CONCRETE FIELD TECHNICIAN STUDY GUIDE

Materials & Tests Unit

NCDOT

Prepared by:
North Carolina Division of Highways
Material and Tests Unit
July 2016

PREFACE

The following information on components of concrete and related subjects has been prepared *as* a practical study guide for technicians, batchers, inspectors, and contractor or producer personnel to help in preparing to become a Certified Concrete Field Technician. We have tried to make it as much a self-study guide as possible. The book has been arranged in the order it will be presented in our schools.

It should help serve as a source of information for the person starting in concrete work, as well as a reference book to those with considerable concrete construction experience. The objective is to train and educate so that the end results will be better quality concrete in the construction of our highways.

The information included in this book is generally compatible with current specifications and instructions; however, it should not be considered a specification. It should be used only as a guide and as a reference to supplement the reader's knowledge of concrete.

Christopher A. Peoples , P.E.
State Materials Engineer
North Carolina Division of Highways

ACKNOWLEDGEMENTS

The writers would like to express their appreciation to the following sources of information used in this book:

American Concrete Institute
American Association of State Highway and Transportation Officials
ASTM International
NCDOT Standard Specifications for Roads and Structures (2012 edition)
Portland Cement Association
Virginia Department of Highways and Transportation

The writers also express their gratitude to all personnel of the Department who assisted in the preparation of this study guide. Special thanks to the Department of Civil Construction and Environmental Engineering at NC State University.

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NCDOT CONCRETE FIELD TECHNIAN SCHOOL PRE-EXAM

Components

1. The chemical reaction between water and cement is called _____________ .

2. List the basic components that are used to make concrete.
   _________, __________, _________, and __________.

3. There are __________ types of Portland cement.

4. Initial set takes place _____ to ________ hours after the cement has come in contact with the water.

5. Final setting takes place approximately ____ to _____ hours after the cement and water are placed in contact.

6. Fly Ash is a byproduct of :
   a) concrete
   b) sand
   c) the combustion of pulverized coal in coal power plants
   d) reaction between cement and water under pressure

7. What are the two most important characteristics when selecting a fly ash for concrete?
   a) Specific gravity and shape
   b) Reactivity and absorption
   c) Fineness and carbon content

8. According to NCDOT Standard Specifications fly ash may be substituted for Portland cement up to _________ by weight of the required cement.

9. The allowable pH range for mixing water used to batch concrete for NCDOT projects is ______ to ______.

10. Air entraining agent is added to concrete primarily to _________________________________.

11. Less air is entrained as the temperature of the concrete ____________________.

Specifications

12. Make sure the concrete temperature at the time of placement in the forms is not less than _________ °F nor more than _______ °F.

13. Do not place concrete when the air temperature is below ______ °F without permission.

14. A curing day is defined as any consecutive _______ period, beginning when the manipulation of each separate mass is ____________, during which the air temperature adjacent to the mass does not fall below ________ °F.

15. The ________________ will review the mix design for compliance with the Specifications and notify the ________________ as to its acceptability.

16. An air entraining agent is added at the time of mixing to produce air content in the range of _________________ for incidental and structural concrete when tested at the job site.
    a) 5.0 ± 1.5 percent
    b) 4.5 ± 1.5 percent
    c) 6.0 ± 1.0 percent
    d) 6.0 ± 1.5 percent

17. Use an approved set retarding admixture in all concrete placed in the superstructure of bridges. True or False

18. A _________________ must be present during all acceptance testing and placement when concrete is being used in structures and incidental construction
    a) Certified Concrete Field Technician
    b) Certified Concrete Batch Technician

Policies

19. When using 6” x 12” cylindrical specimens for strength determination, place the concrete in _____ layers of approximately equal volume.

20. The minimum set of cylinders that can be made for a Class AA concrete pour of 100 cubic yards concrete is ___________.

21. When an air entraining agent is added on the jobsite to bring concrete within specifications, the concrete must be mixed ________ revolutions at mixing speed.

22. Mix designs for structural concrete shall be submitted to the Engineer _______ before proposed use.

NCDOT CONCRETE FIELD TECHNIAN SCHOOL PRE-EXAM ANSWER KEY

Components

1. The chemical reaction between water and cement is called **hydration**.

2. List the basic components that are used to make concrete.
   cement, water, aggregate, and admixtures

3. There are **5** types of Portland cement.

4. Initial set takes place **2 to 4** hours after the cement has come in contact with the water.

5. Final setting takes place approximately **5 to 8** hours after the cement and water are placed in contact.

6. Fly Ash is a byproduct of :
   a) concrete
   b) sand
   c) the combustion of pulverized coal in coal power plants
   d) reaction between cement and water under pressure

7. What are the two most important characteristics when selecting a fly ash for concrete?
   a) Specific gravity and shape
   b) Reactivity and absorption
   c) Fineness and carbon content

8. According to NCDOT Standard Specifications fly ash may be substituted for Portland cement up to **20%** by weight of the required cement.

9. The allowable pH range for mixing water used to batch concrete for NCDOT projects is **4.5 to 8.5**.

10. Air entraining agent is added to concrete primarily to **increase freeze/thaw resistance and durability**.

11. Less air is entrained as the temperature of the concrete **increases**.

Specifications

12. Make sure the concrete temperature at the time of placement in the forms is not less than **50 °F** nor more than **95 °F**.

13. Do not place concrete when the air temperature is below **35 °F** without permission.

14. A curing day is defined as any consecutive **24 hour** period, beginning when the manipulation of each separate mass is **finished**, during which the air temperature adjacent to the mass does not fall below **40 °F**.

15. The **engineer** will review the mix design for compliance with the Specifications and notify the **contractor** as to its acceptability.

16. An air entraining agent is added at the time of mixing to produce air content in the range of _________________ for incidental and structural concrete when tested at the job site.
    a) 5.0 ± 1.5 percent
    b) 4.5 ± 1.5 percent
    c) 6.0 ± 1.0 percent
    d) 6.0 ± 1.5 percent

17. Use an approved set retarding admixture in all concrete placed in the superstructure of bridges. **True** or False

18. A _________________ must be present during all acceptance testing and placement when concrete is being used in structures and incidental construction.
    a) Certified Concrete Field Technician
    b) Certified Concrete Batch Technician

Policies

19. When using 6" x 12" cylindrical specimens for strength determination, place the concrete in **3** layers of approximately equal volume.

20. The minimum set of cylinders that can be made for a Class AA concrete pour of 100 cubic yards concrete is **1**.

21. When an air entraining agent is added on the jobsite to bring concrete within specifications, the concrete must be mixed **30** revolutions at mixing speed.

22. Mix designs for structural concrete shall be submitted to the Engineer **35 days** before proposed use.

NCDOT / ACI EXAMINATION PROCEDURES AND REQUIREMENTS

Obtaining the NCDOT / ACI Certification: All Students must have a passing grade on both the written (Part 1) and Field Performance (Part 2) examinations as described herein:

PART 1: Written Examinations

NCDOT Written Exam:
Exam Duration: 1 hour
Minimum Passing Grade: 80%
Question Format: various types of questions, requiring
- fill in the blanks,
- multiple choice,
- hand calculations,
- composite questions (question composed of various parts)

Areas Covered:
- Class discussion
- NCDOT book (sections I, II, III, IV, V)

How to Prepare for this Exam?
- Follow class presentation and discussion
- Study the NCDOT Concrete Field Technician study guide
- Review homework questions, take home exam, and quiz

ACI Written Exam:
Exam Duration: 1 hour
Number of Questions: 55 total (covering 7 sections, one for each ASTM Standard Test)
Minimum Passing Grades: 60% on each section; 70% overall test
Question Format: various types of questions, answers require a multiple choice decision, selecting the correct answer will require knowledge of the ASTM standard and/or hand calculations.
Areas Covered:
- Only the 7 ASTM Standard Test Methods (see below)

How to Prepare for this Exam?
- Follow class presentation and discussion
- Study the ASTM Standard Test Methods contained in the ACI Technician Publication CP-1
- Review homework questions

Passing PART 1: All Students must have a passing grade in the NCDOT and ACI Written Exams to have a passing grade on Part 1

PART 2: Field Performance Examinations

Exam Duration:

NCDOT Field Performance (Chace Examination):	approximately 5 minutes/student
ACI and NCDOT Field Performance (7 ASTM Standard Tests):	approximately 3 hours/class

Areas Covered:

- NCDOT Field Performance: Students must correctly perform all procedural steps required by the Chace Indicator Test (AASHTO T-199) in accordance to a check list developed by the NCDOT
- ACI and NCDOT Field Performance: Students must perform correctly all procedural steps required by each of 7 ASTM Standard Tests (see table below), in accordance to a check list developed by the ACI. Proficiency with regard to ASTM C-172 (Sampling Freshly Mixed Concrete) will be demonstrated by taking an oral examination, in accordance with corresponding check list developed by the ACI.

Criteria

- All ACI and NCDOT Field Performance Exams will be graded on a pass/fail basis.
- A passing grade on any given ACI and NCDOT Field Performance Exam will be determined by having a passing grade in all and each of the procedural steps required for each test, as noted in the corresponding performance check list.

Exam Format:

- Students complete the required paperwork for all exam materials. Then, students are assigned to a test station, walk to the test station, hand-out exams materials to the examiner, perform each test, and receives a pass/fail grade in the test. The process is repeated until all tests are completed.
- No verbal interaction or questions are allowed during the examination
- If the student believes that he/she did NOT conduct a test in accordance with all required procedures, the student can consider a test "retrial" (a voluntary suspension of the test). This can be done while conducting the test, or right after he/she completes all test procedures, but **before** the examiner determines a pass or fail grade for that specific test.
- The student has a maximum of **two trials** to perform each test satisfactorily (a maximum of three times if the student used a "retrial" option in any of the two allowed trials).
- A "retrial" test can be conducted immediately after the student uses a voluntary suspension of a test; the same examiner can conduct this "retrial", or, the student can request another examiner for this purpose.
- A failed test requires that the student returns to queue line and waits for a next turn to conduct another trial; the student can request a different examiner after having failing a test.

How to Prepare for this Exam?

- Follow class presentation and discussion
- Study the ASTM Standard Test Methods contained in the ACI CP-1 Publication
- Study Section V in the NCDOT Concrete Field Technician study guide
- Review homework questions
- Use the allowed practice time wisely: ask questions, try each test.

Passing PART 2: All Students must have a passing grade in the NCDOT and ACI Field Performance Tests to have a passing grade on Part 2

<u>NCDOT / ACI FIELD TESTS</u>

TESTS	NCDOT (AASHTO)	ACI (ASTM)
Temperature of Freshly Mixed Concrete		C-1064
Sampling Freshly Mixed Concrete	T-141	C-172
Slump of Hydraulic-Cement Concrete	T-119	C-143
Density (Unit Weight)	T-121	C-138
Air Content by Pressure Meter	T-152	C-231
Air Content by Volumetric Method	T-196	C-173
Making and Curing Test Specimens	T-23	C-31
Air Content by Chace Indicator*	T-199	

* NOTES:
1) As indicated in the scope of AASHTO T-199, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Chace Indicator, this method has been found satisfactory for determining the **<u>approximate</u>** air content of freshly mixed concrete. This method should not be considered suitable for replacing gravimetric, volumetric or pressure methods. This method is most useful for determining whether the concrete has low, medium, or high air contents, and whether the air content is reasonably constant from batch to batch of concrete.
2) Consistent with NOTE 1), the NCDOT requires that each and every load of concrete be tested using the Chace Indicator Test.
3) The NCDOT requires that: a) the cup be tamped after rodding is completed, b) the Chace indicator be fully assembled prior to the introduction of isopropyl alcohol, and c) the alcohol level be read to the nearest ¼ graduation.

DO'S AND DO NOT'S OF SAMPLING AND TESTING PORTLAND CEMENT CONCRETE

1. Do — Get a copy of approved DOT batch ticket from truck driver as soon as concrete arrives on project.

2. **Don't** — As DOT Inspector, instruct the truck driver to add water to a load of concrete (Contractor's Responsibility).

3. **Don't** — Sample concrete for any test until all water is added and mixing revolutions completed.

4. Do — Run Chace Air Indicator Test before allowing any concrete to be placed into forms (With calibrated Chace Indicator 70% Isopropyl Alcohol).

5. **Don't** — Sample the first quantity of concrete discharged from truck mixer for any test.

6. Do — Divert entire discharge stream into sampling container when sampling from truck mixer.

7. **Don't** — Sample concrete deposited on bucket or forms.

8. **Don't** — Exceed allowed water/cement ratio.

9. Do — Take Representative Sample — (For cylinders out of middle portion of load).

10. Do — Take minimum size sample when making test cylinders of one cubic foot.

11. Do — Run all tests according to prescribed procedures.

12. Do — Remix sample thoroughly before running any field test.

13. **Don't** — Use concrete for more than one field test.

14. Do — Run all field tests immediately after securing the sample with all test being completed within 15 minutes after the sample is taken.

15. Do — Protect and cure cylinders first 20 to 24 hours after making and get them to the Laboratory for standard curing and protection as soon as possible after first 24 hours, but no later than seven days after making.

16. **Don't** — Make cylinders where there is any movement or vibrations of heavy equipment, etc., that may damage them during first 20 to 24 hours.

17. Do — Rerun any failing field test before rejecting a load of concrete.

18. **Don't** — Move cylinders after they are made within first 20 to 24 hours (Cylinders may be moved immediately for protection).

19. Do — Record all field test accurately and sign name certifying accuracy of information.

SECTION I

COMPONENTS OF CONCRETE

INTRODUCTION

Concrete is a manufactured product that has two main phase components: aggregates and paste. Aggregates are normally of two types, fine and coarse, and occupy about 60 to 80 percent of the volume of the concrete. The paste is typically composed of cement, water, and entrained air. The paste ordinarily constitutes about 20 to 40 percent of the total volume of the concrete.

In properly manufactured concrete, the aggregate phase should consist of particles having adequate strength and weather resistance and should not contain materials having injurious effects. Well graded aggregates have a uniform size distribution and a low void content. Well graded aggregates allow for an efficient use of the paste fraction since, in quality concrete production, the paste must completely coat each aggregate particle and fill the space between them.

The quality of the concrete is greatly dependent upon the quality of the paste. In turn, the quality of the paste is dictated by the quality and control imposed over of the paste main components (cement, water, air), and by the extent of curing provided after the concrete mixture is in place. The use of proper quantities of water and cement in a concrete mixture can be monitored through the use of the water to cement ratio concept (quantity of water / quantity of cement). The water/cement ratio has the greatest effect on strength, durability, and water tightness of concrete. For a given quantity of cement, the strength and durability of the concrete will decrease with increased amounts of water. All other things remaining equal, the strength of the concrete will decrease with increased amounts of entrained air. Cement and water combine chemically in a reaction, called hydration. The hydration process can continue for a long period of time in favorable moisture conditions. The quantity of water used in a typical concrete mixture is greater than the quantity required for the hydration to occur, and is necessary to provide plasticity and workability to the concrete mixture. Strength gain ends when hydration stops.

Desirable Properties of Concrete

1. **Durability:** Ability of hardened concrete to resist deterioration caused by weathering, chemicals, and abrasion.
2. **Workability:** Ease of placing, handling, and finishing.
3. **Weather Resistant:** Resistance to deterioration caused by: freezing and thawing, wetting and drying, and heating and cooling.
4. **Erosion Resistant:** Resistance to deterioration caused by: water flow, traffic, and wind blasting.
5. **Chemical Resistant:** Resistance to deterioration caused by: deicing salts, salt water, and sulfate salts.
6. **Water Tightness:** Resistance to water infiltration.
7. **Strong**
8. **Economical**

CONCRETE INGREDIENTS

Portland Cement

Portland cements and blended cements (which incorporate pozzolan and/or mineral admixtures to normally manufactured Portland cements) are hydraulic since they set and harden to form a stone-like mass by reacting with water. The term hydraulic cement is an all-inclusive term that includes both Portland cement and blended cement. Cement is the bonding agent used in a concrete mix.

Cement Types

There are five types of Portland cement (I, II, III, IV, V), each manufactured to meet different needs and therefore having somewhat different physical and chemical characteristics.

Type I is normal, general-purpose cement. It is suitable for all uses when the special properties of the other cement types are not required.

Type II cement generates less heat at a slower rate and has a moderate resistance to sulfate attack. It can also be used in structures of considerable mass, such as large piers, heavy abutments, and heavy retaining walls to control temperature rise within the concrete and/or in warm or hot weather concreting. Type II is also used when sulfate concentrations in ground waters are higher than normal.

Type III is a high-early-strength-cement. It develops higher strength at an earlier age. It is used when early form removal is desired. Alternatively, richer mixtures (with higher cement content) of Types I and II may be used to gain early strength.

Type IV cement has a low heat of hydration and develops strength at a slower rate than other cement types. It is used in massive concrete structures, such as dams. This type of cement is for use where there is a little chance for the heat to escape from the concrete mass, and when temperature control is critical.

Type V cement is used in concrete exposed to a severe sulfate exposure. It is used mainly where concrete is exposed to severe sulfate action such as concrete structures exposed to soil and groundwater with high sulfate content.

Cement Properties

1. Fineness

The fineness of cement affects the rate of hydration. As cement fineness increases, the surface area of the cement particles increases. Therefore, the rate of reaction increases, and the strength development is accelerated.

2. Setting Time
A cement paste must remain plastic long enough to permit normal placing and finishing. The length of time that a concrete mixture remains plastic depends more on the temperature and water content of the paste than on the setting time of the cement.

3. False Set
False set is evidenced by a significant loss of plasticity shortly after the concrete is mixed. Further mixing without the addition of water can restore plasticity. There are several factors that promote false set; the most common is heating of the cement during grinding operations.

4. Heat of Hydration
Heat of hydration is the heat generated when cement and water react. The amount of heat generated is dependent chiefly upon the chemical composition of the cement. The rate of heat generation is affected by the fineness of the cement, the temperature of curing, and the chemical composition of the cement.

5. Quick Set or Flash Set
Quick Set or Flash Set usually occurs when Portland cement is insufficiently retarded; the time of initial setting is considerably less than one hour at normal temperatures. Quick set may be due to insufficient or faulty gypsum in the Portland cement, or to improper chemical composition of the clinker. The chemical reactions involved liberate a large amount of heat and the set cannot be overcome by remixing the paste.

6. Specific Gravity
Specific gravity is the ratio resulting from dividing the solid weight of a material to the weight of an equal volume of water at standard conditions of temperature and pressure. The specific gravity of Portland cement is generally about 3.15.

Shipping and Storage

Most cement is shipped in bulk by railroad, barges or truck. One bag of cement weighs 94 pounds. Portland cement must be kept dry in order for its quality to be retained.

Hydration Process

The chemical process by which cement reacts with water is called “hydration”. As the reactions proceed, heat is liberated (exothermic reaction) and the products of the hydration process gradually bond the concrete components. It is possible to get an indication of the rate at which cement minerals and water are reacting by monitoring the fluidity and the rate at which heat is generated in the concrete mixture.

Setting Time

During the hydration process the concrete paste gradually loses its plasticity, shows signs of stiffness, and then becomes a stiff mass but without any sizeable strength. The time and degrees of relative stiffness can be measured by a standard test method which allows the determination of both the initial set and final set of a given concrete mixture.

Initial setting defines the point in time when the concrete is no longer fluid and shows the first signs of stiffening. Initial set takes place approximately 2 to 4 hours after the cement has come into contact with the water.

Final setting defines the point in time when the concrete has completely lost its fluidity and shows the consistency of a stiff mass but without any appreciable strength. Final set in a typical concrete mixture takes place approximately 5 to 8 hours after the cement and water were placed in contact.

One should recognize that the "setting" process is associated with fluidity of the concrete mass, and is not necessarily accompanied by a drying process; it takes place even if the fresh cement paste is kept under water. The strength development process, also known as "hardening", is associated with strength gain and takes place after the concrete reaches final setting.

"Hydration", "setting" and "hardening" processes are the result of a series of simultaneous and consecutive chemical reactions between water and the constituents of portland cement.

Fly Ash (Pozzolan)

Fly ash is a byproduct of the burning of coal in power plants. It is removed by mechanical collectors or electrostatic precipitators as a fine particulate residue from the combustion gases before they are discharged to the atmosphere.

Only a few power plants produce an "ideal" fly ash (with a combination of high fineness and low carbon content). Some plants produce a coarse fly ash, with low carbon content and low fineness. This type of fly ash can be satisfactory used in concrete provided that laboratory tests confirm its beneficial performance.

Fly ash particles are generally finer than cement particles. A fly ash having finer particles is generally preferred for use in concrete, as it will generally promote higher strength. The specific gravity of fly ash generally ranges between 1.88 and 2.84, with the finer particles having higher specific gravities.

Types of Pozzolanic Materials

Class N: Raw or calcined natural pozzolans

1. Clays and shales: montmorillonite, kaolinite, and illite types.
2. Opaline materials: opaline cherts and shales, and diatomaceous earths.
3. Volcanic tuffs and pumicites: rhyolitic, andesitic, phonolitic and basaltic types.

Class F: Fly ash normally produced from burning anthracite or bituminous coal that meets the applicable requirements for this class as given in ASTM C 618. This fly ash has pozzolanic properties.

Class C: Fly ash normally produced from lignite or sub-bituminous coal that meets the applicable requirements for this class as given in ASTN C 618. This class of fly ash has some cementitious properties. Some Class C fly ashes may contain lime contents higher than 10%.

Class S: Any pozzolan that meets the applicable requirements for this class as given in ASTM C 618. Examples of materials in this class include certain processed pumicites, and certain calcined and ground shales, clays, and diatomites.

Potential Benefits of Using Fly Ash and other Pozzolans in Concrete

Cement is the most expensive component of a concrete mixture. The introduction of a pozzolan in a concrete mixture can improve the fresh and hardened properties of a concrete mixture while reducing its costs. Some of the effects of using a pozzolan in a concrete mixture are listed below:

In Fresh Concrete:

1. Reduced water requirements of the mixture, especially when the pozzolan is fly ash.
2. Increased workability, reduced bleeding and segregation.

In Hardened Concrete:

1. Modification of the mixture's strength development characteristics by postponing strength gain; this can increase plastic flow at early ages and reduce cracking.
2. Reduced drying shrinkage.
3. Improved water tightness of the concrete.
4. Improved resistance to sulfate active soils and waters with high sulfate content.
5. Inhibited and/or reduced alkali-aggregate reaction.
6. Reduce adiabatic heat of hydration of massive members.

Potential Deleterious Effects of Using High Carbon Fly Ash in Concrete

Unburned, residual, carbon in fly ash can have a dual detrimental effect in concrete. First, unburned carbon particles will tend to float to the surface due to their low density and can cause discoloration problems in the concrete. Second, unburned carbon particles can affect both the amount and stability of air entrained agents (AEA) used in concrete, thus affecting the cost and the freeze and thaw durability of the concrete. Consistently low carbon content is extremely desirable in a fly ash to maintain and control the air content in a concrete mixture.

Mixing Water

Almost any natural water that is drinkable is satisfactory as mixing water for making or curing concrete. However, water suitable for making concrete may not be necessarily fit for drinking. Water is added during batching of the concrete volumetrically or by weight. To add all the components in concrete in like units, it may be necessary to convert gallons of water to pounds of water. The conversion factor used is 1 gallon of water weighs 8.33 pounds. For example,

32.0 gallons of water x 8.33 = 267 pounds of water

The allowable pH level for water used in concrete is 4.5 to 8.5.

Aggregates

Aggregates must conform to certain requirements and should consist of clean, hard, strong, and durable particles; free of chemicals, coatings of clay, or other fine materials that may affect the hydration and bond of the cement paste. Aggregates characteristics influence the properties of concrete.

Weak, friable or laminated aggregate particles are undesirable. A well graded aggregate with a low void content is desired for efficient use of paste. Aggregates containing natural shale or shaley particles, soft and porous particles, and certain types of chert should be especially avoided since they have poor resistance to weathering. In a properly made concrete mix the concrete should consist of particles having adequate strength and suitable weather resistance.

Characteristics of Aggregates

1. Resistance to Freezing and Thawing - (Important in structures subjected to weathering): The freeze-thaw resistance of an aggregate is related to its porosity, absorption, and pore structure. NCDOT Specifications require that resistance to weathering be demonstrated by the sodium sulfate test.

2. Abrasion Resistance - (Important in pavements, loading platforms, floors, etc.): Abrasion resistance is the ability to withstand loads without excessive wear or deterioration of the aggregate. NCDOT Specifications require that abrasion resistance be demonstrated by the Los Angeles Abrasion Test.

3. Chemical Stability - (Important to strength and durability of all types of structures.): Aggregates must not be reactive with cement alkalis. This reaction may cause abnormal expansion and map-cracking of concrete.

4. Particle Shape and Surface Texture - (Important to the workability of fresh concrete): Rough textures or flat and elongated particles, require more water to produce workable concrete than do rounded or cubical aggregates.

5. Grading - (Important to the workability of fresh concrete): Grading or particle size distribution of an aggregate is determined by a sieve analysis. Grading (size distribution) and particle size can affect important properties of concrete such as cementitious requirements and ability to entrain air.

6. Specific Gravity - The specific gravity of an aggregate is the ratio of its solid weight to the weight of an equal volume of water at a given temperature and pressure. Most normal weight aggregates have specific gravity in the range of 2.4 to 2.9. It is not a measure of aggregate quality. It is used to calculate mixture proportions.

7. Absorption and moisture - Batch weights of materials must be adjusted for moisture conditions of the aggregates. The moisture conditions of an aggregate are shown below. They are designated as:

a) **Oven Dry**: completely dry, thus fully absorbent
b) **Air-Dry**: dry at the surface but containing some interior moisture, thus somewhat absorbent.
c) **Saturated Surface-Dry (SSD)**: neither absorbing water from, nor contributing water to, the concrete mixture.
d) **Wet with Free Moisture**: containing an excess of moisture on the surface.

State:	Oven-Dry	Air-Dry	Saturated Surface-Dry	Damp or Wet

Total Moisture:	None	Less than Potential	Equal to Potential Absorption	Greater that Absorption

8. Dry-rodded Unit Weight: Is the weight of one cubic foot of dry coarse aggregate that is compacted by rodding in a standard container in three equal layers. For any aggregate, the dry rodded unit weight varies with the particle size and gradation.

Admixtures

Admixtures include all materials other than cement, water and aggregates that are added to concrete. Admixtures can be broadly classified as follows:

1. Air-entraining
2. Retarding
3. Water-reducing
4. Accelerating (only used in special circumstances)
5. Pozzolans
6. Workability agents
7. Miscellaneous, such as permeability-reducing agent, gas forming agents, and grouting agents
8. Water-reducing and retarding
9. Water-reducing and accelerating (only used in special circumstances)
10. Superplasticizers

Concrete should be workable, finishable, strong, durable, watertight, and wear-resistant. These qualities can often be obtained without the use of chemical admixtures (except for air-entraining admixtures) by using suitable materials and properly proportioning the mixture. There may be instances when special properties may be desired such as extended time of set, acceleration of strength, or a reduction in shrinkage. These types of concrete characteristics can be obtained by the use of admixtures. However, admixtures in general (any type or quantity) should not be considered as a substitute for good concrete practices.

Air-Entraining Admixtures

Concrete that is not air-entrained contains mostly entrapped air. Concrete that is air-entrained contains both entrained air as well as reduced amounts of entrapped air (depending on various factors including the degree and quality of consolidation). Entrained air is characterized by microscopic air bubbles that are well distributed, but not interconnected, throughout the cement paste. These bubbles are small and invisible to the naked eye. Entrapped air is composed of visible air voids that occur randomly in all concrete mixtures. The amount of entrapped air is largely a function of aggregate characteristics and degree of consolidation.

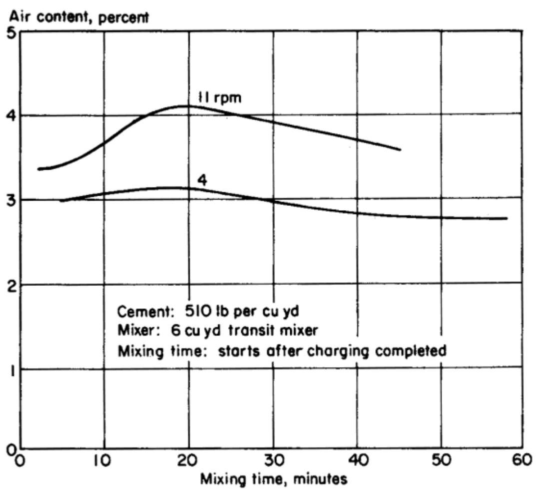
A concrete mixture can experience variations on its air content. These variations are the result of different factors such as aggregate proportions, gradation, mixing time, temperature, and slump. Adequate control is required to ensure the proper air content at all times. Since the amount of air-entraining agent per batch is relatively small (i.e., 3 to 8 oz. per cubic yard of concrete), it is important to first disperse the agent in the mixing water prior to mixing, and then proceed with the mixing process. This is important to achieve proper spacing, size and uniform distribution of the air voids within the concrete to achieve adequate freeze and thaw protection of the concrete.

Effects of Entrained Air on Concrete

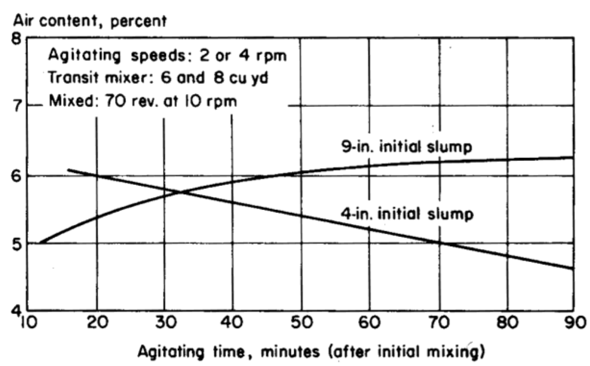
1. **Durability (Freeze Thaw Resistance):** Is improved as air voids act as reservoirs which relieve the pressure of expanding water as it freezes. This prevents damage to the concrete. Air entraining agent is added to concrete primarily for increased Freeze Thaw Resistance, or Durability.
2. **Workability:** Is improved. Sand and water contents can be reduced. The plastic mass is more cohesive and looks and feels “fatty” or “workable”. As water is reduced, segregation and bleeding of the mixture can also be reduced.
3. **Resistance to Deicing:** Surface scaling is reduced.
4. **Sulfate Resistance:** Is improved.
5. **Strength:** Is reduced (if the only change is increased air). Strength depends upon the voids/cement ratio. “Voids” is defined as the total volume of water plus air (entrained and entrapped). If all things remain equal, and the only affected factor is an increase in the amount of air voids, then the concrete strength will decrease. However, strength reduction can be minimized because the improved workability allows for a lower water-cement ratio.
6. **Abrasion Resistance:** About the same as non-air-entrained concrete of the same compressive strength.

Factors Affecting Air Content

1. **Coarse Aggregate Gradation:** For given cement content there is little change in air content when the maximum nominal size of the aggregate is increased above 1-1/4 inch. For aggregate sizes smaller than ¼ inch, the air content increases sharply as the size decreases because of the increase in mortar volume.
2. **Fine Aggregate Content:** An increase in the amount of fine aggregate causes an increase in air content with a given amount of air-entraining agent.
3. **Cement Content:** As the cement increases, the air content decreases.
4. **Slump:** The air content increases as the slump increases up to about 7 inches, and decreases with further increases in slump.
5. **Vibration:** Prolonged vibration should be avoided. Regardless of the slump, 15 seconds of vibration causes a considerable reduction in air content. If vibration is properly applied, little of the intentionally entrained air is lost. Air lost during handling and vibration consists mostly of entrapped air, which large bubbles are undesirable for strength and finishability.
6. **Temperature:** Less air is entrained as the temperature of the concrete increases.
7. **Mixing Action:** The amount of entrained air varies with the type and condition of the mixer, the mixing rate, and amount of concrete being mixed. Figure 5 shows the effect of mixing speed and mixing time in a transit mixer. Figure 6 shows the effect on air content as agitating time is increased.



Relationship between mixing time and air content of concrete



Relationship between agitating time, air content, and slump of concrete.

The amount of air specified in air-entrained concrete depends on the type of structure and the extent of exposure to deicing chemicals, freeze-thaw cycles, and chemically reacting soils or waters.

Retarding Admixtures

A retarding admixture is a material that is used for the purpose of delaying the setting time of concrete. Retarders are used in concrete to:

1. Offset the accelerating effect of hot weather on the setting of concrete.
2. Provide time for placing, or finishing, critical members such as bridge decks or large piers.

All retarders, listed on the NCDOT approved list, also function as water reducers. These are frequently called “water-reducing retarders.” Some retarders also entrain some air in concrete. A retarded concrete may lose slump faster than a non-retarded concrete. Because some retarding admixtures react with certain air-entraining admixtures, they are introduced into the mixing water separately.

Water-reducing Admixtures

A water-reducing admixture is a material used for the purpose of reducing the quantity of mixing water required to produce a concrete mixture of a given consistency. These materials increase the slump of concrete for given water content. A water reduction of about 5% is possible for a given slump.

Many water-reducing admixtures may also retard the setting time of concrete. Some water-reducing admixtures can also entrain air into the concrete. An increase in strength can generally be obtained with water-reducing admixtures if the water content is reduced and if the cement content and slump are kept the same. A rapid loss in slump, and a significant increase in drying shrinkage, can result from the use of some of these admixtures. Therefore, trail batch tests should be made with job materials.

Accelerating Admixtures

An accelerating admixture is used to accelerate the setting time and the strength development of concrete. The rate of strength gain in concrete can also be accelerated by:

1. Using Type III Cement
2. Lowering the water-cement ratio, or increasing the cement content
3. Cure concrete at higher temperatures

Most of the commonly used accelerators cause an increase in the drying shrinkage of concrete. Calcium chloride is the most commonly used accelerating admixture. Calcium chloride and other materials used as accelerators are not antifreeze agents. When used in normal amounts, accelerators can slightly reduce the freezing point of concrete by only a few degrees.

Many commercial accelerating admixtures contain calcium chloride and are not recommended for use in items such as:

1. Prestressed concrete
2. Concrete with embedded aluminum conduit
3. Concrete with galvanized steel reinforcement
4. Concrete subject to alkali-aggregate reaction

North Carolina Specifications do not allow the use of an accelerator except when approved by the Engineer.

High Range Water Reducing Admixtures (Superplasticizers)

A superplasticizer is a high range water reducing admixture. These materials reduce water in the 12 to 20% range. Dosage rates are typically specified in ounces of admixture per 100 lbs. of cement used in the concrete mixture. The dosage rate is usually recommended by the manufacturer.

Effects of using a superplasticizer

1. Recommended for concrete to be pumped or tremied.
2. Allows lower water-cement ratios, which will result in higher strengths.
3. Increased flow-ability for a placement where vibration cannot be achieved.
4. Labor could be reduced.
5. Shrinkage cracking may be reduced due to lower water content.
6. Recommended for precast work, such as prestress concrete, where early strengths are required to release concrete beds for production purposes.

Many superplasticizers lose workability within 30 to 60 minutes depending on conditions and dosage rates. Some may entrain air and retard the setting time. If slump becomes too high, it is possible to have segregation; drying shrinkage may also become a problem. Trial batches should be checked with job materials before using superplasticizers.

ALKALI-SILICA REACTIVITY

Alkali-Silica Reactivity (ASR) is a chemical reaction that deteriorates hardened concrete. The reaction occurs when alkali rich fluid present in concrete react with reactive siliceous minerals in the aggregate. The product of this reaction is a gel that may absorb water and increase in volume over time. The presence of the alkali-silicate gel does not always cause damage to the concrete; however gels of the appropriate formation can absorb large quantities of water. The major problem that results from the absorption of large quantities of water is that pressure generated by the increased volume ruptures the aggregate particles and causes cracking. Reactions usually become visible in five to ten years after placement of concrete. Typical indicators of ASR are random map cracking, closed joints, and spalled concrete.

The progress of the reaction can be extremely slow, and signs of ASR may only appear after the concrete is years to decades old.

STUDY QUESTIONS
(COMPONENTS OF CONCRETE)

1. A mixture of cement paste and fine aggregate is called:
   A. Concrete
   B. Mortar
   C. Paste
   D. Coarse Aggregate

2. The chemical reaction between water and cement is called:
   A. Hydration
   B. Cement Factor
   C. Natural Cement
   D. Unit weight

3. A pH value of 7.0 indicates:
   A. Neutrality
   B. Alkalinity
   C. Acidity
   D. All of the above

4. The property that reflects the ease or difficulty in placing and finishing freshly mixed concrete, is called:
   A. Workability
   B. Hydration
   C. Durability
   D. Harshness

5. A chemical, such as calcium chloride, used to “speed up” the setting time of concrete is called:
   A. Hydration
   B. False set
   C. Retarder
   D. Accelerator

6. A significant loss of plasticity (without heat generation) shortly after the concrete is mixed is called:
   A. Fineness of cement
   B. Heat of hydration
   C. False set
   D. Batch Operator Error

7. The time it takes a cement paste to have the consistency of a stiff mass is known as:
   A. High early strength
   B. Flash set
   C. Final setting
   D. False set

8. The bonding agent used in a concrete mix is:
   A. Water
   B. Set retarder
   C. Cement
   D. Aggregate

9. A by-product of the combustion of pulverized coal in a Coal-Fired power plant is:
   A. Cement
   B. Carbon
   C. Admixture
   D. Fly Ash

10. A material used for the purpose of delaying the setting time of concrete is:
    A. Retarding admixture
    B. Water reducing agent
    C. Accelerator
    D. Superplasticizer

11. The pH limits of mixing water to be used in NCDOT concrete are:
    A. 1.0 -12.0
    B. 4.5 - 7.0
    C. 4.5 - 7.5
    D. None of the above

12. The weight of one gallon of water is:
    A. 6.65 pounds
    B. 10.25 pounds
    C. 8.33 pounds
    D. 5.00 pounds

13. The ability of hardened concrete to resist the deterioration caused by weathering, chemicals, and abrasions is known as:
    A. Consistency
    B. Durability
    C. Flexibility
    D. Workability

14. The specific gravity of Portland cement is:
    A. 1.00
    B. 2.65
    C. 3.15
    D. 4.50

15. The NCDOT allowable range for air content in incidental and structural concrete is:
    A. 2.0 - 5.5
    B. 3.5 - 7.5
    C. 4.5 - 7.5
    D. 4.5 - 8.5

16. The most important effect of entrained air in concrete is to:
    A. Increase strength
    B. Decrease mixing water
    C. Increase workability
    D. Increase durability

17. Concrete should have the desired slump before beginning any other tests.
    A. True
    B. False

18. Two desirable properties of an aggregate are (one correct answer):
    A. High porosity and inert
    B. Low absorption and abrasive resistance
    C. High porosity and laminated
    D. Laminated and cubical shape

19. In NCDOT mixtures fly ash may be substituted for Portland cement up to ______ by weight of the specified cement:
    A. 10%
    B. 20%
    C. 30%
    D. 40%

20. Which of the following has the greatest effect on the strength, durability, and water tightness of concrete:
    A. Aggregate durability
    B. Color of cement
    C. Cement content
    D. Water-cement ratio

STUDY QUESTIONS
(COMPONENTS OF CONCRETE)
Answer Key

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    B. Color of cement
    C. Cement content
    D. Water-cement ratio

SECTION II

NCDOT - M&T POLICIES

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Michael F. Easley
Governor

Lyndo Tippett
Secretary

March 2, 2004

MEMORANDUM TO: Division Engineers

FROM: Cecil L. Jones, PE
State Materials Engineer

SUBJECT: Determining Air Content of Fresh Concrete Containing Marine Limestone and Lightweight Aggregates

Current procedures require the use of a correction factor of 1% when determining the air content of fresh concrete containing marine limestone aggregates with a pressure meter in accordance with AASHTO T 152. In reviewing project records, we discovered inconsistencies in the application of this correction factor. The Materials and Tests Unit also conducted comparisons with several different concrete mixes with different marine limestone sources during last construction season. We found the differences between the pressure meters and the volumetric meters to vary to the extent that the 1% correction factor is not felt to adequately identify' the correct air content of concrete using these aggregates.

The durability of concrete is dependent to some degree on the air void content of the mixture, exclusive of air that may be inside voids within aggregate particles. For this reason, it is important to make sure that we are not measuring voids within aggregate particles when determining the air content of fresh concrete. AASHTO T 152 states that the pressure method is applicable to concrete made with relatively dense aggregate particles and requires the determination of an aggregate correction factor. Most aggregates in North Carolina are very dense, so this is not a concern. However, marine limestones are more porous and it therefore becomes important to make sure that we are not measuring voids within the aggregate. Because the volumetric method described in AASHTO T 196 does not apply external pressure, it only measures air voids of the mix and it applies to any type aggregate, whether it is dense, cellular or lightweight. It has always been the Department's policy to use the volumetric method, or "rollometer" as described by T 196 for lightweight concrete.

Based upon the results of our findings, beginning May I, 2004 all concrete mixes produced using lightweight aggregates, including marine limestone, must be tested using the volumetric method. Current sources of marine limestone include Belgrade, Castle Hayne, Clarks, Goretown Mine, Myrtle Beach, New Bern, Onslow and Rocky Point. Current lightweight aggregate sources include Stalite and Solite.

All NCDOT certified concrete field technicians have received training and have demonstrated proficiency using the volumetric meters. The volumetric meters currently being used are much lighter in weight and easier to use than those used in previous years. We have a supply of volumetric meters available and have more on order to supply those offices affected by this change.

Additional meters will be available through our central office in Raleigh. If you are interested in acquiring one or have any questions concerning this new policy please contact Sam Frederick at 919-733-7091. Your local concrete technician can also provide additional training, or assist you in any concrete related matter.

cc: Steve Varnedoe, PE
Steve DeWitt, PE
Ellis Powell, PE
John Emerson, PE
Resident Engineers
District Engineers
Roadway Construction Engineers
Bridge Construction Engineers

NCDOT III (a)

Date: March 2, 2004

Subject: Determining Air Content of Fresh Concrete Containing Marine Limestone and Lightweight Aggregates.

Summary of Changes:

- Use Volumetric Method, or "Roll-o-meter", in accordance to AASHTO T 196 / ASTM C 173
- For Lightweight and Marine Limestone Aggregates

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

February 15, 2010

MEMORANDUM TO: Division Engineers

FROM: Christopher A. Peoples, PE
State Materials Engineer

SUBJECT: Making, Storing and Transporting Concrete Cylinders

We continue to see improperly made, stored and cured concrete cylinders delivered to the Materials and Tests' laboratories for acceptance testing of concrete. In order to insure that the concrete being placed on NCDOT projects complies with the Department's specifications, valid sampling and handling processes must be followed. All concrete cylinders must be sampled, prepared and cured in accordance with AASHTO T-23. Whenever AASHTO T-23 is not followed, the concrete cannot be properly tested. This results in an investigation of the concrete member which in turn causes considerable delay and additional costs in the acceptance process.

To re-emphasize the importance of following proper practices, attached are recommended procedures for use of the 4"x8" plastic cylinder molds and the Department's policy regarding improperly made specimens that was first issued on September 9, 2003 by the State Materials Engineer.

Please share this information with all parties involved.

CAP/lj

cc: Jon Nance, PE
Ricky Greene, PE
Ron Hancock, PE
Bridge Construction Engineers
Roadway Construction Engineers
Randy Pace, PE

PROCEDURES FOR USE OF THE 4” X 8” PLASTIC MOLDS

I. Preparing the 4” X 8” plastic molds for reuse.

1. Drill a small hole, approximately 1/8 inch in diameter, in the bottom of mold.

2. Seal the hole on the inside of the cylinder mold with tape to make the cylinder mold water tight.

3. Apply a light coat of lubricant (form oil, CRC, etc.) to the mold interior. This aids in separation of the mold from the concrete cylinder and helps prevent damage to the molds interior surface. Make sure there is no standing oil in the mold before placing any concrete in it.

II. Casting the 4” X 8” cylinders.

Note: A person who is currently certified by the Materials and Tests Unit as a Field Concrete Technician must make all concrete test cylinders.

1. Select and prepare a proper site for preparing the molds and making the test specimens. This location should be as close as possible to where the member is cast but far enough away to protect them from construction activities, vibrations or other disturbances.

2. Select a representative sample of concrete and remix it before making the cylinders. (See Concrete Field Technician Study Guide) For 4" x 8" cylinders only 2 layers are required. The tamping rod shall be a 3/8 inch diameter straight steel rod approximately 18 inches long, having a hemispherical tip. For specimens with a slump of 1" or less use a wooden flat or stake with a 1" x 1" dimension. Fill the cylinder with two layers, rodding each layer 25 times. In the case of 1" slump or less, penetration of the underlying layer is not required.

3. After casting the cylinders, seal them with opaque plastic caps. The initial storage of all cylinders should be in some type of curing box. A 32 quart or larger Igloo cooler works well. Ensure that the curing box and cylinders are level.

4. Protect the cylinders from vibration and other disturbances for the first 24 hours. Keep them in a moist condition at temperature between 60° and 80°F. Moisture can be maintained by simply putting a 1/4 inch of water in the bottom of the cooler.

III. Curing – Cure the cylinders until they are delivered to the laboratory. One or more of the following procedures can control a satisfactory temperature environment during the initial curing of the specimens: Use of ventilation, use of ice, use of thermostatically controlled heating or cooling devices, use of heating methods such as stoves or light bulbs.

IV. Transporting test cylinders to the laboratory.

Recommended procedure: Transport cylinders to the laboratory in the 4” X 8” plastic reusable molds.

a. Deliver the cylinders to the laboratory no later than 3 days (72 hours) after casting.

b. Do not allow the cylinders to roll or fall while transporting them to the laboratory. The Department has purchased cylinder crates that can store a maximum of 8 cylinders at one time. The crates will fit securely inside a 32-quart cooler. These crates are available through your local Section Concrete Technicians or can be picked up at the central laboratory.

c. Identify each cylinder by contract number, sample number, and date made.

V. Removal of Cylinders from the 4" X 8" reusable plastic molds at the laboratory by the Construction Technician.

Remove the cylinders at the laboratory with compressed air. Cylinders must be at least 24 hours old prior to removing them from the mold.

Procedure:

a. Remove the cap, turn the cylinder upside down, and apply air pressure to the hole in the bottom of the cylinder mold. The mold should then rise on the cylinder. If the cylinder cannot be removed from the mold with compressed air, carefully split one side of the mold with the tool provided at the lab.

b. Use a permanent marker to transfer the identification information to the cylinder. This is provided at the laboratory.

c. Laboratory personnel are not responsible for removing molds or marking cylinders.

VI. Reuse of the 4" X 8" plastic molds.

a. Inspect the 4" X 8" plastic mold before and after each use.

b. Check the plastic mold for warping, splitting, and pitting.

c. Discard the mold if it is deformed to the extent that it will not produce an acceptable cylinder.

Policy on Improperly Made, Stored, Handled or Transported Concrete Cylinders

1. Concrete cylinder specimens that do not conform to requirements of AASTHO T-23 will be marked as failing compressive strength requirements.

2. An investigation will be conducted by the local Concrete Technician to determine the cause of the deficiency and the acceptability of the concrete member it represents.

3. If the investigation reveals that the technician was deficient in the making, curing, handling or transportation of the cylinders in an excess of three times, his/her concrete certification will be removed. In order for the technician to become re-certified, he/she must attend the full Concrete Field Technician school

The purpose of this process is to inform all parties involved with the ongoing problems of unsatisfactory handling and storage of concrete cylinders. It is not intended to remove certifications from trained technician. The methods for making, storage, handling and transporting of cylinders should follow the guidelines stated in AASHTO T-23, a copy of which is attached.

NCDOT III (b)

Date: February 5, 2010

Subject: Making, storing, and transporting concrete cylinders

Summary of Changes:

- Store concrete cylinders in correct initial curing temperature after properly making.
- Transport cylinders in a protective manner to the testing facility.
- Low strength break results will result in an investigation.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE GOVERNOR	EUGENE A. CONTI, JR. SECRETARY

January 15, 2010

MEMORANDUM TO: DIVISION ENGINEERS, RESIDENT ENGINEERS, ROADWAY CONSTRUCTION ENGINEERS AND BRIDGE CONSTRUCTION ENGINEERS

Walton I Jones

FROM: Walton I. Jones
Field Concrete Engineer

SUBJECT: Minimum Sampling for Incidental and Structural Concrete

The minimum testing frequencies for Portland cement concrete for structures and incidental construction are the following. All tests must be performed by a certified "Concrete Field Technician" using the most recent AASHTO/ASTM standards. Additional tests may be required if directed by the Engineer.

CLASS AA,A, and B:

AIR CONTENT- CHACE INDICATOR (AASHTO T-l99): Performed on every load.

SLUMP (AASHTO T-119 / ASTM C-143): Performed on the first load, and a random load per 30 cubic yards or fraction thereof. When test specimens are made.

AIR CONTENT – PRESSURE AIR METER (AASHTO T- 152 / ASTM C-231): Performed on the first load, and a random load per 30 cubic yards or fraction thereof. When test specimens are made.

TEMPERATURE (ASTM C-1064): Performed on the first load and when test specimens are made.

TEST SPECIMENS (AASHTO T-23 / ASTM C-31): One set of cylinders per each placement operation per each 100 cubic yards cumulative or fraction thereof for Class AA and A Concrete. One set of cylinders per each 100 cubic yards or fraction thereof for Class B Concrete.

LIGHTWEIGHT:

AIR CONTENT – CHACE INDICATOR (AASHTO T-199): Performed on every load.

SLUMP (AASHTO T-119 / ASTM C-143): Performed on the first load, and a random load per 30 cubic yards or fraction thereof. When test specimens are made.

AIR CONTENT – VOLUMETRIC (AASHTO T-196 / ASTM C-173): Performed on the first load, and a random load per 30 cubic yards or fraction thereof. When test specimens are made.

UNIT WEIGHT (AASHTO T-121 / ASTM C-138): Performed on the first load, and when test specimens are made.

TEMPERATURE (ASTM C-1064): Performed on the first load and when test specimens are made.

TEST SPECIMENS (AASHTO T-23 / ASTM C-31): One set of cylinders per each placement operation per each 100 cubic yards or fraction thereof.

DRILL PIER:
Air content-Chace method (air content not to exceed 7.5%), slump, temperature, and test specimens will be performed on every load.

<u>NCDOT III (c)</u>

Date: January 15, 2010

Subject: Minimum Sampling Frequencies for Incidental and Structural Concrete.

Summary of Changes:

- Minimum sampling frequencies are established for three general categories of concrete:
    a. Class B, A, AA concrete
    b. Lightweight concrete
    c. Drill pier concrete

- Sampling and testing frequencies are defined as a function of:
    a. The number of truck loads in the placement operation
    b. The volume of concrete in the placement operation
    c. The instance when concrete cylinders are prepared

(c.1) Summary Chart

MINIMUM SAMPLING FREQUENCY

Class A, AA Concrete

TEST	BY LOAD?	BY VOLUME?	OTHER?
SLUMP	First Load	Each 30 cy (Randomly)	Cylinders Made
AIR CONTENT (PRESSURE)	First Load	Each 30 cy (Randomly)	Cylinders Made
TEMPERATURE	First Load	N/R	Cylinders Made
TEST SPECIMENS	Each Placement Operation	Each 100 cy (Randomly)	N/A
UNIT WEIGHT	N/R	N/R	N/R
AIR CONTENT (CHACE)	Every Load	N/R	N/R

(c.2) Summary Chart

MINIMUM SAMPLING FREQUENCY

Class B Concrete

TEST	BY LOAD?	BY VOLUME?	OTHER?
SLUMP	First Load	Each 30 cy (Randomly)	Cylinders Made
AIR CONTENT (PRESSURE)	First Load	Each 30 cy (Randomly)	Cylinders Made
TEMPERATURE	First Load	N/R	Cylinders Made
TEST SPECIMENS		Minimum of one per mix, up to 100 cy, then each 100 cy (Randomly)	N/A
UNIT WEIGHT	N/R	N/R	N/R
AIR CONTENT (CHACE)	Every Load	N/R	N/R

(c.3) Summary Chart

MINIMUM SAMPLING FREQUENCY

LIGHTWEIGHT Concrete

TEST	BY LOAD?	BY VOLUME?	OTHER?
SLUMP	First Load	Each 30 cy (Randomly)	Cylinders Made
AIR CONTENT (VOLUMETRIC)	First Load	Each 30 cy (Randomly)	Cylinders Made
TEMPERATURE	First Load	N/R	Cylinders Made
TEST SPECIMENS	Each Placement Operation	Each 100 cy (Randomly)	N/A
UNIT WEIGHT	First Load	N/R	Cylinders Made
AIR CONTENT (CHACE)	Every Load	N/R	N/R

(c.4) Summary Chart

MINIMUM SAMPLING FREQUENCY

DRILL PIER Concrete

TEST	BY LOAD?	BY VOLUME?	OTHER?
SLUMP	Each Load	N/R	N/R
AIR CONTENT (VOLUMETRIC or PRESSURE)	Optional	N/R	N/R
TEMPERATURE	Each Load	N/R	N/R
TEST SPECIMENS	Each Load	N/R	N/R
UNIT WEIGHT	Optional	N/R	N/R
AIR CONTENT (CHACE)	Each Load ≤ 7.5%	N/R	N/R

M&T Policy for Adding Air-Entraining Agents. Revised January 2, 2002

When the air content of Portland cement concrete measured at the discharge within the time limits of Table 1000-2 of the Standard Specifications is below the specified level by more than the allowable tolerance, the manufacturer may use additional air-entraining admixture to bring the concrete to within specification limits if the following conditions are met:

1. The admixture is the same brand and type as that originally introduced at the concrete plant unless otherwise permitted by the Engineer.

2. The admixture, if liquid, is measured into a bucket containing 1 gallon of water. The admixture, if prepackaged powder, is added according to the manufacturer's recommendation.

3. The admixture, if liquid, is thoroughly mixed with the water and the mixture is then directed as far back in the drum as possible while the drum is momentarily stopped.

4. The maximum allowable water-cementitious material ratio of the concrete is not exceeded with the addition of the water-admixture solution.

5. The concrete is then mixed 30 revolutions at mixing speed.

6. A record is kept by project personnel of the brand, type, and quantity of admixture and the quantity of water added. This information must be recorded and clearly noted on the sample card and the batch ticket.

This policy shall apply only to trucks already on the jobsite and enroute. Concrete plant personnel shall adjust admixture proportions in subsequent loads at the plant so that the air content meets specifications.

Air-entraining agent may be added twice per truck on the job site as long as the total time allowed by the specifications between batching and placement has not elapsed. If, after the second addition the concrete fails to meet air content and/or slump specifications, the concrete shall be rejected.

The intent of this policy is to allow for small adjustments at the start-up of batching operations. It does not relieve the producer from the responsibility of producing good quality concrete on a consistent basis. The routine use of these procedures to meet specification requirements may result in the removal from the Departments' Approved List until such time as the ability to consistently produce good quality concrete is demonstrated.

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Date: January 2, 2002

Subject: Adding Air-entrained Agent (AEA) to Ready-mix Concrete at the Job Site.

Summary of Changes:

Addition of AEA is permitted at the job site to bring concrete to within specifications provide that:

- Admixture is the same brand/type
- Liquid Admixture is diluted in 1 gal of water and directed to the back of drum
- Concrete is mixed, 30 revolutions minimum at mixing speed
- Admixture is added maximum 2 times
- Not to exceed:

  w/c ratio

  time allowed for placement

  slump

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLY
Governor

P.O. BOX 25201, RALEIGH, NC. 27611-5201

LYNDO TIPPETT
Secretary

January 2, 2002

CONCRETE MIX DESIGN NEW NUMBERING SCHEME

Previous mix design identifications have been replaced with a new numbering scheme. The “old” numbering system (2AA-67-43-122) has been replaced due to difficulty distinguishing between two plants using the same aggregates, or between brands of cement and brands of pozzolan. The new numbering scheme incorporates the producer’s own mix number and provides immediate identification of concrete class and plant number, supplies codes for air-entrainment and vibration status, and pozzolan use. An example of the new numbering scheme is the following:

1782VO03081BCE

- 178 – The Ready Mix Plant’s Certification Number
- 2 – Concrete Class (AA)
- V – Vibrated and Air-entrained
- O – Without Pozzolan
- 03081BC – Producer’s Mix Number
- E – English

CONCRETE MIX DESIGN CODES

Class of Concrete

3 = Class AAA
2 = Class AA
R = Class AA, slip-form barrier rail
1 = Class A

B = Class B
M = Class B, curb & gutter machine
D = Drill shaft

S = Class S
T = Pavement
H = High early strength patch mix
F = Flowable fill

P = Prestress
E = Precast
L = Latex modified concrete

Air-Entrainment and Vibration Status

V = Vibrated and air-entrained
N = Non-vibrated and air-entrained
X = Vibrated and non air-entrained
Y = Non-vibrated and non air-entrained

Pozzolan

O = No pozzolan
F = Class F fly ash
C = Class C fly ash
G = Ground granulated blast furnace slag
U = Silica fume

NCDOT III (e)

Date: January 2, 2002

Subject: Concrete Mix Design New Numbering Scheme.

Summary of Changes:

- Replace previous 10 character mixture ID with new 14 character mixture ID

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLY
Governor

P.O. BOX 25201, RALEIGH, NC. 27611-5201

LYNDO TIPPETT
Secretary

November 15, 2001

Instructions for Submittal and Acceptance of Concrete Mix Designs

The Physical Testing Engineer, head of the Physical Testing Subunit at the Materials and Tests Unit, is responsible for acceptance of concrete mix designs for all construction and maintenance projects. This includes all cast-in-place, prestress, and precast concrete.

According to the Standard Specifications, mix designs for structural concrete shall be submitted to the Engineer 35 days before proposed use and mix designs for concrete paving shall be submitted 30 days before proposed use.

The Physical Testing Engineer uses a computerized database and mix design assignment program to manage acceptance of concrete mix designs. This is part of the DOT's HiCams system.

Acceptance of a concrete mix design is a twofold process. Step one is entry of the mix design into the database. Step two is assignment of a database mix design to a specific project or, in the case of certain prestress and precast mixes, to a specific manufacturing plant for specific items. A mix design must be in the database for it to be assigned to a project or prestress or precast plant.

For database entry, concrete producers must submit directly to the Physical Testing Engineer each mix design on M & T Form 312U, which requires a listing of class of concrete, materials, mix proportions and properties, and accompanying data.

The concrete producer must state his mix design number on each design. Any combination of numbers and/or letters up to eight places is acceptable. Each mix number must be unique within a given plant. This means that when a producer changes a material source, quantity, or property he must assign a different number to the mix and resubmit it for the database. Only admixture quantities are exempt from this requirement. It is understood that admixture quantities may vary in concrete production due to concrete temperature, environmental conditions, presence of other admixtures, etc. (But remember that use of admixtures must be in accordance with the DOT approved list.)

When the mix design is entered in the database, the computer automatically assigns a prefix to the producer's mix design number. This prefix consists of the DOT-assigned plant number (one, two, or three places) and a three-place code to identify the class of concrete, the vibration/air-entrainment status, and the type of pozzolan used in the mix (if any). The computer also assigns a suffix to the producer's mix number – the letter "E" – to designate that the mix proportions are in the English system of measurement. (All mixes are currently in English. We are not issuing mixes in metric.)

With the mix design in the database, it may now be assigned to a project upon request from the contractor. This is step two in the acceptance process. The contractor must complete and sign Form 312U, the mix design request form, and submit it to the

Resident or Maintenance Engineer. Form 312U includes the project number, other administrative data, and a list of producer mix design numbers the contractor wishes to be accepted. The Resident Engineer in turn submits the form to the Physical Testing Engineer for review.

The Physical Testing Engineer retrieves each requested mix design from the database and reviews it for compliance with project specifications. He then assigns each appropriate mix to the project on the HiCams Concrete Mix Contract Assignment screen. Printed copies are sent to the Resident or Maintenance Engineer and other relevant parties.

Anyone with access to HiCams may view the Concrete Mix Contract Assignment screen for any project. (The database is also available for viewing at any time.) However, only the Physical Testing Engineer and Assistant Physical Testing Engineer may enter mixes in the database and assign mixes on the Concrete Mix Contract Assignment screen.

NCDOT III (f)

Date: November 15, 2001

Subject: Submittal and Acceptance of Concrete Mix Designs.

Summary of Changes:

- Anticipation of submittals
  a. Structural concrete: 35 days
  b. Paving: 30 days before intended use

- Use NCDOT form 312 U

ETHICS POLICY REVISIONS

North Carolina Department of Transportation

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ETHICS POLICY

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Preamble

The holding of a public office by appointment or employment is a public trust. Independence and impartiality of public officials and employees of the Department of Transportation are essential to maintain the confidence of our citizens.

The members of the Board of Transportation, officers and employees of the North Carolina Department of Transportation have a duty to the people of North Carolina to uphold the public trust, prevent the occurrence of conflicts of interest, and endeavor at all times to use their position for the public benefit.

To this end, members of the board, officers, and employees of the Department of Transportation shall ensure that an atmosphere of ethical behavior is promoted and maintained at all times.

Introduction

The major transportation functions of the North Carolina Department of Transportation (NCDOT) include highways, public transportation, motor vehicles, railways, bicycles, pedestrian facilities, aeronautics and ferries. The NCDOT is statutorily responsible for providing the necessary planning, construction, maintenance, and operation of an integrated statewide transportation system for the economical and safe transportation of people and goods as provided for by law, including the registration of transportation vehicles and driver's license. It is in the public interest to establish policies on ethical conduct which set forth a code of behavior to be followed by employees of the NCDOT that is consistent with federal and state laws, <u>as well as related Department policies.</u> These policies on ethical behavior are intended to guide the actions of all employees of NCDOT.

Employees of the NCDOT are expected to maintain and exercise the highest ethical standards of conduct in the performance of their duties and responsibilities, and as a condition of employment shall abide by this policy. Employees of the NCDOT are expected to conduct themselves in a manner that prevents all forms of impropriety, to include but not limited to, placement of self interest above public interest, partiality, prejudice, favoritism and undue influence.

This policy applies to all employees of the NCDOT and shall be brought to the attention of each employee during orientation and during annual training by Human Resources. Failure to comply with this policy will be grounds for disciplinary action up to and including dismissal.

Definitions

1. Conflict of interest

A conflict of interest arises when an employee's private interest, usually of a personal, financial or economic nature, conflicts or creates the appearance of a conflict with the employee's public duties and responsibilities.

2. Gift

A gift is anything of value given without compensation.

3. Favor

A favor is any opportunity, service, accommodation, use of facility, or other benefit made available for less than fair market or normal value given in exchange for being influenced in the discharge of one's duties and responsibilities.

4. Employee

Employee for the purposes of this policy shall mean both State officer and employee holding an office or employment with the North Carolina Department of Transportation.

5. Family

Family for the purposes of this policy includes spouse, you and your spouse's children, parents, in-laws, step-parents, step-child, step-sibling, grandchildren, brother, sister, uncle, aunt, first cousin, also any dependent person living in the same household.

I. Conflict of Interest

No employee shall have any interest, financial or otherwise, direct or indirect, or engage in any business, transaction or activity that is in conflict or could appear to be in conflict with the proper discharge of his or her duties. An appearance of a conflict of interest exists when a reasonable person would conclude from the circumstances that the employee's ability to protect the public interest, or perform public duties, is compromised by personal interest. Examples of conflict of interest are as follows:

A. Misuse of Official Position

No employee shall use or attempt to use his or her position with the NCDOT to secure unwarranted privileges or advantages for himself, herself, or others.

B. Contracts and Purchasing Order Agreements

No employee authorized to draft, negotiate, administer, accept or approve any contract, subcontract or purchase order agreement on behalf of the State, or any member of his/her family, shall have, directly or indirectly, any financial interest in such contract, subcontract or purchase order agreement.

In an effort to avoid the appearance of impropriety while conducting the public's business, employees will be restricted from accepting any employment or engaging in any relationship following their employment with NCDOT with any business entity in connection with any contract, subcontract or purchase order agreement that they participated in any of the following activities:

1. Drafting the contract, subcontract or purchasing order agreement;
2. Defining the scope of the contract, subcontract or purchasing order agreement;
3. Selection of the business entity for services;
4. Negotiation of the cost of the contract, subcontract or purchasing order agreement, including calculation of man-hours, fees or extent of services;
5. Administration of the contract or purchase order agreement.

This section is not intended to prohibit employment with a business entity if the employment is on work other than the specific contract, subcontract or purchase order agreement with which they were involved. An exception to this section of the policy may be granted when recommended by the Secretary <u>of Transportation</u> and approved by the Board of Transportation.

C. Real/Personal Property

No employee or member of his/her family shall use an employee's position to profit from, directly or indirectly, an interest in real or personal property.

D. Business Opportunities

No employee or member of his/her immediate family shall accept any business or professional opportunity when such person knows, or reasonably should know, that the opportunity is being afforded to them with the intent to influence the performance of the employee's official duties.

E. Outside Employment and Activities

In accordance with NCDOT Secondary Employment policy, the employment responsibilities to the State are primary for any employee working full-time and and other employment in which that person chooses to engage is secondary. An employee shall have the approval from the division, branch or unit manager before engaging in any secondary employment.

No employee shall accept employment or render services for any private or public interest when that employment or service is in conflict with the discharge of his or her official duties or when that employment may tend to impair his or her objectivity or independence of judgement in the performance of such duties or induce them to disclose confidential or any information gained through their State duties.

F. Use of Information

No employee shall, directly or indirectly, use, disclose, or allow the use of official information which was obtained through or in connection with his or her official duties and which has not been made available to the general public for the purpose of furthering the private interest or personal profit of any business entity or person, including the employee.

II. Gifts and Favors

No employee should knowingly, directly or indirectly, ask, accept, demand, exact, solicit, seek, assign, receive, or agree to receive anything of value for the employee or for another person, in return for being influenced in the discharge of the employee's duties and responsibilities.

No employee shall solicit for a charitable purpose a gift from a subordinate employee, except as provided in NC Gen. Stat. Section 138A-32 (b).

No employee shall solicit or accept, directly or indirectly, on behalf of himself or herself or family member, any gift or favor from a contractor, subcontractor, vendor, supplier, lobbyist or any other individual or other business entity that:

1. Has or is seeking to obtain contractual or other business or financial relations with the Department;
2. Conducts operations or activities that are regulated by the Department;
3. Have interests that may be substantially affected by the performance or non-performance of the employee's official duties.

Exceptions to this section, gifts and favors, are noted in NC Gen. Stat. Section 138A-32 (e).

Any such gift or favor received from a contractor, subcontractor, supplier, lobbyist or any other individual or other business entity must be reported and remitted immediately through the appropriate chain of command to the Secretary of Transportation.

III. Consultation

Employees are urged to consult with the Division of Human Resources, Classification, Compensation & Policy Unit staff when an ethical question arises under this policy.

IV. Distribution and Training of Ethics Policy

A copy of this policy will be presented to all new employees at the time of employment and posted in a conspicuous place throughout the Department and made available on the NCDOT web site.

Training shall be provided by Human Resources every other year.

V. Enforcement and Compliance

This policy will be enforced by the Secretary of Transportation. Failure to comply with the above policy will be grounds for disciplinary action up to and including dismissal from employment with the NCDOT. Conflicts of interest or unethical behavior that defrauds the Department , vendor, contractor, subcontractor, or supplier may also be violations of criminal law an may result in criminal prosecution.

VI. Disclosures

Any employee who identifies a conflict of interest shall disclose the same promptly in writing through appropriate management channels to the Secretary of Transportation.

FALSIFICATION

North Carolina State Law G.S. Chapter 136, Roads and Highways

13.2 Falsifying highway inspection reports.

(a) Any person who knowingly falsifies any inspection report or test report required by the Department of transportation in connection with the construction of highways shall be guilty of a Class H Felony.

(b) Any person who directs a subordinate under his direct or indirect supervision to falsify an inspection report or test report required by the Department of Transportation in connection with the construction of highways shall be guilty of a Class H Felony.

Punishment for a Class H Felony can result in up to 10 years in jail, up to $10,000.00 in fines, or both.

Federal Law Title 18-Crimes and Criminal Procedure

Part I- Crimes

Chapter 47- Fraud and False Statements

Section 1020. Highway Projects

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

Whoever knowingly makes any false statement or false representation as to a material fact in any statement, certificate, or report submitted pursuant to the provisions of the Federal-Aid Road Act approved July 11, 1916 (39 Stat. 355), as amended and supplemented,

Shall be fined under this title $10,000.00 or imprisoned not more than five years, or both.

Falsification of Records is defined as the changing or misrepresentation of Data or Tests. Falsification also includes the destruction or alteration of records.

SECTION III

NCDOT FORMS

NCDOT M&T Form 903

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Batch ticket for Central and Transit-Mix Concrete. To accompany each load of concrete delivered. Not applicable on concrete pavement if batch plant set for project.

1. Ticket No. ______________________ Date ______________
2. Project No. ______________________ Mortar Content ______________
3. Plant Name ______________________ State No. ______________
4. Truck No. __________ Truck Load ______ C.Y. Accum. Yard ______ C.Y.
5. Class Concrete ______________ Free Moisture F.A. ______________
6. Mix Design No. ______________ Free Moisture C.A. ______________
7. Maximum water permitted per cu.yd. ______________ gals.
8. Total mixing water per cu.yd. ______________ gals.
9. Additional water which may be added per cubic yard and not exceed maximum wlc ratio ______ gals.
10. Air agent ounces per yard ______________
11. Retarder ounces per 100 # cement ______________
12. Other admixtures and amount used ______________
13. Time batching completed ______________ If ice used ______ lbs/load
    (A minimum of 70 revolutions at mixing speed is required at the batching plant and/or at the work site.)
14. Number of revolutions at mixing speed at plant ______________
    (See nameplate or mixer for proper mixing speed.)

Certified Technician   Cert. No.

TO BE FILLED OUT BY FIELD INSPECTOR

Station ______________
Structure Member ______________
Additional Water Added ______________ gals (Not to Exceed Line 9)
(If additional water is added, minimum of 25 revolutions of the mixer drum at mixing speed shall be made)
No. revolutions at mixing speed at job site: ______________
Time at completion of discharge: ______________
Slump __________ Temperature: Air ______ °F. Concrete ______ °F.
Pressure meter air test ______________ % Air
Air indicator stem reading ______ X ______ = ______ + ______ = ______ % Air
Factor   Curve Corr.
Sample No. of Cylinders made from this load: ______________

Project Inspector

CHACE INDICATOR CORRECTION TABLES

Use only 70% Alcohol

Table 1
Mortar Correction Factors

Chase Indicator

Mortar Content ft^3/yd	Scratched on glass Indicator 1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
27	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40
20	1.19	1.26	1.33	1.41	1.48	1.56	1.63	1.71	1.78
19	1.13	1.20	1.27	1.34	1.41	1.48	1.55	1.62	1.69
18	1.07	1.14	1.20	1.27	1.33	1.40	1.47	1.54	1.60
17	1.01	1.07	1.13	1.20	1.26	1.33	1.39	1.45	1.51
16	0.95	1.01	1.07	1.13	1.19	1.25	1.30	1.36	1.42
15	0.89	0.95	1.00	1.06	1.11	1.17	1.22	1.28	1.33
14	0.83	0.88	0.93	0.99	1.04	1.09	1.14	1.19	1.24
13	0.77	0.82	0.87	0.92	0.96	1.10	1.06	1.11	1.16
12	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.07
11	0.65	0.69	0.73	0.77	0.81	0.86	0.90	0.94	0.98
10	0.59	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89

Table 2
Curve Correction

Mortar Corrected Air Content (%)	Curve Correction (%)	Mortar Corrected Air Content (%)	Curve Correction (%)
1.0	-0.1	7.0	0.8
2.0	0.0	7.5	0.9
3.0	0.2	8.0	1.0
3.5	0.3	8.5	1.1
4.0	0.3	9.0	1.2
4.5	0.4	9.5	1.3
5.0	0.5	10.0	1.3
5.5	0.6	11.0	1.5
6.0	0.7	12.0	1.7
6.5	0.8	13.0	1.8

STEP BY STEP METHOD OF FILLING OUT M&T FORM 903

1. Line One: The Ticket Number runs consecutively each day for each class of concrete. The Date is the date the concrete is being batched.

2. Line Two: The Project Number is the NCDOT project the concrete is being sent to. The Mortar Content comes from the approved mix design (Form 312).

3. Line Three: The Plant Name is the firm that is supplying the concrete. The State Number is assigned to each plant that has been certified.

4. Line Four: The Truck Number comes off the Ready Mix truck and should appear on the up-dated "Approved Truck List" for that plant. The TruckLoad is the cubic yards of concrete being carried to the job. The Accumulative Yardage is the yards sent to that project that day of that class of concrete.

5. Line Five: The Class of Concrete is the DOT classification of concrete, which comes from the approved mix design. The Free Moisture Fine Aggregate is expressed as a percentage and should be run at least once a day.

6. Line Six: The Mix Design Number comes from the approved mix design Form 312. The Free Moisture Coarse Aggregate is expressed as a percentage and should be run at least once a day.

7. Line Seven: The Maximum Water Permitted Per Cubic Yard is recorded in gallons and comes from the approved mix design.

8. Line Eight Total Mixing Water Per Cubic Yard is recorded in gallons and includes all metered water plus all water in the form of free moisture located in the fine and coarse aggregate.

9. Line Nine: Additional Water is the difference between the maximum water permitted per cubic yard and the total mixing water used per cubic yard (Line 7 - Line 8). THIS MAY NEVER EXCEED THE MAXIMUM WATER CEMENT RATIO!

10. Line Ten: Air Agent Ounces Per Yard is the amount used per cubic yard to entrain 6.0% air 1.5% as determined by the Producer.

11. Line Eleven: Retarder Ounces Per 100* Cement is determined by the brand being used and comes off the updated "Approved Admixture List" and is based on the air temperature or the concrete temperature — whichever is highest.

12. Line Twelve: Other Admixtures And Amount Used is any additional admixtures which may have been used, (i.e. superplasticizers.)

13. Line Thirteen: Time Batching Completed is the time when all materials are batched into truck. If Ice Used, the total pounds used in the truckload **I** should be recorded and subtracted from the metered water.

14. Line Fourteen: Number Of Revolutions At Mixing Speed At Plant is the, actual number of evolutions at mixing speed as recommended by the manufactures rating plate on the truck should be recorded before the truck leaves the plant.

15. Line Fifteen: Certified Technician and Certification Number is the current certified Concrete Technician or Batcher performing the operations. He/She should sign their name and certificate number to the ticket. Only those currently certified may sign the batch ticket.

TO BE FILLED OUT BY FIELD INSPECTOR
BOTTOM OF FORM

1. Station: the station number where the concrete is being placed.

2. Structure Member: is the type of use the concrete is being used in (Bridge Deck, Footing, Curb and Gutter, etc.).

3. Additional Water Added: is any water added to the load after the mixing process is complete. This amount should not exceed the amount shown on Line 9 of the batch ticket.

4. Number Revolutions At Mixing Speed At Job Site: if any additional mixing is needed on the job site, it is recorded. There is no maximum number of revolutions.

5. Time At Completion Of Discharge: the time when all the concrete is off the truck is recorded and must not exceed elapsed time for placing concrete as shown in the Specifications.

6. Slum Temperature Air, and Temperature Concrete: he slump should be recorded to the nearest 1/4''. The air and concrete temperatures should be recorded to the nearest one-degree Fahrenheit.

7. Pressure Meter Air Test: is recorded to the nearest 1/10% and should range between 4.5% and 7.5%.

8. Air Indicator: a calibrated Chace Air indicator should be used. The stem reading is taken directly off the Chace glass tube after the procedure is completed and recorded. The stem reading is then multiplied by the value determined from Table 1, from the back of the batch ticket (using the Mortar Content and Chace Indicator Calibration Number). The mortar-corrected air content is now added to the Curve Correction value, determined from Table 2 (located on the back of the batch ticket). This value will give you the corrected Chace Air. The Chace Air should range from 4.5% to 7.5%.

9. Cylinders: if cylinders are made from the load of concrete, the sample number of the cylinders is recorded and the inspector performing the field tests on the concrete should sign the ticket.

This ticket serves two important functions:

1. Communication: it serves as a means of communication between the Batcher at the plant and the inspector in the field.
2. Documentation: it serves as a permanent record for the project in case it is needed for reference anytime in the future.

North Carolina Department of Transportation, Division of Highways, Materials and Tests Unit Statement of Concrete Mix Design and Source of Materials

Project 8.2446902	Concrete Producer HOME CONCRETE INC
County TRANSYLVANIA	Plant Location & DOT No. CHERRYFIELD, NC -69
Resident Engr. DRACK COUNT	Contractor BLOOD CONSTRUCTION CO
Class of Concrete CLASS AA	Date AUGUST 27, 2003
Mix Design No. 0692V03333FFE	Contractor's Signature
Note Mix Design Units (US or Metric) ENG	

Mix Design Proportions Based on SSD Mass of Aggregates

Material	Producer	Source	Qty. per Cu. Yd.
Cement, Type	GIANT	HARLEYVILLE, SC	650 lbs.
Pozzolan			
Fine Agg., + M	FRANK-N-STIEN	PUMPKINGTOWN, SC	1154 lbs.
Coarse Agg., + M	DARKTOWN STONE	BREVARD, NC	1800 lbs.
Other Agg., + M			
Total Water		CITY	32.0 gals.
Air. Entr. Agent	W.R.GRACE & CO.	DARAVAIR AT60	3.0 oz.
Retarder	W.R.GRACE & CO.	DARATARD 17	22.0 (OZ/100#) oz.
Water Reducer			
Superplasticizer			
Other			
Other			

Mix Properties and Specifications

Slump 3.50 in. Mortar Content 16.20 cu. ft.
Max. Water 33.2 gals. Air Content 6.0 %

Aggregate and Pozzolan Data

Material	Specific Gravity	% Absorption	Unit Mass	Fineness Modulus
Material Fine Agg. Type (2S or 2MS)	2.64	0.4	NA	2.70
Coarse Agg., Size (No. 57, 67, or 78M)	2.67	0.6	97.5	NA
Other Agg., Type or Size				
Pozzolan		NA	NA	NA

Cast-in-place concrete shall conform to Section 1000, precast concrete to Section 1077, and prestressed concrete to Section 1078 of the 1995 Standard Specifications for Roads and Structures plus all applicable Special Provisions.

Accepted By ______________________ (Physical Testing Engineer) Date ________

M&T Form 903

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Batch ticket for Central and Transit-Mix Concrete. To accompany each load of concrete delivered. Not applicable on concrete pavement if batch plant set for project.

1. Ticket No. 1 Date Oct. 31, 2003
2. Project No. 8.2446902 Mortar Content 16.20
3. Plant Name Home Concrete Inc State No. 69
4. Truck No. 15 Truck Load 8.0 C.Y. Accum. Yard 8.0 C.Y.
5. Class Concrete Class AA Free Moisture F.A. 1.6 %
6. Mix Design No. 0692VO3333FFE Free Moisture C.A. 2.1 %
7. Maximum water permitted per cu.yd. 33.2 gals.
8. Total mixing water per cu.yd. 32.0 gals.
9. Additional water which may be added per cubic yard and not exceed maximum wlc ratio 1.2 gals.
10. Air agent ounces per yard 3.0
11. Retarder ounces per 100 # cement 22.0
12. Other admixtures and amount used None
13. Time batching completed 3:25 pm If ice used None lbs/load
    (A minimum of 70 revolutions at mixing speed is required at the batching plant and/or at the work site.)
14. Number of revolutions at mixing speed at plant 75
    (See nameplate or mixer for proper mixing speed.)

Jay Hardwork PCB 000Ø

Certified Technician Cert. No.

TO BE FILLED OUT BY FIELD INSPECTOR

Station 12+50, 35 feet right of the centerline
Structure Member Bent #2 – Column A Drill Shaft
Additional Water Added 4.0 gals (Not to Exceed Line 9)
(If additional water is added, minimum of 25 revolutions of the mixer drum at mixing speed shall be made)
No. revolutions at mixing speed at job site: 35
Time at completion of discharge: 3:45 pm
Slump 3.25'' Temperature: Air 75 °F. Concrete 77 °F.
Pressure meter air test 6.40 % Air
Air indicator stem reading 4.25 X 1.30 (Factor) = 5.5 + 0.6 (Curve Corr.) = 6.1 % Air
Sample No. of Cylinders made from this load: P-2468

Justin Time PCT ØØØA

Project Inspector

M & T Form 250
Rev. 3/10

North Carolina Department of Transportation

DAILY PLANT REPORT ON READY MIXED CONCRETE OPERATIONS

Contract No. / Work Order No. ______________________ Date ______________

Cement Producer ______________________ Cement Producer Location ______________________

Pozzolan Producer ______________________ Fine Agg Source ______________________

Ready Mix Facility & No. Ready Concrete Company Coarse Agg Source ______________________

Class of Concrete	Mix Design No.	Number of Loads	Total Yards Batched	Total Yards Rejected (To be completed by field inspector)

MOISTURE IN AGGREGATES

Fine Aggregate:

Trial 1 Time: ______________

Wet Wt. ________ Minus Dry Wt. ________ = ________ X 100 = ________ % Total Moisture

Dry Wt. ________

Total Moisture ________ Minus Absorbed Moisture ________ = ________ % Free Moisture

Trial 2 Time:________

Wet Wt. ________ Minus Dry Wt. ________ = ________ X 100 = ________ % Total Moisture

Dry Wt. ________

Total Moisture ________ Minus Absorbed Moisture ________ = ________ % Free Moisture

Coarse Aggregate:

Trial 1 Time: ______________

Wet Wt. ________ Minus Dry Wt. ________ = ________ X 100 = ________ % Total Moisture

Dry Wt. ________

Total Moisture ________ Minus Absorbed Moisture ________ = ________ % Free Moisture

Trial 2 Time:__

Wet Wt. ________ Minus Dry Wt. ________ = ________ X 100 = ________ % Total Moisture

Dry Wt. ________

Total Moisture ________ Minus Absorbed Moisture ________ = ________ % Free Moisture

Certified Batcher Signature: ______________________ Certification No. ______________

Certified Field Inspector Signature: ______________________ Certification No. ______________

M&T Form 250 is to be completed by certified batcher, pink copy of form shall be sent with first load, and the completed white (original) copy shall be sent with final load. If form is not completed and received on site, concrete is subject to rejection.

Sample Card

* Required Field

☐ Metric
☐ English

t May Be Required Based on Material

HiCAMS #:

*** Material:** ______________________

t Sample Owner: ____________ **t** Contract #: ____________

* Testing Category: ____________ Field ID: ____________

Check Sample? **Y N** (Circle One) Proj/Po/Wo#: ____________

t Related Sample ID: ____________ Line Item #: ____________

t Corr. Sample ID: ____________ RE: ____________

\# of Pieces: ____________ *** Rep. Qty:** ____________

*** To Be Used In:** ______________________

Comment:

*** Sample Date:** ____________ *** Sample By:** ____________

*** Sample From:** ____________ Truck/ Container #: ____________

Structure Number: ____________ Route Desc: ____________

Route Type: I US NC SR (Circle One) Alignment: ____________

Route Number: ____________ * Location: ________ Offset Dist: ________

Map Number: ____________ * Sta. From: ____+____ Sta. To: ____+____+____

County: ____________ Coastal Plain: Y N (circle One)

☐ Other

t Producer/Supplier: ____________ **t** Plant ID: ____________

t Brand Name: ____________ Shelf Life Date: ____________

t Date produced: ____________

t Concrete Mix: ____________ **t** Asphalt Mix/ JMF ID: ____________

t Alternate Ids Type:	**Prefix:**	**Range:**	**Description of Items:**
☐			

Please use reverse side for test data, comments, and additional information. Check here if more on reverse

Sample Card for Home Concrete Inc Ready Mix

* Required Field

☐ Metric

☐ English

t May Be Required Based on Material

HiCAMS #:

* Material:	Class AA Drill Shaft		
t Sample Owner:	Project	t Contract #:	
* Testing Category:	Acceptance	Field ID:	
Check Sample?	Y N (Circle One)	Proj/Po/Wo#:	8.2446902
t Related Sample ID:		Line Item #:	
t Corr. Sample ID:		RE:	
# of Pieces:		* Rep. Qty:	32 cu yds
* To Be Used In:	Drill Shaft		

Comment:

* Sample Date:	October 31, 2003	* Sample By:	Holly Hicky

* Sample From:	Concrete Truck	Truck/ Container #:	15		
Structure Number:	Bent # 2	Route Desc:			
Route Type:	I US NC SR (Circle One)	Alignment:			
Route Number:		* Location:		Offset Dist:	
Map Number:		* Sta. From:	12 + 50	Sta. To:	+ +
County:		Coastal Plain:	Y N (circle One)		

☐ Other

t Producer/Supplier:	Billy-Bob's Ready Mix	t Plant ID:	69
t Brand Name:		Shelf Life Date:	
t Date produced:			
t Concrete Mix:	0692VO3333FFE	t Asphalt Mix/ JMF ID:	

t Alternate Ids Type:	Prefix:	Range:	Description of Items:
☐			

Please use reverse side for test data, comments, and additional information. Check here if more on reverse

SECTION V

FIELD TEST PROCEDURES AND STANDARDS

THE TESTING OF PORTLAND CEMENT CONCRETE

The NCDOT goal is to insure that a durable, quality and economic concrete material is produced, delivered and installed in all concrete structures owned by the State of North Carolina. In doing so, the NCDOT maintains a quality assurance process that includes field testing of all concrete used in NCDOT projects to verify compliance with NCDOT specifications and requirements. Field tests are run by an NCDOT approved inspector. As of July 1st 1992, the concrete inspector must be a certified concrete technician in accordance with both NCDOT and ACI requirements.

The test type, ranges of acceptability, and associated policies and directives are included in sections I, II and III of this book as specified by the NCDOT in its most current specifications. As noted in section III (c), the NCDOT requires that each test be conducted with minimum frequency criteria. Section IV presents information concerning procedures for mixture submittal, and for recording and reporting field tests in compliance with NCDOT specifications. Section V presents information concerning acceptable test procedures, which must be performed in accordance to the noted ASTM and AASHTO standards.

The following table presents a summary of the field tests, and their corresponding standard test method, required by the NCDOT

TESTS	AASHTO	ASTM
Temperature of Freshly Mixed Concrete		C-1064
Sampling Freshly Mixed Concrete	T-141	C-172
Slump of Hydraulic Cement Concrete	T-119	C-143
Density (Unit Weight) of Concrete	T-121	C-138
Air Content by Pressure Method	T-152	C-231
Air Content by Volumetric Method	T-196	C-173
Making and Curing Test Specimens	T-23	C-31
Air Content by Chace Indicator	T-199	

In general, field tests required by the NCDOT focus on the strength, consistency, air content, and temperature characteristics of the concrete mixture.

Strength tests are of two types: compressive and flexural. Compressive strength tests are normally run on structural and incidental concrete elements as classified by the NCDOT. Flexural strength tests are normally run on pavement concrete mixtures. The consistency of the fresh concrete is determined by measuring its slump. Abnormal variations in slump can provide an indication of changes affecting the concrete mixture that could in turn affect the in-place quality and performance of the concrete. Tests for air content are conducted utilizing the Chace indicator (in all truck loads), the pressure meter (in all normal-density concrete), and the volumetric meter (in all concrete made with lightweight and marine limestone aggregates as noted in section III (a)).

Except for strength tests (which are normally tested several days after the mixture is in place), all other field tests provide immediate feedback concerning compliance of a concrete mixture with NCDOT requirements for consistency, temperature, and air content. Concrete can be rejected in accordance with applicable NCDOT policies for the test and the type of concrete or structure under control. Section II includes information relevant to actions and procedures for instances when a test falls outside acceptable limits.

TEMPERATURE FOR FRESHLY MIXED CONCRETE (ASTM C-1064)

1. Run temperature test on first load and when cylinders or beams are made.

2. Use a calibrated thermometer.

3. Insert probe into sample a minimum of 3 inches for a minimum time of two minutes. The probe shall be surrounded by at least 3 inches of concrete in all directions.

4. Record temperature to the nearest 1º F.

5. Concrete temperature for incidental and structural concrete, 50º - 95º for all except bridge decks and drilled piers. Bridge deck and drill pier concrete placement temperature is 50º - 90º F. Cold weather specifications applies when one of the components is heated. When a component is heated, the temperature range is 55º - 80ºF.

6. Temperature test must be completed within 5 minutes after obtaining sample.

SAMPLING FRESHLY MIXED CONCRETE (ASTM C-172)

1. Upon arrival of the concrete on the project the inspector checks the batch ticket to verify the project number and class of concrete match up with the mix design. The inspector notes the time batching is completed to ensure placement time is not exceeded. Also the inspector determines based on the batch ticket how much water is allowable to be added.

2. The contractor verifies that the mix will provide the workability required. If additional water is needed the contractor is allowed to add up to the limit the inspector communicates. All water and admixtures must be added *before* tests are conducted.

3. Once the contractor adds all water to be used the inspector samples the concrete. The acceptance tests for slump and air must begin within 5 minutes of the time the sample is obtained. Temperature test should begin immediately.

4. Test specimens are to be made within 15 minutes after obtaining the sample.

5. Concrete should be sampled from the discharge end of placement. If concrete is pumped, the sample shall be obtained from the end of the pump for acceptance testing.

6. Obtain the sample by passing the receptacle through the entire discharge stream or divert the stream completely into a sampling container.

7. If additional water or admixtures are added after sampling, new representative samples must be taken and tested even if the tests have already been conducted.

SLUMP TEST ASTM C-143

The equipment needed to run the slump test is shown above. The slump cone, a tamping rod, a scoop, a ruler, and a non-absorbent surface that is stable and level.

Thoroughly remix the sample of concrete prior to testing.

Remember: Air, Temperature and Slump tests must be **started** within 5 minutes after the composite sample is prepared. The temperature test must be **finished** within these first 5 minutes.

Moisten the slump cone and the testing surface prior to filling of the cone.

Stand on the foot pieces to hold the cone firmly in place. Do not step off at any time until cone is to be lifted.

Fill the cone mold 1/3 full by volume with concrete (2 5/8 in. depth), distributing concrete evenly.

Rod the first layer 25 times. Slightly incline rod, distributing rodding strokes over entire cross section of the cone, penetrating the entire depth of the layer. DO NOT tap the side of the cone.

The second layer is to be filled up to 2/3 by volume (6 1/8 in. depth), distributing concrete evenly.

Rod the second layer 25 times, the rod should penetrate the first layer by 1 in. DO NOT Tap the sides of the cone.

Fill the third and final layer until concrete overflows.

Rod 25 times with the rod penetrating 1 in. into the second layer. Distribute the strokes evenly. DO NOT tap the sides of the cone. Keep the 3rd layer full at all times.

Strike off all excess concrete. Make sure you do not step off the cone at this time.

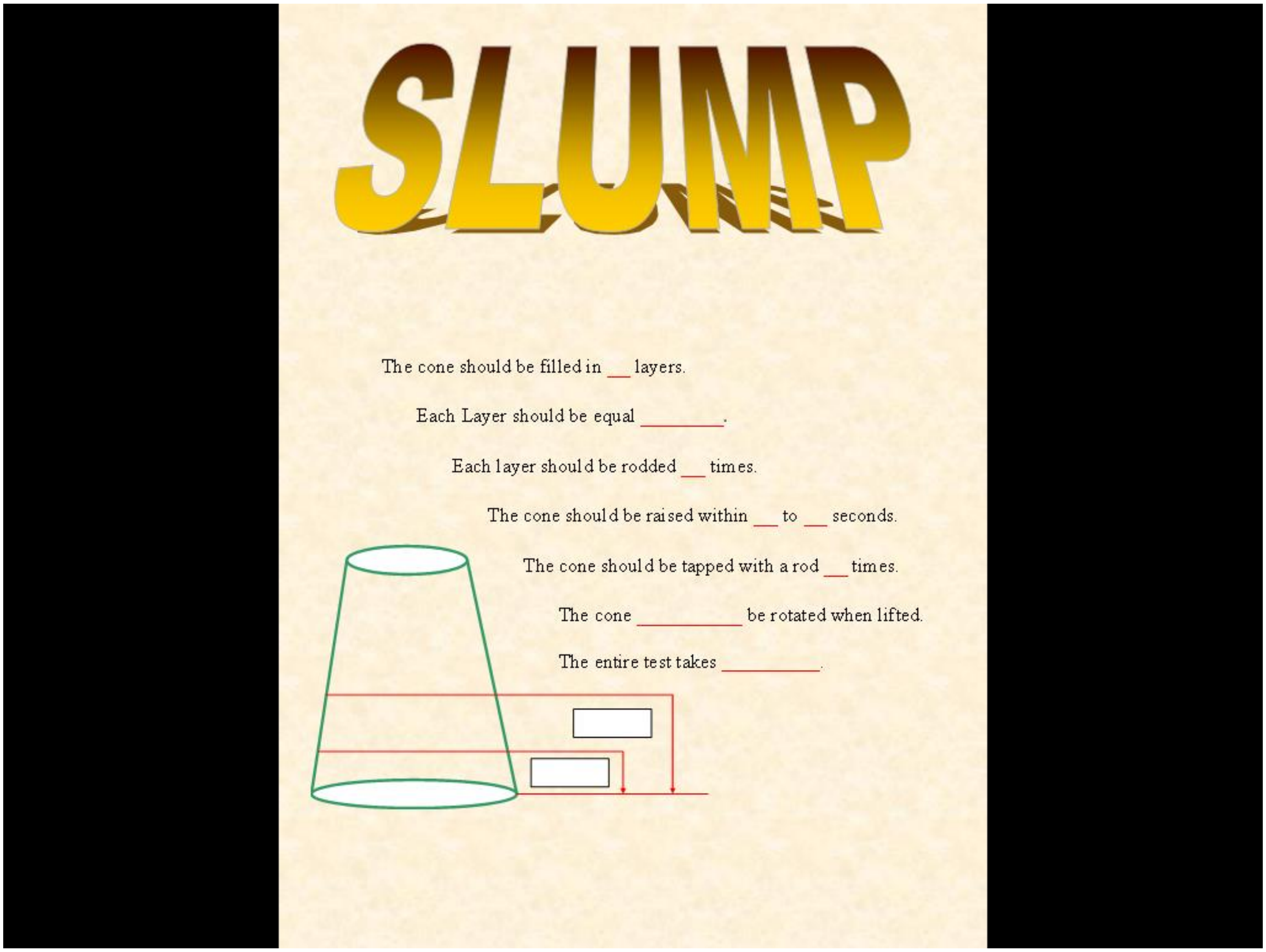
Clean any excess concrete from the top and around the cone, making sure the cone is completely full.

Immediately after completion of cleaning, place hands on the handles and supply downward pressure, then remove feet while holding the cone firmly.

Lift the cone in a steady upward motion with no twisting. This operation must be completed between 3 and 7 seconds.

Invert the cone and place the rod across the top. Measure the distance from the rod to the original displaced center to the nearest 0.25 in. Record the slump. The time limit for this operation is 2.5 minutes.

Clean your equipment. Do not reuse the tested concrete. Do not perform a slump test until all water has been added to the load (this includes adding water at the site). If the slump is out of specification, immediately clean up equipment and perform another test.



1. Perform test on first load, and random load per 30 cubic yards, and when cylinders are made.
2. Add all water before test is performed.
3. Begin test within 5 minutes after obtaining the sample.
4. Test to be completed in 2.5 minutes.
5. Record slump to the nearest ¼ inch.
6. Slump measures consistency.

DENSITY (UNIT WEIGHT) TEST ASTM C-138

The equipment needed to run the unit weight test is shown above. A scale, a unit weight bucket, a tamping rod, a scoop, a rubber mallet, a strike-off plate, a calculator, pencil, and paper, and a level surface.

Thoroughly remix the sample of concrete prior to testing.

Record a weight of the bucket empty.

Moister and/or clean the unit weight bucket, and empty excess water.

Fill the measuring bucket with concrete to about 1/3 of its volume, distributing concrete evenly.

Rod the first layer without hitting bottom of the bucket. Distributing rodding strokes over entire cross section of the bucket, penetrating the entire depth of the layer.

Consolidate the concrete by tapping the sides of the bucket 10 – 15 times.

The second layer is to be filled to approximately 2/3 of the measure volume, distributing concrete evenly.

Rod the second layer, penetrating the first layer by 1 in.

Consolidate second layer by tapping side of bucket 10 – 15 times.

Fill the third and final layer. Rod the third layer with the rod penetrating 1 in. into the second layer. Distribute the strokes evenly.

Tap 10 – 15 times to consolidate.

Place strike-off plate covering 2/3 of surface of the bucket. With a side to side sawing motion, bring plate toward you creating a smooth finish.

Place the strike-off plate again on the bucket, covering about 2/3 of the top surface. Continuing with the side to side sawing motion, force the plate in the forward direction creating a smooth finish. Repeat strike-off plate operation if necessary until a smooth surface is achieved.

Clean off all excess concrete from the sides, handles, and bottom of the bucket.

The amount of concrete should be LEVEL with the top of the bucket. Weight the bucket full of concrete and calculate the unit weight.

NOTE:

If bucket volume is 0.5 ft^3 or smaller, each layer is rodded 25 times. If bucket volume is greater than 1.0 ft^3, then each layer is rodded 50 times.

Formula for calculating the UNIT WEIGHT of CONCRETE:

$$\textbf{UNIT WEIGHT} = \frac{\textbf{WEIGHT OF CONCRETE AND BUCKET (in pounds) – WEIGHT OF BUCKET (in pounds)}}{\textbf{VOLUME OF BUCKET (in cubic feet)}}$$

UNIT WEIGHT (units) = lbs/cf (pounds per cubic foot)

Formulas for calculating the YIELD of a CONCRETE BATCH:

$$\textbf{YIELD} = \frac{\textbf{TOTAL WEIGHT OF MATERIALS IN THE BATCH (in pounds)}}{\textbf{UNIT WEIGHT OF CONCRETE IN THE FIELD (pounds per cubic foot)}}$$

YIELD (units) = cf (cubic feet)

2) To calculate yield in cubic yards, use the following formula, or divide cubic ft by 27.

$$\textbf{YIELD} = \frac{\textbf{TOTAL WEIGHT OF MATERIAL IN THE BATCH (in pounds)}}{\textbf{UNIT WEIGHT OF CONCRETE IN THE FIELD (pounds per cubic feet) x 27}}$$

YIELD (units) = cy (cubic yards)

Formula for calculating the GRAVIMETRIC % AIR of CONCRETE:

$$\% \textbf{ AIR} = \frac{(T - W)}{T} \times 100$$

T = Theoretical weight of concrete computed on air-free basis.
W = Unit weight of concrete (field unit weight).

AIR (units) = % (percent)

Examples

Density

Wt of empty bucket	23.20 pounds
Wt of concrete and bucket	94.80 pounds
Volume of bucket	0.51 cubic ft

$$\frac{94.80 - 23.20 \text{ pounds}}{0.51 \text{ cubic ft}} = 140.39 \text{ pounds per cubic ft} \quad (\text{pcf})$$

Yield

Given the following weights, determine the yield.

Cement	564 pounds
Stone	1948 pounds
Sand	1100 pounds
Water	34.5 gallons

Field Density 144.20 pcf

Add all materials in pounds.

564 + 1948 + 1100 + (34.5 x 8.33) = 3899 pounds

$$\text{Yield} = \frac{3899 \text{ pounds}}{144.20 \text{ pcf}} = 27.03 \text{ cubic ft}$$

To compute yield in cubic yds, divide 27.03 Cu ft / 27 to get 1.0 cu yd

Air

Theoretical Density = 159.65 pcf

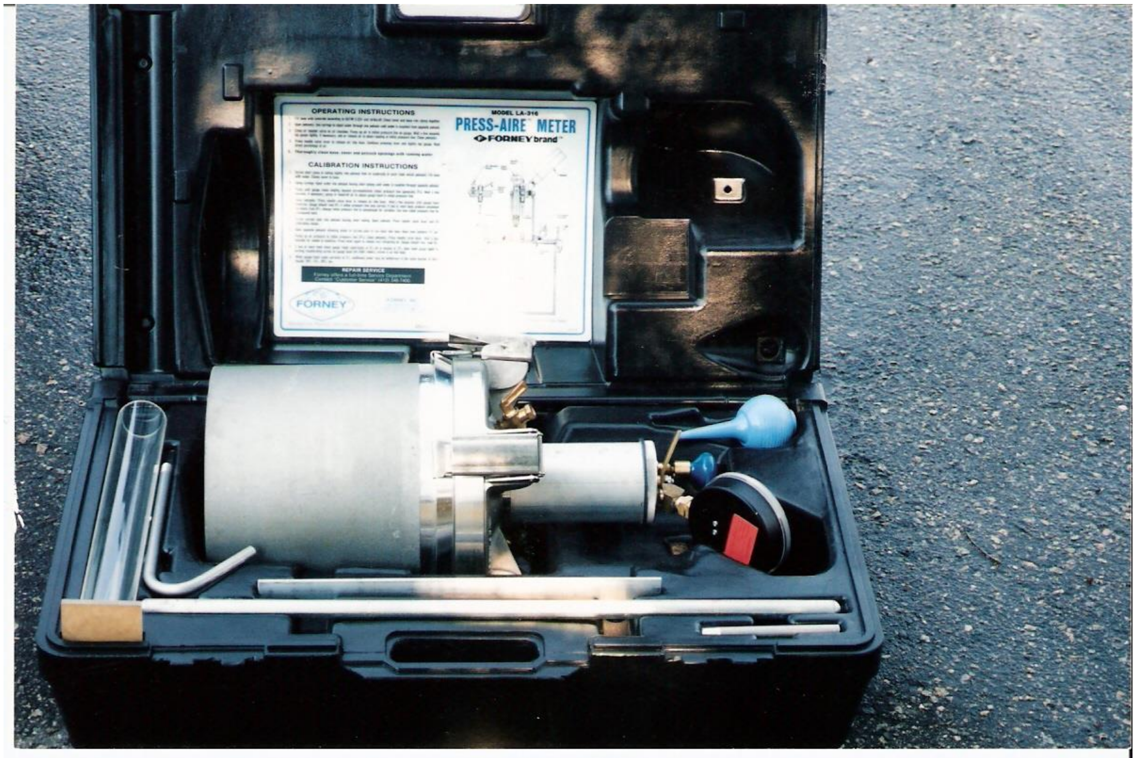
Density (D) = 149.20 pcf

What is the % air content ?

$$\% \text{ Air} = \frac{159.65 - 149.20}{159.65} \times 100$$

% Air = 6.5 %

TYPE B PRESSURE AIR METER ASTM C-231



The equipment needed to run the air content test is shown above. Includes: a measuring bowl and cover assembly, a tamping rod, a scoop, a rubber mallet, a strike-off bar, a syringe, and a level surface. Thoroughly remix the sample of concrete prior to testing.

Clean the measuring bowl and all the equipment to be used, drain any excess of water.

Fill the first layer with concrete to about 1/3 of the volume of the bowl, distribute the concrete evenly.

Rod the first layer 25 times. Distribute rodding stokes over the entire cross section of the measuring bowl, penetrating the entire depth of the layer.

Tap the sides of the measuring bowl 10 – 15 times to consolidate the concrete.

The second layer is to be filled up to 2/3 of the volume of the measuring bowl (this is equivalent to filling up to 2/3 of the height of the bowl), distributing concrete evenly.

Rod the second layer 25 times, penetrating the first layer by 1 in.

Consolidate the second layer by tapping the sides of the bowl 10 – 15 times.

Fill the third and final layer (slightly overfill).

Rod 25 times, the rod penetrating 1 in. into the second layer. Distribute the strokes evenly.

Tap the sides 10 – 15 times to consolidate.

Remove all excess concrete with the strike-off bar, creating a smooth finish.

Clean the rim/flange of any concrete residue. The rim/flange must be clean moist before the cover assembly is applied. A damp rag or towel is helpful.

Moisten and clean the cover assembly gasket to ensure a good seal. Do not clean the lid over the base of the meter.

Note: NCDOT requires that both petcocks be closed **prior** to installing the cover assembly. Close the airbleeder valve (the rounded one on the air chamber, which controls the air pressure in the pump chamber). Install the cover assembly. Use the clamps to secure the cover assembly tightly on to the base. Secure opposite clamps simultaneously.

After installing the cover assembly, **open** both petcocks. Keep the bleeder valve **closed** (the rounded one located in the chamber). Use the syringe to inject water into one petcock until it flows out the other.

<u>Keep</u> both petcocks open. Check the gauge to make sure there is no prior pressure reading (the needle is in its "hands free" zone). Pump air into the air chamber until the gauge needle reaches the equipment's "initial pressure line". Allow a few seconds for the gauge to stabilize. Use the airbleeder valve to adjust the chamber's air pressure until the gauge reading is at its "initial pressure line" (each equipment can have its own, calibrated, initial pressure line).

Tap the gauge lightly, again, this will stabilize the gauge needle.

Close the petcocks. Press the air needle valve (the one with the lever) to release air in to the bowl base. Wait for the gauge needle to stabilize. Tap the sides of the measuring bowl with the mallet to relieve local constraints.

Tap the gauge lightly, and then repress air needle valve again to release any trapped air. Tap gauge lightly to stabilize. Read the percentage of air directly off the gauge. Subtract the aggregate correction factor and record.

PRESSURE AIR METER CALIBRATION INSTRUCTIONS

TYPE B

1. Screw short piece of tubing tightly into petcock hole on underside of cover (note which petcock). Fill base with water. Clamp cover to base.

2. Using syringe, inject water into petcock having short tubing until water is expelled through opposite petcock.

3. Pump until gauge reads slightly beyond pre-established initial pressure line (generally 3%). Wait a few seconds. If necessary, pump or bleed- off air to adjust gauge hand to initial pressure line.

4. Close petcocks. Press needle valve lever to release air into base. Wait a few seconds until gauge hand stabilizes. Gauge should read 0% if initial pressure line was correct. If two or more tests produce consistent variations from 0%, change initial pressure line to compensate for variation. Use new initial pressure line for subsequent tests.

5. Screw curved tube into petcock having short tubing. Open petcock. Press needle valve lever and fill calibrating vessel.

6. Open opposite petcock allowing water in curved pipe to run back into base. Base now contains 5% air.

7. Pump up air pressure to initial pressure line (3%). Close petcocks. Press needle valve lever. Wait a few seconds for needle to stabilize. Press lever again to release any remaining air. Gauge should now read 5%.

8. If two or more tests show gauge reads incorrectly at 5% air in excess of .2%, then reset gauge hand by turning recalibrating screw on gauge hand (on older meters, screw is on dial face).

9. When gauge hand reads correctly at 5%, additional water may be withdrawn in the same matter to check results 10%, 15%, 20%, etc.

*** Forney offers a full-time SERVICE REPAIR DEPARTMENT. Contact “Customer Service” @412-346-7400.

TYPE B PRESSURE AIR METER CALIBRATION

The equipment needed to calibrate the Type B meter is shown above. The meter base and lid, 5% calibration cylinder, tubing, and a surface that is stable and level.

Screw the short piece of tubing into petcock hole on underside of cover (note which petcock)

Fill the base with water

Securely clamp the lid onto the base. Alternate side clamps should be tightening simultaneously.

Using syringe, inject water in to petcock having short tubing until water is expelled through opposite petcock.

Pump air meter until gauge reads slightly beyond pre-established initial pressure line.

Wait a few seconds. If necessary, pump or bleed off air to adjust gauge hand to the initial pressure line.

Close the petcocks.

Press needle valve level to release air into base. Wait until gauge hand stabilizes. Gauge should now read 0% if initial pressure line was corrected.

Screw curved tube into petcock having short tubing. Open petcock. Press needle valve level and fill calibrating vessel.

Open opposite petcock allowing water in curved pipe to run back into base. Base contains 5% air.

Pump up air pressure to initial pressure line (typically 3%)

Close petcocks. Leave curved tube attached to lid.

Press needle valve lever. Wait needle to stabilize. Press lever again to release any remaining air. Gauge should now read 5%.

If two or more tests show gauge read incorrectly at 5% air in excess of 0.2%, then reset gauge hand. Remove cover from gauge to make adjustment.

Adjust the gauge hand by turning the recalibration screw on the gauge face. (For airpots issued by the department, the concrete technician should be contacted to make this adjustment).

VOLUMETRIC METHOD (ROLL-O-METER) ASTM C-173

Dampen roll-o-meter bowl. Pour off excess water.

Fill the 1st layer with concrete to about half of the volume of the bowl.

Rod the first layer 25 strokes

Tap the sides of the bowl 10-15 times to consolidate the concrete.

Slightly overfill the base. Rod the 2^{nd} layer twenty five times, penetrating the 1^{st} layer one inch. Tap the mold 10-15 times with the mallet to consolidate.

Remove excess concrete with a strike off bar, creating a smooth finish.

Clean the rim of any concrete residue.

Moisten and clean the lid gasket. Clamp top to the base.

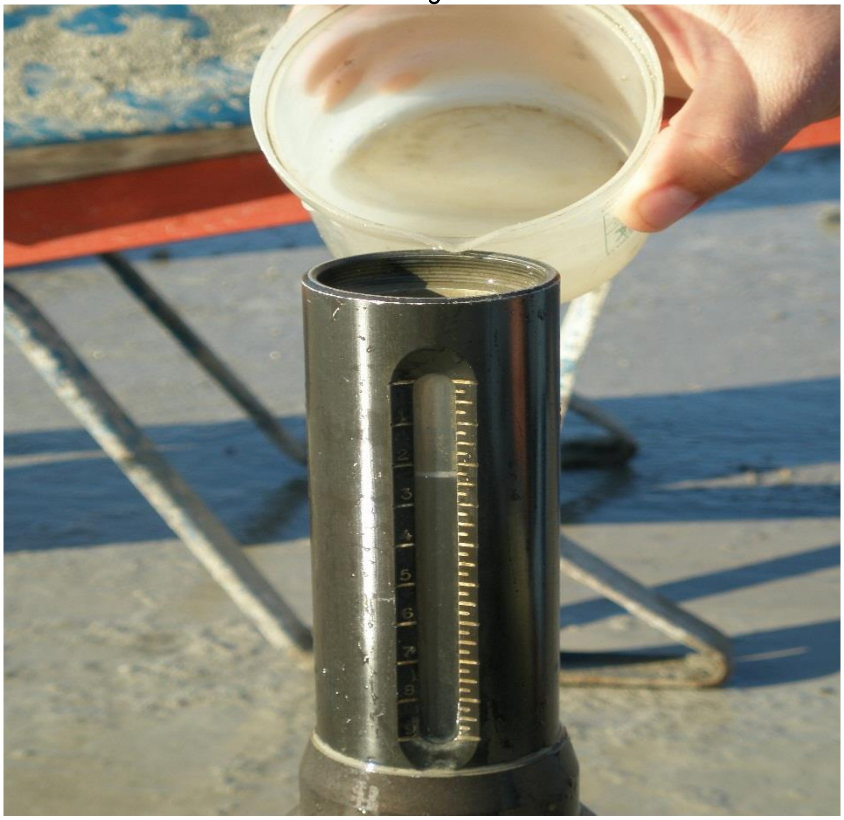
Insert the funnel to add water.

Add at least 1 pint of water through funnel.

Measure the amount of 70% isopropyl alcohol to be used and add through the funnel.

Continue adding water though funnel until water level is visible in the glass.

Remove the funnel once the fluid level is visible in the glass.



Continue filling with water to the zero mark.

Once the water level is on the top mark (zero line), place the cap on.

Invert meter and begin agitation. The meter is agitated for a minimum of 45 seconds.

After a maximum time of 5 seconds, drop base downward. Invert and drop continually for a minimum of 45 seconds.

Begin the rolling process, vigorously rotating the meter forward and backward for minimum of 1 minute.

After rolling, set meter upright, remove cap, and let the fluid level stabilize for a minimum of 2 minutes. If the level does not stabilize within 6 minutes, the test is invalid.

Once the level is stable read the fluid level to the nearest quarter percent.

After the first reading, place the cap back on and begin the rolling process again for a minimum of 1 minute.

Remove cap, allow the fluid level to stabilize for a minimum of 2 minutes, and read to the nearest of quarter inch. The reading must be within quarter percent of the initial reading. If second reading is not within ¼ % of the first reading, the rolling process must be performed for a third and final time.

After the final reading is accomplished, disassemble the meter, dump out the contents of the base, and examine for undisturbed tightly packed concrete. If undisturbed concrete is present, the test is invalid. Also, if the 3rd reading, if needed, is not within ¼ % of the 2nd reading the test is invalid and a new sample is required.

The final air content is equal to the Final Meter Reading minus the correction for large amounts of alcohol plus the number of calibrated cups of water added. The air content is reported to the nearest quarter of a percent.

- When less than 2.5 pints of alcohol is used and calibrated cups of water are not added, the final meter reading is the air content of the sample of concrete tested.
- When 2.5 or more pints of isopropyl alcohol are used subtract the correction determined in Table 1 of ASTM C-173 section 4.

MAKING AND CURING TEST SPECIMENS IN THE FIELD (ASTM C-31)

1. Obtain a representative sample from the middle of the load by passing the receptacle through the entire discharge stream or divert the stream completely into the receptacle.

2. The minimum size sample obtained shall be one cubic foot.

3. Air, slump, and temperature tests must be run before cylinders are molded.

4. Transport the sample to the location at which the cylinders are to be made. The process of making the cylinders should begin no later than 15 minutes after obtaining the sample.

5. Cylinders should be made simultaneously. One sample consists of two cylinders.

6. After molding, the specimens should be left in place and protected for a minimum of 20-24 hours. The air temperature surrounding the cylinders shall be 60-80°F.

7. Cylinders should be transported to the lab no later than **72 hours** after molding.

8. Maintain the specimens in the field at a temperature of 60-80º F.

9. A sample card should be filled out and submitted with the cylinders.

10. Remove the molds at the lab and write project number, sample number, and the date made on each cylinder.

CHASE INDICATOR TEST (AASHTO T-199)

The equipment needed to run the chace indicator test is shown above.

Thoroughly remix the sample of concrete prior to testing.

Obtain a sample of mortar using the spatula, make sure to exclude particles greater than #10 sieve. Overfill the brass cup.

Rod the sample 10 – 15 times, tap the sides of the cup (say 10 -15 times). This will consolidate the mortar. If larger particles are detected during the rodding and/or tapping stages, remove them. If necessary, add mortar with the spatula, rod and tap the sides again.

Strike off any excess mortar to be flush with the top of the cup.

Clean the cup, insert the cup into the calibrated glass indicator. Fill indicator with 70% isopropyl alcohol to the top line of the stem (so the **bottom** of the meniscus is in line with the “zero” mark). DO NOT OVER FILL. DO NOT DISTURB CUP. Remove any excess alcohol by gently flicking your wrist, then add alcohol as needed so the bottom of the meniscus is in line with the “zero” mark.

Place thumb on the stem opening and gently roll indicator from a vertical to a horizontal position several times. While rolling with one hand, tap the sides of your rolling hand with your other hand.

With the indicator in a vertical position, count the number of marks from the “zero” line of the stem to the bottom of the meniscus of the alcohol level. Record to the alcohol level to **the nearest 0.25%** (this is your “stem reading”). Correct the air content using Tables 1 and 2 on the back of M&T Form 903. Record the air content to the nearest **0.10 %.**

Chace Indicator Example

- Indicator reading 3.25
- Chace Calibration 2.2
- Mortar Content 16.75

CHACE INDICATOR CORRECTION TABLES

Use only 70% Alcohol Table 1

Mortar Correction Factors

Mortar Content		Chace Indicator Scratched on glass Indicator							
Ft.^{3}/ yd	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
27	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40
20	1.19	1.26	1.33	1.41	1.48	1.56	1.63	1.71	1.78
19	1.13	1.20	1.27	1.34	1.41	1.48	1.55	1.62	1.69
18	1.07	1.14	1.20	1.27	1.33	1.40	1.47	1.54	1.60
17	1.01	1.07	1.13	1.20	1.26	1.33	1.39	1.45	1.51
16	0.95	1.01	1.07	1.13	1.19	1.25	1.30	1.36	1.42
15	0.89	0.95	1.00	1.06	1.11	1.17	1.22	1.28	1.33
14	0.83	0.88	0.93	0.99	1.04	1.09	1.14	1.19	1.24
13	0.77	0.82	0.87	0.92	0.96	1.01	1.06	1.11	1.16
12	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.07
11	0.65	0.69	0.73	0.77	0.81	0.86	0.90	0.94	0.98
10	0.59	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89

Use Table 1 to get Mortar Correction Factor of 1.39

Air indicator stem reading 3.25 X 1.39 (Factor) = 4.5 + ________ (Curve Corr.) = ________ % Air

Table 2

Curve Corrections

Mortar Corrected Air Content (%)	Curve Correction(%)	Mortar Corrected Air Content(%)	Curve Correction(%)
1.0	-0.1	7.0	0.8
2.0	0.0	7.5	0.9
3.0	0.2	8.0	1.0
3.5	0.3	8.5	1.1
4.0	0.3	9.0	1.2
4.5	0.4	9.5	1.3
5.0	0.5	10.0	1.3
5.5	0.6	11.0	1.5
6.0	0.7	12.0	1.7
6.5	0.8	13.0	1.8

From Table 2, get Curve Correction Factor of 0.4

Air indicator stem reading 3.25 X 1.309 (Factor) = 4.5 + 0.4 (Curve Corr.) = 4.9 % Air

Notes: When using Table 1, round the Mortar Content to the whole number. For example, 16.4 would round to 16. 16.5 would round to 17. To get the Curve Correction using Table 2, round the Mortar Corrected Air Content to the closest half. If the Mortar Corrected air is 4.7, use 4.5 on the table. If the Mortar Corrected air is 4.8, use the closest number, which is 5.0. Base the Curve Correction on the rounded number.

Chace Problem

- Mortar Content 16.37
- Chace Indicator Calibration 1.8
- Stem Reading 3.75

Air indicator stem reading ________ X ________ = ________ + ________ = ________ % Air

Factor ... Curve Corr.

Air indicator stem reading	________	X	________	=	________	+	________	=	________ % Air
			Factor				Curve Corr.		

Use the Correction Tables on the following page.

CHACE INDICATOR CORRECTION TABLES

Use only 70% Alcohol **Table 1**

Mortar Correction Factors

Mortar Content Ft.^{3}/ yd	Chace Indicator Scratched on glass Indicator								
	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
27	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40
20	1.19	1.26	1.33	1.41	1.48	1.56	1.63	1.71	1.78
19	1.13	1.20	1.27	1.34	1.41	1.48	1.55	1.62	1.69
18	1.07	1.14	1.20	1.27	1.33	1.40	1.47	1.54	1.60
17	1.01	1.07	1.13	1.20	1.26	1.33	1.39	1.45	1.51
16	0.95	1.01	1.07	1.13	1.19	1.25	1.30	1.36	1.42
15	0.89	0.95	1.00	1.06	1.11	1.17	1.22	1.28	1.33
14	0.83	0.88	0.93	0.99	1.04	1.09	1.14	1.19	1.24
13	0.77	0.82	0.87	0.92	0.96	1.01	1.06	1.11	1.16
12	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.07
11	0.65	0.69	0.73	0.77	0.81	0.86	0.90	0.94	0.98
10	0.59	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89

Table 2

Curve Corrections

Mortar Corrected Air Content (%)	Curve Correction(%)	Mortar Corrected Air Content(%)	Curve Correction(%)
1.0	-0.1	7.0	0.8
2.0	0.0	7.5	0.9
3.0	0.2	8.0	1.0
3.5	0.3	8.5	1.1
4.0	0.3	9.0	1.2
4.5	0.4	9.5	1.3
5.0	0.5	10.0	1.3
5.5	0.6	11.0	1.5
6.0	0.7	12.0	1.7
6.5	0.8	13.0	1.8

SECTION V

STUDY QUESTIONS

TESTING of PORTLAND CEMENT

(NCDOT SPECIFICATIONS)

THE TESTING OF PORTLAND CEMENT CONCRETE

1. In making a slump test:

    a. The cone should be filled in ___________ layers.
    b. Each layer should be equal ___________ .
    c. Each layer should be rodded ____________ times.
    d. The cone should be rapped with a rod ___________ times.
    e. The cone (should, should not) be rotated slightly when lifted.
    f. The cone should be raised within _______ to _______ seconds.
    g. In filling the slump cone, one-third of the volume of the mold fills to a depth of _______ inches; two thirds of the volume fills to a depth of _______ inches.

2. The amount of slump, as determined by the slump cone, is calculated by measuring the difference between the height of the mold and the height over the displaced center of the top of the specimen. (True or False)

3. Slump is a good measure of concrete.

    a. Consistency
    b. Flowability
    c. Setting time
    d. None of the above

4. Using the following information, determine the unit weight of a concrete mixture:

Weight of empty bucket	15.62 lbs
Weight of full bucket	52.69 lbs
Volume of bucket	0.33 Cu. Ft.

5. When checking the air content, the Pressure Method AASHTO T-152 is not as reliable as the Chace Indicator AASHTO T-199. (True or False)

6. When checking the air content on structure concrete, the Chace Indicator AASHTO T-199 should be run on the first load and a random load in each four load “lots” thereafter and when test cylinders are made. (True or False)

7. Concrete should have the desired slump before any type of air check is made or before test cylinders are made. (True or False)

8. What is the minimum size sample for preparing test specimens for concrete strength tests? (ASTM C-172)

    a. 0.1 Cu. Ft.
    b. 0.5 Cu. Ft.
    c. 1.0 Cu. Ft.
    d. None of the above.

9. What is the correct method to “perform sampling” (i.e., collect the concrete sample) when the concrete is delivered to a job site by means of a revolving drum mixer truck , or an agitator truck.
    a. Wait until the concrete is in the forms and perform sampling in the forms.
    b. Perform sampling by passing the receptacle through the entire discharge stream, or by diverting the stream completely so that it discharges into a container.
    c. Wait until the concrete is deposited in a bucket and perform sampling in the bucket.
    d. None of the above.

10. The sample should be remixed, (just prior to making the test specimens), protected from the sunlight and wind during the period between taking and using, but in no case when time exceeds:

    a. 5 minutes
    b. 10 minutes
    c. 15 minutes
    d. 30 minutes

11. When curing test cylinders for the first 20 to 24 hours, they must be kept moist and at temperature between:

    a. 40 to 50 deg. F.
    b. 60 to 80 deg. F.
    c. 90 and above
    d. none of the above

12. Test cylinders should be sent to the laboratory for standard curing, within 7 days. (True or False)

13. When test cylinders are being made on a truckload of concrete, what other type test should be run on the same load of concrete?

THE TESTING OF PORTLAND CEMENT CONCRETE – STUDY QUESTION ANSWERS

1. In making a slump test:

    a. The cone should be filled in **3** layers.
    b. Each layer should be equal **volume**.
    c. Each layer should be rodded **25** times.
    d. The cone should be rapped with a rod **0** times.
    e. The cone (should, **should not**) be rotated slightly when lifted.
    f. The cone should be raised within **3** to **7** seconds.
    g. In filling the slump cone, one-third of the volume of the mold fills to a depth of **2 5/8** inches; two thirds of the volume fills to a depth of **6 1/8** inches.

2. The amount of slump, as determined by the slump cone, is calculated by measuring the difference between the height of the mold and the height over the displaced center of the top of the specimen. (**True** or False)

3. Slump is a good measure of concrete.

    a. Consistency
    b. Flowability
    c. Setting time
    d. None of the above

4. Using the following information, determine the unit weight of a concrete mixture:

Weight of empty bucket	15.62 lbs
Weight of full bucket	52.69 lbs
Volume of bucket	0.33 Cu. Ft.

$$\text{Unit Weight} = \frac{\text{Weight of Full Bucket} - \text{Weight of Empty Bucket}}{\text{Volume of Bucket}}$$

$$112.33 \text{ lbs/Ft.Cu.} = \frac{52.69\text{lbs} - 15.62 \text{ lbs}}{0.33 \text{ Cu. Ft.}}$$

5. When checking the air content, the Pressure Method AASHTO T-152 is not as reliable as the Chace Indicator AASHTO T-199. (True or **False**)

6. When checking the air content on structure concrete, the Chace Indicator AASHTO T-199 should be run on the first load and a random load in each four load "lots" thereafter and when test cylinders are made. (True or **False**)

7. Concrete should have the desired slump before any type of air check is made or before test cylinders are made. (**True** or False)

8. What is the minimum size sample for preparing test specimens for concrete strength tests? (ASTM C-172)

   a. 0.1 Cu. Ft.
   b. 0.5 Cu. Ft.
   c. <u>1.0 Cu. Ft.</u>
   d. None of the above.

9. What is the correct method to "perform sampling" (i.e., collect the concrete sample) when the concrete is delivered to a job site by means of a revolving drum mixer truck , or an agitator truck.
   a. Wait until the concrete is in the forms and perform sampling in the forms.
   b. <u>Perform sampling by passing the receptacle through the entire discharge stream, or by diverting the stream completely so that it discharges into a container.</u>
   c. Wait until the concrete is deposited in a bucket and perform sampling in the bucket.
   d. None of the above.

10. The sample should be remixed, (just prior to making the test specimens), protected from the sunlight and wind during the period between taking and using, but in no case when time exceeds:

    a. 5 minutes
    b. 10 minutes
    c. <u>15 minutes</u>
    d. 30 minutes

11. When curing test cylinders for the first 20 to 24 hours, they must be kept moist and at temperature between:

    a. 40 to 50 deg. F.
    b. <u>60 to 80 deg. F.</u>
    c. 90 and above
    d. none of the above

12. Test cylinders should be sent to the laboratory for standard curing, within 7 days. (True or **<u>False</u>**)

13. When test cylinders are being made on a truckload of concrete, what other type test should be run on the same load of concrete?

    Slump, Air Content, Temperature

SECTION VI

TERMS AND DEFINITIONS

AASHTO – American Association of State Highway and Transportation Officials

Absorbed Moisture – The moisture within the pores and capillaries of an aggregate.

Accelerator – A chemical, such as Calcium Chloride, used to “speed up” the setting time of concrete.

Acid Water – Water which contains concentrations of hydrochloric, sulfuric or other common acids.

Aggregate – An inert filler material, such as crushed stone, gravels, and sand which is mixed with cement and water to make concrete.

Air-dry – A condition at which an aggregate particle is dry on the surface but contains moisture within the pores of the aggregate.

Air Entraining Agent (AEA) – A chemical composed of surfactants which when added to concrete entrains microscopic air voids in the concrete.

Air Entrained Concrete – Concrete which has had an air entraining agent added to entrain minute air bubbles that are distributed uniformly throughout the cement paste.

Alkaline Water – Water which contains concentrations of sodium hydroxide, potassium, or other hydroxide.

Bleeding of Concrete – A condition whereby an excess amount of mixing water is accumulated on the surface of plastic concrete. This condition is caused by settlement and consolidation of the plastic concrete.

Cement – The bonding agent used in a concrete mix.

Cement Factor – The number of bags or pounds of cement in one cubic yard of concrete.

Coarse Aggregate – Aggregate larger than about 1/2” in diameter, usually referred to as stone or gravel.

Consistency – A condition of plastic concrete which relates to the repeatability of its plastic properties such as cohesion, wetness, and flow. The consistency of a concrete mixture can be measured by the slump test.

Daily Placement Operation – The amount of concrete placed per day of a designated concrete mix design.

Deleterious Substances in Aggregates – Undesirable substances that may be found in aggregates. These harmful substances include organic impurities, silty clay, coal lignite, and certain lightweight and soft particles.

Durability – The ability of hardened concrete to resist the deterioration caused by weathering (freezing, thawing, heating, cooling, wetting, drying, etc.) chemicals, and abrasions.

False Set – A significant loss of plasticity shortly after the concrete is mixed.

Fine Aggregate – A natural silica or manufactured aggregate smaller than about 1/4” in diameter, normally referred to as sand.

Fineness of Cement – The particle size to which cement is ground. The fineness of cement affects the rate of hydration. As cement fineness increases, the rate of cement hydration increases and causes acceleration in strength development.

Free Moisture – The moisture on the surface of an aggregate. The amount of free moisture is the difference between the total moisture and the absorbed moisture.

Freeze-Thaw Resistance of an Aggregate – A condition related to an aggregate’s porosity, absorption and pore structure.

Harsh Mix – A coarse mix which is difficult to place and finish. This usually indicates that the mix does not contain enough fine aggregate to provide a dense, workable mixture. A harsh mix segregates easily because it is not cohesive.

Heat of Hydration – The heat generated when cement and water react.

Hydration – The chemical reaction between water and cement.

Loss on Ignition – Loss on ignition (LOI) is determined by heating a cement sample of known weight to between 900°C and 1000°C until a constant weight is obtained. The weight loss of the sample is then determined.

Mortar – Product resulting from combination of cement paste (cement, water, and admixture) and fine aggregate.

Natural Cement – A cement which has not been controlled in its making. It is generally found in its natural state.

Oven-Dry – A condition of an aggregate which contains no moisture either absorbed or free.

pH – The measure of hydrogen ion concentration. The pH value of neutral water is 7.0; values below 7.0 indicate acidity and those above 7.0 indicate alkalinity.

Placement Operation – The process of pouring plastic concrete in a structure, pavement, or incidental item. Each item is considered to be a placement operation. Items range from bridge decks to pave ditches.

Portland Cement – A manufactured product obtained by heating to a clinker and then pulverizing the combination of properly proportioned limestone, marl, shale, or clay, silica sand, and iron ore.

Portland Cement Concrete (PCC) – A concrete that consists of Portland cement, fine aggregate, coarse aggregate, water, and such admixtures as may be specified.

Saturated Surface Dry (SSD) – A condition at which an aggregate will neither absorb moisture from concrete nor contribute moisture to mix.

Set Retarder – A material composed of (1) calcium, sodium, potassium, or ammonium salt of lignosulfonic acid; (2) hydroxylated carboxylic acid or its salt; or (3) carbohydrates, except sucrose, that is used for the purpose of delaying the setting time of concrete. Retarders provide a lubricating effect and function as a water reducing agent also.

Setting Time – The time that it takes a cement paste to begin hardening.

Total Moisture – The sum of the moisture on the surface and the moisture absorbed into the pores and capillaries of an aggregate.

Unit Weight – The weight per unit volume. For concrete, the unit weight is pounds per cubic foot.

Water – The ingredient in a concrete mix that causes a chemical reaction with cement called hydration. The water assists in providing the necessary workability for the concrete.

Water-Cement Ratio (W/C) – The quantity of water divided by the quantity of cement (i.e, pounds of water per pound of cement) used in a concrete mixture.

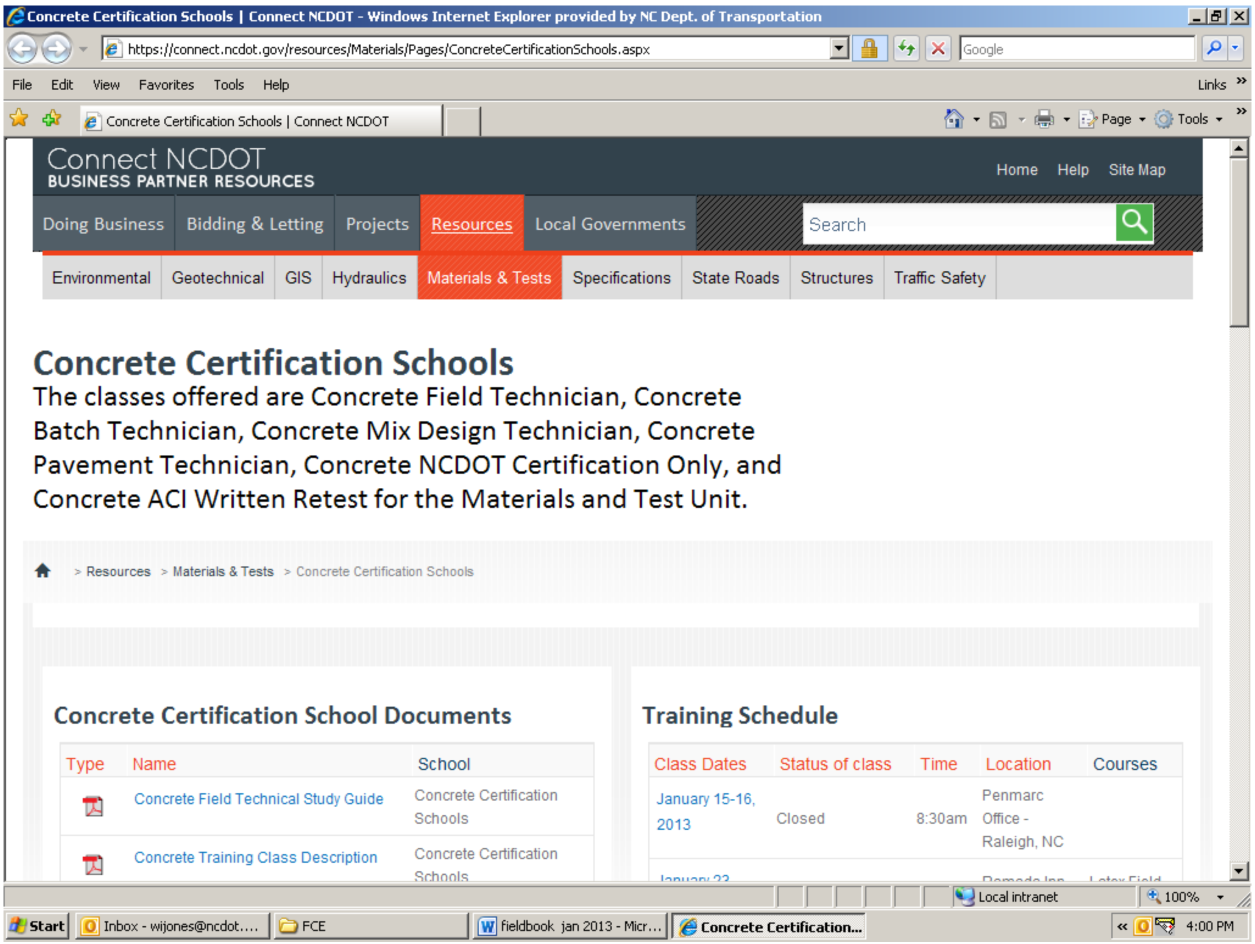
Water Reducing Agent – Material used for the purpose of reducing the quantity of mixing water in concrete. This additive, which provides a lubricating effect, will cause an increase in slump and workability when placed in a concrete mix of a given consistency.

Workability – The property of freshly mixed concrete which is the ease or difficulty in placing and finishing of concrete. “Good workability” means that the concrete may be placed or finished with little difficulty and the mass contains a uniform gradation of aggregates. The slump test is not a measure of the workability.

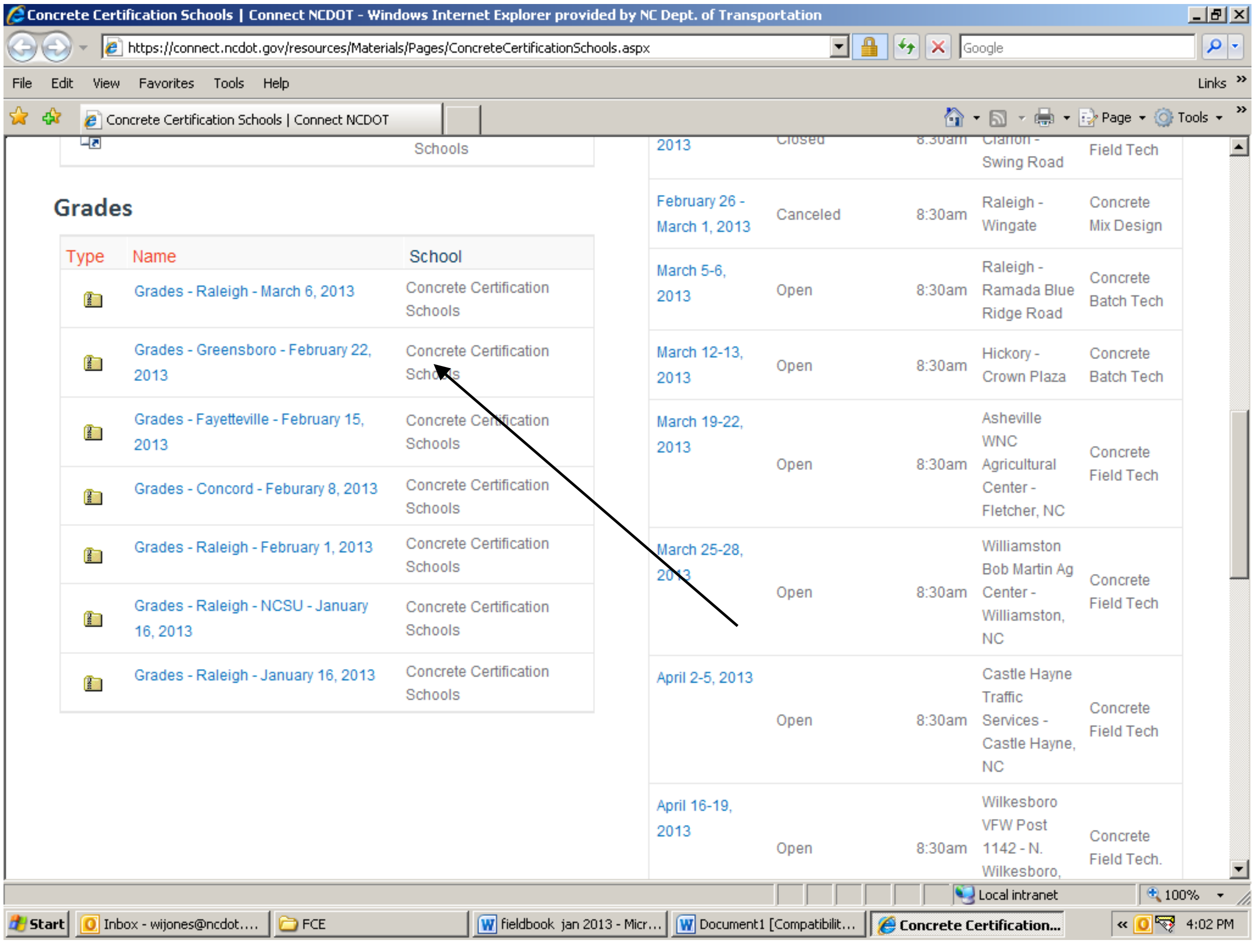
ASSESSING NCDOT TEST RESULT FROM M&T WEB PAGE

The written tests will not be graded in the classroom. To learn the test result, assess the M&T web site one week after the test date to view score. A letter with the test results and the Batch Certificate will be mailed out two weeks after the test date. Batch Certificate will be granted based on successful completion of the class to Technicians currently Concrete Field Technician certified. Directions to access the M&T web site are below.

- Type www.ncdot.org/~mtu in the web address bar



- Scroll toward bottom, looking left



- Select Concrete Certification Schools
- Click on the Concrete Certification Grades
- Locate the date, class, and site where test was taken

The grade will be listed by the first letter of last name and the last 4 digits of the Social Security number

SECTION VII

Course Evaluation

Chace Indicator Check List

Materials & Tests Unit

NCDOT

CONCRETE SCHOOL COURSE EVALUATION

MATERIALS AND TEST UNIT NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Course Title: ____

Site Location: ____

Instructors: ____

FACILITY	ADEQUATE	INADEQUATE
Location of the course		
Classroom Size		
Temperature		
Seating and Workspace		
Breaks		
Comments:		

5 = very good; 1 = poor

COURSE	5	4	3	2	1	N/A
Course requirements were clear.						
Length of course was sufficient.						
Course was organized.						
Manual was helpful.						
Test was fair.						
Comments:						

INSTRUCTOR	5	4	3	2	1	N/A
Instructor was organized.						
Instructor was knowledgeable of the subject.						
Time allotted for this portion sufficient.						
Answered all questions sufficient.						
Will you be able to use this information?						
Comments:						

AUDIO-VISUALS	5	4	3	2	1	N/A
Audio-visuals were interesting						
Audio-visuals were of good sound quality						
Audio-visuals were of good visual quality						
Contributed to learning:						
Comments:						

PLEASE ANSWER THE FOLLOWING HONESTLY:

Will this course help you do a better job, and how did this course help you? ____________

How could this course be improved? ____________

What was most beneficial? ____________

Any Additional comments: ____________

STUDENT NAME ____________

RESIDENT ENGINEER OR COMPANY ____________

STUDENT NAME (Print) ________________________________ **Last Four digits SS** __________

Checklist Chase Indicator AASHTO T-199-00 (NCDOT Modified)

	TRIAILS 1ST	TRIAILS 2ND	RETRIAL
1. Fill brass cup with mortar. Do not consolidate during filling. Exclude particles of sand which would be retained on a 2.00 mm (No. 10) sieve.	____	____	____
2. Rod the mortar in the cup using a thin stiff wire (No. 1 GEM paper clip). If detected during rodding, exclude particles of sand which would be retained on a 2.00 mm (No. 10) sieve. Consolidate by tapping the side.	____	____	____
3. Strike off mortar flush with top or the cup.	____	____	____
4. Insert cup into glass tube and add alcohol to the “0” reference on the stem. Make sure the bottom of the meniscus is in line with the “0” reference line.	____	____	____
5. Be careful not to change setting of the stopper.	____	____	____
6. Roll and tap the indicator until all mortar is dispersed in the alcohol and no more bubbles appear.	____	____	____
7. Read and record the stem reading to the nearest ¼%.	____	____	____
8. Calculate the air content to the nearest 0.1%	____	____	____
	(Circle One)		
Overall Score	Pass Fail	Pass Fail	Pass Fail

I certify that I have not helped, coached, or any way interfered with the examinee during this performance examination.

Examiner ________________________________ ________________________
Name Date