Delivering Quality in Pavement Construction

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Understanding Quality

- **Public**
  - For them Quality is good ride with minimal disruption.

- **Owner Agency**
  - For them Quality is long lasting pavement at minimal cost

- **Contractor**
  - For them Quality is building the project to specifications and getting paid.
Everyone has a different perspective
Understanding Quality

Meeting everyone's needs mean hitting the sweet spot.
Distresses to be Addressed

- Raveling
- Fatigue Cracking
- Low Temperature Cracking
- Rutting
Innovation!
The key is identifying the problem is asking the right question.

- Is the rock too large?
- Is the truck too small?
If the rock is too Large
If the truck is too small
So Where We Have Been with Specs

- 1960’s Method Specifications
- 1970’s Experimentation with QA specifications
- 1980’s Implementation of QA specifications
- 1990’s Use of contractor test results for acceptance
- 2000’s Warranties, PPP
Types of Specifications

- Method
- End-Result
- Quality Assurance (QA)
- Performance-Related
- Performance-Based
Quality Assurance (QA)

(1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or

(2) making sure the quality of a product is what it should be.
Core elements of a QA Program

- Agency Acceptance
- Dispute Resolution
- Independent Assurance
- Contractor Quality Control
- Lab Qualification
- Personnel Qualification
Understanding the Term “Quality Assurance”
Quality Assurance Functions

Three **Main** Components of Construction Quality Assurance:

- Quality Control
- Acceptance
- Independent Assurance
Process Control

- A method for keeping a process within boundaries and/or the act of minimizing the variation of a process.
- Voluntary part of the Quality Assurance program that could include sampling, testing, inspection, etc.
  - Asphalt content and gradation is PC not QC
- Responsibility of the Contractor.
Quality Control

- The system used by a Contractor to monitor, assess and adjust their production and placement processes to ensure that the final product will meet the specified level of quality.
- Includes sampling, testing, inspection, and corrective action (where required) to maintain continuous control of a production or placement process.
  - Volumetrics, Density,
- **Responsibility of the Contractor.**
Acceptance

- The process used by the Owner/Agency (i.e., sampling, testing, and inspection) to determine the degree of compliance with contract requirements (Specifications) and to determine the corresponding value for a given product.
  - Can simulate QC or go beyond

- Responsibility of the Owner/Agency.
Independent Assurance (IA)

- A procedure/process used by the Owner/Agency to ensure that the people, equipment and procedures used by the Contractor are compliant with the Specifications.
- It is an unbiased and independent evaluation of all the sampling and testing (or inspection) procedures used in the QA program.
- Responsibility of the Owner/Agency.
Performance Related Specifications (PRS)

- These types of specifications are enhanced QA specs that use quality characteristics and lifecycle cost relationships correlated to product performance.
- They provide a link between construction quality and long-term performance; and use mathematical models to quantify relationships between quality characteristics, for example smoothness and permeability, and product performance.
- They thus provide the basis for rational acceptance/pay adjustment decisions.
Balanced Mix Design Approach and Development
Hierarchy of Mix Designs

- Performance
- Superpave (Volumetrics) ± Plus Performance
- Superpave (Volumetrics) Plus Performance
An optimized design approach should yield a mix which meets the mix design and production goals.
What types of pavement distress does your agency want to address with mixture performance tests?

<table>
<thead>
<tr>
<th>Answers (DOT)</th>
<th># (%) Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue cracking</td>
<td>35 (85%)</td>
</tr>
<tr>
<td>Rutting</td>
<td>32 (78%)</td>
</tr>
<tr>
<td>Thermal cracking</td>
<td>28 (68%)</td>
</tr>
<tr>
<td>Moisture damage</td>
<td>26 (63%)</td>
</tr>
<tr>
<td>Reflection cracking</td>
<td>24 (59%)</td>
</tr>
<tr>
<td>Raveling</td>
<td>21 (51%)</td>
</tr>
<tr>
<td>Others (block cracking, slippage, etc.)</td>
<td>22 (53%)</td>
</tr>
</tbody>
</table>

NCAT Survey
What does the Future Hold?

Generally a greater focus on tests and measures that are more closely related to performance.
What does the Future Hold?

Rutting Tests:
- Hamburg Wheel Tracking Device (HWTD)
- Asphalt Pavement Analyzer (APA)
- AMPT Flow Number
- Dynamic Modulus

Cracking Tests:
- Semi Circular Bend Test (SCB)
- Texas Overlay Test (TOL)
- Disc Shaped Compact Tension Test (DCT)
- Bending Beam Fatigue
- AMPT Cyclic Fatigue

- More Design-Build/Warranty projects
Which of the following performance tests do you think have the most potential to address rutting?

- Hamburg Wheel Tracking Test (HWTT) - DOT: 34, Contractor: 25
- Asphalt Pavement Analyzer (APA) - DOT: 17, Contractor: 18
- Flow Number (FN) - DOT: 11, Contractor: 1
- Superpave Shear Tester (SST) - DOT: 1, Contractor: 1
- Hveem Stability - DOT: 1, Contractor: 0

NCAT Survey
Which of the following performance tests do you think have the most potential to address thermal cracking?

- Semi-Circular Bend (SCB) Test at Low Temperature
- Disk-Shaped Compact Tension Test (DCT)
- Indirect Tensile (IDT) Creep Compliance and Strength Test
- Thermal Stress Restrained Specimen Test (TSRST)
- Illinois Flexibility Index Test (I-FIT)
- Bending Beam Rheometer (BBR) Sliver Test

NCAT Survey
Which of the following performance tests do you think have the most potential to address reflection cracking?

- Texas Overlay Test (OT)
  - DOT: 19
  - Contractor: 10

- Illinois Flexibility Index Test (I-FIT)
  - DOT: 17
  - Contractor: 11

- Disk-Shaped Compact Tension Test (DCT)
  - DOT: 8
  - Contractor: 5

NCAT Survey
Field Acceptance Processes

1. Volumetric

- Volumetrics
- Field Density

2. Volumetrics + Performance

- Volumetrics
- Field Density
- Performance

3. Performance

- Field Density
- Performance

Note: “Performance” Tests may include fundamental tests and/or empirical tests.

Note: “Performance” Tests conducted during mixture design may vary from those used during field verification.

Ranges from minimal (P_a only) to robust (P_b, P_a, VMA)

Discretionary Frequency And Actions

Required Frequency; Specified Actions
First Step in Quality Placement

- Material Transfer Devices
- Proper Screed Setup
Compaction Westrack Sections

Coarse at Opt. AC Content

% Fatigue Cracking

Low 5% Pavement Air Void Content

Med 8%

High 11%

3.4 Million
No Cracking

2.8 Million

2.8 Million

D’Angelo Consulting
For tough mixes use pneumatic rollers for Breakdown.
Intermediate rollers in echelon to assure good coverage.
Intelligent Compaction

GPS / positioning with reference station
In the end good quality pavement with minimal depressions and cracking
Smooth Roads Ahead