Commitment to Quality Produces Long Life Concrete Pavements
--An FHWA Perspective--

Michael F. Praul, P.E.
Senior Concrete Engineer
FHWA Office of Asset Management,
Pavements, and Construction
Why Quality Matters

- Iowa Highway Research Board funded project
- Collecting data on overlay performance in the whole IA system
- This plot represents 12 foot slabs showing IRI vs age
- Typical of all data collected
Why Quality Matters

- Clear bifurcating data set
  - Orange = normal
  - Blue = premature failure
    - 30/257 data points
    - Foundation system
    - Joints
    - Design
Historic pavement performance trend in Washington State

Data source: WSDOT Materials Lab.
Impact of budget shortfall on projected pavement condition in Washington State

2011
- Very Good: 35%
- Good: 40%
- Fair: 15%
- Poor: 5%
- Very Poor: 4%

2023
- Very Poor: 35%
- Poor: 31%
- Fair: 20%
- Good: 10%
- Very Good: 4%
How Things Change!

Concrete
- Slump Cone: 1922, ASTM C143
- Pressure Meter: 1949, ASTM C231
- Rapid Chloride Permeability Test: 1981, FHWA/PCA

Cars
- 1920
- 1940
- 1960
- 1980
- 2000
Why Move to a Performance Approach?

- MAP-21
  - Greater Federal emphasis on performance
  - Linking investments to outcomes

- Demographics in “Our World”

- Public agency and industry desire
  - It’s a natural evolution
  - Improved durability and mix design
  - Sustainability

- Completed research and new tests → Innovation
Performance Engineered Mixture Concept

- Understand what makes concrete last and what failure mechanisms do we see
- Specify the critical properties and test for them
- Prepare the mixtures to meet those specifications
- Starting point for a performance-driven QA specification and acceptance program for states and other owner agencies
Quality Assurance Defined
23 CFR 637

- Agency Acceptance
- Contractor Quality Control

- Qualified (certified) Personnel
- Qualified Laboratories
- Independent Assurance
- Dispute Resolution for Test Results

State processes, independent of material
Quality Control

- PEM acknowledges the key role of QC in a performance specification
- Requires an approved QC Plan
- Requires QC testing and control charts
  - Unit weight
  - Air content/SAM
  - Water content
  - Formation Factor (via resistivity)
  - Strength
- QC
  - Testing targets, frequency, and action limits
  - Guidance will expand on this
Quality Control

- Change state mindset that QC is not their business
- Gordon Smith example
- Provide guidance on developing state specification language on:
  - Equipment inspection
  - Construction inspection
  - Testing guide (very similar to guidance for the acceptance program but slanted to industry)
    - Appropriate QC tests
    - Frequency
    - Control charts and usage
Quality Control

- Uses real time feedback

- A good Contractor QC system:
  - Doesn’t just echo Agency requirements
  - Implements QC procedures as standard practice
  - Isn’t just paperwork...it’s a mindset
Long-Term Implementation of PEM

- Demonstration through shadow specification
  - IN, IA, MI, MN, ND, SD, WI, IL Tollway, Manitoba (ACPA chapters participating)

- Establish “enhanced” ETG
- Guidance on specification, tests, and quality control
- Fill in research gaps
- Build on PEM to establish a model concrete acceptance program
PEM Champion States

+Manitoba, FHWA MCT
& Illinois Tollway
A Coordinated Approach to PEM Implementation

FHWA

Performance Engineered Mixes

Agencies

Industry

Academia
Road Map to the Future of Performance

- Pooled fund solicitation to support performance approach to concrete: 5 years
  - FHWA ($200,000/yr)
  - States (14 states, $15,000 each/yr)
  - Industry ($200,000/yr)
  - Identify and address research needs

- Follow-up FHWA initiatives
  - Concrete Pavement Performance System (CPPS)
  - Support PEM with Concrete Pavement Trailer
  - Support PEM and a performance approach to concrete QA programs...training, training, training
Concrete Pavement Performance System (CPPS)

Coordinated effort to provide guidance and tools to states and industry to advance concrete Quality Assurance programs in the direction of performance.

- Mobile Concrete Trailer
- Video clips
- QA Toolkit
- QC framework
- Implementation Workshops
CPS Testing Videos and Guidance

- YouTube style 5-10 minute videos of PEM and other tests
- Will include narrative and be appropriate for technician training
- Mobile Concrete Trailer will participate
- “One pagers” (possible app)
  - Describe the test, what it measures and why
  - Incorporating the test into acceptance or QC programs
  - Suggested frequency
  - Data analysis (PWL, single test pass/fail, control charting)
CPPS Tests

- Super Air Meter
- Unit weight
- Strength
- Surface Resistivity
- MIT Scan
- MIT Scan T2
- Maturity

- Microwave water content
- Box Test
- V-Kelly
- Formation factor
- Coefficient of thermal expansion
- Calorimetry
PEM/CPPS Implementation Workshops

- FHWA is being called on by states and industry to provide training
- PEM and CPPS workshop
- Timing for development of workshop dependent on PEM and CPPS progress and implementation
- Conceptual phase (pooled fund)
“One pagers” Related to Performance

- Largely based on MCT results
- Lowering Cement Content is nearly ready for distribution
- 2nd will be on Optimized Gradation (including spreadsheet tool)
- Looking for suggestions
CPPS Plant Approval/Certification

- Industry programs
- State-based program

Identify current best practices

What do these look like in a performance specification?
CPPS Pre-production Materials Acceptance

- Cement
- Supplementary Cementitious Materials (fly ash, slag cement, silica fume)
- Aggregates (addressed in PEM specification)
- Water
- Admixtures

What does this process look like in a performance specification?
FHWA Mobile Concrete Trailer

**Mission**

- Technology Transfer to SHA’s
  - Field demos on active projects
  - Equipment loan
  - Training of staff
  - Conferences and workshops
Additional Benefits / Outcomes

- Evaluate new technologies / equipment
  - On actual field projects / geographical regions
  - Under **practical** working conditions
  - Feedback to researchers
  - Lowers the technology refinement time
FHWA Mobile Concrete Trailer

- Nondestructive/In-situ Tests
- Sustainability
- AASHTOWare Pavement ME Design
- Performance Related Specifications
- Quality Assurance
- Performance Engineered Mixture

2017 WCPA Annual Concrete Pavement Workshop
Wisconsin Concrete Pavement Association
February 16, 2017
Thank You

- For more information:
  michael.praul@dot.gov
  (207) 512-4917