TIPS FROM AN EXPERT ON PREPARING FOR AN ACI CERTIFICATION

Luke M. Snell, P.E., FACI
Concrete Consultant
Edwardsville, IL

How do you make Quality Concrete that will have durability?

How do we make sure we get the Quality Concrete that we need?

Research shows that we need concrete that has:

1. low water/cementitious material ratio
2. air content of about 6%
3. uniform and consistent mixtures
4. temperature control (40-95 F)

The ACI debated how to get quality concrete for three years!

They decided one of the keys to Quality Concrete is qualified Concrete Technicians to provide accurate and reliable test results
ACI started the first of many certification programs:

Field Grade I Certification Program – 1983
Missouri was one of the first certifications
Building Code now requires all Testing Technicians be ACI certified

What is required to be certified?

Understand the American Society for Testing and Materials (ASTM) Standards for Concrete by:
Passing a 55 question Multiple Choice Test on the details of the test methods

AND

WHAT IS REQUIRED TO BE CERTIFIED?

Demonstrate the ability to perform each test accurately:

1. Sampling
2. Making of Test Specimens (cylinders)
3. Slump
4. Unit Weight
5. Air Content – Volumetric
6. Air Content – Pressure
7. Temperature

1. Sampling

2. Making Test Specimens (Cylinders)

3. Slump
4. Unit Weight

5. Air Content – Volumetric

6. Air Content – Pressure

7. Temperature

PROGRAM HAS BEEN EXTREMELY SUCCESSFUL

- Over 100,000 Certified Technicians

This is now required by IBC, ACI 318 and ASTM C 94 as the standard for testing concrete in the field and at the precast plant

FIELD GRADE I

Offered only by approved sponsoring groups

Each area has only one sponsoring group

You can send people to other areas to become certified
FIELD GRADE I

The sponsoring group may or may not have a review class.

You should **NOT** depend on the review class to train your employee.

You must be pro-active and get your employees ready to pass the exam.

To pass the exam they should:
1. Have the current ASTM Standards
2. Answer all the questions in the ACI study book
3. Do each test with an experienced technician
4. Practice, **Practice, Practice !!!**

OTHER CERTIFICATIONS AVAILABLE

Laboratory Testing was added to qualify Technicians that doing routine testing in the Lab.

Includes both Strength and Aggregates Certifications

LABORATORY CERTIFICATIONS

**Strength Testing**
1. Capping a cylinder
2. Testing with unbonded caps
3. Compression testing
4. Flexural testing

**AGGREGATES TESTING**
1. Sampling
2. Reduction of sample size
3. Sieve Analysis and Fineness Modulus
4. Specific Gravity (Coarse and Fine)
5. Moisture content
6. % passing the #200 sieve
7. Organic Impurities

All people that break cylinders are suppose to have this certification.
LAB 2
1. Evaluations of Test Results
2. Developing Concrete Mixtures
3. Evaluations of Cylinder Molds
   (Multi Use and Single Use)
4. Obtaining and Testing Cores
5. Shrinkage Testing of Mortar and Concrete

SPECIAL INSPECTOR
One of ACI Highest Inspector Certification

This person responsible for QC

Makes sure forms, reinforcement placement, curing, testing, form removal, etc. are done correctly
Recommended for your QA/QC Personal

SPECIAL INSPECTOR
3 Day Class (optional) with a comprehensive 3 hour exam and a 1 hour plans reading exam

½ - 5 years of inspection experience required - depends on your education

FOR MORE INFORMATION ON CERTIFICATION

Check your local ACI or ready mixed concrete association or www.concrete.org

ACI CERTIFIED PERSONNEL RESIDE IN 54 COUNTRIES, TRULY INTERNATIONAL
WHAT CAUSES LOW STRENGTH TESTS RESULTS

Bad test results usually blamed on defective sampling/testing

WE ROUTINELY SEE AWFUL TEST CYLINDERS
NOT ALL BAD CYLINDERS GIVE FAILING RESULTS

WE WANTED TO EXAMINE:

a) How routine “mistakes” influence in sampling/testing influence compressive strength
b) Is the statement “Nothing you do in the field will increase the strength of the concrete test specimens” correct?

OUR APPROACH

Selected a long term concrete project
Make one set of cylinders per ASTM Standards
From the same sample, a second set of cylinders (with known violation to the procedure) were made

COMPARE RESULTS BY %
**FIRST PART OF THE RESEARCH**

A “snapshot” of the effects of a defect

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**BASIC CONCRETE INFORMATION**

Design Strength – 4000 psi  
Slump – 5 - 6 inches  
Air Content – 6 ± 1%

Average Range (difference between two cylinders @ 28 days for the ASTM testing) – 125 psi

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**Violation # 1 – Etching top**

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**Etch top**

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**Etching: Note depth of etch**

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**Violation # 2 – Using Rebar**
Using Rebar

Violation # 3
Using Grade Pin

Cylinder made with grade pin

Cylinder made with grade pin

Violation # 4 - Filling “Tubes” (cylinder molds) by scooping concrete into molds

Violation # 5 - Field curing without covers
### Violation # 6
Cylinder made without rodding

### Violation # 7
Cylinder made without tapping sides

### COMPARISON OF RESULTS

<table>
<thead>
<tr>
<th>Violation of ASTM</th>
<th>Strength Gain (+) or Loss (-) 7 day - %</th>
<th>Strength Gain (+) or Loss (-) 28 day - %</th>
<th>Range (Difference between 2 cylinders) 28 day - psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lids</td>
<td>(-5)</td>
<td>+3</td>
<td>300</td>
</tr>
<tr>
<td>No tapping sides</td>
<td>+5</td>
<td>(-2)</td>
<td>350</td>
</tr>
<tr>
<td>1 lift</td>
<td>(-17)</td>
<td>(-7)</td>
<td>40</td>
</tr>
<tr>
<td>No rodding / tapping sides</td>
<td>(-1)</td>
<td>+2</td>
<td>440</td>
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<tr>
<td>From chutes, no rodding, no tapping sides</td>
<td>(-9)</td>
<td>(-12)</td>
<td>1130</td>
</tr>
<tr>
<td>Date &quot;etched&quot; on top of cylinder, no lids</td>
<td>(-11)</td>
<td>+2</td>
<td>510</td>
</tr>
<tr>
<td>Use rebar to rod cylinders, no tapping sides, no lids</td>
<td>(-1)</td>
<td>(-6)</td>
<td>230</td>
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<tr>
<td>Initial cure (24 hr) air temperature of 30°F</td>
<td>(-3)</td>
<td>(+3)</td>
<td>30</td>
</tr>
<tr>
<td>Initial cure (24 hr) air temperature exceeded 120°F (in curing box with 90 watt bulb)</td>
<td>(-29)</td>
<td>(-29)</td>
<td>90</td>
</tr>
<tr>
<td>Hauled loosely in truck</td>
<td>0</td>
<td>+2</td>
<td>70</td>
</tr>
<tr>
<td>6 day field cure, hauled loosely in back of truck</td>
<td>+2</td>
<td>+6</td>
<td>50</td>
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<tr>
<td>Dropped 2 ½´ (from tailgate) onto concrete slab after 24 hr cure</td>
<td>(-6)</td>
<td>(-18)</td>
<td>60</td>
</tr>
<tr>
<td>Tipped over after 2 hours, hauled loosely in truck</td>
<td>+1</td>
<td>(-1)</td>
<td>300</td>
</tr>
<tr>
<td>Rodded with grade pin, holes in bottom of molds</td>
<td>0</td>
<td>+3</td>
<td>110</td>
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VIOLATION OF ASTM THAT CAUSED 7 DAY STRENGTH LOSS (MORE THAN 10% LOSS)

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<tr>
<th>Violation of ASTM</th>
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<td>(-17)</td>
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<td>Date “etched” on top of cylinder, no lids</td>
<td>(-11)</td>
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VIOLATION OF ASTM THAT CAUSED 28 DAY STRENGTH LOSS (MORE THAN 10% LOSS)

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<td>Dropped 2 ½’ (from tailgate) onto concrete slab after 24 hr cure</td>
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<td>From chute, no rodding, no tapping sides</td>
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VIOLATION OF ASTM THAT CAUSED WIDE VARIATION IN RANGE-DIFFERENCE BETWEEN TWO CYLINDERS (DOUBLE THE AVERAGE RANGE FOR ASTM TEST – 250 PSI)

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<th>Violation of ASTM</th>
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<td>1130</td>
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<tr>
<td>Date “etched” on top of cylinder, no lids</td>
<td>510</td>
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<td>Tipped over after 2 hours, hauled loose in truck</td>
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PHASE II OF THE STUDY

What Problems are we likely to see?

Field Cured Cylinders

Did multiple samples
EFFECT OF VIOLATIONS
Variations Caused by Field Cured Cylinders

Field Conditions:
- Air temperature: 20°–57°F
- Average air temperature: 37°F
- Concrete temperatures (as placed): 47°–80°F
- Average concrete temperature: 68°F (30 Test Results)

% Loss
- 7 day strength: (-23)
- 28 day strength: (-15)
- 28 day standard deviation: -28% higher

COMPARSED RESULTS USING STUDENT T TEST

CONDITION TO OTHER RESEARCH

<table>
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<th>Condition</th>
<th>Strength loss</th>
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<tbody>
<tr>
<td>Rough Ends</td>
<td>up to 12%</td>
</tr>
<tr>
<td>Rough Handling</td>
<td>up to 7%</td>
</tr>
<tr>
<td>Rebar Rodding</td>
<td>up to 2%</td>
</tr>
<tr>
<td>Field Curing (7 days)</td>
<td>up to 26%</td>
</tr>
</tbody>
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RESEARCH ON CURING
Curing Study in Phoenix:
Temperature Variations 60-100°F

- Bucket Air Cured
- Bucket Water Cured
- Cooler Water Cured
- Cooler Damp Sand
- Cooler Zonolite
- Control Standard Laboratory Water Cured
- Initial Curing 72 hours
- Design: 705 lbs Cement @ 0.41 w/c ratio

Temperature (°F)
of Standard Laboratory Water Cured Cylinder

Ambient
Cylinder Temp
Water Temp
Cylinder Avg temp.
CONCLUSIONS

• Our test results agree with other research results.

• Violation to ASTM can give you unexpected results.

BOTTOM LINE

To keep cylinders from going bad, you must eliminate the “Effects of Defects”!!

WAYS TO BE IMPROVE YOUR SUCCESS RATE WITH ACI’S CERTIFICATION EXAMS

1. EACH QUESTION HAS ONE (1) CORRECT OR BEST ANSWER.

a. Answer is written in the box

b. If you change an answer, completely erase it – Do NOT cross off the answer and then write the correct answer next to the crossed off answer. Write the correct answer in the box.

EXAMPLE OF A BEST ANSWER

The fuel used in the modern automobile engine is:

A. Salt Water  
B. Uranium  
C. Gasoline  
D. Plutonium

Thus, the best answer is C
2. READ THE ENTIRE QUESTION

Circle or underline the key words in the question.

EXAMPLE:
Which of the following is not a part of the definition of the slump cone rod?
A. 5/8 inch (16 mm) diameter
B. Hemispherical tipped end
C. Straight steel rod
D. 48 inch (1200 mm) length

WHAT ARE THE KEY WORDS?

The key words are: not and slump cone rod – circle or underline these words.

The correct answer is D

3. READ THE ENTIRE QUESTION BEFORE SELECTING THE “CORRECT” ANSWER

Some questions have more than one answer

EXAMPLE:

Which of the following is part of the description of the slump cone rod?
A. 5/8 inch (16 mm) diameter
B. Hemispherical tipped end
C. Straight steel rod
D. All of the above

4. WHEN YOU CAN’T REMEMBER A DETAIL, STOP, CLOSE YOUR EYES, AND VISUALIZE THE EQUIPMENT OR PROCEDURE

Visualize the equipment and go through the steps in your mind

Steps to Answering the Question

Step 1: Select the key words: is and slump cone rod
Step 2: Read all of the answers: “A” is a correct answer but so is “B” and so is “C”
If you stopped reading at “A” and gave that as your answer, it would be wrong.
By reading ALL of the answers, you should select D
EXAMPLE: THE HEIGHT OF THE SLUMP CONE IS:
A. 6 INCHES (150 MM)
B. 12 INCHES (300 MM)
C. 18 INCHES (450 MM)
D. 24 INCHES (600 MM)

Key words are: **height** and **slump cone**
If you don’t remember, close your eyes and visualize the slump cone. Hold your hands at the approximate height, likely you’ll remember it is 12 inches (300 mm); so the correct answer is **B**

5. WHEN YOU DON’T KNOW THE CORRECT ANSWER, ELIMINATE THE ANSWERS YOU KNOW ARE WRONG. THIS INCREASES YOUR CHANCES FOR SUCCESS.

THE TEMPERATURE OF CEMENT AS IT ENTERS A CONCRETE MIX IS TYPICALLY SPECIFIED TO BE:
A. Between 180 – 185 F (82 – 85 C)
B. Less than 180 F (82 C)
C. 185 – 190 F (85 – 88 C)
D. 210 F (99 C)

If you do not know the correct answer:
Ask yourself – Do we heat the cement in cold weather to get it into a higher temperature or in a range?
The answer to that is NO, so we can cross off “A”, “C”, and “D” as possible answers. That leaves you with **B** as the correct answer.

6. ANSWER THE QUESTIONS YOU KNOW FIRST

DO NOT GET HUNG UP ON THE QUESTIONS YOU DO NOT KNOW THE ANSWERS

7. MAKE SURE YOU ARE PUTTING THE ANSWERS IN THE CORRECT BOX

I recommend that you answer the questions in the exam book, then put answers on the answer sheet.
8. DO NOT LEAVE ANY ANSWER BLANK

If all else fails, guess at an the answer

Any answer is better than NO ANSWER.

9. TAKE A DEEP BREATH, REMEMBER YOU HAVE STUDIED THIS MATERIAL.

10. You MUST get an over all score of 70%

and

60% on each ASTM Standard

A perfect score is good for bragging rights.

The goal is to become certified!

ANY QUESTIONS?