Superior Materials, Advanced Test Methods and Specifications

International Technology Scanning Program

presented to:

NCAUPG
Omaha, NE
28 January, 2004

presented by:
Lon Ingram, KS DOT
International Scan Program

- Joint sponsorship between FHWA and AASHTO
- Started in 1991
- Over 50 scans completed
- Scan topics include:
  - Pavements
  - Bridges
  - Geotechnical
  - Planning and Environment
  - Safety
  - Winter Maintenance
  - Transportation Policy and Information
Who we Are

- **State Dept. of Transportation**
  - Lon Ingram – Kansas (Co-Chair)
  - Jimmy Brumfield – Mississippi
  - Mark Felag – Rhode Island
  - Tom Baker – Washington

- **Federal Highway Administration**
  - Keith Herbold – National Resource Center (Co-Chair)
  - Max Grogg – Iowa Division Office
  - Laurin Lineman – Eastern Federal Lands

- **Private Sector**
  - Ted Ferragut, TDC Partners, Ltd. (Implementation Specialist)
  - Dr. Robert Otto Rasmussen, The Transtec Group, Inc. (Reporter)
Where we Visited

- United Kingdom
- Denmark
- Germany
- The Netherlands

International Technology Scan
Superior Materials, Advanced Test Methods and Specifications
Why this Scan?

- A desire for materials approvals and specifications in the U.S. to be:
  - More rapid
  - Less expensive
  - More efficient
  - Uniform from state-to-state

- Technology is rapidly advancing in:
  - Asphalt and concrete
  - Coatings and polymers
  - Composites and electronics
What do we Use Today?

- Individual state DOT “approved product” lists
- Contract special or supplemental provisions
- National Transportation Product Evaluation Program (NTPEP)
- Highway Innovative Technology Center (HITEC)
- AASHTO Product Evaluation List (APEL)
- Federal Land Highways technology development team
Objectives

- Seek out the processes used to approve and specify materials and test methods

and...

- Identify examples of superior materials.
What is a Superior Material?

- Materials and manufactured products that:
  1. Significantly improve performance of the constructed facility;
  2. Are cost effective, both initial and/or life-cycle costs;
  3. Improve safety for both the traveling public and/or the construction worker; and
  4. Reduce time of construction.
What did we Ask?

- What is your approval process?
- Without a performance history, what techniques are used to predict performance?
- How are standard tests developed or adapted for a new material?
- How are produced materials tested to assure consistent quality?
What did we Learn?

- Process-Related Issues
- Evaluation Techniques
- Innovative Materials
- Other Issues and Considerations
What did we Learn?

- Process-Related Issues
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Process-Related Issues

- European Union standardization
  - Intended to improve efficiency and competition
  - Standard specifications so vendors can more easily sell products across national borders
  - Harmonizing test procedures, quality thresholds, and language (English is official, French & German OK)
  - Specifications are commonly functionally driven
  - Tests are fixed, but use of “classifications” allows for degrees of quality
Process-Related Issues

- **European Union standardization**
  - European standard specification organization – Comité Européen de Normalisation (CEN)
  - Centralized agency for testing and evaluation of non-standardized materials – European Organisation for Technical Approvals (EOTA)
  - Some parallels to AASHTO and ASTM, but notable differences also
Process-Related Issues

- Contract mechanisms
  - Warranties generally address quality
  - Performance contracts often lead to innovation
  - Movement to performance specifications but performance standards are not easily defined
- Maintenance contracts
- Quality, life-cycle costs, and sustainability (eco-friendliness) are award considerations
- Awardee is commonly not the lowest bid
Process-Related Issues

- Independent product evaluation / certification
  - EOTA (Europe)
  - BBA HAPAS (U.K.)
    - Predetermined materials categories
    - Expert panels to set standards
    - Vendors get certificates, but revoked if quality drops
  - Independent lab certification – public, quasi-public, or private
  - BRE (U.K.), TRL (U.K.), DRI (Denmark), BASSt (Germany), RWS (The Netherlands)
  - Functional requirements for materials
Roads to the Future (The Netherlands)

From concept to laydown in 2 years

Jump started innovation

Sponsor and vendors shared cost and benefits

Long-range research with short-term benefits

(spin-off technologies)
What did we Learn?

- Process-Related Issues
- Evaluation Techniques
- Innovative Materials
- Other Issues and Considerations
Evaluation Techniques

- Accelerated load testing
- Test for performance instead of properties
- Specific techniques:
  - Torque bond test
  - Striping wheel test
  - Microscopy for stripping
  - Polymer content testing
  - Pulse thermography
What did we Learn?

- Process-Related Issues
- Evaluation Techniques
- Innovative Materials
- Other Issues and Considerations
Innovative Materials

- Pavements
  - Noise attenuating
  - Friction surface treatments
  - Twin-layer asphalt
  - Low temperature asphalts
  - Semi-flexible asphalt
  - Composite pavement (HMA on CRCP)
  - Fiber-reinforced concrete inlays
  - Slag-bound material in concrete
  - Fabric between PCCP and LCB
  - Rapid concrete repairs
Innovative Materials

- Bridges
  - Fiber reinforced polymer strengthening
  - Waterproofing orthotropic decks
  - Long-life wearing courses
Innovative Materials

- Others
  - Dynamic road marking
  - Compact asphalt (two course paving)
  - Sustainability-driven:
    - Wooden guardrail
    - Wooden luminaire
What did we Learn?

- Process-Related Issues
- Evaluation Techniques
- Innovative Materials
- Other Issues and Considerations
Other Issues and Considerations

- **Noise**
  - Major impact on pavement type selection
  - Auto, tire, and pavements industries worked together for solutions

- **Sustainability**
  - Virgin aggregate taxes
  - 100% reuse policy
  - Eco-points for life-cycle costing
What can we Conclude?

- **Drivers for Innovation**
  - Governmental policy
  - “Top down” mandates
  - Technology must respond

- **Standardization**
  - A move to functional requirements
  - Recipe specifications limit innovation

- First cost is not the primary driver
What can we Conclude?

Pyramid of Demands

- user demands: safety, comfort, accessibility, travel time, etc.
- function demands: friction, evenness, noise reduction, number of lanes, etc.
- construction demands: strength, bearing capacity, durability, etc.
- elementary material properties: resistance against fatigue, deformation, cracking, thickness, etc.
- demands on raw materials and building materials: composition, grading, voids, degree of compaction, PSV, pen, TR&B

Models define relation between levels
What can we Conclude?

- Warranties and innovation
  - Warranties may not lead to innovation, but quality may improve
  - Warranties are typically 5 years or less, except for design-build-finance-operate (DBFO) of 30 years +
  - Warrant products with a track record of performance
  - Warranties lead to a transfer of risk from the agencies to the vendors
What can we Conclude?

- **Public versus private roles**
  - Materials vendors often succeed more if they approach the contractor instead of the agency.
  - No reward for agency employees to take risks with innovative products.
  - Government typically supports long-term innovations.
  - Contractors typically support short-term innovations.
  - Sometimes long-term innovation can be explored with public-private partnerships (e.g. “Roads to the future”).
  - Transition from methods to functional specs is a joint effort.
What do we Recommend?

- Further investigation of the European Union standardization – what else can we learn?
- A follow-up with France?
- Assess the need for a national certification program by independent laboratories
- Start with a national pavement marking test facility?
What do we Recommend?

- Explore a “Roads to the Future” concept
- Manufacturer certification of installation contractors