FHWA Mobile Concrete Trailer (MCT)

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In early 80’s FHWA saw technology gap
- Between research and practice
- Implemented Technology Transfer Program
  - Share information
  - Showcase new developments
  - Educate and train

FHWA Mobile Concrete Trailer
FHWA Mobile Concrete Trailer

**Mission**

- Technology Transfer to SHA’s
  - Field demos on active projects
  - Equipment loan
  - Training of staff
  - Conferences and workshops
MCT Typical Activities

Field Visits
- Active field project for a two week period
- Traditional and Innovative testing
- Data in control chart format

Kick-Off Meeting
Testing
Testing

Week 1
Field Visits

- Active field project for a two week period
- Traditional and Innovative testing
- Data in control chart format
MCT Typical Activities

Field Visits

- Close out meeting with the state DOT, FHWA division office and contractor (prior to departure)
- Summary report (3-5 months after field visit)
- A free QA workshop using the field visit data

Close Out

QA Workshop
MCT Typical Activities

Training

- One on one training to DOT engineers and technicians
- Side by side comparison of new technologies
MCT Typical Activities

- Conferences
  - National Conferences (ACI, TRB, ISCP, etc)
  - State DOT / Industry conferences
  - Provide speakers
  - Specialized Workshops
  - Technical Assistance
MCT Typical Activities

- **Equipment Loan Program**
  - Multiple pieces
  - Few weeks to a few months
  - Very successful
FHWA Mobile Concrete Trailer

- Nondestructive/In-situ Tests
- Sustainability
- Performance Related Specifications
- AASHTOWare Pavement ME Design
- Quality Assurance
- Performance Engineered Mixtures
Are we testing the right quality characteristics??

- What do we test for acceptance
  - Slump
  - Air Content
  - Strength
## New Tests and Technologies

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Workability

- Box Test
  - Developed by Dr. Tyler Ley, Oklahoma State University
  - Mixture response to vibration
  - Consolidation check
  - Edge slump check
  - Mix design tool
Box Test

- A workability test
- Simple (lends itself to QC)
- Anticipated as a provisional test method
- Included in PEM Specification
The Box Test

Consolidation Issues

Edge Slump Issues

1. Less than 10% overall surface voids.
2. 10-30% overall surface voids.
3. 30-50% overall surface voids.
4. Over 50% overall surface voids.

Bottom Edge Slumping: If deflection is more than ¼” then it fails.

Top Edge Slumping:
The Box Test

Project A

Finishability Issues

Project B

Edge slump Issues
Air Content

- Total air (4.0% - 8.0%)
- Pressure air meter
  - Measure total air in the field
  - But, the air void system is what counts

Which is freeze / thaw durable?
Current Test Methods

Hover photo
ASTM C 457
Spacing factor

Humboldt photo
ASTM C 666
AASHTO T 161
durability factor

MCT photo
AASHTO TP-08
Spacing factor
Super Air Meter (SAM)

- Measures the Air Void System Modification of existing air test
  - Measures air system quality
  - Small bubbles implode
  - Test
    - Test three times at different pressures
    - Repeat
    - Field friendly
    - 8-12 Minutes
    - Measures total air content
- Provisional Test Method
  - AASHTO TP 118
SAM Principle

- Small bubbles dissolve
- Inverse of bubble coming out of soda after it is opened

Atmospheric pressure

Pressure step 6
SAM Results

Super Air Meter (SAM)
SAM vs. ASTM C457

This test takes 7 – 14 days

Spacing Factor (in)

Recommended SAM number

ACI 201.2R

92% Agreement
- Lab Data OSU
- Field Data
- LAB Data FHWA

Yes!

This test takes 5-10 minutes

SAM Number (psi)
SAM Current Status / Activities

- Round Robin
- Provisional Test Method – AASHTO TP 118
- 29 States, 2 Canadian provinces, and UK
Permeability
(Surrogate Tests for Durability)

Rapid Chloride Penetrability Test (Indirectly)

- Became standard in 1981
- Most common test
- Indicator of vulnerability to water and chloride ingress
- Generally 24 hours to condition and 6 hours for testing

AASHTO T277/ASTM C1202
Rapid Chloride Permeability (RCP) Test

**DAY 1**
- Sample Cutting

**DAY 2**
- Desiccation

**DAY 3**
- Cell Formation
- Test

**Rapid Chloride Permeability (RCP) Test**

**Sample Cutting**

**Desiccation**

**Cell Formation**

**Test**
Permeability
(Surrogate Tests for Durability)

Surface Resistivity Test (Indirectly)

- Standards
  - AASHTO T 358-15
  - ASTM WK37880
- State specification
  - Several states
- 28-day age is being used
- Instant results on hardened concrete
- Easily measures the right property
- Non destructive test
Surface Resistivity Meter

SR = 5801.2(RCP)^{-0.819}
R^2 = 0.9481
Advantages of Resistivity Testing

- Significantly faster test
- No sample preparation involved
- Nondestructive
- No chemicals involved
- Lower equipment cost
- Lower labor costs

AASHTO T 358-15
ASTM WK37880
Formation Factor

\[ F = \frac{\rho_T}{\rho_o} = \frac{1}{\phi \beta} \]

- \( F = Formation Factor \)
- \( \rho_T = Total \ Resistivity \)
- \( \rho_o = Resistivity \ of \ pore \ solution \)
Thickness Testing

- Probe (QC)
- Coring (QA)
MIT Scan T2

- Non-Destructive Technique for Measuring Concrete Pavement Thickness
- Eliminates coring
- Saves time, money, manpower
- Many states are adopting

Step 1: Place the target
Step 2: Pave over it
Step 3: Find the target
Step 4: Measure the thickness
MIT Scan T2 - Advantages

- Easy to use
- Non-destructive
- Rapid measurement
- Significant cost savings
- High accuracy
  - Within ± 0.1 inch of core thickness
Plastic Shrinkage

ACI Nomograph
Capillary Pressure Sensing System

Capillary pressure, concrete temperature
Capillary Pressure Sensing System
Influence of Curing on Capillary Pressure
Controlled Concrete Curing

Capillary pressure dependent surface rewetting

Capillary pressure [kPa]

Time after casting [min]

Upper threshold of capillary pressure

Sensor 1
Sensor 2
Sensor 3
CPSS Advantages / Uses

- Takes concrete properties into account
- Effectiveness of Curing Application rate
- Evaluation of different Curing Compounds
- Controlled Concrete Curing
Additional Technologies

**HIPERPAV**

**Maturity**

**Microwave Water Content**

**UltraSonic Pulse Echo**

**Coefficient of Thermal Expansion**
Additional Technologies

MIT Scan 2
Calorimeter
V-Kelly
Low Temperature DSR
Tarantula Curve

- Decreases workability
- Increases cohesion and reduces edge slumping
- Decreases workability and promotes segregation and edge slumping
- Creates surface finishability problems
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