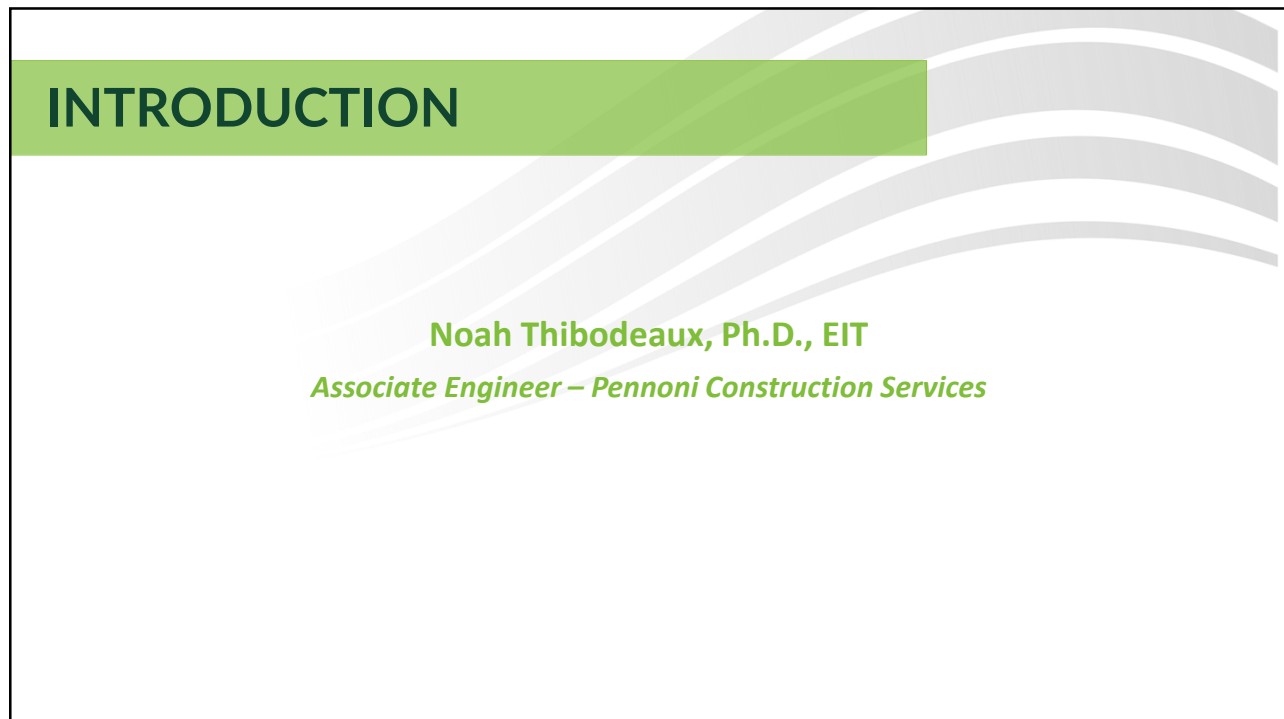




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# INTRODUCTION

## Education:

### New Jersey Institute of Technology

- ❖ Class of 2016
- ❖ Albert Dorman Honors Program
- ❖ John A. Reif Department of Civil and Environmental Engineering

### New Jersey Institute of Technology

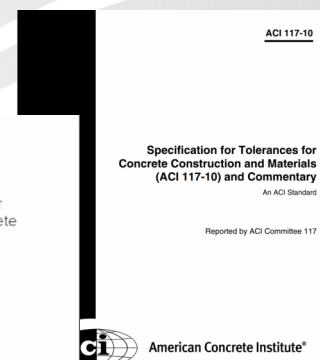
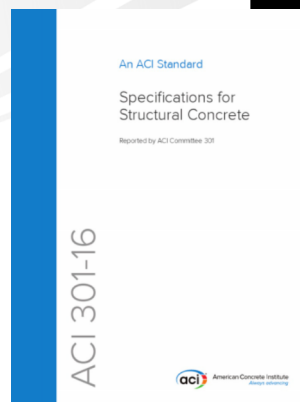
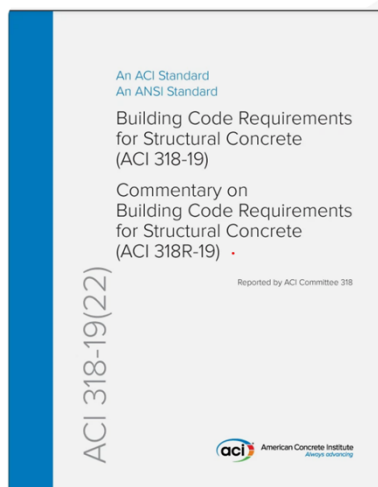
- ❖ Doctoral Candidate in the Materials and Structures Laboratory
- ❖ Funding: Teaching Assistantship / Government Contracts (NJDOT, USDOT, FHWA, Rutgers CAIT)

## Publications:

1. Thibodeaux, N.; Guerrero, D.E.; Lopez, J.L.; Bandelt, M.J.; Adams, M.P. **Effect of Cold Plasma Treatment of Polymer Fibers on the Mechanical Behavior of Fiber-Reinforced Cementitious Composites.** *Fibers* **2021**, *9*, 62. <https://doi.org/10.3390/fib9100062>
2. Thibodeaux, N.A.; Hasan, M.M.; Bandelt, M.J.; Adams, M.P. **Impact of Freeze–Thaw Cycling on the Mechanical and Durability Properties of Rapid Repair-Based Overlay Systems.** *Constr. Mater.* **2025**, *5*, 3. <https://doi.org/10.3390/constrmater5010003>

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# CONCRETE QUALITY CONTROL



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## CONCRETE QUALITY CONTROL

Two Lenses to view quality control of concrete...

### 1. Placement-time quality control

Fresh Concrete Tests:

**C172/C31:** Sampling/Making Samples

**C1064:** Temperature

**C143:** Slump

**C138:** Density

**C231/C173:** Air Content

Acceptance Samples:

**C39:** Compressive Strength,  $f'_c$

**C78:** Flexural Strength

**C469:** Modulus, E

**C805:** Rebound Hammer

### 2. Diagnostics / Durability: (hardened-concrete tests)

In-Situ Strength & Other Properties

**C42:** Taking Cores

**C642:** Density, Absorption, & voids

**C457:** Hardened Air

Durability and Serviceability

**C666/C215:** Freeze-Thaw Resistance and RTG

**C157:** Shrinkage

**C1293/C1260:** ASR Testing

**C1202/C1218:** Chloride Transport/Content

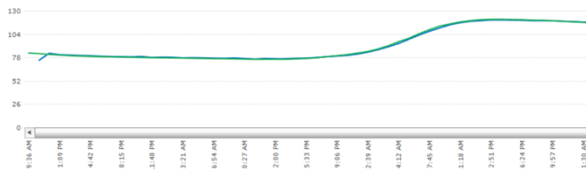
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## CONCRETE QUALITY CONTROL

So... What does field testing of concrete look like?

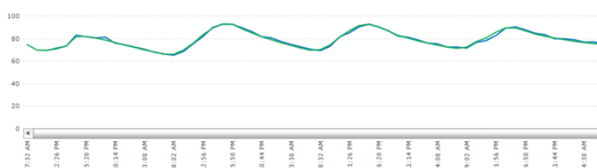
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## CONCRETE QUALITY CONTROL



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## CONCRETE QUALITY CONTROL



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## CONCRETE QUALITY CONTROL

In the laboratory...



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## CONCRETE QUALITY CONTROL

Guideline for accepting or rejecting placed concrete:

... Let's say design strength,  $f'_c$  of a planned section of concrete is **5,000 psi**

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## CONCRETE QUALITY CONTROL

### Guideline for accepting or rejecting placed concrete:

- ◆ **ACI 318 & ACI 301:**

Rule 1: Average strength of the *last three* consecutive strength tests  $\geq f'_c$

Rule 2: Each individual test....

result is NO LESS than **500 psi** under  $f'_c$

result is NO LESS than  **$0.9f'_c$**

*If regular cylinders fail... **C42** (coring) is a destructive option to evaluate portions of an element*

- ◆ **ACI 318 Acceptance:**

Rule 1: Average strength of *three* cores must be **85%** of  $f'_c$

Rule 2: No single core's  $f'_c$  can be less than **75%** of the specified/design  $f'_c$

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## CONCRETE QUALITY CONTROL

Sometimes it becomes *your* responsibility to coordinate with engineers, contractors, and the design team if a low break is observed and further testing is needed

Further Testing...

- ◆ **ASTM C42** is generally the next step when the need to evaluate the in place (in-situ) concrete becomes a need
- ◆ While coring is not NDT, it is the best indicator of the strength of an element

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## CONCRETE QUALITY CONTROL

What to do when that fails?

If your **C39** results from your **C42** cores is unsatisfactory from an engineering and safety standpoint, the engineer needs to make a call...

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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*“The breaks came back low but passed... now there are questions about how the testing agency performed the air content and density testing... To add to this, there’s evidence that the batch plant over-dosed AEA... What testing should be performed?”*

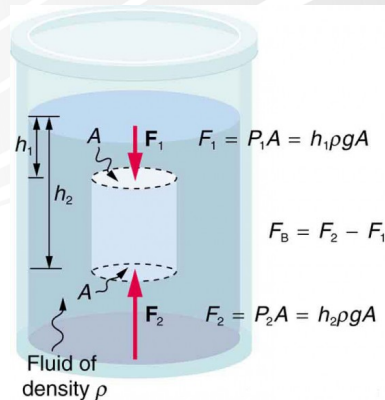
If the concrete in question is in a freeze-thaw zone or exposed to salts, then there are legitimate concerns about future durability or *service-life* of that concrete structure

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## CONCRETE QUALITY CONTROL

### ASTM C642: Hardened Density and Air via Suspended Weight

- ◆ Archimedes principle in action
- ◆ Gives a true density value without the need for exact measurement



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## CONCRETE QUALITY CONTROL

### ASTM C457: Hardened Air Analysis via Point Count of a Linear Traverse

- ◆ Statistical representation of air voids
- ◆ Also used to evaluate paste and aggregate proportions
- ◆ Very useful in describing the air-void system



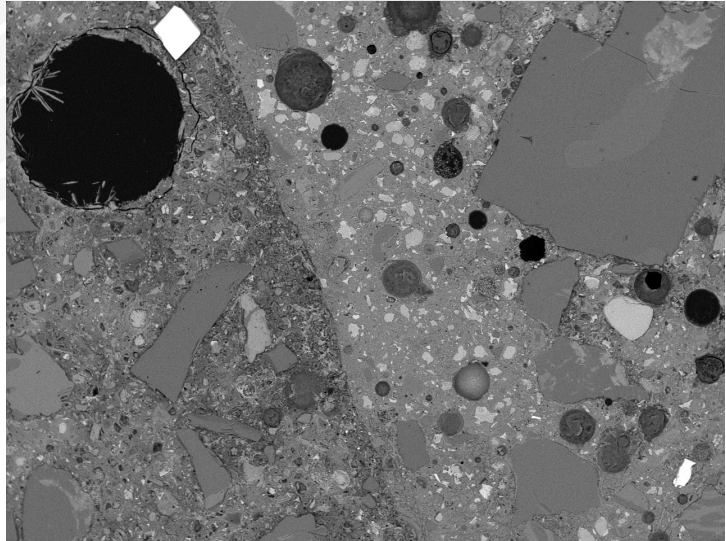
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## CONCRETE QUALITY CONTROL

**ASTM C457:** Hardened Air Analysis via Point Count of a Linear Traverse

- ◆ Statistical representation of air voids
- ◆ Also used to evaluate paste and aggregate proportions
- ◆ Very useful in describing the air-void system



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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*“What will this concrete pavement look/act like after 300 cycles of in service freezing and thawing?”*

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## CONCRETE QUALITY CONTROL

### ASTM C666/C215: Freeze-Thaw Resistance of Concrete

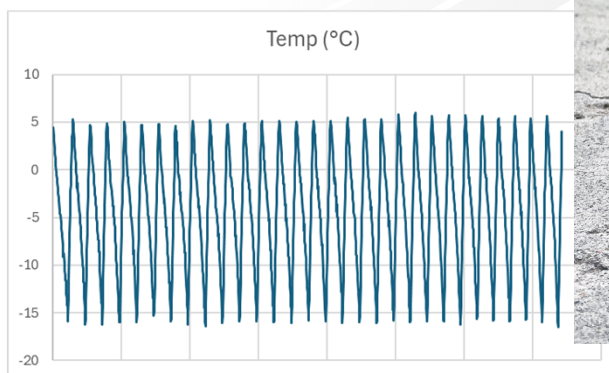
- Concrete is subjected to a prescribed number of cycles (300)
- Every 30 cycles, a resonant transverse frequency is obtained



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## CONCRETE QUALITY CONTROL

### ASTM C666/C215: Freeze-Thaw Resistance of Concrete



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## CONCRETE QUALITY CONTROL

### ASTM C666/C215: RTG Instrumentation

- ◆ Converts a frequency response to a strength state (modulus)
- ◆ Very useful in trialing mixes for FT resistance



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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*“How much will this concrete shrink after it is placed?”*

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## CONCRETE QUALITY CONTROL

### ASTM C157: Linear Drying Shrinkage

- ◆ Provides a strain value corresponding to drying shrinkage
- ◆ Useful information when low shrink is required



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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*"Its growing... Why the hell is it growing?!..."*



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## CONCRETE QUALITY CONTROL

### **ASTM C1260/C1567/C1293:** Alkali Silica Reaction

- ◆ These tests determine the likelihood of ASR due to the aggregate phase
- ◆ Both tests rely on the acceleration of reaction kinetics
- ◆ ASR progression is extremely detrimental to a structure



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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*“How susceptible is this concrete to Chloride Ingress? How much Chloride is already present?”*

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## CONCRETE QUALITY CONTROL

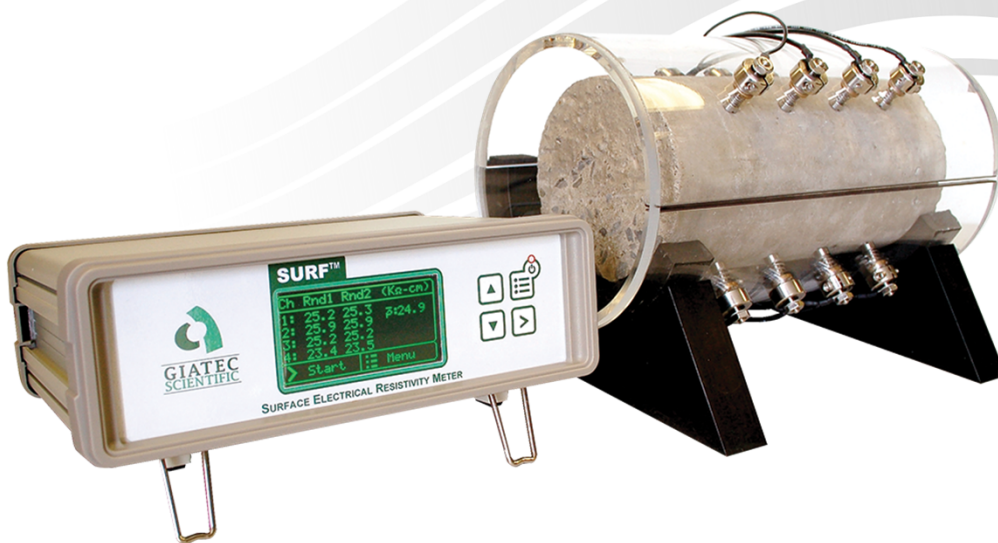
### ASTM C1202: Rapid Chloride Permeability Test

- ◆ Voltage application across an Ionic diffusion potential
- ◆ Results in 6 hours (once test conditions are established)



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## CONCRETE QUALITY CONTROL



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## CONCRETE QUALITY CONTROL

### ASTM C1218: Chloride Content Analysis

- ◆ Determines the amount of chloride present by % of cement
- ◆ Gives an indication of transport properties



Pennoni

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## CONCRETE QUALITY CONTROL

Sometimes what you *need* to know about the concrete cannot be determined from field and strength testing...

*“How well is this overlay going to bond with my existing substrate?”*

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## CONCRETE QUALITY CONTROL

### ASTM C1583: Tensile Bond Strength

- ◆ Provides an indication of substrate/overlay bond
- ◆ Failure mode is an important feature in this test



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## NON-DESTRUCTIVE METHODS (NDT)



Rebound or Shmidt Hammer



Windsor Probe Gun

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## NON-DESTRUCTIVE METHODS (NDT)



Ultrasonic Pulse Velocity (UPV)



Ground Penetrating Radar (GPR)

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## QUESTIONS?

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[nthibodeaux@pennoni.com](mailto:nthibodeaux@pennoni.com)

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