from passing vehicles and include provisions for protection of the falsework from errant vehicles.

6 If falsework from one bridge is to be used on another bridge, determine new loading conditions and verify the adequacy of the falsework system. Incorporate into the design any adjustments or changes necessary.

7 When the project Plans require the use of cofferdams and/or shoring systems for construction of bridge substructures or other elements of work, the Contractor is required to retain the services of an engineer(s) licensed pursuant to the laws of South Carolina who has (have) a minimum of 3 years of experience in the design of cofferdams and/or shoring systems. The Contractor is responsible for all structural and geotechnical design of the cofferdam or shoring system. Design all cofferdams or shoring systems using LRFD methods and in accordance with the following documents:

A. AASHTO Guide Design Specifications for Bridge Temporary Works, latest version with all interims
B. AASHTO Construction Handbook for Bridge Temporary Works, latest version with all interims

C. AASHTO LRFD Bridge Construction Specifications, latest version with all interims
D. AASHTO LRFD Bridge Design Specifications, latest version with all interims
E. SCDOT Geotechnical Design Manual (GDM), latest version including all Geotechnical Design Bulletin (GDBs).

8 The load (γ) and resistance (φ) factors for temporary structures [service life (S_L) less than 5 years (S_L < 5 years)] contained in the SCDOT GDM shall be used in the design of the cofferdam or shoring system. Do not use Extreme Event I (EE I) in the design of cofferdams or temporary shoring systems, unless the cofferdam or permanent shoring system will be in use for 5 years or more. Prior to designing any cofferdam or permanent shoring system to be in service for 5 years or more, coordinate and discuss with the Regional Production Engineer, why the cofferdam or permanent shoring system must be in service 5 years or more.

9 Design all cofferdams or shoring systems to resist all dead and live loadings including earth pressures, hydrostatic pressures, traffic loads, point loads, line loads, and surcharge loads that the cofferdam or shoring system may experience during the life of the structure (include on working drawings).

10 The Contractor is solely responsible for the external and internal stability of all cofferdams or shoring systems. Use the soils information provided in the plans for these designs. If additional cofferdams or shoring systems are required by the Contractor's means and methods, the Contractor is solely responsible for obtaining the required geotechnical information. The Contractor's geotechnical exploration shall meet the requirements of the SCDOT GDM (latest version). All cofferdams or shoring systems are considered to be Earth Retaining Structures (ERSs).

11 Submit the results of the geotechnical investigation; all design calculations, including soil design parameters used; methods of construction; details of components that will not be removed; and detailed drawings for design cases to RCE.

12 When permanent embankments are to be constructed against the temporary shoring system, submit a method to prevent reflective cracking of the pavement structure at the top of the embankment that may occur at the interface between the two construction phases. This may be accomplished by constructing a load transfer platform beneath the pavement structure or approach slab that crosses over the two construction phases. Backfill any voids created by removal of the cofferdam or temporary shoring system.

13 Provide all submittals in accordance with **Section 725**. Only submittals that have the seal and signature of the Contractor's Design (Structural and/or Geotechnical) Engineer-of-Record, who is licensed pursuant to the Laws of South Carolina, are acceptable.

APPROVED:
Division Administrator
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FEDERAL HIGHWAY ADMINISTRATION

July 1, 2021

Fine and Coarse Aggregate for Portland Cement Concrete and Prestressed Concrete

Delete **Subsection 701.2.9.1** of the Standard Specifications in its entirety and replace it with the following:

Section 701.2.9.1 General

Submit the fine aggregate in the concrete mix design for approval to the OMR. Use natural sand, manufactured sand, or a combination of natural and manufactured sand meeting the requirements of **Subsection 701.2.9.1** through **701.2.9.8**. Use marine limestone aggregate only if the water soluble chloride content of the aggregate, when tested in accordance with ASTM C1524, is below 200 ppm. Marine limestone coarse and fine aggregate can be used together only if their combined water soluble chloride content, when tested in accordance with ASTM C1524, is less than 200 ppm.

Delete **Subsection 701.2.10.1** of the Standard Specifications in its entirety and replace it with the following:

Section 701.2.10.1 General

Use coarse aggregate that is clean, tough, durable crushed gravel or crushed stone. Make sure that it is free from soft, thin, elongated, or laminated pieces and sufficiently washed during production to produce a clean aggregate free from lumps or coatings of clay, disintegrated particles, vegetation, or deleterious substances. Adherent coatings are considered injurious. Do not use coarse aggregate with a Los Angeles Abrasion loss exceeding 60% as determined by AASHTO T 96. Use coarse aggregate that has a weighted loss not exceeding 15% when subjected to five alternations of the sodium sulfate soundness test determined by AASHTO T 104. Use coarse aggregate for Portland cement concrete conforming to the requirements in **Subsection 701.2.10.1** through **701.2.10.4**.

Use marine limestone coarse aggregate in reinforced concrete only if the water soluble chloride content of the aggregate, when tested in accordance with ASTM C1524, is below 200 ppm. Marine limestone coarse and fine aggregate can be used together only if their combined water soluble chloride content, when tested in accordance with ASTM C1524, is less than 200 ppm. For non-reinforced concrete applications, use marine limestone coarse aggregate that has a weighted loss not exceeding 25% when subjected to five alternations of the sodium sulfate soundness test conducted in accordance with AASHTO T 104. When a marine limestone aggregate is used, use a sprinkler system to produce a saturated aggregate during concrete batching.

Delete **Subsection 704.2.1 (A)** of the Standard Specifications in its entirety and replace it with the following:

Section 704.2.1 (A)

Use marine limestone coarse aggregate and/or fine aggregate in prestressed concrete only if the total water soluble content of the combined coarse and fine aggregate, when tested in accordance with ASTM C1524, is below 100 ppm.

APPROVED:
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FEDERAL HIGHWAY ADMINISTRATION

July 1, 2021

General

Delete Section 702.4.16 entirely and replace with the following:

702.4.16 Grooved Surface Finish

1 After the new bridge deck concrete has cured and all applicable rideability specifications have been satisfied, cut grooves into the hardened concrete deck in conformance with this section. Groove the new bridge deck prior to opening the bridge to traffic. Groove any areas of bridge decks constructed in stages prior to opening the bridge to temporary or permanent traffic.

2 Cut the grooves into the hardened concrete using a mechanical sawing device that leaves grooves that are 0.125 inch wide and 0.125 inch deep. Provide grooves with a center-to-center spacing that vary randomly from 0.625 inch to 1.125 inches. Do not groove across expansion or contraction joints.

3 Skew angles discussed in this section are as measured from perpendicular to the centerline of the bridge. Groove the hardened surface of the bridge deck to the extents and in the directions as follows:

a. On bridges with skew angles less than or equal to 20 degrees, cut grooves parallel to the expansion or contraction joints. Extend grooving to within 2 to 4 inches from the edge of expansion or contraction joints and to between 6 and 18 inches from the gutterline or edge of the raised median. Triangular areas of ungrooved surface concrete are permitted within the 6 to 18 inches of transverse offset from the gutterline or edge of raised median.
b. On bridges with skew angles greater than 20 degrees or for irregular bridges with skews that vary, cut grooves perpendicular to the bridge centerline. Extend the grooving to between 2 and 18 inches from and perpendicular to the edge of expansion or contraction joints. Do not groove across expansion or contraction joints. Triangular areas of ungrooved surface concrete are permitted within the 2 to 18 inches of offset from expansion or contraction joints. Extend grooving to within 11 to 13 inches from the gutterline or edge of the raised median.
c. Cut grooves as directed in Paragraph A or B above for bridges constructed in stages whenever possible. If transverse grooving on a bridge constructed in stages would result in ungrooved pavements or an otherwise unsatisfactory groove pattern within the travel lanes, the Contractor may cut grooves parallel to the bridge centerline with written BCE approval. When grooving parallel to the bridge centerline, extend the groove pattern as directed in Paragraph B above.

5 Remove residue from the sawing operation from the deck by vacuum or other methods. Make certain all residue is legally disposed of off the construction site or uniformly distributed in the roadway embankment as directed by the RCE. Ensure that the residue does not remain on the deck nor is washed into the bridge drainage system.

6 Notify the RCE at least 3 calendar days before performing any deck grooving work. Any deviation from the above requirements shall be approved in writing by the RCE prior to starting work. Provide a written groove pattern to the RCE for approval utilizing Standard Form 700.21 before the work begins. Do not perform grooving without the presence of the RCE or a Department representative on site to view the grooving operation.

APPROVED:
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FEDERAL HIGHWAY ADMINISTRATION

July 1, 2021

General

Delete Subsection 702.4.5 of the Standard Specifications in its entirety and replace it with the following:

702.4.5 Removal of Falsework and Forms

1 In order to obtain a satisfactory surface finish, remove the forms for ornamental work, railings, parapets, and other vertical surfaces that will be exposed in the finished work as soon as the concrete has hardened sufficiently to allow the removal of the forms without damaging the edges, corners, and faces of the concrete. Do not remove the forms in less than 5 hours, nor more than 48 hours, unless the concrete is poured on Friday, in which case the forms may be removed the following Monday. Column and pier forms may be removed after 24 hours.

2 Keep forms and falsework under slabs, decks, beams, girders, caps, arches, and structures or parts of structures carrying static dead loads in place until the concrete compressive strength reaches at least 75% of the design strength. Compressive strength verification for the removal of forms and falsework on bent caps and full-depth patches on bridge decks may be performed through the use of a calibrated rebound hammer in conformance with SC-T-49. Other nondestructive test methods may be used where rebound hammer is allowed with prior approval by the BCE. For all other elements referenced above, make additional test cylinders and cure under similar conditions for use in form and falsework removal strength determinations. Document and report the results of all strength tests performed by the Contractor to the RCE prior to removing forms and falsework, regardless of the test method.

3 The allowance for the use of the calibrated rebound hammer described above is strictly for removal of forms and falsework. Strength requirements for the addition of superimposed load as described in Section 702.4.6 shall be verified with concrete test cylinders.

4 Do not use methods of form and falsework removal that are likely to cause overstressing of the concrete. In general, remove the forms from the bottom upward. Do not remove forms without the consent of the RCE.

5 Strike falsework supporting concrete beams, slabs, and brackets that will support sidewalks, concrete railing, or other applicable items before the sidewalk, concrete railing, or the other items are cast.

6 Extra test cylinders for early form or falsework removal will be at no additional expense to the Department.

July 1, 2021

APPROVED:
Division Administrator

By: THADDEUS W KITOWICZ Digitally signed by THADDEUS W KITOWICZ Date: 2021.05.11 14:35:08 -04'00'

FEDERAL HIGHWAY ADMINISTRATION

High-Tensile-Strength Seven-Wire Strand

Subsection 704.2 of the SCDOT Standard Specifications is amended as follows:

Delete **Subsection 704.2.2.2** and replace with the following:

704.2.2.2 High-Tensile-Strength Seven-Wire Strand

1 Ensure high-tensile-strength seven-wire strand conforms to the requirements of AASHTO M 203. Use only high-tensile-strength seven-wire strand produced by sources included on the most recent edition of *SCDOT Qualified Product List 106*.

Delete **Subsection 704.2.4** and replace with the following:

704.2.4 Prestressing Steel, Post-Tensioning Strand and Anchorage Sampling and Testing

1 The Department reserves the right to sample and test prestressing steel, post-tensioning strands, and anchorage assemblies at any time when used on an SCDOT project.

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Date: 2021.11.19 09:57:23 -05'00'
By: ______________
FEDERAL HIGHWAY ADMINISTRATION

January 1, 2022

General

Delete Subsection 702.4.2.5 of the Standard Specifications in its entirety and replace it with the following:

702.4.2.5 Mass Concrete Placement

Requirements for the use of mass concrete procedures are a function of equivalent cement content (ECC) of the concrete mix and the dimensions of the pour. ECC shall be determined on a per cubic yard basis with the following formula:

ECC = 1.0(PC) + 0.5(FAF) + 0.8(FAC) + 1.2(SF) + 1.0(SC)

Where:
PC = portland cement, FAF = Class F fly ash, FAC = Class C fly ash, SF = silica fume, and SC = slag cement. All units are in pounds per cubic yard.

SCDOT requires the use of mass concrete procedures as outlined below:

- For concrete mixes with an ECC < 650 pounds per cubic yard, use procedures for mass concrete placement for a pour that has dimensions of 5 feet or greater in 3 different directions. In the case of a circular cross-section, a mass concrete placement is defined as a pour that has a diameter of 6 feet or greater and a length of 5 feet or greater.
- For concrete mixes with an ECC ≥ 650 pounds per cubic yard, use procedures for mass concrete placement for a pour that has dimensions of 4 feet or greater in 3 different directions. In the case of a circular cross-section, a mass concrete placement is defined as a pour that has a diameter of 5 feet or greater and a length of 4 feet or greater.
- Mass concrete requirements do not apply to Foundation Seals (Class 4000S).

For all mass concrete pours, do not allow the maximum temperature during curing to exceed the temperatures listed below:

- For concrete mixes where the total cementitious materials consist of at least 25% Class F fly ash, 35% Class C fly ash, or 35% water granulated blast furnace slag by weight, the maximum temperature during curing shall not exceed 180ºF.
- For all other concrete mixes, the maximum temperature during curing shall not exceed 160ºF.

For all mass concrete pours, do not allow the mix temperature to exceed 80ºF measured at discharge into the forms or shaft. With the exception of permanently cased drilled shafts, maintain a temperature differential of 35ºF or less between the interior and exterior of all mass pour elements during curing. Temperature differential management is not required for drilled shafts that utilize construction casing in accordance with **Subsection 712.4.8.3**.

No later than 30 days before placing mass concrete, submit to the BCE for review and acceptance a *Mass Concrete Placement Plan* containing, but not limited to, the following:

- Concrete mix design to be used for the mass concrete pour,
- Analysis of the anticipated thermal developments within mass pour placements using the proposed materials and casting methods,

- *Temperature Control Plan* outlining specific measures to control the maximum temperature and differential within the limits noted above, and
- Details of the proposed monitoring system.

Submit for review by the OMR all special concrete mix designs, which are part of the *Temperature Control Plan*. Do not use High-early-strength (AASHTO M 85 Type III) cement or accelerating admixtures in mass concrete. As an additional measure to aid in temperature control of mass concrete elements, up to 35% of the minimum cement content may be replaced with fly ash.

Provide temperature monitoring devices to ensure the requirements of this specification are met. Temperature monitoring devices shall collect and record a minimum of one data point per hour. Redundancy shall be provided such that loss of a single monitoring device does not result in the inability to verify the requirements of this specification. Provide the RCE with a copy of each set of readings and a temperature chart for each mass pour element showing temperature readings vs. time. Temperature data shall be provided to the RCE on a daily basis through the conclusion of monitoring. The RCE, at their discretion, may suspend subsequent mass concrete placements for failure to comply with the reporting requirements herein.

An exclusion to the temperature monitoring requirements will be permitted for drilled shafts meeting all of the following conditions:

1. Shaft diameter less than 10 feet (thickness of casing, if present, may be excluded from measurement),
2. Total cementitious materials within concrete mix consists of at least 25% Class F fly ash by weight,
3. ECC of concrete mix is less than or equal to 575 pounds per cubic yard, and
4. Placement temperature of 80 ºF or less.
5. Use of construction casing in accordance with **Subsection 712.4.8.3**.

For drilled shafts not meeting all of the conditions outlined above, place temperature monitoring devices on 10-foot maximum intervals from the mid-depth to the top of the shaft. Monitors should not be placed within one shaft diameter from the top of the shaft. For shafts less than 40 feet in length, a minimum of 2 elevations shall be monitored. For uncooled shafts, monitoring locations should be centrally located. Minor offsets may be permitted to allow for tremie access if permitted by the BCE. Where cooling tubes are utilized, monitoring locations shall be laterally placed at the estimated center of heat generation. Coordinate the placement of temperature monitoring devices with shaft reinforcing and CSL access tubes provided in accordance with Section 727 of the Standard Specifications. Do not provide additional access tubes around the perimeter of the reinforcing cage that will reduce reinforcing clearances. Do not use monitoring equipment cast into shafts that will interfere with CSL testing. Continue monitoring temperatures in drilled shafts for a minimum of 36 hours after the maximum temperature is measured.

For all other mass concrete placements, record temperature development between the location of maximum heat and exterior of the element at points accepted by the BCE and closely monitor the mass pour maximum temperature and temperature differential. Generally, use one monitoring point in the center of the largest mass of concrete and a second point approximately 2 inches inside the face nearest to the first monitoring point. Continue monitoring temperature until the interior temperature is within 35ºF of the lowest ambient temperature or a maximum of two weeks.

If the monitoring indicates that the proposed measures are not controlling the concrete temperatures as specified herein, provide to the BCE an engineering assessment of the short and long-term impacts associated with the non-conformance. All costs associated with inspection, testing, and evaluation of the non-conformance are the sole responsibility of the Contractor. Additionally, make the necessary revisions to the *Temperature Control Plan* and submit the revised plan for review. No additional mass concrete placements will be allowed until the required items have been provided and accepted by the BCE.

The Contractor assumes all risks connected with placing a mass pour of concrete. BCE review of the Contractor's *Mass Concrete Placement Plan* will in no way relieve the Contractor of the responsibility for obtaining satisfactory results. Should any mass concrete placed under this specification prove unsatisfactory in the judgement of the Department, make the necessary repairs or remove and replace the material at no expense to the Department.

Provide the control of temperatures in mass concrete pours in addition to any other requirements found on the Plans and/or in the Special Provisions that apply to the work in question. Include all costs associated with temperature controls for mass concrete placement in the unit cost of the concrete.

January 1, 2022

General

Delete Subsection 702.4.2.5 of the Standard Specifications in its entirety and replace it with the following:

702.4.2.5 Mass Concrete Placement

Requirements for the use of mass concrete procedures are a function of equivalent cement content (ECC) of the concrete mix and the dimensions of the pour. ECC shall be determined on a per cubic yard basis with the following formula:

$$ECC = 1.0(PC) + 0.5(FAF) + 0.8(FAC) + 1.2(SF) + 1.0(SC)$$

Where:
PC = portland cement, FAF = Class F fly ash, FAC = Class C fly ash, SF = silica fume, and SC = slag cement. All units are in pounds per cubic yard.

SCDOT requires the use of mass concrete procedures as outlined below:

- For concrete mixes with an ECC < 650 pounds per cubic yard, use procedures for mass concrete placement for a pour that has dimensions of 5 feet or greater in 3 different directions. In the case of a circular cross-section, a mass concrete placement is defined as a pour that has a diameter of 6 feet or greater and a length of 5 feet or greater.
- For concrete mixes with an ECC ≥ 650 pounds per cubic yard, use procedures for mass concrete placement for a pour that has dimensions of 4 feet or greater in 3 different directions. In the case of a circular cross-section, a mass concrete placement is defined as a pour that has a diameter of 5 feet or greater and a length of 4 feet or greater.
- Mass concrete requirements do not apply to Foundation Seals (Class 4000S).

For all mass concrete pours, do not allow the maximum temperature during curing to exceed the temperatures listed below:

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- *Temperature Control Plan* outlining specific measures to control the maximum temperature and differential within the limits noted above, and

- Details of the proposed monitoring system.

Submit for review by the OMR all special concrete mix designs, which are part of the *Temperature Control Plan*. Do not use High-early-strength (AASHTO M 85 Type III) cement or accelerating admixtures in mass concrete. As an additional measure to aid in temperature control of mass concrete elements, up to 35% of the minimum cement content may be replaced with fly ash.

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An exclusion to the temperature monitoring requirements will be permitted for drilled shafts meeting <u>all</u> of the following conditions:

1. Shaft diameter less than 10 feet (thickness of casing, if present, may be excluded from measurement),
2. Total cementitious materials within concrete mix consists of at least 25% Class F fly ash by weight,
3. ECC of concrete mix is less than or equal to 575 pounds per cubic yard, and
4. Placement temperature of 80 ºF or less.
5. Use of construction casing in accordance with **Subsection 712.4.8.3**.

For drilled shafts not meeting all of the conditions outlined above, place temperature monitoring devices on 10-foot maximum intervals from the mid-depth to the top of the shaft. Monitors should not be placed within one shaft diameter from the top of the shaft. For shafts less than 40 feet in length, a minimum of 2 elevations shall be monitored. For uncooled shafts, monitoring locations should be centrally located. Minor offsets may be permitted to allow for tremie access if permitted by the BCE. Where cooling tubes are utilized, monitoring locations shall be laterally placed at the estimated center of heat generation. Coordinate the placement of temperature monitoring devices with shaft reinforcing and CSL access tubes provided in accordance with Section 727 of the Standard Specifications. Do not provide additional access tubes around the perimeter of the reinforcing cage that will reduce reinforcing clearances. Do not use monitoring equipment cast into shafts that will interfere with CSL testing. Continue monitoring temperatures in drilled shafts for a minimum of 36 hours after the maximum temperature is measured.

For all other mass concrete placements, record temperature development between the location of maximum heat and exterior of the element at points accepted by the BCE and closely monitor the mass pour maximum temperature and temperature differential. Generally, use one monitoring point in the center of the largest mass of concrete and a second point approximately 2 inches inside the face nearest to the first monitoring point. Continue monitoring temperature until the interior temperature is within 35ºF of the lowest ambient temperature or a maximum of two weeks.

If the monitoring indicates that the proposed measures are not controlling the concrete temperatures as specified herein, provide to the BCE an engineering assessment of the short and long-term impacts associated with the non-conformance. All costs associated with inspection, testing, and evaluation of the non-conformance are the sole responsibility of the Contractor. Additionally, make the necessary revisions to the *Temperature Control Plan* and submit the revised plan for review. No additional mass concrete placements will be allowed until the required items have been provided and accepted by the BCE.

The Contractor assumes all risks connected with placing a mass pour of concrete. BCE review of the Contractor's *Mass Concrete Placement Plan* will in no way relieve the Contractor of the responsibility for obtaining satisfactory results. Should any mass concrete placed under this specification prove unsatisfactory in the judgement of the Department, make the necessary repairs or remove and replace the material at no expense to the Department.

Provide the control of temperatures in mass concrete pours in addition to any other requirements found on the Plans and/or in the Special Provisions that apply to the work in question. Include all costs associated with temperature controls for mass concrete placement in the unit cost of the concrete.

Chapter 6

Moisture Correction and Concrete Batching

This chapter will contain:

Class Presentations

And step-by-step instruction regarding:

6.1 Moisture Correction for Fine and Course Aggregate using the Dry Method

6.2 Concrete Batching

Minimum Cement Content
Additional Cementitious Material Content
Maximum Water to Cementitious Material (w/c) Ratio
Fine to Course Aggregate Ratio

AGGREGATE MOISTURE CORRECTIONS & CONCRETE BATCHING
(Chapter 6)

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AGGREGATE MOISTURE CORRECTION

- The moisture content in aggregates must be considered when batching concretes to assure consistency and to control total water content in the concrete mixture
- Not taking into account the free moisture on the aggregates can lead to exceeding specified water to cement ratios
- It can lessen the durability of the concrete structure, as well as lower the compressive and flexural strengths.

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ASTM C 566 or AASHTO T 255 *Standard Test Method for Total Evaporable Moisture Content by Drying* gives guidance in the proper way to determine the moisture content to aggregates.

SSD MOISTURE CONTENT OF THE AGGREGATE IS:

$$S = \left[\left(\frac{W - D}{D}\right)*100\right] - A$$

WHERE:

S = Total moisture content of sample at SSD in percent
W = Mass of original sample in grams
D = Mass of dried sample in grams
A = Absorption of the aggregate in percent

EXAMPLE

You are given a moist sample of fine aggregate in a pan where the combined weight of the pan and the fine aggregate sample weighs 215 grams. The fine aggregate came from **B. V. HEDRICK GRAVEL & SAND** from **LILESVILLE, NC** (Lilesville Mine) and you are instructed to get the moisture content for the saturated surface dry material in order to make concrete mix design corrections for the moisture content of a SCDOT Class 4000 concrete. The pan that you are using to dry the material weighs 100 grams. After the material has finished drying, the fine aggregate that you dried and the pan used to dry the material has a combined weight of 209 grams.

What is SSD moisture content of the fine aggregate?

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STEP 1. Determine the weight of the fine aggregate before and after drying.

Weight of the Fine Aggregate prior to Drying:

W= 215g-100g

$\boldsymbol{W}$ **= 115g**

Weight of Fine Aggregate after Drying:

D= 209g-100g

$\boldsymbol{D}$ **= 109g**

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STEP 2. Determine the Absorption of the Aggregate.

- Go to the SCDOT QPL for Fine Aggregate and look up the B. V. HEDRICK GRAVEL & SAND from LILESVILLE, NC (Lilesville Mine) and find the absorption for that aggregate.

- Qualified Products List 1 Page 1 has the absorption for B. V. HEDRICK GRAVEL & SAND from LILESVILLE, NC (Lilesville Mine) as 0.8 percent.

STEP 3. Substitute values from Step 1 and Step 2 into equation and solve for *S*

$$S = \left[\left(\frac{W - D}{D} \right) * 100 \right] - A$$

$$S = \left[\left(\frac{115 - 109}{109} \right) * 100 \right] - 0.8$$

$$\boxed{S = 4.7\%}$$

If the moisture adjustment was not used in a concrete mix that contained 1100 pounds of fine aggregate per cubic yard, there would be 51.7 pounds or 6.2 gallons of additional water added to the concrete mix and the water to cement ratio would most probably be exceeded.

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MIX PROPORTION DEVELOPMENT

The proportioning of a concrete mix design should result in an economical and practical combination of materials to produce concrete with the properties desired for its intended use, such as workability, strength, durability and appearance.

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STRUCTURAL CONCRETE

Class of Concrete	*Bag of Cement Per Cubic Yard of Concrete*	*Designed Strength at 28 Days psi*	*GRAVEL—COARSE AGGREGATE*					*CRUSHED STONE—COARSE AGGREGATE*				
			Pounds of Cement	*Pounds of Fine Aggregate*	*Pounds of Coarse Aggregate*	*Water Gallons*	*Yield Cu. Yds.*	*Pounds of Cement*	*Pounds of Fine Aggregate*	*Pounds of Coarse Aggregate*	*Water Gallons*	*Yield Cu. Yds.*
AA	7¼	3500	94*	135*	302*	4.30*	1.38*	94*	133*	294*	4.50*	.138*
A	6¼	3000	94*	150*	346*	4.90*	.160*	94*	160*	334*	5.00*	.160*
B	5¼	2500	94	193	440	6.25	.190	94	210	410	6.85	.190
C	4¼	2000	94	250	545	8.00	.235	94	275	505	8.70	.235
A	6¼	3000	94	155	358	5.60	.160	94	160	350	5.70	.160

* Based on 4½ percent of air.

Weights based on a bulk specific gravity (saturated surface-dry basis) of aggregates of 2.65. If aggregates which have specific gravities other than 2.65 are used, proportionate adjustments shall be made in the above weights so as to secure equivalent volumes.

The above quantities are based on the aggregates being saturated surface-dry, which is to say that internal voids in each piece of aggregate are filled with water but the surface area of each piece of aggregate is dry.

X 7½ 5000 4 130 275 5 Gal

2007

701.2.12.2 Structural Concrete Table

1 Unless otherwise noted or directed, make certain that the properties of the various classes of concrete incorporated into the work conform to the following Structural Concrete Table. Compressive strength is based on ASTM C 39.

Structural Concrete Table					
Aggregate Type	**Minimum Cement Content (lbs./CY)**	**Other Cementitious Material (lbs./CY)**	**Min. 28 Day Mix Design (psi)**	**Percent Fine to Coarse Aggregate Ratio**	**Max. Water to Cementitious Material Ratio**
Class 2500 (Non Structural)					
Crushed stone	494	--	2500	36:64	0.54
Gravel	494	--	2500	35:65	0.52
Marine Limestone	494	--	2500	40:60	0.56

(table continued on the next page)

(table continued from the previous page)

Structural Concrete Table

Aggregate Type	Minimum Cement Content (lbs./CY)	Other Cementitious Material (lbs./CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cementitious Material Ratio
Class 3000					
Crushed stone	588	--	3000	35:65	0.46
Gravel	588	--	3000	34:66	0.44
Marine Limestone	588	--	3000	39:61	0.47
Class 4000					
Crushed stone	611	--	4000	35:65	0.40
Gravel	611	--	4000	34:66	0.40
Class 4000S					
Crushed stone	682	--	4000	38:62	0.45
Gravel	682	--	4000	38:62	0.45
Class 4000DS (See Notes 2 & 4)					
Crushed stone	625	--	4000	40:60	0.44
Gravel	625	--	4000	39:61	0.43
Class 4000P (See Note 5)					
Crushed stone	682	--	4000	34:66	0.43
Gravel	682	--	4000	33:67	0.38
Class 5000					
Crushed stone	705	--	5000	35:65	0.46
Gravel	705	--	5000	34:66	0.42

(table continued from the previous page)

Structural Concrete Table

Aggregate Type	Minimum Cement Content (lbs./CY)	Other Cementitious Material (lbs./CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cementitious Material Ratio
Class 6000					
Crushed stone	750	--	6000	34:66	0.44
Gravel	750	--	6000	33:67	0.39
Class 6500 (See Notes 1 & 3)					
Crushed stone	500	CF35, FA140	4000	37:63	0.37
Gravel	500	CF35, FA140	4000	38.62	0.37
Class 7000					
Crushed stone	800	---	7000	35:65	0.37
Gravel	800	---	7000	34:66	0.37
Class 8000					
Crushed Stone	840	---	8000	34:66	0.30
Gravel	840	---	8000	34:66	0.30
Class 10000					
Crushed stone, or Gravel	800	Silica Fume: 74 & Fly Ash, Type F: 100	10000	34:66	0.25

Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Class 4000 Concrete.

Design the Mix such that 20% of the cement is replaced with fly Ash.

Coarse Aggregate	Gravel	Specific Gravity (SG) = 2.70	1% Moisture Content
Fine Aggregate	Sand	Specific Gravity (SG) = 2.68	4% Moisture Content

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement ______________

Fly Ash ______________

Silica Fume ______________

Added Water ______________

Fine Aggregate ______________

Coarse Aggregate ______________

How many gallons of **Added Water** were required? ______________

CONCRETE BATCHING
PER CUBIC YARD

			cu. yd batch weight
Cement:	______ / 3.15 x 62.4 lbs =	______ ft^3	______ lbs
Fly Ash	______ / 2.25 x 62.4 lbs =	______ ft^3	______ lbs
Silica Fume	______ / 2.20 x 62.4 lbs =	______ ft^3	______ lbs
Other	______ / ____ x 62.4 lbs =	______ ft^3	______ lbs
Added Water:	______ / 1 x 62.4 lbs =	______ ft^3	______ lbs
Air:	27 x ______ % =	______ ft^3	

Volume of Paste ______ ft^3 (A)

Volume of Aggregate: 27 – (A) ______ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

______ (B) x ______ (%FA) = ______ (C) ft^3 x ______ (SG) x 62.4 ______ lbs

Coarse Aggregate

______ (B) x ______ (%CA) = ______ (D) ft^3 x ______ (SG) x 62.4 ______ lbs

Check Volum (A+C+D must = 27 ft^3) ________ ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

Standard Specifications 701.20.C

STRUCTURAL CONCRETE TABLE					
Aggregate Type	Minimum Cement Content (lbs/CY)	Other Cementitious Material (lbs/CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cement Ratio
Class 4000 (see note 4)					
Crushed Stone	**611**	**--**	**4000**	**35:65**	**0.40**
Gravel	**611**	**--**	**4000**	**34:66**	**0.40**

STEP 1-3. Read the instructions carefully and refer to the step by step guide.

STEP 4A. Per the Structural Concrete Table located in the SCDOT Construction Manual, Section 701.20, a Class 4000 PCC made with gravel requires a minimum cement content of 611 lbs. per cubic yard. Since this mix calls for a 20% fly ash replacement, the necessary weight of cement will be 20% less than 611 lbs.

611 – (611 x 20%) = 488.8 = 489 lbs

STEP 4B. Convert 489 lbs to a volume expressed in cubic feet by dividing the weight by the product of 3.15 x 62.4. Carry the answer for three decimal places.

*round to three decimal places for **Volumes**

Cement: $\frac{489}{3.15*62.4}$ lbs = 2.488 ft^3 Yd^3 batch Weight 489

CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft^3	489	lbs
Fly Ash	____ / 2.25 x 62.4	lbs =	____ ft^3	____	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____ ft^3	____	lbs
Other	____ / ____ x 62.4	lbs =	____ ft^3	____	lbs
Added Water:	____ / 1 x 62.4	lbs =	____ ft^3	____	lbs
Air:	27 x ____	% =	____ ft^3		

Volume of Paste ____ ft^3 (A)

Volume of Aggregate: 27 – (A) ____ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

____ (B) x ____ (%FA) = ____ (C) ft^3 x ____ (SG) x 62.4 ____ lbs

Coarse Aggregate

____ (B) x ____ (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft^3) ____ ft^3

Total Weight per cu. yd. ____ lbs/cu.yd.

STEP 5A. To determine the minimum weight of fly ash required per cubic yard, subtract the final weight of cement (489 lbs) from the initial weight of cement (611 lbs).

611 - 489 = 122 lbs — Round to the nearest pound!

STEP 5B. SCDOT policy (701.25) requires a replacement ratio for fly ash not less than 1.2:1. This means that for each pound of cement removed, a minimum of 1.2 lbs of fly ash must be used as a replacement.

122 lbs x 1.2 = 146 lbs — Round to the nearest pound!

STEP 5C. Convert 146 lbs to a volume expressed in cubic feet by dividing the weight by the product of 2.25 x 62.4. Carry the answer for three decimal places.

Round to three decimal places!

Fly Ash: $\frac{146}{2.25 * 62.4}$ lbs = <u>1.040 ft^3</u>   Yd^3 batch Weight <u>146</u>

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft^3	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040 ft^3	146	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____ ft^3	____	lbs
Other	____ / ____ x 62.4	lbs =	____ ft^3	____	lbs
Added Water:	____ / 1 x 62.4	lbs =	____ ft^3	____	lbs
Air:	27 x ____	% =	____ ft^3		

Volume of Paste ____ ft^3 (A)

Volume of Aggregate: 27 – (A) ____ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
____ x ____ = ____ ft^3 x ____ x 62.4 ____ lbs
(B) %FA (C) SG

Coarse Aggregate
____ x ____ = ____ ft^3 x ____ x 62.4 ____ lbs
(B) %CA (D) SG

Check Volum (A+C+D must = 27 ft^3) ____ ft^3

Total Weight per cu. yd. ____ lbs/cu.yd.

STEP 6. Determine the total cementitous material weight by adding the cement and fly ash cubic yard batch weights. This value will be required to determine the amount of added water.

489 + 146 = 635 lbs of cementitious material

STRUCTURAL CONCRETE TABLE					
Aggregate Type	Minimum Cement Content (lbs/CY)	Other Cementitious Material (lbs/CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cement Ratio
Class 4000 (see note 4)					
Crushed Stone	**611**	**--**	**4000**	**35:65**	**0.40**
Gravel	**611**	**--**	**4000**	**34:66**	**0.40**

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REMINDER: **STEP 6.** Determine the total cementitous material weight by adding the cement and fly ash cubic yard batch weights. This value will be required to determine the amount of added water.

489 + 146 = <u>635 lbs of cementitious material</u>

STEP 7. Determine the weight of added water necessary for one cubic yard of PCC by multiplying the water to cement ratio (w/c) found on the Structural Concrete Table by the total cementitious materials weight.

The w/c for class 4000 made with gravel is 0.40

0.40 x 635 (lbs of cementitious material) = 254 lbs   Round to the nearest pound!

STEP 7. Determine the volume of added water by dividing the weight of added water by 62.4. (62.4 lbs is the weight of one cubic foot of water.)

Water: $\frac{254}{1.00 * 62.4}$ lbs = <u>4.070 ft^3</u>   Yd^3 batch Weight <u>254</u>

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / 3.15 x 62.4	lbs = 2.488 ft^3		489 lbs
Fly Ash	146 / 2.25 x 62.4	lbs = 1.040 ft^3		146 lbs
Silica Fume	____ / 2.20 x 62.4	lbs = ____ ft^3		____ lbs
Other	____ / ____ x 62.4	lbs = ____ ft^3		____ lbs
Added Water:	254 / 1 x 62.4	lbs = 4.071 ft^3		254 lbs
Air:	27 x ____	% = ____ ft^3		

Volume of Paste ________ ft^3 (A)

Volume of Aggregate: 27 – (A) ________ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
____ (B) x ____ (%FA) = ____ (C) ft^3 x ____ (SG) x 62.4 ________ lbs

Coarse Aggregate
____ (B) x ____ (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ________ lbs

Check Volum (A+C+D must = 27 ft^3) ________ ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 9. Determine the volume of entrained air (there is no weight component). To determine this volume, multiply the entrained air target value for SCDOT work, (4.5%) by 27.

$$27 \times 0.045 = 1.215 \text{ ft}^3$$

Air:	27 x 0.045 =	1.215 ft^3

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CONCRETE BATCHING
PER CUBIC YARD

					cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488	ft^3	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040	ft^3	146	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____	ft^3	____	lbs
Other	____ / ____ x 62.4	lbs =	____	ft^3	____	lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071	ft^3	254	lbs
Air:	27 x 4.5	% =	1.215	ft^3		

Volume of Paste ____ ft^3 (A)

Volume of Aggregate: 27 – (A) ____ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

____ (B) x ____ (%FA) = ____ (C) ft^3 x ____ (SG) x 62.4 ____ lbs

Coarse Aggregate

____ (B) x ____ (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft^3) ____ ft^3

Total Weight per cu. yd. ____ lbs/cu.yd.

STEP 10. Determine the volume of paste by summing the volumes of cement, fly ash, added water and air.

2.488 + 1.040 + 4.071 + 1.215 = 8.814 ft^3 Maintain (3) decimal places!

Volume of Paste: 8.814 ft^3 (A)

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / 3.15 x 62.4	lbs = 2.488	ft^3	489 lbs
Fly Ash	146 / 2.25 x 62.4	lbs = 1.040	ft^3	146 lbs
Silica Fume	____ / 2.20 x 62.4	lbs = ____	ft^3	____ lbs
Other	____ / ____ x 62.4	lbs = ____	ft^3	____ lbs
Added Water:	254 / 1 x 62.4	lbs = 4.071	ft^3	254 lbs
Air:	27 x 4.5	% = 1.215	ft^3	

Volume of Paste 8.814 ft^3 (A)

Volume of Aggregate: 27 – (A) ____ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

____ (B) x ____ (%FA) = ____ (C) ft^3 x ____ (SG) x 62.4 ____ lbs

Coarse Aggregate

____ (B) x ____ (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft^3) ____ ft^3

Total Weight per cu. yd. ____ lbs/cu.yd.

STEP 11. Determine the volume of aggregate that will be required per cubic yard by subtracting the volume of paste from 27 ft³.

27.000 – 8.814 = 18.186 ft³ Maintain (3) decimal places!

Volume of Aggregate: 27 – (A)	18.186 ft³	(B)

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft³	489 lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040 ft³	146 lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____ ft³	____ lbs
Other	____ / ____ x 62.4	lbs =	____ ft³	____ lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071 ft³	254 lbs
Air:	27 x 4.5	% =	1.215 ft³	
Volume of Paste			8.814 ft³ (A)	
Volume of Aggregate: 27 – (A)			18.186 ft³ (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
____ x ____ = ____ ft³ x ____ x 62.4 ____ lbs
(B) %FA (C) SG

Coarse Aggregate
____ x ____ = ____ ft³ x ____ x 62.4 ____ lbs
(B) %CA (D) SG

Check Volum (A+C+D must = 27 ft³) ________ ft³

Total Weight per cu. yd. ________ lbs/cu.yd.

CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft³	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040 ft³	146	lbs
Silica Fume	___ / 2.20 x 62.4	lbs =	___ ft³	___	lbs
Other	___ / ___ x 62.4	lbs =	___ ft³	___	lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071 ft³	254	lbs
Air:	27 x 4.5	% =	1.215 ft³		

Volume of Paste 8.814 ft³ (A)

Volume of Aggregate: 27 – (A) 18.186 ft³ (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

	(B)	x	%FA / %CA	=	(C) / (D)	ft³ x	SG	x 62.4		lbs
Fine Aggregate	___	x	___	=	___	ft³ x	___	x 62.4	___	lbs
Coarse Aggregate	___	x	___	=	___	ft³ x	___	x 62.4	___	lbs

Check Volum (A+C+D must = 27 ft³) ________ ft³

Total Weight per cu. yd. ________ lbs/cu.yd.

CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft³	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040 ft³	146	lbs
Silica Fume	___ / 2.20 x 62.4	lbs =	___ ft³	___	lbs
Other	___ / ___ x 62.4	lbs =	___ ft³	___	lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071 ft³	254	lbs
Air:	27 x 4.5	% =	1.215 ft³		

Volume of Paste 8.814 ft³ (A)

Volume of Aggregate: 27 – (A) 18.186 ft³ (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

	(B)	x	%FA / %CA	=	(C) / (D)	ft³ x	SG	x 62.4		lbs
Fine Aggregate	18.186	x	___	=	___	ft³ x	___	x 62.4	___	lbs
Coarse Aggregate	18.186	x	___	=	___	ft³ x	___	x 62.4	___	lbs

Check Volum (A+C+D must = 27 ft³) ________ ft³

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 12. Determine the volume of Fine aggregrate that will be required per cubic yard by multiplying the appropriate percentage of fine aggregate by the total volume of aggregate (labeled (B)) For this example, the ratio of fine:coarse aggregate is given as **34:36** (based on the type of coarse aggregate) in the Structural Concrete Table.

STRUCTURAL CONCRETE TABLE					
Aggregate Type	Minimum Cement Content (lbs/CY)	Other Cementitious Material (lbs/CY)	Min. 28 Day Mix Design (psi)	Percent Fine to Coarse Aggregate Ratio	Max. Water to Cement Ratio
Class 4000 (see note 4)					
Crushed Stone	**611**	**--**	**4000**	**35:65**	**0.40**
Gravel	**611**	**--**	**4000**	**34:66**	**0.40**

CONCRETE BATCHING
PER CUBIC YARD

			cu. yd batch weight
Cement:	489 / 3.15 x 62.4 lbs =	2.488 ft³	489 lbs
Fly Ash	146 / 2.25 x 62.4 lbs =	1.040 ft³	146 lbs
Silica Fume	____ / 2.20 x 62.4 lbs =	____ ft³	____ lbs
Other	____ / ____ x 62.4 lbs =	____ ft³	____ lbs
Added Water:	254 / 1 x 62.4 lbs =	4.071 ft³	254 lbs
Air:	27 x 4.5 % =	1.215 ft³	
Volume of Paste		8.814 ft³ (A)	
Volume of Aggregate: 27 – (A)		18.186 ft³ (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = ____ (C) ft³ x ____ (SG) x 62.4 ____ lbs

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = ____ (D) ft³ x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft³) ____ ft³

Total Weight per cu. yd. ____ lbs/cu.yd.

CONCRETE BATCHING
PER CUBIC YARD

					cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488	ft^3	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040	ft^3	146	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____	ft^3	____	lbs
Other	____ / ____ x 62.4	lbs =	____	ft^3	____	lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071	ft^3	254	lbs
Air:	27 x 4.5	% =	1.215	ft^3		

Volume of Paste 8.814 ft^3 (A)

Volume of Aggregate: 27 – (A) 18.186 ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x ____ (SG) x 62.4 ____ lbs

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft^3) ________ ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Class 4000 Concrete.

Design the Mix such that 20% of the cement is replaced with fly Ash.

Coarse Aggregate	Gravel	Specific Gravity (SG) = 2.70	1% Moisture Content
Fine Aggregate	Sand	Specific Gravity (SG) = 2.68	4% Moisture Content

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement ______________

Fly Ash ______________

Silica Fume ______________

Added Water ______________

Fine Aggregate ______________

Coarse Aggregate ______________

How many gallons of **Added Water** were required? ______________

STEP 13. Review the problem statement to find the fine aggregate specific gravity. Transfer this value to the correct space as shown. (In this example, the fine aggregate SG was **2.68** and the coarse aggregate SG was **2.70**)

STEP 14. Using the volume of fine aggregate, its specific gravity and the **62.4** conversion factor, calculate the weight of fine aggregate per cubic yard.

18.186 x 34% = 6.183 ft^3 — Round to three decimal places!

6.183 x 2.68 x 62.4 = 1034 lbs — Round to the nearest pound!

$$\text{Fine Aggregate:}\quad \frac{18.186}{(\mathrm{B})} \times \frac{34\%}{\%\mathrm{FA}} = \frac{6.183\ \mathrm{ft}^3}{(\mathrm{C})} \times \frac{2.68}{\mathrm{SG}} \times 62.4 = 1034\ \mathrm{lbs}$$

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / (3.15 x 62.4)	lbs =	2.488 ft^3	489 lbs
Fly Ash	146 / (2.25 x 62.4)	lbs =	1.040 ft^3	146 lbs
Silica Fume	____ / (2.20 x 62.4)	lbs =	____ ft^3	____ lbs
Other	____ / (____ x 62.4)	lbs =	____ ft^3	____ lbs
Added Water:	254 / (1 x 62.4)	lbs =	4.071 ft^3	254 lbs
Air:	27 x 4.5	% =	1.215 ft^3	

Volume of Paste 8.814 ft^3 (A)

Volume of Aggregate: 27 – (A) 18.186 ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x 2.68 (SG) x 62.4 1034 lbs

Coarse Aggregate

18.186 (B) x 0.66 (%CA) = ____ (D) ft^3 x ____ (SG) x 62.4 ____ lbs

Check Volum (A+C+D must = 27 ft^3) ________ ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 15-17. Repeat steps 12-14 for the coarse aggregate using the correct coarse aggregate percentage and the appropriate SG value.

18.186 x 66% = 12.003 ft^3

Round to three decimal places!

Coarse Aggregate: $\underset{(B)}{\underline{18.186}} \times \underset{\%CA}{\underline{66\%}} = \underset{(D)}{\underline{12.003\ \text{ft}^3}} \times \underset{SG}{\underline{2.70}} \times 62.4 = \underline{2022\ \text{lbs}}$

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 (3.15 x 62.4)	lbs = 2.488	ft^3	489 lbs
Fly Ash	146 (2.25 x 62.4)	lbs = 1.040	ft^3	146 lbs
Silica Fume	(2.20 x 62.4)	lbs =	ft^3	lbs
Other	(____ x 62.4)	lbs =	ft^3	lbs
Added Water:	254 (1 x 62.4)	lbs = 4.071	ft^3	254 lbs
Air:	27 x 4.5	% = 1.215	ft^3	
Volume of Paste		8.814	ft^3 (A)	
Volume of Aggregate: 27 – (A)		18.186	ft^3 (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x 2.68 (SG) x 62.4 1034 lbs

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = 12.003 (D) ft^3 x 2.70 (SG) x 62.4 2022 lbs

Check Volum (A+C+D must = 27 ft^3) ________ft^3

Total Weight per cu. yd ________lbs/cu yd

STEP 18. Perform a volume check. If the combined volumes of paste, fine aggregate and coarse aggregate do not equal 27 ft^3, then a mistake has been made.

$$A + C + D \text{ must} = 27 \text{ ft}^3$$

Check Volume: (A) 8.814 + (C) 6.183 + (D) 12.003 = 27 ft^3

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / (3.15 x 62.4)	lbs =	2.488 ft^3	489 lbs
Fly Ash	146 / (2.25 x 62.4)	lbs =	1.040 ft^3	146 lbs
Silica Fume	____ / (2.20 x 62.4)	lbs =	____ ft^3	____ lbs
Other	____ / (____ x 62.4)	lbs =	____ ft^3	____ lbs
Added Water:	254 / (1 x 62.4)	lbs =	4.071 ft^3	254 lbs
Air:	27 x 4.5	% =	1.215 ft^3	

Volume of Paste 8.814 ft^3 (A)

Volume of Aggregate: 27 – (A) 18.186 ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x 2.68 (SG) x 62.4 1034 lbs

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = 12.003 (D) ft^3 x 2.70 (SG) x 62.4 2022 lbs

Check Volum (A+C+D must = 27 ft^3) 27.00 ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

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Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Class 4000 Concrete.

Design the Mix such that 20% of the cement is replaced with fly Ash.

Coarse Aggregate	Gravel	Specific Gravity (SG) = 2.70	1% Moisture Content
Fine Aggregate	Sand	Specific Gravity (SG) = 2.68	4% Moisture Content

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement	_______________
Fly Ash	_______________
Silica Fume	_______________
Added Water	_______________
Fine Aggregate	_______________
Coarse Aggregate	_______________

How many gallons of **Added Water** were required? ______________

STEP 19. Although now the form is now complete, the process of designing the mix is not. The aggregates each contain moisture, and this water must be accounted for in the mix preparation. The problem statement says that the fine aggregate has a moisture percentage of 4% and the coarse aggregate has 1% moisture beyond SSD conditions. To determine what the weight of aggregate moisture is – multiply the individual aggregate weights by their respective moisture contents as shown.

Fine Aggregate weight: **1034 lbs**

1034 x 4% = 41 lbs   Round to the nearest pound!

Coarse Aggregate weight: **2022 lbs**

2022 x 1% = 20 lbs   Round to the nearest pound!

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STEP 20-21. The weights of 41 lbs and 20 lbs represent the weight of water that would enter the mix via the aggregates. The inclusion of this water also means that the weight of fine aggregate entering the mix is actually less than the 1034 measured. The same reasoning applies to the coarse aggregate. To compensate, 41 lbs of fine aggregate must be added to the mix design value of 1034 lbs. Also, 20 lbs of coarse aggregate must be added to the design weight of 2022 lbs.

Adjusted Fine Aggregate weight: 1034 + 41 = 1075 lbs

Adjusted Coarse Aggregate weight: 2022 + 20 = 2042 lbs

Fine Aggregate:

$$\frac{18.186}{(\mathrm{B})} \times \frac{34\%}{\%\mathrm{FA}} = \frac{6.183\ \mathrm{ft}^3}{(\mathrm{C})} \times \frac{2.68}{\mathrm{SG}} \times 62.4 = \cancel{1034\ \mathrm{lbs}}$$

Adj. Wt. = 1034 + 41 = **1075 lbs**

Coarse Aggregate:

$$\frac{18.186}{(\mathrm{B})} \times \frac{66\%}{\%\mathrm{CA}} = \frac{12.003\ \mathrm{ft}^3}{(\mathrm{D})} \times \frac{2.70}{\mathrm{SG}} \times 62.4 = \cancel{2022\ \mathrm{lbs}}$$

Adj. Wt. = 2022 + 20 = **2042 lbs**

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CONCRETE BATCHING
PER CUBIC YARD

			cu. yd batch weight
Cement:	489 lbs = (3.15 x 62.4)	2.488 ft^3	489 lbs
Fly Ash	146 lbs = (2.25 x 62.4)	1.040 ft^3	146 lbs
Silica Fume	___ lbs = (2.20 x 62.4)	___ ft^3	___ lbs
Other	___ lbs = (____ x 62.4)	___ ft^3	___ lbs
Added Water:	254 lbs = (1 x 62.4)	4.071 ft^3	254 lbs
Air:	27 x 4.5 % =	1.215 ft^3	
Volume of Paste		8.814 ft^3 (A)	
Volume of Aggregate: 27 – (A)		18.186 ft^3 (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

	(B)		%FA / %CA		(C) / (D)		SG		
Fine Aggregate	18.186	x	0.34	=	6.183 ft^3	x	2.68	x 62.4	1034 lbs
							Adj. Wt. 1034+ 41 = **1075**		
Coarse Aggregate	18.186	x	0.66	=	12.003 ft^3	x	2.70	x 62.4	2022 lbs
							2022 + 20 = **2042**		

Check Volume (A+C+D must = 27 ft^3) 7.00 ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 22. The weights of 41 lbs and 20 lbs that represent the weight of water entering the mix via the aggregates, must be subtracted from the quantity of added water. To compensate, 41 lbs of water must be subtracted because of the fine aggregate moisture and 20 lbs of water must be subtracted because of the coarse aggregate moisture.

Added Water – Fine Agg. Moisture – Coarse Agg. Moisture = Adj. Added Water Weight

Adjusted Added Water weight:	254 – 41 – 20 =	**193 lbs**

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CONCRETE BATCHING
PER CUBIC YARD

					cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488	ft³	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040	ft³	146	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =		ft³		lbs
Other	____ / ____ x 62.4	lbs =		ft³		lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071	ft³	~~254~~	lbs
Air:	27 x 4.5	% =	1.215	ft³	- 41 - 20	
Volume of Paste			8.814	ft³ (A)	193 lbs	
Volume of Aggregate: 27 – (A)			18.186	ft³ (B)		

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

18.186 (B) x 0.34 (%FA) = 6.183 (C) ft³ x 2.68 (SG) x 62.4 1034 lbs

Adj. Wt. 1034+ 41 = 1075

Coarse Aggregate

18.186 (B) x 0.66 (%CA) = 12.003 (D) ft³ x 2.70 (SG) x 62.4 2022 lbs

2022 + 20 = 2042

Check Volum (A+C+D must = 27 ft³) 7.00 ft³

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 23-24. Total the weights of the components to obtain the total weight per cubic yard for this mix.

Cement	489
Fly Ash	146
Silica Fume	0
Added Water	193
Fine Aggregate	1075
Coarse Aggregate	2042
Mix Wt./ cubic yard	**3945 lbs**

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CONCRETE BATCHING
PER CUBIC YARD

				cu. yd batch weight
Cement:	489 / 3.15 x 62.4	lbs =	2.488 ft^3	489 lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040 ft^3	146 lbs
Silica Fume	____ / 2.20 x 62.4	lbs =	____ ft^3	____ lbs
Other	____ / ____ x 62.4	lbs =	____ ft^3	____ lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071 ft^3	~~254~~ lbs
Air:	27 x 4.5	% =	1.215 ft^3	- 41 - 20
Volume of Paste			8.814 ft^3 (A)	193 lbs
Volume of Aggregate: 27 – (A)			18.186 ft^3 (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x 2.68 (SG) x 62.4 1034 lbs
Adj. Wt. 1034+ 41 = 1075

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = 12.003 (D) ft^3 x 2.70 (SG) x 62.4 2022 lbs
2022 + 20 = 2042

Check Volum (A+C+D must = 27 ft^3) 7.00 ft^3

Total Weight per cu. yd. ________ lbs/cu.yd.

STEP 23-24. Total the weights of the components to obtain the total weight per cubic yard for this mix.

Cement	489
Fly Ash	146
Silica Fume	0
Added Water	193
Fine Aggregate	1075
Coarse Aggregate	2042
Mix Wt./ cubic yard	**3945 lbs**

CONCRETE BATCHING
PER CUBIC YARD

					cu. yd batch weight	
Cement:	489 / 3.15 x 62.4	lbs =	2.488	ft^3	489	lbs
Fly Ash	146 / 2.25 x 62.4	lbs =	1.040	ft^3	146	lbs
Silica Fume	____ / 2.20 x 62.4	lbs =		ft^3		lbs
Other	____ / ____ x 62.4	lbs =		ft^3		lbs
Added Water:	254 / 1 x 62.4	lbs =	4.071	ft^3	~~254~~	lbs
Air:	27 x 4.5	% =	1.215	ft^3	- 41	
					- 20	
Volume of Paste			8.814	ft^3 (A)	193 lbs	
Volume of Aggregate: 27 – (A)			18.186	ft^3 (B)		

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate
18.186 (B) x 0.34 (%FA) = 6.183 (C) ft^3 x 2.68 (SG) x 62.4 1034 lbs

Adj. Wt. 1034+ 41 = 1075

Coarse Aggregate
18.186 (B) x 0.66 (%CA) = 12.003 (D) ft^3 x 2.70 (SG) x 62.4 2022 lbs

2022 + 20 = 2042

Check Volum (A+C+D must = 27 ft^3) 7.00 ft^3

Total Weight per cu. yd. 3945 lbs/cu.yd.

Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement ________________

Fly Ash ________________

Silica Fume ________________

Added Water ________________

Fine Aggregate ________________

Coarse Aggregate ________________

How many gallons of **Added Water** were required? ______________

STEP 25. Multiply the single yard weights by the appropriate number of yards to determine the total weight of each mix component called for in the problem statement.

	Weight per Yd^3	Totals for 6 Cubic Yards
Cement	489	2934 lbs
Fly Ash	146	876 lbs
Silica Fume	0	0
Added Water	193	1158 lbs
Fine Aggregate	1075	6450 lbs
Coarse Aggregate	2042	12252 lbs
Mix Wt./ cubic yard	**3945 lbs**	**23670 lbs**

SCDOT

UNIVERSITY OF South Carolina

Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement	2,934
Fly Ash	876
Silica Fume	0
Added Water	1,158
Fine Aggregate	6,450
Coarse Aggregate	12,252

How many gallons of **Added Water** were required? _______________

UNIVERSITY OF South Carolina

STEP 26. Determine the total volume of **Added Water** required by dividing the total weight of water in pounds by **8.33**, to obtain the total volume of water in gallons.

Added Water weight : $\frac{1158\ lbs}{8.33\ lbs/gal} = 139\ \text{gal}$

Round down to the previous gallon!

SCDOT

Develop the Mix Proportions for a Class 4000 PCC using SCDOT Guidelines.

Determine the required weight of each component to batch a total of 6 cubic yards.

Cement	**2,934**
Fly Ash	**876**
Silica Fume	**0**
Added Water	**1,158**
Fine Aggregate	**6,450**
Coarse Aggregate	**12,252**

How many gallons of **Added Water** were required? **139**

6.1 Moisture Correction for Fine and Coarse Aggregates using the Dry Method

The moisture content in aggregates must be considered when batching concretes to assure consistency and to control total water content in the concrete mixture. Not taking into account the free moisture on the aggregates can lead to exceeding specified water to cement ratios and can lessen the durability of the concrete structure, as well as lower the compressive and flexural strengths.

ASTM C 566 or AASHTO T 255 Standard Test Method for Total Evaporable Moisture Content by Drying gives guidance in the proper way to determine the moisture content to aggregates so that proper adjustments can be made to the concrete mixture to account for this free moisture. This method can also be used to check the calibration of moisture probes and moisture meters.

In this exercise, we will look at the oven or hot plate method to determine the moisture content of an aggregate when that aggregate is completely dried, however a microwave oven can also be used.

The size of the sample that is needed to perform the test is a function of the nominal maximum aggregate particle size, therefore different sample sizes are needed for different size aggregates. The sample size needed can be found in a table listed in the test methods listed above.

The formula used to determine the moisture content of the aggregate is:

$$\boldsymbol{p = \left(\frac{W - D}{D}\right) * 100}$$

Where:

$\boldsymbol{p} =$ Total moisture content of sample at SSD in percent

$\boldsymbol{W} =$ Mass of original sample in grams

$\boldsymbol{D} =$ Mass of dried sample in grams

However, this will determine the total moisture content of the aggregate and you will need to determine only the surface moisture content of aggregate due to the fact that the concrete mix design was based on the saturate surface dried (SSD) aggregate. Therefore it is necessary at account for the absorbance of the aggregate and:

The formula used to determine the SSD moisture content of the aggregate is:

$$\boldsymbol{S = \left(\frac{W - D}{D}\right) * 100 - A}$$

Where:

$\boldsymbol{S} =$ Total moisture content of sample at SSD in percent

$\boldsymbol{W} =$ Mass of original sample in grams

$\boldsymbol{D} =$ Mass of dried sample in grams

$\boldsymbol{A} =$ Absorption of the aggregate in percent

Mix Proportion Development **Example Q1**

Develop the mix proportioning for a CLASS 2500 Concrete having 5% of the cement replaced with fly ash using the following aggregate:

Coarse Aggregate / L. Stone	Specific Gravity (SG) = 2.74	2% moisture
Fine Aggregate	Specific Gravity (SG) = 2.68	2% moisture

A mix proportion form is provided at the end of this exam booklet.

If 14 cubic yards of this mix is required, determine:

total ***weight*** of:

cement ______________________

fly ash ______________________

silica fume ______________________

added water ______________________

fine aggregate ______________________

coarse aggregate ______________________

total ***volume*** of **added** water required (Gal) ______________________

number of ready mix trucks required: ______________________

Mix Proportion Development **Example Q2**

Develop the mix proportioning for a CLASS 3000 Concrete having 6% of the cement replaced with fly ash using the following aggregate:

Coarse Aggregate / Crushed	Specific Gravity (SG) = 2.91	1% moisture
Fine Aggregate	Specific Gravity (SG) = 2.68	3% moisture

A mix proportion form is provided at the end of this exam booklet.

If 10 cubic yards of this mix is required, determine:

total ***weight*** of:	cement	______________
	fly ash	______________
	silica fume	______________
	added water	______________
	fine aggregate	______________
	coarse aggregate	______________

total ***volume*** of **added** water required (Gal) ______________

number of ready mix trucks required: ______________

Mix Proportion Development **Example Q3**

Develop the mix proportioning for a CLASS 7000 Concrete having 8% of the cement replaced with fly ash using the following aggregate:

Coarse Aggregate / Crushed	Specific Gravity (SG) = 2.47	1% moisture
Fine Aggregate	Specific Gravity (SG) = 2.68	3% moisture

A mix proportion form is provided at the end of this exam booklet.

If 18 cubic yards of this mix is required, determine:

total ***weight*** of:

cement ____________________

fly ash ____________________

silica fume ____________________

added water ____________________

fine aggregate ____________________

coarse aggregate ____________________

total ***volume*** of **added** water required (Gal) ____________________

number of ready mix trucks required: ____________________

Mix Proportion Development **Example Q4**

Develop the mix proportioning for a CLASS 4000 Concrete having 20% of the cement replaced with fly ash using the following aggregate:

Coarse Aggregate / Gravel	Specific Gravity (SG) = 2.70	1% moisture
Fine Aggregate / Sand	Specific Gravity (SG) = 2.68	4% moisture

If 6 cubic yards of this mix is required, determine:

total ***weight*** of:

cement __________________

fly ash __________________

silica fume __________________

added water __________________

fine aggregate __________________

coarse aggregate __________________

Volume of **added** water required in Gallons: __________________

Mix Proportion Development **Example Q5**

Develop the mix proportioning for a CLASS 6500 Concrete using the following aggregate:

Coarse Aggregate / Crushed	Specific Gravity (SG) = 2.69	1% moisture
Fine Aggregate / Sand	Specific Gravity (SG) = 2.61	4% moisture

If 3.5 cubic yards of this mix is required, determine:

total ***weight*** of:

cement ____________________

fly ash ____________________

silica fume ____________________

added water ____________________

fine aggregate ____________________

coarse aggregate ____________________

Volume of **added** water required in Gallons: ____________________

Mix Proportion Development **Example Q6**

Develop the mix proportioning for a CLASS 5000 Concrete having 10% of the cement replaced with fly ash using the following aggregate:

Coarse Aggregate / Crushed	Specific Gravity (SG) = 2.70	1% moisture
Fine Aggregate / Sand	Specific Gravity (SG) = 2.68	6% moisture

If 24 cubic yards of this mix is required, determine:

total ***weight*** of:

	cement	______________
	fly ash	______________
	silica fume	______________
	added water	______________
	fine aggregate	______________
	coarse aggregate	______________

Volume of **added** water required in Gallons: ______________

Concrete Mix Proportion Development Calculator

Answer Q1

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information				Aggregate Information			
Concrete Type	Class	2500		Fine	Coarse		(revised for new specs.
Number of Yds^3 to be batched		14	Type	Sand	L. Stone	***Ratio Total should = 100%***	8/9/2005)
FA Replacement % (decmile)		0.05	Ratio	0.4	0.6	100%	
Max Water to Cement Ratio		0.56	% Moisture	0.02	0.02		
			Spec. Grav.	2.68	2.74		

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	494	
Final Cement	469	2.386
Fly Ash	30	0.214
Total Cementitious	499	
Initial Water	279	4.471
Final Water	216	
Air	0	1.215
Paste	N/A	8.286
Free Volume		18.714
Vol Check	***should = 27***	27.000

Fine Aggregate

18.714	0.4	7.486	2.68	1252	25	1277
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

18.714	0.6	11.228	2.74	1920	38	1958
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	14
Cement	469		6,566
Fly Ash	30		420
Water	216		3,024
Fine Ag.	1,277		17,878
Coarse Ag	1,958		27,412
Total /Yd^3	**3,950**		55,300

Total Vol of added water (Gal)
= 363

Concrete Mix Proportion Development Calculator

Answer Q2

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information				Aggregate Information		
Concrete Type	Class	3000		Fine	Coarse	
Number of Yds^3 to be batched		10	Type	Sand	Crushed	***Ratio Total Should = 100%***
FA Replacement % (decmile)		0.06	Ratio	0.35	0.65	100%
Max Water to Cement Ratio		0.46	% Moisture	0.03	0.01	
			Spec. Grav.	2.68	2.91	

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	588	
Final Cement	553	2.813
Fly Ash	42	0.299
Total Cementitious	595	
Initial Water	274	4.391
Final Water	220	
Air	0	1.215
Paste	N/A	8.718
Free Volume		18.282
Vol Check	***Should = 27***	27.000

Fine Aggregate

18.282	0.35	6.399	2.68	1070	32	1102
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

18.282	0.65	11.883	2.91	2158	22	2180
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	10
Cement	553		5,530
Fly Ash	42		420
Water	220		2,200
Fine Ag.	1,102		11,020
Coarse Ag	2,180		21,800
Total /Yd^3	**4,097**		40,970

Total Vol of added water (Gal)
= 264

Concrete Mix Proportion Development Calculator

Answer Q3

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information

Concrete Type	Class	7000		Fine	Coarse	
Number of Yds^3 to be batched		18	Type	Sand	Crushed	***Ratio Total Should = 100%***
FA Replacement % (decmile)		0.08	Ratio	0.35	0.65	100%
Max Water to Cement Ratio		0.37	% Moisture	0.03	0.01	
			Spec. Grav.	2.68	2.47	

(Aggregate Information)

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	800	
Final Cement	736	3.744
Fly Ash	77	0.548
Total Cementitious	813	
Initial Water	301	4.824
Final Water	255	
Air	0	1.215
Paste	N/A	10.331
Free Volume		16.669
Vol Check	***Should = 27***	27.000

Fine Aggregate

16.669	0.35	5.834	2.68	976	29	1005
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

16.669	0.65	10.835	2.47	1670	17	1687
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	18
Cement	736		13,248
Fly Ash	77		1,386
Water	255		4,590
Fine Ag.	1,005		18,090
Coarse Ag	1,687		30,366
Total /Yd^3	**3,760**		67,680

Total Vol of added water (Gal) = 551

Concrete Mix Proportion Development Calculator

Answer Q4

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information

Concrete Type	Class	4000	
Number of Yds^3 to be batched		6	
FA Replacement % (decmile)		0.2	
Max Water to Cement Ratio		0.4	

Aggregate Information

	Fine	Coarse	
Type	Sand	Gravel	***Ratio Total Should = 100%***
Ratio	0.34	0.66	100%
% Moisture	0.04	0.01	
Spec. Grav.	2.68	2.7	

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	611	
Final Cement	489	2.488
Fly Ash	146	1.040
Total Cementitious	635	
Initial Water	254	4.071
Final Water	193	
Air	0	1.215
Paste	N/A	8.814
Free Volume		18.186
Vol Check	***Should = 27***	27.000

Fine Aggregate

18.186	0.34	6.183	2.68	1034	41	1075
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

18.186	0.66	12.003	2.7	2022	20	2042
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	6
Cement	489		2,934
Fly Ash	146		876
Water	193		1,158
Fine Ag.	1,075		6,450
Coarse Ag	2,042		12,252
Total /Yd^3	**3,945**		23,670

Total Vol of added water (Gal) = 139

Class 6500 Mix Proportion Development Calculator

Answer Q5

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information

					Aggregate Information		
Concrete Type	Class	6500			Fine	Coarse	
Number of Yds^3 to be batched		3.5	Type		Sand	Crushed	***Ratio Total Should = 100%***
			Ratio		0.37	0.63	100%
Max Water to Cement Ratio		0.37	% Moisture		0.04	0.01	
			Spec. Grav.		2.61	2.69	

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	500	2.544
Fly Ash	140	0.997
Silica Fume	35	0.255
Total Cementitious	675	
Initial Water	250	4.006
Final Water	188	
Air	0	1.215
Paste	N/A	9.017
Free Volume		17.983
Vol Check	***Should = 27***	27.000

Fine Aggregate

17.983	0.37	6.654	2.61	1084	43	1127
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

17.983	0.63	11.329	2.69	1902	19	1921
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	3.5	Total Vol of added water (Gal)
Cement	500		1,750	= 79
Fly Ash	140		490	
Silica Fume	35		123	
Water	188		658	
Fine Ag.	1,127		3,945	
Coarse Ag	1,921		6,724	
Total /Yd^3	**3,911**		13,689	

Concrete Mix Proportion Development Calculator — Answer Q6

Fill in the appropriate values to the shaded areas to complete the calculations. Enter percentages as decmile values.

Cement Information			
Concrete Type	Class	5000	
Number of Yds^3 to be batched		24	
FA Replacement % (decmile)		0.1	
Max Water to Cement Ratio		0.46	

Aggregate Information	Fine	Coarse	
Type	Sand	Crushed	***Ratio Total Should = 100%***
Ratio	0.35	0.65	100%
% Moisture	0.06	0.01	
Spec. Grav.	2.68	2.7	

	Weight (lb)	Vol (ft^3)
Initial Cement/Yd^3	705	
Final Cement	635	3.231
Fly Ash	84	0.598
Total Cementitious	719	
Initial Water	331	5.304
Final Water	254	
Air	0	1.215
Paste	N/A	10.348
Free Volume		16.652
Vol Check	***Should = 27***	27.000

Fine Aggregate

16.652	0.35	5.828	2.68	975	59	1034
Free Vol	FA %	Volume FA	Spc Grav FA	Init.Wt. FA	Additional FA	Final Wt FA

Coarse Aggregate

16.652	0.65	10.824	2.7	1824	18	1842
Free Vol	CA %	Volume CA	Spc Grav CA	Init.Wt. CA	Additional CA	Final Wt CA

Final Wts	Lbs/Yd^3	Total Yds^3=	24
Cement	635		15,240
Fly Ash	84		2,016
Water	254		6,096
Fine Ag.	1,034		24,816
Coarse Ag	1,842		44,208
Total /Yd^3	**3,849**		92,376

Total Vol of added water (Gal) = 732

CONCRETE BATCHING
Per Cubic Yard

			Cu. Yd Batch Weight
Cement:	$\dfrac{\_\_\_\_\_\_}{3.15 \times 62.4}$ lbs =	______ ft^3	______ lbs
Fly Ash:	$\dfrac{\_\_\_\_\_\_}{2.25 \times 62.4}$ lbs =	______ ft^3	______ lbs
Silica Fume:	$\dfrac{\_\_\_\_\_\_}{2.20 \times 62.4}$ lbs =	______ ft^3	______ lbs
Other:	$\dfrac{\_\_\_\_\_\_}{\_\_\_\_ \times 62.4}$ lbs =	______ ft^3	______ lbs
Added Water:	$\dfrac{\_\_\_\_\_\_}{1 \times 62.4}$ lbs =	______ ft^3	______ lbs
Air:	27 x _____ % =	______ ft^3	

Volume of Paste ______ ft^3 **(A)**

Volume of Aggregate: 27 - (A) ______ ft^3 **(B)**

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

______ (B) **x** ______ %FA **=** ______ (C) ft^3 **x** ______ SG **x 62.4 =** ______ **lbs**

Coarse Aggregate

______ (B) **x** ______ %CA **=** ______ (D) ft^3 **x** ______ SG **x 62.4 =** ______ **lbs**

Check Volume (A + C + D must = 27 ft^3) ______ ft^3

Total Weight per Cu. Yd. ______ **lbs/Cu.Yd.**

CONCRETE BATCHING
Per Cubic Yard

			Cu. Yd Batch Weight
Cement:	$\dfrac{\_\_\_\_\_\_\_\_}{3.15 \times 62.4}$ lbs =	________ ft^3	________ lbs
Fly Ash:	$\dfrac{\_\_\_\_\_\_\_\_}{2.25 \times 62.4}$ lbs =	________ ft^3	________ lbs
Silica Fume:	$\dfrac{\_\_\_\_\_\_\_\_}{2.20 \times 62.4}$ lbs =	________ ft^3	________ lbs
Other:	$\dfrac{\_\_\_\_\_\_\_\_}{\_\_\_\_ \times 62.4}$ lbs =	________ ft^3	________ lbs
Added Water:	$\dfrac{\_\_\_\_\_\_\_\_}{1 \times 62.4}$ lbs =	________ ft^3	________ lbs
Air:	27 x _____ % =	________ ft^3	

Volume of Paste ________ ft^3 (A)

Volume of Aggregate: 27 - (A) ________ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

________ (B) x ________ %FA = ________ (C) ft^3 x ________ SG x 62.4 = ________ lbs

Coarse Aggregate

________ (B) x ________ %CA = ________ (D) ft^3 x ________ SG x 62.4 = ________ lbs

Check Volume (A + C + D must = 27 ft^3) ________ ft^3

Total Weight per Cu. Yd. ________ lbs/Cu.Yd.

CONCRETE BATCHING
Per Cubic Yard

				Cu. Yd Batch Weight
Cement:	______ lbs = / 3.15 x 62.4	______	ft^3	______ lbs
Fly Ash:	______ lbs = / 2.25 x 62.4	______	ft^3	______ lbs
Silica Fume:	______ lbs = / 2.20 x 62.4	______	ft^3	______ lbs
Other:	______ lbs = / ____ x 62.4	______	ft^3	______ lbs
Added Water:	______ lbs = / 1 x 62.4	______	ft^3	______ lbs
Air:	27 x _____ % =	______	ft^3	

Volume of Paste ______ ft^3 (A)

Volume of Aggregate: 27 - (A) ______ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

______ x ______ = ______ ft^3 x ______ x 62.4 = ______ lbs

(B) %FA (C) SG

Coarse Aggregate

______ x ______ = ______ ft^3 x ______ x 62.4 = ______ lbs

(B) %CA (D) SG

Check Volume (A + C + D must = 27 ft^3) ______ ft^3

Total Weight per Cu. Yd. ______ lbs/Cu.Yd.

CONCRETE BATCHING
Per Cubic Yard

				Cu. Yd Batch Weight
Cement:	________ lbs = / 3.15 x 62.4	________	ft^3	________ lbs
Fly Ash:	________ lbs = / 2.25 x 62.4	________	ft^3	________ lbs
Silica Fume:	________ lbs = / 2.20 x 62.4	________	ft^3	________ lbs
Other:	________ lbs = / ____ x 62.4	________	ft^3	________ lbs
Added Water:	________ lbs = / 1 x 62.4	________	ft^3	________ lbs
Air:	27 x _____ % =	________	ft^3	
Volume of Paste		________	ft^3 (A)	
Volume of Aggregate: 27 - (A)		________	ft^3 (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

________ x ________ = ________ ft^3 x ________ x 62.4 = ________ lbs
(B) %FA (C) SG

Coarse Aggregate

________ x ________ = ________ ft^3 x ________ x 62.4 = ________ lbs
(B) %CA (D) SG

Check Volume (A + C + D must = 27 ft^3) ________ ft^3

Total Weight per Cu. Yd. ________ lbs/Cu.Yd.

CONCRETE BATCHING
Per Cubic Yard

			Cu. Yd Batch Weight
Cement:	$\dfrac{\_\_\_\_\_\_\_\_}{3.15 \times 62.4}$ lbs =	________ ft^3	________ lbs
Fly Ash:	$\dfrac{\_\_\_\_\_\_\_\_}{2.25 \times 62.4}$ lbs =	________ ft^3	________ lbs
Silica Fume:	$\dfrac{\_\_\_\_\_\_\_\_}{2.20 \times 62.4}$ lbs =	________ ft^3	________ lbs
Other:	$\dfrac{\_\_\_\_\_\_\_\_}{\_\_\_\_ \times 62.4}$ lbs =	________ ft^3	________ lbs
Added Water:	$\dfrac{\_\_\_\_\_\_\_\_}{1 \times 62.4}$ lbs =	________ ft^3	________ lbs
Air:	27 x _____ % =	________ ft^3	

Volume of Paste ________ ft^3 (A)

Volume of Aggregate: 27 - (A) ________ ft^3 (B)

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

________ x ________ = ________ ft^3 x ________ x 62.4 = ________ lbs
(B) %FA (C) SG

Coarse Aggregate

________ x ________ = ________ ft^3 x ________ x 62.4 = ________ lbs
(B) %CA (D) SG

Check Volume (A + C + D must = 27 ft^3) ________ ft^3

Total Weight per Cu. Yd. ________ lbs/Cu.Yd.

CONCRETE BATCHING
Per Cubic Yard

				Cu. Yd Batch Weight
Cement:	$\frac{\_\_\_\_\_\_}{3.15 \times 62.4}$ lbs =	______	ft^3	______ lbs
Fly Ash:	$\frac{\_\_\_\_\_\_}{2.25 \times 62.4}$ lbs =	______	ft^3	______ lbs
Silica Fume:	$\frac{\_\_\_\_\_\_}{2.20 \times 62.4}$ lbs =	______	ft^3	______ lbs
Other:	$\frac{\_\_\_\_\_\_}{\_\_\_ \times 62.4}$ lbs =	______	ft^3	______ lbs
Added Water:	$\frac{\_\_\_\_\_\_}{1 \times 62.4}$ lbs =	______	ft^3	______ lbs
Air:	27 x ______ % =	______	ft^3	
	Volume of Paste	______	ft^3 (A)	
	Volume of Aggregate: 27 - (A)	______	ft^3 (B)	

(B) x Aggregate Ratio = Volume of Each Aggregate

Fine Aggregate

______ x ______ = ______ ft^3 x ______ x 62.4 = ______ lbs
(B) %FA (C) SG

Coarse Aggregate

______ x ______ = ______ ft^3 x ______ x 62.4 = ______ lbs
(B) %CA (D) SG

Check Volume (A + C + D must = 27 ft^3) ______ ft^3

Total Weight per Cu. Yd. ______ lbs/Cu.Yd.

Chapter 7

Form 700.04

& Aggregate Sampling

SCDOT Form 700.04 is the reporting form for ready mix concrete batches. It is intended for QC/QA purposes in order to record and monitor:

- **Concrete origin, load, placing, time on site and mixing information**
- **Concrete slump and air content**
- **Actual concrete mix versus design proportions**
- **Water and admixture proportions and history**

Copies of Form 700.04 (US Units) are provided at the end of this section.

This section also contains step-by-step guidelines, an example tutorial for completing the Form 700.04, and a selection of practice problems and their solutions.

Guidelines for Completing the SCDOT Form 700.04

Filling out Form 700.04 will require the maximum water to cement ratio from the Structural Concrete Table, SCDOT Specifications Section 701. Additionally, a batch ticket or batch computer screen will be required to obtain the theoretical mix component weights and volumes. This guide refers to the standard mix design as the batch ticket or batch computer screen and the listing of the actual amounts of each material used. Lab Form 271 (R-02) <u>OR</u> Equivalent can be used to verify the SSD mix design material weights for one cubic yard. Titles that appear in "quotation marks" correspond to specific fields within the Form 700.04.

A bag of cement weighs 94 pounds.

<u>STEPS</u>

1. Read the Problem Statement.
2. Find the appropriate batch ticket or batch computer screen paying attention to class and additional cementitious materials.
3. Fill in basic batch information at the top of the form.
4. Fill in the appropriate individual weight values for cement(s), and the total cement weight as listed on the batch ticket or batch computer screen, for the appropriate batch size.
5. Fill in the course aggregate weight as listed on the batch ticket or batch computer screen typically listed as the "target weight".
6. Fill in the sand weight for the specified sand percent moisture as listed on the batch ticket or batch computer screen.
7. Fill in the cumulative aggregate weight by adding aggregate values as listed on the batch ticket or batch computer screen.
8. Fill in the water weight and volume (gal) as listed on the batch ticket or batch computer screen to the appropriate blocks.
9. Calculate the allowable tolerances (weight ranges) for the cementitious materials (-1%), and for the aggregates (±2%). Round to the nearest pound.

10. Obtain the loading/dosage rates for any admixtures to be incorporated into the batch from the problem statement, fill in the *rate values given for the air entrainment agent, water reducing agent or retarding agent.

11. Calculate the amounts of air entrainment agent, water reducing agent or retarding agent to be added to the mix, based on the total amount of cement material specified for the mix.

12. Using the batch ticket values (actual proportions that are in the truck or central mixer) fill in the Actual Batch Weight values. Verify that a double batch was/was not required.

13. Determine the total cementitious material quantity by adding the cement, fly ash, and silica fume weights. Place this value in the appropriate space.

14. From the batch ticket obtain the actual batched water in gallons from the "Batched" column. *Some plants weigh water and it will already be given in pounds.* If the batch ticket does not give the weight of water in pounds, take the number of gallons and multiply by 8.33 to get the pounds to the nearest whole number.

15. Evaluate the actual batch weights to determine if they meet the acceptable "Theoretical Batch Values". Place a mark in the corresponding YES box for proportions that are within the acceptable range. Place a mark in the NO box for proportions that are outside of the acceptable range.

16.
    a. Fill in the "Free Moisture Percent" spaces with the appropriate values. The values for the aggregate moistures are obtained from the Batch Ticket or Batch Computer Screen.
    b. Calculate the "SSD Weight" of the aggregates by following the formula provided ** on the Form 700.04. Round to the nearest pound.
    c. Determine the "Free Aggregate Moisture" by subtracting the "SSD Weight" from the "Actual Batch Weights" for each type of aggregate.

17. Transfer the actual amount of "Meter Water" added to the mix from the "Actual Batch Weight" column.

18. Obtain the “Total Water Added at the Plant” by summing the two “Free Aggregate Moistures” and the “Meter Water” weights.

19. Determine the “Maximum Water Allowed for the Mix AS Batched” by multiplying the correct w/c ratio by the “Actual Batch Weight for Total Cementitious Material”.

20. Determine the “Max Water Allowed for Site Additions” by subtracting the “Total Water Added at Plant” from the “Max Water Allowed for the Mix AS Batched”. Convert the weight of water into gallons by dividing the weight by 8.33.

21. Account for water added at site (this includes the water needed to modify slump). The general rule for increasing slump is that the addition of 1 gallon of water increases the slump of one cubic yard of concrete by 1 inch.

22. Determine the total weight of water in the load by adding the total weight of water from the plant to any water that was required for slump adjustments.

23. Calculate the Water to Cementitious Material Ratio by dividing the Total Water in the Load by the Total Cementitious Material’s Actual Batch Weight.

24. Compare the load’s w/c ratio to the maximum water/cement ratio listed in the Structural Concrete Table from the SCDOT Specification 701 to insure that this load of PCC meets the requirements set forth.

25. For Field Inspectors, fill out the On Site Batch Information based on acceptance test data, observations relevant to the load and times obtained from the truck driver.

Form 700.04

(Chapter 7)

FORM 700.04

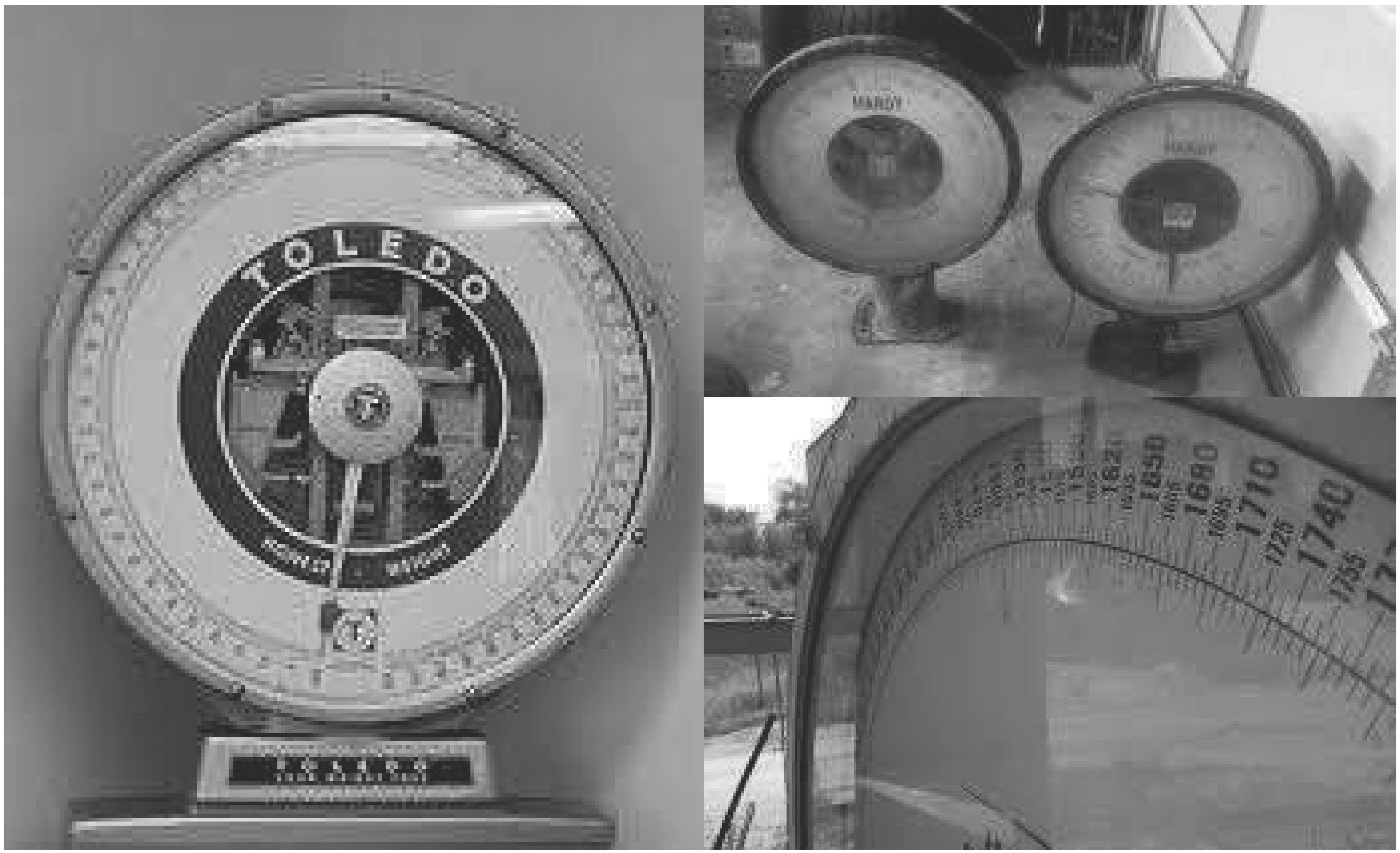
This form is the reporting form for **ready mix concrete** batches. It is used for QC/QA purposes in acceptance and recording and monitoring:

- Concrete origin, load, time on site, and mixing information
- Used to make sure that the delivered concrete is within acceptable limits of SCDOT Specifications
- Record of the plastic properties of the concrete (air, slump, re-tempering with water and chemical additions of the concrete on site)
- Actual concrete mix versus design proportions

Concrete Batch Plants are starting to keep up with technology and it is getting easier to access the information you need.

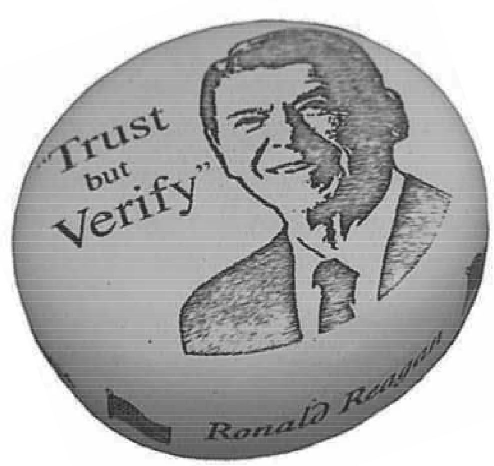
Remember, some plants still use dial scales and they are acceptable. No printable batch ticket will be available and material weights will be determined by reading the scale values from the dial gauges.

Also remember that some plants weigh water and some use volumetric methods (typically gallons.)



Lab Form 271 (R-02) **OR** Equivalent shall be stamped as Reviewed by the OMR.

“ **701.2.5.11** after successful review of a mix design by the OMR, do not change the mix proportions for the concrete of that class unless modifications are necessary and are approved in advance. ”



SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
Concrete Mix Proposal/Fly Ash-Slag (other)

Company ABC Ready Mix
Address 123 Nowhere St.
Individual to Contact John Doe **Phone No.** 803-555-1234
Testing Agency
Address
Individual to Contact **Phone No.**
Class of Concrete Class 5000 with Fly Ash **Special Mix**

Material	Source	Location or Trade Name	Sp. Grav. SSD Used	Amt./Cu. Yd. SSD			
Cement	Holcim	Holly Hill Type I/II	3.15	6.000	Bag/	564	lb
Fly Ash	SEFA	Approved sources	2.25	1.798	Bag/	169	lb
Slag Mod.			3.05	0.000	Bag/		lb
Silica Fume			2.20	0.000			lb
DCI			1.30	0.000			gal
Other Cor.Inhibitor							gal
Fine Agg.	Sumter County Sand	Sumter, SC	2.63			1117	lb
Int. Agg.						0	lb
Coarse Agg	Martin Marietta	Cayce	2.63			1675	lb
Inter. Cr. Agg						0	lb
Admix 1	W.R. Grace	Darex II	NR			As Nec.	oz.
Admix 2	W.R. Grace	Zyla 620	NR			As Nec.	oz
Admix 3	W.R. Grace	Recover	NR			As Nec.	oz
Admix 4	W.R. Grace	ADVA 198	NR			As Nec.	oz
Water			1.00	gal. 35.18		293.20	lb

Date(s) of Mix Performed By: Slump in
Air Content % By Pressure Meter Rollometer
Unit Weight 141.4 lbs/Cu.Ft. The yield 27.00 Cu.Ft.
Average Compressive Strength PSI @ 3 Days PSI @ 7 Days
PSI @ 28 Days

Percent of Fine Aggregate to total Aggregate by Volume	40.00	%
Percent of Int. Aggregate to total Aggregate by Volume	0.00	%
Percent of Coarse Aggregate to total Aggregate by Volume	60.00	%
Percent of Inter. Cr. Aggregate to total Aggregate by Volume	0.00	%
Must Total 100% Total	100.00	%

Bag Mix	
Cement	94
FA	143
IA	0
CA	215
ICA	0
Water	4.51

Total Cementitious Material 733.0 (lb) divided by 94 = 7.798 bags
Total gallons of water 35.18 divided by 7.798 bags = 4.51
Total lbs of water 293.20 divided by total cementitious 733.0 0.4000 W/C Ratio

Designed % Air 4.50 % Range 3% to 6%

Comments

SCDOT OFFICE OF MATERIALS AND RESEARCH
☒ REVIEWED
☐ REVIEWED - COMMENTS IN RED
☐ REVISE AND RESUBMIT
☐ NOT REVIEWED-INCOMPLETE SUBMITTAL
JmcCabe 12-25-16
CONCRETE SUPERVISOR DATE

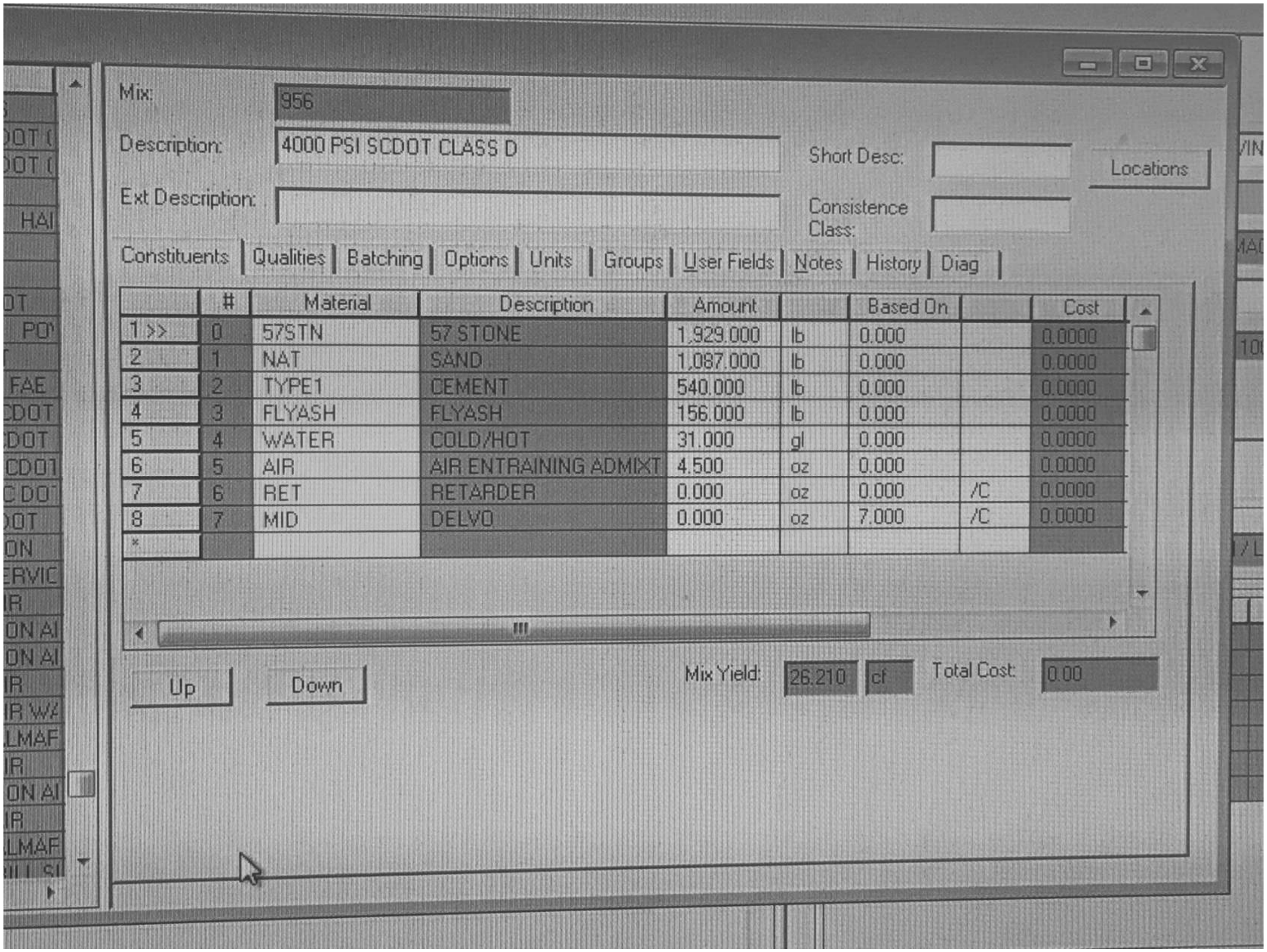
Signed By:
Date:

Return To: South Carolina Department of Transportation
Office of Materials and Research
Attn: Concrete Section
P. O. Box 191
Columbia, SC 29202
Fax (803) 737-6649

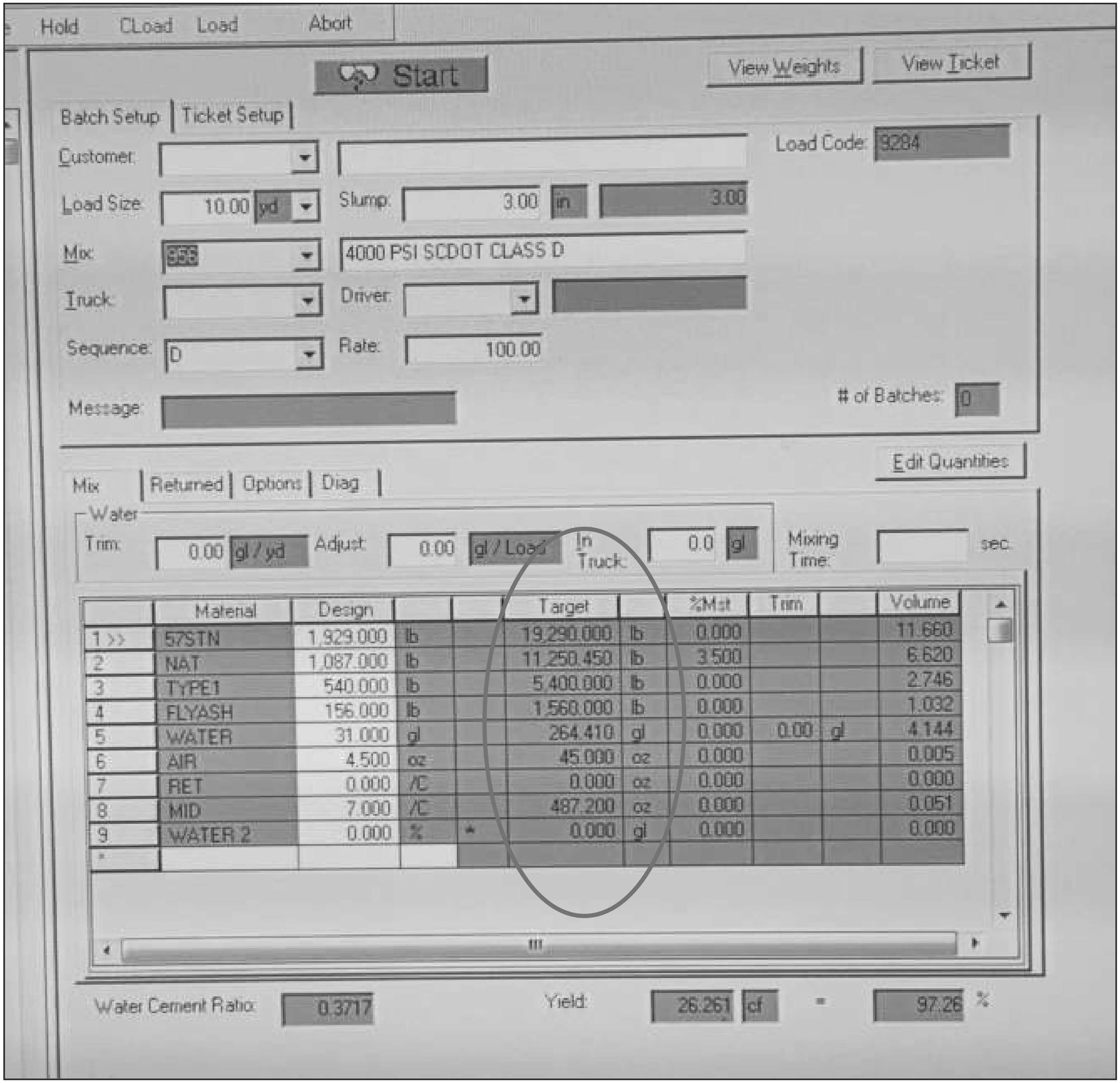
Lab Form 271(R-02)

From the Batch Panel Screen, they can pull up the SSD Mix Design that is being used. You can see that this is Mix: 956 ….

Are the same mix proportions used on the Form 271 (R-02)?



The **theoretical batch** weights adjusted for the aggregate moistures can be obtained from the batch computer screen or a printout of the batch ticket.



Unless the Batch Ticket has been approved by the OMR for use as an alternative to the 700.04 (Supplemental Specification 04/05/10)

The values at the bottom of the batch ticket shall not be used!

Truck	Driver	User	Disp Ticket
		user	
Load Size	Mix Code	Returned	Qty
10.00 yd	956		

Material	Design Qty	Required	Batched	% Var	% Moisture
57STN	1929 lb	19290 lb	19125 lb	-0.86%	
NAT	1087 lb	11250 lb	11142 lb	-0.96%	3.50% M
TYPE1	540.0 lb	5400.0 lb	5419.8 lb	0.37%	
FLYASH	156.0 lb	1560.0 lb	1545.7 lb	-0.92%	
WATER	31.00 gl	264.41 gl	265.28 gl	0.33%	
AIR	4.50 oz	45.00 oz	46.69 oz	3.76%	
MID	.00 /C #	.00 oz	.00 oz		

FORM 700.04 - EXAMPLE Q1

STEP 1. Read the Problem Statement.

Total Concrete required for the pour:

70 cubic yards, delivered by seven trucks carrying 10 cubic yards each.

Class 3000 Concrete with 6% Fly Ash

AGGREGATES	AGGREGATE TYPE	SPECIFIC GRAVITY	MOISTURE PERCENTAGE
COARSE	Crushed Stone	2.65	1.0%
FINE	Sand	2.62	3.0%

ADMIXTURE	DOSAGE RATE
Air Entrainer	0.60 oz/bag
Water Reducer	2.50 oz/100 lbs.

Cement Scale	6000 lbs. MAX
Aggregate Scale	25,000 lbs. MAX

Water	
First Site Addition	Enough to increase the slump by 2 inches
Second Site Addition	

** Remember that we need the Type of coarse aggregate so we can get the correct w/c ratio from the Structural Concrete Table **

BATCH TICKET PRINTOUT OR BATCH COMPUTER SCREEN

STEP 2. Find the appropriate batch ticket paying attention to class and additional cementitious materials.

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	~~1.02~~	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	~~1.00~~	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	~~1.00~~	
Fly Ash	42 lb	420 lb	431 lb	~~1.03~~	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.		-1%										
FLY ASH, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		±2%										
AGGREGATE (2) LBS		±2%										
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)		—										
CRR. INHIB., GAL		—								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. ———— =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL.		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ = ☐

1st WATER ADDED AT SITE		GAL. x 8.33 = LBS.	
2nd WATER ADDED AT SITE		GAL. x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ———— LBS.			

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

Mix Information As Batched

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	1.02	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	1.00	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	1.00	
Fly Ash	42 lb	420 lb	431 lb	1.03	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

You must always verify that the SSD Material Weights are the same SSD weights used on the SCDOT Reviewed Mix Design from the OMR. A copy of the SCDOT Approved Mix Design can be obtained from the RCE or the Ready Mix Concrete Plant will have access to the approved design.

Mix Information As Batched

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	1.02	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	1.00	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	1.00	
Fly Ash	42 lb	420 lb	431 lb	1.03	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

You must also verify that the materials used are from the source that were used on the approved mix design and that they are approved on the current QPL.

STEP 3. Fill in basic batch information at the top of the form.

This includes the:

File Number
Date
Class of Concrete
Load Number
Load Size
Accumulated Load Size (= Load number x Load Size)
Truck Number

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

Top Portion of 700.04 Form

STEP 3. Fill in basic batch information at the top of the form.

This includes the:

File Number
Date
Class of Concrete
Load Number
Load Size
Accumulated Load Size (= Load number x Load Size)
Truck Number

Form 700.04

South Carolina Depatment Of Transportation
Ready Mix Concrete Report

File No. 34.017 **Date:** 10/31/16 **Class:** 3000 **Load No.** 2 **Cu Yds** 10 **Accumulative CY** 20 **Truck #** 98

Time Mixing Began (Time) **Revs @ Plant, @ Mixing Speed** (Revolutions) **Plant and Location** (Plant, City, State)

Plant Inspector John Q. Doe

Top Portion of 700.04 Form

STEP 4-8. The Batch Total Weights are given on the appropriate concrete plant batch ticket or the screen of the computer of the batch system. These are the **theoretically ideal values** for proportioning this specific class of concrete using the prescribed materials.

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*	SSD WEIGHT	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	
CEMENT, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.		-1%										
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		±2%										
AGGREGATE (2) LBS		±2%										
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)		—										
CORR. INHIB., GAL		—								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. ______ =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ =

1st WATER ADDED AT SITE		GAL x 8.33 = LBS.
2nd WATER ADDED AT SITE		GAL x 8.33 = LBS.
TOTAL WATER IN LOAD = (SUM)		LBS.

COMMENTS: ______ MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

SLUMP: ______ ENTR. AIR %: ______ ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

CYLINDERS MADE (NO / YES): ______ ID #: ______ MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

TIME UNLOADING OF TRUCK ENDED: ______ CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

POUR LOCATION: ______

FIELD INSPECTOR: ______

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

Mix Information As Batched

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	1.02	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	1.00	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	1.00	
Fly Ash	42 lb	420 lb	431 lb	1.03	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

The Target Weight is the theoretical weight of the materials that have been adjusted for moisture content for the given size load of concrete.

STEP 4-8. The Theoretical Batch Total Weights can be obtained from the Batch Ticket or Batch Computer Screen. These are the theoretically ideal values for proportioning this specific class of concrete using the prescribed materials.

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER
98	34.017	D. Taylor	654984

LOAD SIZE	MIX CODE	RETURNED QUANTITY
10.00	3000AEF	0

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT
Coarse Agg	2158 lb	21800 lb
Int Agg		
Fine Agg	1070 lb	11020 lb
Total Agg (lbs)		
Cement	553 lb	5530 lb
Fly Ash	42 lb	420 lb
WR	2.5 oz/ 100 Lbs.	149 oz
Air	0.6 oz/bag	38 oz
Water (lbs)	274 lb	2199 lb
Water (gal)		264 gal

Batch Ticket

MATERIALS	* BATCH CHART TOTAL
CEMENT LBS.	5530
FLY ASH LBS.	420
SILICA FUME LBS.	
TOTAL CEM. MATERIAL	"5950"
AGGREGATE (1) LBS.	21800
AGGREGATE (2) LBS.	11020
AGGREGATE (3) LBS.	
TOTAL (1) + (2) + (3)	"32820"
METER WATER GAL (= GAL x 8.33)	264
METER WATER LBS	2199

700.04 Form

STEP 9. Calculate the allowable weight tolerances as indicated. Round the weights to the nearest pound.

5530 – (.01 x 5530) = **5475**
5530 x .99 = **5475**

420 x .99 = **416**
5950 x .99 = **5891**

21800 – (.02 x 21800) = **21364**
21800 + (.02 x 21800) = **22236**

11020 x 0.98 = **10800**
11020 x 1.02 = **11240**

There are multiple methods to calculate the low and high values used to bracket the acceptable tolerance. You may use any method you are comfortable with. Two different methods are show above.

MATERIALS	* BATCH CHART TOTAL	TOLERLANCE	* Batch Chart Total	
			Low -	High +
CEMENT LBS.	5530	-1%	**5475**	XXXXX
FLY ASH LBS.	420	-1%	**416**	XXXXX
SILICA FUME LBS.		-1%		XXXXX
TOTAL CEM. MATL.	5950	-1%	**5891**	XXXXX
AGGREGATE (1) LBS.	21800	±2%	**21364**	**22236**
AGGREGATE (2) LBS.	11020	±2%	**10800**	**11240**
AGGREGATE (3) LBS.		±2%		
TOTAL (1) + (2) + (3)	32820	---		
COR. INHIBITOR GAL		---		
METER WATER GAL	264		* Rate	
METER WATER LBS.	2199		oz/Bag	oz/100 lbs

700.04 Form

STEP 10-11. Obtain the loading/dosage rates for any admixtures to be incorporated into the batch from the problem statement. For this example, the AEA loads at 0.6 oz/bag of cementitious material. Since a bag of cement weighs 94 lbs., the loads rate could be written 0.6 oz/94 lbs. Notice that WRA's and WRR's dose per 100 lbs. cementitious material. For this example, the WRA loads at 2.5 oz/ 100 lbs. of cementitious material.

MATERIALS	* BATCH CHART TOTAL	TOLERLANCE	* Rate	
CEMENT LBS.	5530	-1%		
FLY ASH LBS.	420	-1%		
SILICA FUME LBS.		-1%		
TOTAL CEM. MATL.	5950	-1%		
AGGREGATE (1) LBS.	21800	±2%		
AGGREGATE (2) LBS.	11020	±2%		
AGGREGATE (3) LBS.		±2%		
TOTAL (1) + (2) + (3)	32820	---		
COR. INHIBITOR GAL		---		
METER WATER GAL	264			
METER WATER LBS.	**2199**		oz/Bag	oz/100 lbs
AIR ENT. AGENT	**38**		**0.6**	XXXXX
WATER RED. AGENT	**149**		XXXX	**2.5**
WATER RED/RETARDER			XXXX	

700.04 Form

To calculate the amount of AEA to the nearest oz:

(0.60/94) x 5950 = **38 oz**

OR

(5950/94) x 0.60 = **38 oz**

To calculate the amount of WRA to the nearest oz:

(2.50/100) x 5950 = **149 oz**

OR

(5950/100) x 2.5 = **149 oz**

STEP 12. Using the batch ticket values (**actual proportions that are in the truck or central mixer),** fill in the Actual Batch Weight values. Verify that a double batch was/was not required.

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	1.02	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	1.00	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	1.00	
Fly Ash	42 lb	420 lb	431 lb	1.03	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

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STEP 12. Using the batch ticket values (**actual proportions that are in the truck or central mixer),** fill in the Actual Batch Weight values. Verify that a double batch was/was not required.

DISPATCH TICKET NUMBER	TICKET ID	
654984	20907	

RETURNED QUANTITY	CUMMULATIVE YARDS
0	20 Y

TARGET WEIGHT	BATCHED		
21800 lb	22197 lb		
11020 lb	11130 lb		
5530 lb	5535 lb		
420 lb	431 lb		
149 oz	149 oz		
38 oz	38 oz		
2199 lb			
264 gal	235 gal		

Batch Ticket

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE	
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO
CEMENT, LBS.	5530	-1%	5475				5535		
FLY ASH, LBS.	420	-1%	416				431		
SILICA FUME, LBS.		-1%							
TOTAL CEM. MATL.	5950	-1%	5891						
AGGREGATE (1) LBS	21800	±2%	21364	22236			22197		
AGGREGATE (2) LBS	11202	±2%	10800	11240			11130		
AGGREGATE (3) LBS		±2%							
TOTAL (1) + (2) + (3)	32820	—							
CRR. INHIB., GAL		—							
METER WATER GAL	264	*RATE						TRUCK WASH WATER	
METER WATER LBS	2199	oz / BAG		oz / 100 LBS				METER WATER LBS. —	
AIR ENT. AGENT, oz	38	0.60						Max. Water Allow	
WATER RED. AGENT, oz	149			2.5				GAL	
WATER RED/RETARDED, oz								TOTAL WATE	
MR/HR WATER RED.RET.oz									

700.04 Form

STEP 13. To determine the total cementitious material quantity, add the cement, and fly ash weights. Place this value in the appropriate space.

5535 + 431 = **5966**

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BAT RAN
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES
CEMENT, LBS.	5530	-1%	5475				5535	
FLY ASH, LBS.	420	-1%	416				431	
SILICA FUME, LBS.		-1%						
TOTAL CEM. MATL.	5950	-1%	5891				5966	
AGGREGATE (1) LBS	21800	±2%	21364	22236			22197	
AGGREGATE (2) LBS	11020	±2%	10800	11240			11130	
AGGREGATE (3) LBS		±2%						
TOTAL (1) + (2) + (3)	32820	—						
CRR. INHIB., GAL		—						
METER WATER GAL	264	*RATE						TRUCK WA
METER WATER LBS	2199	oz / BAG		oz / 100 LBS				METER W
AIR ENT. AGENT, oz	38	0.60						Max
WATER RED. AGENT, oz	149			2.5				GAL.
WATER RED/RETARDED, oz								
MR/HR WATER RED.RET.oz								

700.04 Form

STEP 14. From the batch ticket obtain the actual batched water in gallons from the "Batched" column.

* Some plants weigh water and it will already be given in pounds.

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BAT RAN
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES
CEMENT, LBS.	5530	-1%	5475				5535	
FLY ASH, LBS.	420	-1%	416				431	
SILICA FUME, LBS.		-1%						
TOTAL CEM. MATL.	5950	-1%	5891				5966	
AGGREGATE (1) LBS	21800	±2%	21364	22236			22197	
AGGREGATE (2) LBS	11020	±2%	10800	11240			11130	
AGGREGATE (3) LBS		±2%						
TOTAL (1) + (2) + (3)	32820	—						
CRR. INHIB., GAL		—						
METER WATER GAL	264	*RATE					235	TRUCK WA
METER WATER LBS	2199		oz / BAG	oz / 100 LBS				METER W
AIR ENT. AGENT, oz	38		0.60					Max
WATER RED. AGENT, oz	149			2.5				GAL.
WATER RED/RETARDED, oz								
MR/HR WATER RED.RET.oz								

700.04 Form

STEP 14. If the batch ticket does not give the weight of water in pounds, take the number of gallons and multiply by 8.33 to get the pounds to the nearest whole number. 235 x 8.33 = **1958**

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE LOW -	HIGH +	IF SINGLE OR DOUBLE BATCHED ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	IF SINGLE BATCHED OR SUM OB DBL BATCH ACTUAL BATCH WEIGHT	MEETS BAT RAN YES
CEMENT, LBS.	5530	-1%	5475				5535	
FLY ASH, LBS.	420	-1%	416				431	
SILICA FUME, LBS.		-1%						
TOTAL CEM. MATL.	5950	-1%	5891				5966	
AGGREGATE (1) LBS	21800	+2%	21364	22236			22197	
AGGREGATE (2) LBS	11020	+2%	10800	11240			11130	
AGGREGATE (3) LBS		+2%						
TOTAL (1) + (2) + (3)	32820	—						
CRR. INHIB., GAL		—						
METER WATER GAL	264	*RATE					235	TRUCK WA
METER WATER LBS	2199	oz / BAG		oz / 100 LBS			1958	METER
AIR ENT. AGENT, oz	38	0.60						Max
WATER RED. AGENT, oz	149			2.5				GAL.
WATER RED/RETARDED, oz								
MR/HR WATER RED.RET.oz								

700.04 Form

STEP 15. Evaluate the actual batch weights to determine if they meet the acceptable "Theoretical Batch Values". Place a mark in the corresponding YES box for proportions that are within the acceptable range. Place a mark in the NO box for proportions that are outside of the acceptable range.

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE LOW -	HIGH +	IF SINGLE OR DOUBLE BATCHED: ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	IF SINGLE BATCHED OR SUM OB DBL BATCH: ACTUAL BATCH WEIGHT	MEETS BATCH CHART RANGE: YES	NO
CEMENT, LBS.	5530	-1%	5475				5535	X	
FLY ASH, LBS.	420	-1%	416				431	X	
SILICA FUME, LBS.		-1%							
TOTAL CEM. MATL.	5950	-1%	5891				5966	X	
AGGREGATE (1) LBS	21800	±2%	21364	22236			22197	X	
AGGREGATE (2) LBS	11020	±2%	10800	11240			11130	X	
AGGREGATE (3) LBS		±2%							
TOTAL (1) + (2) + (3)	32820	—							
CRR. INHIB., GAL		—							
METER WATER GAL	264	*RATE					235	TRUCK WASH WATER	
METER WATER LBS	2199	oz / BAG		oz / 100 LBS			1958	METER WATER LBS. —	
AIR ENT. AGENT, oz	38	0.60						Max. Water Allow	
WATER RED. AGENT, oz	149			2.5				GAL.	
WATER RED/RETARDED, oz								TOTAL WATI	
MR/HR WATER RED.RET.oz									

In this example, 5966 lbs cement exceeds the minimum acceptable value of 5475 lb, so the cement weight meets the tolerance. 22197 lbs of crushed stone falls between the acceptable low of 21364 lbs and the acceptable high of 22236, so the coarse aggregate meets tolerance.

STEP 16a. Fill in the “Free Moisture Percent” spaces with the appropriate values.

The values for the aggregate moistures are obtained from the Batch Ticket or Batch Computer Screen.

IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*		
ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197					
11130					
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
	METER WATER LBS. ____ =				
	Max. Water Allowed for Site Additions				
	GAL.		LBS.		
	TOTAL WATER AT PLANT =				
1st WATER ADDED AT SITE			GAL.x 8.33 = LBS.		
2nd WATER ADDED AT SITE			GAL.x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ____ LBS.					

700.04 Form

Mix Information As Batched

TRUCK #	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	20907	12:06	10/31/2016

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS	
10.00	3000AEF	0	20 Y	

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	2158 lb	21800 lb	22197 lb	1.02	1.00%
Int Agg					0.00%
Fine Agg	1070 lb	11020 lb	11130 lb	1.00	3.00%
Total Agg (lbs)					
Cement	553 lb	5530 lb	5535 lb	1.00	
Fly Ash	42 lb	420 lb	431 lb	1.03	
WR	2.5 oz/ 100 Lbs.	149 oz	149 oz		
Air	0.6 oz/bag	38 oz	38 oz		
Water (lbs)	274 lb	2199 lb			
Water (gal)		264 gal	235 gal		

STEP 16a. Fill in the “Free Moisture Percent” spaces with the appropriate values.

TICKET ID	BATCH TIME	DATE
20907	12:06	10/31/2016

CUMMULATIVE YARDS	
20 Y	

BATCHED	% Var	% Moisture
22197 lb	1.02	1.00%
		0.00%
11130 lb	1.00	3.00%
5535 lb	1.00	
431 lb	1.03	
149 oz		
38 oz		
235 gal		

For this example, the coarse aggregate moisture is 1.00% which corresponds to **0.01** as a decimal. The fine aggregate moisture is 3% or **0.03.**

IF SINGLE BATCHED OR SUM OB DBL BATCH ACTUAL BATCH WEIGHT	MEETS BATCH CHART RANGE YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197			0.01		
11130			0.03		
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
	METER WATER LBS. ______ =				
	Max. Water Allowed for Site Additions				
	GAL.		LBS.		
	TOTAL WATER AT PLANT =				
1st WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
2nd WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ______ LBS.					

700.04 Form

STEP 16b. Calculate the “SSD Weight” of the aggregates by following the Formula provided ** on the Form. 700.04. Round to the nearest pound.

SSD Weight Actual = $\dfrac{\textbf{Batched Weight}}{(\textbf{1+Moisture Content})}$

Coarse Aggregate:

22197/(1.00 + 0.01) = **21977 lbs**

Fine Aggregate:

11130/(1.00 + 0.03) = **10806 lbs**

IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*		
ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197			0.01	21977	
11130			0.03	10806	
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
	METER WATER LBS. ______ =				
	Max. Water Allowed for Site Additions				
	GAL.		LBS.		
	TOTAL WATER AT PLANT =				
1st WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
2nd WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ______ LBS.					

700.04 Form

STEP 16c. Determine the "Free Aggregate Moisture" by subtracting the SSD Wt. from the "Actual Batch Weights" for each type of Aggregate.

Coarse Aggregate:

22197 – 21977 = **220**

Fine Aggregate:

11130 – 10806 = **324**

IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*		
ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197			0.01	21977	220
11130			0.03	10806	324
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
	METER WATER LBS. ——— =				
	Max. Water Allowed for Site Additions				
	GAL.		LBS.		
	TOTAL WATER AT PLANT =				
1st WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
2nd WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ——— LBS.					

700.04 Form

STEP 17. Transfer the actual amount of "Meter Water" added to the mix, from the "Actual Batch Weight" column.

In this example:

The weight is **1958 pounds**.

IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*		
ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197			0.01	21977	220
11130			0.03	10806	324
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
235 x 8.33 = 1957.55 = 1958	METER WATER LBS. ——— =				1958
	Max. Water Allowed for Site Additions				
	GAL.		LBS.	243	
	TOTAL WATER AT PLANT =				
1st WATER ADDED AT SITE	20		GAL. x 8.33 = LBS.		167
2nd WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ——— LBS.					2668

Right Hand Side 700.04 Form

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STEP 18. Obtain the “Total Water Added at the Plant” by summing the two “Free Aggregate Moistures” and the “Meter Water” weights.

220 + 324 + 1958 = 2502

IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		*		
ACTUAL BATCH WEIGHT	YES	NO	FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
5535					FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
431					
5966					
22197			0.01	21977	220
11130			0.03	10806	324
			32 oz / GAL	(DCI ONLY)	
235	TRUCK WASH WATER			GAL. X 8.33 =	
	METER WATER LBS. ——— =				1958
	Max. Water Allowed for Site Additions				
	GAL.		LBS.		
	TOTAL WATER AT PLANT =				2502
1st WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
2nd WATER ADDED AT SITE			GAL. x 8.33 = LBS.		
TOTAL WATER IN LOAD = (SUM) ——— LBS.					

700.04 Form

STEP 19. To determine the "Maximum Water Allowed for the Mix AS Batched", multiply the correct w/c ratio by the "Actual Batch Wt. Total Cementitious Material".

For this example: The correct w/c ratio is 0.46 according to the SCDOT Structural Concrete Table in section 701.20 of the Construction Manual for a **Crushed Stone**.

MAX WATER ALLOWED FOR THE MIX AS BATCHED	**2744**

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX 0.46 x 5966 = 2744

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE LOW -	HIGH +	IF SINGLE OR DOUBLE BATCHED: ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	IF SINGLE BATCHED OR SUM OB DBL BATCH: ACTUAL BATCH WEIGHT	MEETS BATCH CHART RANGE: YES	NO
CEMENT, LBS.		-1%	**5475**				**5535**		
FLY ASH, LBS.		-1%	**416**				**431**		
SILICA FUME, LBS.		-1%							
TOTAL CEM. MATL.		-1%	**5891**				$\boxed{\textbf{5966}}$		
AGGREGATE (1) LBS		+2%	**21364**	**22236**			**22197**		
AGGREGATE (2) LBS		+2%	**10800**	**11240**			**11130**		
AGGREGATE (3) LBS		+2%							
TOTAL (1) + (2) + (3)		—							
CRR. INHIB., GAL		—							
METER WATER GAL		*RATE						TRUCK WASH WATER	

700.04 Form

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STEP 20. Determine the “Max Water Allowed for Site Additions” by subtracting the “Total Water Added at Plant” from the “Max Water Allowed for the Mix AS Batched”.   Convert the weight of water into gallons by dividing the weight by 8.33.

2744 – 2502 = **242 lbs**

243 lbs/8.33 = **29.2 Gallons** **Do NOT Round Up to Next Gallon**

MAX WATER ALLOWED FOR THE MIX AS BATCHED	2744

	Max. Water Allowed for Site Additions GAL. 29 LBS. 242		
	TOTAL WATER ADDED AT PLANT =		2502
1^{ST} Water Added at Site		Gal x 8.33 = Lbs	
		Gal x 8.33 = Lbs	
TOTAL WATER IN LOAD = (SUM) ______________________ LBS.			

STEP 21. According to the Problem Statement, this truck load required a slump adjustment of two inches. The accepted formula for slump adjustments states that 1 yd^3 on concrete will increase in slump by 1 inch for each 1 gallon of water added. (Inches to move *x* # of yd^3s = Gallons Required.)

In this example, there are 10 yd^3 of material to be moved 2”

2 inches x 10 yd^3 = **20 Gallons**
20 Gallons x 8.33 = **167 lbs. of Water for 1st Site Addition**

Repeat for the 2nd Water Added At Site if required.

	Max. Water Allowed for Site Additions		
	GAL. 29	LBS. 242	
	TOTAL WATER ADDED AT PLANT =		**2502**
1ST Water Added at Site	20	Gal x 8.33 = Lbs	167
		Gal x 8.33 = Lbs	
TOTAL WATER IN LOAD = (SUM) ______________________ LBS.			

STEP 22. The Total Water in the Load (SUM) is determined by adding the Total Water Added at the Plant plus any on-site water additions.

Total Water in the Load" 2502 + 167 = **2669**

	Max. Water Allowed for Site Additions		
	GAL. 29	LBS. 242	
	TOTAL WATER ADDED AT PLANT =		**2502**
1^{ST} Water Added at Site	20	Gal x 8.33 = Lbs	167
		Gal x 8.33 = Lbs	
TOTAL WATER IN LOAD = (SUM) ________		LBS.	2669

STEP 23. Calculate the Water to Cementitious Material Ratio by dividing the Total Water in the Load (2669 lbs) by the Total Cementitious Material's Actual Batch Weight (5966 lbs.)

$$\text{Ratio} = \frac{\text{Total Water in Load (lbs.)}}{\text{Total Cementitious Material (lbs.)}} = \frac{\text{2669 lbs. Water}}{\text{5966 lbs. Cem. Matl.}} = \boxed{0.45}$$

STEP 24. Compare the w/c ratio for this load (**0.45**) to the w/c for this class of PCC (**0.46**).

STEP 24. It is the Field Inspector’s job to fill out all of the relevant information below for each Form 700.04.

COMMENTS: ____________________ MIXING REV. AT SITE: __________ REV. AFTER SITE WATER ADDED ________

SLUMP: __________ ENTR. AIR %: __________ ADMIXTURE ADDED AT SITE: __________ TOTAL oz __________ oz / 100 LBS

CYLINDERS MADE (NO / YES): _____ ID #: __________ MIXING TIME AFTER ADDING ADMIXTURE: __________ MINUTES

TIME UNLOADING OF TRUCK ENDED: __________ CONCRETE TEMPERATURE @ PLACEMENT: __________ DEG. F

POUR LOCATION: ____________________

FIELD INSPECTOR: ____________________

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.

**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

Bottom Portion of 700.04 Form

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: 34.017 DATE: 10/31/2016 CLASS 3000 LOAD NO. 2 CU YDS 10 ACC. CY 20 TRUCK # 46

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: John Q. Doe MAX. WATER ALLOWED FOR THE MIX 0.46 x 5966 = 2744

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.	5530	-1%	5475				5535	X				FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.	420	-1%	416				431	X				
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.	5950	-1%	5891				5966	X				
AGGREGATE (1) LBS	21800	±2%	21582	22236			22197	X		0.01	21977	220
AGGREGATE (2) LBS	11020	±2%	10800	11240			11130	X		0.03	10806	324
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)	32820	—										
CRR. INHIB., GAL		—								32 oz / GAL	(DCI ONLY)	
METER WATER GAL	264	*RATE					264-29=235	TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS	2199	oz / BAG		oz / 100 LBS			235 x 8.33 = 1958	METER WATER LBS. ______ =				1958
AIR ENT. AGENT, oz	38	0.60						Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz	149			2.5				GAL. 29		LBS. 242		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				2502
MR/HR WATER RED.RET.oz												

1st WATER ADDED AT SITE	20	GAL. x 8.33 = LBS.	167
2nd WATER ADDED AT SITE		GAL. x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ______ LBS.			2669

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = 2669 / 5966 = 0.45

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

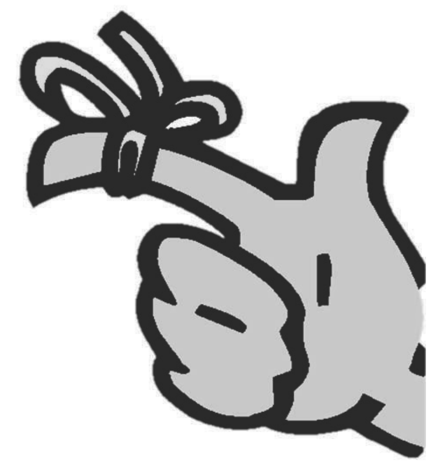
CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

Two external sources of information are required to complete the Form 700.04. They are the **Structural Concrete Table** (needed only for the water to cementitious material ratio) and a **batch ticket or batch computer screen**.

THINGS TO REMEMBER

- Verify that the proper mix is being used.
- Make sure that proper materials per mix design are being used.
- Always ROUND DOWN – <u>Gallon units only!</u>
- Make sure that proper mixing is complete before the truck leaves the plant



Example Q2

Use the Class 5000 concrete batch ticket with 13% Fly Ash to complete the Form 700.04 example problem.

Form 700.04

Required Mix Design

Total Concrete required for the pour:
64 cubic yards, delivered by eight trucks carrying eight cubic yards each

Class 5000 Concrete with 13% Fly Ash

Aggregates	Aggregate Type	Moisture Percentage
Coarse:	Crushed Stone	damp
Fine:	Sand	7.00%

Admixture	Dosage Rate
Air Entrainer	0.3 oz/bag
Water Reducer	3.5 oz/100 Lbs.

Cement Scale: 6,000 Lbs. Max
Aggregate Scale: 25,000 Lbs. Max

Water:

First Site Addition: Enough to increase the slump by 1.5 inches
Second Site Addition:

Mix Information as Batched

TRUCK	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
98	34.017	D. Taylor	654984	48966	1:32 AM	11/28/2009

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS
8.00 CY	5000AEDOT	0	32 Y

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	1835 lb	14680 lb	14824 lb	0.98%	0.50%
Int Agg					0.00%
Fine Agg	1025 lb	8200 lb	8077 lb	-1.50%	7.00%
Total Agg (lbs)					
Cement	613 lb	4904 lb	4953 lb	1.00%	
Fly Ash	110 lb	880 lb	924 lb	5.00%	
WR	3.5 oz/100 lbs				
Air	0.3 oz/bag				
Water (lbs)	257 lb	2056 lb			
Water (gal)		246 gal	221 gal		

Example Q3

Use the Class 5000 concrete batch ticket with 13% Fly Ash to complete the Form 700.04 example problem.

Form 700.04

Required Mix Design

Total Concrete required for the pour:
27 cubic yards, delivered by nine trucks carrying 3 cubic yards each

Class 5000 Concrete with 13% Fly Ash

Aggregates	Aggregate Type	Moisture Percentage
Coarse:	Crushed Stone	damp
Fine:	Sand	4.00%

Admixture	Dosage Rate
Air Entrainer	0.2 oz/bag
Water Reducer	2.5 oz/100 Lbs.

Cement Scale: 4,000 Lbs. Max
Aggregate Scale: 25,000 Lbs. Max

Water:

First Site Addition: 6 gallons
Second Site Addition:

Mix Information as Batched

TRUCK	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
4	31.017	S. Roland	874961	14766	8:19 PM	11/30/2013

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS
3.00 CY	5000AEDOT	0	21 Y

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	1835 lb	5505 lb	5560 lb	1.00%	0.50%
Int Agg					0.00%
Fine Agg	1044 lb	3132 lb	3085 lb	-1.50%	4.00%
Total Agg (lbs)					
Cement	613 lb	1839 lb	1857 lb	0.98%	
Fly Ash	110 lb	330 lb	347 lb	5.15%	
WR	2.5 oz/100 lbs				
Air	0.2 oz/bag				
Water (lbs)	266 lb	798 lb			
Water (gal)		95 gal	87 gal		

Example Q4

Use the Class 5000 concrete batch ticket with 13% Fly Ash to complete the Form 700.04 example problem.

Form 700.04

Required Mix Design

Total Concrete required for the pour:
81 cubic yards, delivered by nine trucks carrying 9 cubic yards each

Class 5000 Concrete with 13% Fly Ash

Aggregates	Aggregate Type	Moisture Percentage
Coarse:	Crushed Stone	damp
Fine:	Sand	3.00%

Admixture	Dosage Rate
Air Entrainer	0.5 oz/bag
Water Reducer	2.6 oz/100 Lbs.

Cement Scale: 10,000 Lbs. Max
Aggregate Scale: 50,000 Lbs. Max

Water:

First Site Addition: 18 GAL
Second Site Addition:

Mix Information as Batched

TRUCK	FILE #	USER	DISPATCH TICKET NUMBER	TICKET ID	BATCH TIME	DATE
24	34.013	Q. Smith	156946	2568	2:55PM	11/26/2011

LOAD SIZE	MIX CODE	RETURNED QUANTITY	CUMMULATIVE YARDS
9.00 CY	5000AEDOT	0	18 Y

MATERIAL	DESIGN QTY (SSD/YD)	TARGET WEIGHT	BATCHED	% Var	% Moisture
Coarse Agg	1835 lb	16515 lb	16680 lb	1.00%	0.50%
Int Agg					0.00%
Fine Agg	987 lb	8883 lb	8750 lb	-1.50%	3.00%
Total Agg (lbs)					
Cement	613 lb	5517 lb	5572 lb	1.00%	
Fly Ash	110 lb	990 lb	1040 lb	5.05%	
WR	2.6 oz/100 lbs				
Air	0.5 oz/bag				
Water (lbs)	295 lb	2655 lb			
Water (gal)		318 gal	300 gal		

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: 34.017 DATE: 11/28/2009 CLASS 5000 LOAD NO.3 CU YDS 8 ACC. CY 24 TRUCK # 98

TIME MIXING BEGAN: 1:32 AM REV. @ PLANT, @ MIXING SPEED 70 PLANT AND LOCATION

PLANT INSPECTOR: D. Taylor MAX. WATER ALLOWED FOR THE MIX 2703 LBS W/C Ratio 0.46

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	Yes	No			
CEMENT, LBS.	4904	-1%	4855				4953	ok				FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.	880	-1%	871				924	ok				
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.	5784	-1%	5726				5877	ok				
AGGREGATE (1) LBS	14680	±2%	14386	14974			14824	ok		0.005	14750	74
AGGREGATE (2) LBS	8200	±2%	8036	8364			8077	ok		0.07	7549	528
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)	22880											
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL	246	*RATE					221	TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS	2056	oz / BAG		oz / 100 LBS			1841	METER WATER LBS. --------------------------------- =				1841
AIR ENT. AGENT, oz	18	0.3						Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz	202			3.5	oz	oz		GAL.	31	LBS.	260	
WATER RED/RETARDED, oz					oz	oz		TOTAL WATER AT PLANT =				2443
MR/HR WATER RED.RET.oz					oz	oz						

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = 2543.000 / 5877 = 0.430

ok w/c

1st WATER ADDED AT SITE	12	GAL.x 8.33 = LBS.	100
2nd WATER ADDED AT SITE	0	GAL.x 8.33 = LBS.	0
TOTAL WATER IN LOAD = (SUM) ------------------------------------ LBS.			2543

COMMENTS:
SLUMP: ENTR. AIR %:
CYLINDERS MADE (NO / YES): ID #:
TIME UNLOADING OF TRUCK ENDED:

MIXING REV. AT SITE: REV. AFTER SITE WATER ADDED
ADMIXTURE ADDED AT SITE: TOTAL oz oz / 100 LBS
MIXING TIME AFTER ADDING ADMIXTURE: MINUTES
CONCRETE TEMPERATURE @ PLACEMENT: DEG. F

POUR LOCATION:
FIELD INSPECTOR:

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: 31.017 DATE: 11/30/2013 CLASS 5000 LOAD NO. 7 CU YDS 3 ACC. CY 21 TRUCK # 4

TIME MIXING BEGAN: 8:19 PM REV. @ PLANT, @ MIXING SPEED 70 PLANT AND LOCATION

PLANT INSPECTOR: S. Roland MAX. WATER ALLOWED FOR THE MIX 1014 LBS 122 GAL. W/C RATIO 0.46

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	LOW	HIGH			
CEMENT, LBS.	1839	-1%	1821				1857	YES				
FLY ASH, LBS.	330	-1%	327				347	YES				FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
SILICA FUME, LBS.		-1%					0	YES				
TOTAL CEM. MATL.	2169	-1%	2147				2204	YES				
AGGREGATE (1) LBS	5505	±2%	5395	5615			5560	YES	YES	0.5	5532	28
AGGREGATE (2) LBS	3132	±2%	3069	3195			3085	YES	YES	4	2966	119
AGGREGATE (3) LBS	0	±2%						YES	YES			
TOTAL (1) + (2) + (3)	8637	±2%	8464	8810			8645	YES	YES			
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL	95	*RATE					87	TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS	791	oz / BAG		oz / 100 LBS			725	METER WATER LBS. ---------------------------------- =				725
AIR ENT. AGENT, oz	5	0.2					5	Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz	54			2.5			54	GAL.	17	LBS.	142	
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				872
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

$$\text{RATIO} = \frac{\text{TOTAL WATER IN LOAD (LBS)}}{\text{TOTAL CEM. MATL. (LBS)}} = \frac{921}{2204} = \boxed{0.42}$$

1st WATER ADDED AT SITE	6.0	GAL.x 8.33 = LBS.	50
2nd WATER ADDED AT SITE	0	GAL.x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ------------------------------------- LBS.			921

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: 34.013 DATE: 11/26/2011 CLASS 5000 LOAD NO. 2 CU YDS 9 ACC. CY 18 TRUCK # 24

TIME MIXING BEGAN: 2:55 PM REV. @ PLANT, @ MIXING SPEED 70 PLANT AND LOCATION

PLANT INSPECTOR: Q. Smith MAX. WATER ALLOWED FOR THE MIX 3042 LBS 365 GAL. W/C RATIO 0.46

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	LOW	HIGH			
CEMENT, LBS.	5517	-1%	5462				5572	YES				FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.	990	-1%	980				1040	YES				
SILICA FUME, LBS.		-1%						YES				
TOTAL CEM. MATL.	6507	-1%	6442				6612	YES				
AGGREGATE (1) LBS	16515	±2%	16185	16845			16680	YES	YES	0.5	16597	83
AGGREGATE (2) LBS	8883	±2%	8705	9061			8750	YES	YES	3	8495	255
AGGREGATE (3) LBS		±2%						YES	YES			
TOTAL (1) + (2) + (3)	25398	±2%	24890	25906			25430	YES	YES			
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL	318	*RATE					300	TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS	2649	oz / BAG		oz / 100 LBS			2499	METER WATER LBS. --------------------------------- =				2499
AIR ENT. AGENT, oz	35	0.5					35	Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz	169			2.6			169	GAL.	24	LBS.	205	
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				2837
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = 2987.000 / 6612 = 0.450

1st WATER ADDED AT SITE	18	GAL.x 8.33 = LBS.	150
2nd WATER ADDED AT SITE	0	GAL.x 8.33 = LBS.	0
TOTAL WATER IN LOAD = (SUM) ------------------------------------- LBS.			2987

COMMENTS:

SLUMP: ENTR. AIR %:

CYLINDERS MADE (NO / YES): ID #:

TIME UNLOADING OF TRUCK ENDED:

POUR LOCATION:

FIELD INSPECTOR:

MIXING REV. AT SITE: REV. AFTER SITE WATER ADDED

ADMIXTURE ADDED AT SITE: TOTAL oz oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.		-1%										
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		+2%										
AGGREGATE (2) LBS		+2%										
AGGREGATE (3) LBS		+2%										
TOTAL (1) + (2) + (3)		----										
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. --------------------------------- =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL.		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ = [ ]

1st WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
2nd WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ------------------------------------- LBS.			

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

POUR LOCATION: ______

FIELD INSPECTOR: ______

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.		-1%										
FLY ASH, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		±2%										
AGGREGATE (2) LBS		±2%										
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)		----										
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. -------------------------------- =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL.		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ = ☐

1st WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
2nd WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ------------------------------------ LBS.			

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
FLY ASH, LBS.		-1%										
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		+2%										
AGGREGATE (2) LBS		+2%										
AGGREGATE (3) LBS		+2%										
TOTAL (1) + (2) + (3)		----										
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. ---------------------------------- =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL.		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ = ______

1st WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
2nd WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) ------------------------------------- LBS.			

COMMENTS: ______
SLUMP: ______ ENTR. AIR %: ______
CYLINDERS MADE (NO / YES): ______ ID #: ______
TIME UNLOADING OF TRUCK ENDED: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______
ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS
MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES
CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

POUR LOCATION: ______
FIELD INSPECTOR: ______

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
			LOW -	HIGH +	ACTUAL BATCH WEIGHT (single)	ACTUAL BATCH WEIGHT	ACTUAL BATCH WEIGHT	YES	NO			
CEMENT, LBS.		-1%										
FLY ASH, LBS.		-1%										FREE AGG. MOISTURE = ACT. BATCH WT. MINUS SSD WEIGHT
SILICA FUME, LBS.		-1%										
TOTAL CEM. MATL.		-1%										
AGGREGATE (1) LBS		±2%										
AGGREGATE (2) LBS		±2%										
AGGREGATE (3) LBS		±2%										
TOTAL (1) + (2) + (3)		----										
CRR. INHIB., GAL		----								32 oz / GAL	(DCI ONLY)	
METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
METER WATER LBS		oz / BAG		oz / 100 LBS				METER WATER LBS. ---------------------------------- =				
AIR ENT. AGENT, oz								Max. Water Allowed for Site Additions				
WATER RED. AGENT, oz								GAL.		LBS.		
WATER RED/RETARDED, oz								TOTAL WATER AT PLANT =				
MR/HR WATER RED.RET.oz												

CALCULATION OF WATER/CEMENTITIOUS MATERIAL RATIO:

RATIO = TOTAL WATER IN LOAD (LBS) / TOTAL CEM. MATL. (LBS) = ______ = [ ]

1st WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
2nd WATER ADDED AT SITE		GAL.x 8.33 = LBS.	
TOTAL WATER IN LOAD = (SUM) -------------------------------------- LBS.			

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.

**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ________ DATE: ________ CLASS ________ LOAD NO. ________ CU YDS ________ ACC. CY ________ TRUCK # ________

TIME MIXING BEGAN: ________ REV. @ PLANT, @ MIXING SPEED ________ PLANT AND LOCATION ________

PLANT INSPECTOR: ________ MAX. WATER ALLOWED FOR THE MIX ________

MATERIALS	* BATCH CHART TOTAL WEIGHT	TOLERANCE	* BATCH CHART TOTAL WEIGHT RANGE		IF SINGLE OR DOUBLE BATCHED		IF SINGLE BATCHED OR SUM OB DBL BATCH	MEETS BATCH CHART RANGE		* FREE MOISTURE PERCENT	SSD WEIGHT ACTUAL** BATCH WEIGHT DIVIDED BY (1+%Moist.)	TOTAL LBS WATER IN LOAD
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TOTAL WATER IN LOAD = (SUM) ------------------------------------ LBS.			

COMMENTS: ________

SLUMP: ________ ENTR. AIR %: ________

CYLINDERS MADE (NO / YES): ________ ID #: ________

TIME UNLOADING OF TRUCK ENDED: ________

POUR LOCATION: ________

FIELD INSPECTOR: ________

MIXING REV. AT SITE: ________ REV. AFTER SITE WATER ADDED ________

ADMIXTURE ADDED AT SITE: ________ TOTAL oz ________ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ________ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ________ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04

REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

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TOTAL WATER IN LOAD = (SUM) -------------------------------------- LBS.			

COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

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**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

FORM 700.04
REVISED (06/12)

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
READY MIX CONCRETE REPORT

FILE NO: ______ DATE: ______ CLASS ______ LOAD NO. ______ CU YDS ______ ACC. CY ______ TRUCK # ______

TIME MIXING BEGAN: ______ REV. @ PLANT, @ MIXING SPEED ______ PLANT AND LOCATION ______

PLANT INSPECTOR: ______ MAX. WATER ALLOWED FOR THE MIX ______

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METER WATER GAL		*RATE						TRUCK WASH WATER			GAL. X 8.33 =	
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COMMENTS: ______

SLUMP: ______ ENTR. AIR %: ______

CYLINDERS MADE (NO / YES): ______ ID #: ______

TIME UNLOADING OF TRUCK ENDED: ______

POUR LOCATION: ______

FIELD INSPECTOR: ______

MIXING REV. AT SITE: ______ REV. AFTER SITE WATER ADDED ______

ADMIXTURE ADDED AT SITE: ______ TOTAL oz ______ oz / 100 LBS

MIXING TIME AFTER ADDING ADMIXTURE: ______ MINUTES

CONCRETE TEMPERATURE @ PLACEMENT: ______ DEG. F

*FILL IN FOR 1st LOADS EACH DAY - THEN ONLY IF THERE IS A CHANGE.
**ADD 1.00 TO MOISTURE % (DECIMAL FORM)

LEVEL II: CONCRETE INSPECTION

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COVERED IN THIS SECTION

- Aggregate Sampling (SC-T-1 & SC-T-2)
- Standard Specifications 702
- Standard Specifications 703 & QPL 60
- Standard Specifications Appendix
- Construction Manual
- SCT Procedures

SCDOT

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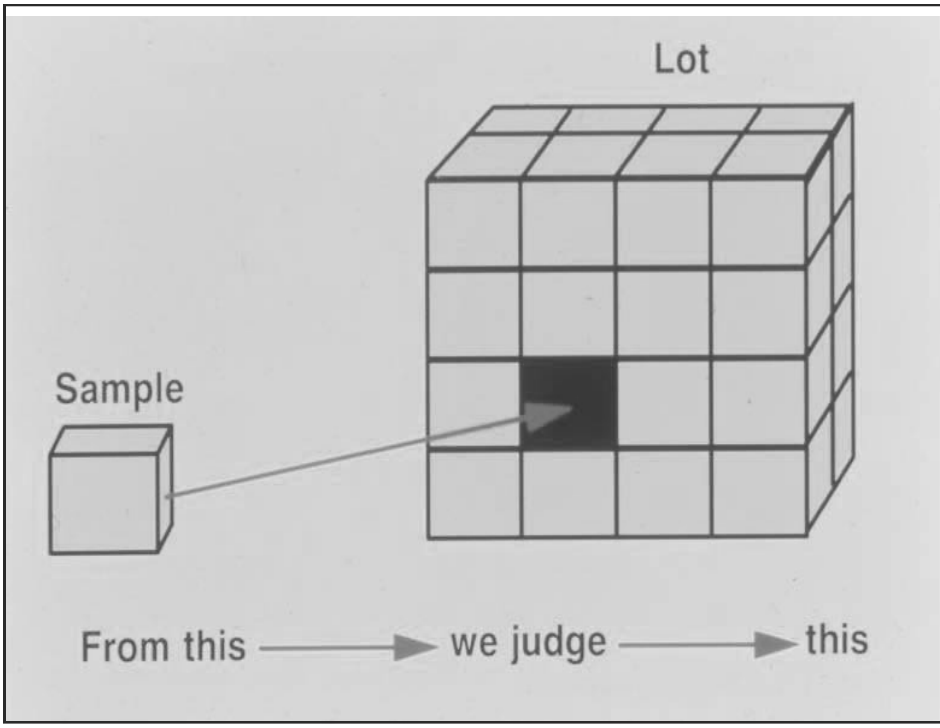
AGGREGATE SAMPLING

Sampling is equally as important as the testing. Samples should show the true nature and condition of the materials that they represent.

Please refer to the applicable SC Test Procedures on the SCDOT website for sampling. Procedures for both coarse and fine aggregates have been recently revised.



Methods of Sampling Coarse Aggregates SC-T-1

Samples can be taken from the following:

- Sample Pad / Stockpiles
- Truck dumps
- Storage Bins
- Conveyor belts
- Base samples are taken from roadway

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SAMPLE SIZES

The required minimum size of the sample is listed in the appropriate test procedures:

SC-T-1: Coarse Aggregates SC-T-2: Fine Aggregates

Type of Aggregate	Minimum Weight of Field Samples (pounds)
Coarse Aggregates (5, 57, 67, 789, etc)	40
Aggregate Base (Macadam, MLBC, RPCC)	70
Fine Aggregates	20

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SAMPLING FROM SAMPLE PAD

- Create sample pad with loader by taking 2 buckets of material and dumping together, mixing, and back dragging to ½ original height
- Divide pad into four quadrants and take one full shovel of material from each quadrant
- If additional material is needed, take an additional portion from center of the pad

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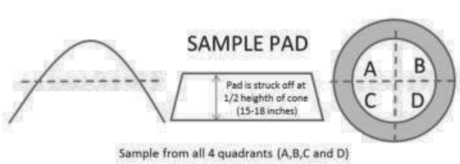
SAMPLING FROM SAMPLE PAD



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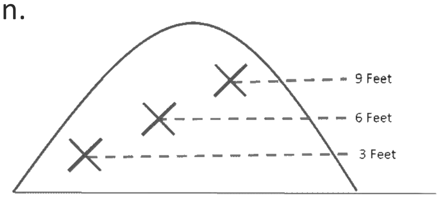
SAMPLING FROM STOCKPILES

- Take first portion approximately 3 feet above ground.
- Move laterally and take second portion approximately 6 feet above ground.
- Move laterally and take third portion approximately 9 feet above ground.
- If additional material is needed take another portion from center location.



SAMPLING FROM STOCKPILES
Figure SC-T-1B

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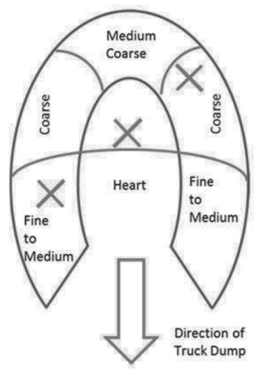
SAMPLING FROM A TRUCK DUMP

- Least preferred method.
- Do not sample if material has already been removed.
- Use a loader to remix and form a sample pad if loader is available.



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SAMPLING FROM CONVEYOR BELTS

- Sample is 3 portions
- Scrape clean at least 2 feet of belt
- Allow belt to make 2 revolutions between portions

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Locate an 18 to 24 inch section


Isolate the sampling area by removing the material from each side


Isolated sampling site


Remove material from within the sampling area and …


carefully place material into the 5 gallon bucket


Carefully remove all material (including fines) and
place in bucket

SAMPLING FROM STORAGE BINS

- Permit sufficient flow before taking sample to ensure that flow is uniform.
- Sample entire cross section of flow.

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SAMPLING BASE FROM ROADWAY

- Sample locations determined by random sampling. 1st location is job control sample, 2nd and 3rd locations are check samples.
- Sample by taking 3 portions for full depth of layer, one from near centerline and one approx. 2 feet from either edge.
- Combine portions to form one sample.

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Sampling Fine Aggregates SC-T-2

Samples can be taken from the following:

- Stockpile
- Conveyor Belt

Sample Handling and Contamination

How can you contaminate a sample?

- Improper or mishandling
- Improper sampling procedures example:
  Stockpiles – should not overlap