Implementation of M-E Design Guide

2004 Workshops
What are the key benefits of the Design Guide?

- Improved confidence in design
- Increased pavement life
- More cost-effective designs
- Special analysis capabilities
  - Extrapolation for unusual designs
  - Complicated rehab designs
  - Identify problems with existing designs
  - Forensic analyses
  - Special loadings
How will I benefit from the Design Guide?

It Ties Together:
• Structural Design
• Materials Selection
• Construction

Making sure that the design criteria have been met or exceeded.

Agency/Owner and Contractor/Supplier
M-E Guide

Significant Challenges

• The process represents a radical change in the way pavements are analyzed and designed
• Implementation will require a significant commitment of resources to be successful
• Time required 3-5 years (minimum)
• The design guide is not a cookbook
Implementation Challenges

• Requires leadership and coordination
• Individual champions needed
• Lead States are needed
• Specialization in the pavement engineering discipline
• Technical assistance mechanism needed (DGIT is a start)
Guide Implementation Requirements

- Compare new and existing design systems
- Evaluate sensitivity to local factors and conditions
- Move from national to local calibration
- Develop short and long term action plans
Steps for Implementation

1. Knowledge of System
2. Action Plan
3. Verification
4. Calibration
5. Validation
Step 1. System Knowledge

- Release of final product
- Understanding concepts and procedures
- Experience using product
Is the Guide Ready to Implement?

- Panel concerns
- JTFP concerns
- Expectation - AASHTO standard
- Time required to change
- Future enhancement activities
- This is the best available national system!
Step 2. Action Plan

• Questions for action plan
  ▪ What needs to change?
  ▪ Can local data information be used/converted?
  ▪ What is most critical?
  ▪ How much it will cost?
Experimental Concepts Definitions

**Verification** – assuring general reasonableness

**Calibration** – minimize difference between predicted and observed distress

**Validation** – confirm accuracy of calibrated model
Step 3. Verification

• Questions needing answers
  ▪ Does it make sense?
  ▪ Predict logical results?
  ▪ Does it fit your local conditions?
  ▪ Represent improvement?
  ▪ Potential for adjustment?
Step 4. Calibration

• Questions needing answers
  ▪ Is there a significant difference between your data and national defaults?
  ▪ What data is needed?
  ▪ How long performance period?
  ▪ How many sites needed?
1-37A Guide Calibration

Done with national LTPP data
Default values also from LTPP
Confirm/change national defaults
Regional/Local Calibration Process

Calibrated National Predicted Performance

Actual Field Performance

$\beta_s = $ Agency Calibration Factor
\[ N_f = 0.00432 \times C^n \beta \psi k_1 \left( \frac{1}{E_s} \right)^{0.8} \left( \frac{1}{F} \right)^{0.8} \]

\[ C = 10^{n} \]

\[ M = 4.84 \left( \frac{V_s}{V_s + V_0} - 0.69 \right) \]

- Special Analysis
- National Calibration
- State/Regional Calibration
- Typical Agency Values

\[ k_1 = 0.00432 \quad k_2 = 3.9492 \quad k_3 = 1.281 \]
\[ B_1 = 1 \quad B_2 = 1 \quad B_3 = 1 \]
Calibration

- Requires extensive experimental studies, including:
  - Field testing programs
  - Laboratory testing
  - Data analysis

Pool your resources to maximize effort and efficiency!
Required Data Bases

- Materials database
- Traffic database
- Performance database
- Rehabilitation database
Flexible Pavement Distress Needing Calibration

- **Rutting** – Unbound Base/Subbase/Subgrade Layers, AC Layers and Total Rut Depth

- **Fatigue Cracking** - Surface Down-Longitudinal and Bottom Up- Alligator Cracking

- **Transverse (Thermal) Cracking**

- **IRI** - Accuracy depends upon predictive accuracy of all other Distress
Rigid Pavement Distress
Needing Calibration

• Faulting in JPCP
• Transverse Cracking in JPCP – Top-Down and Bottom-Up cracking
• Edge Punchout in CRCP
• IRI for Rigid Pavements - Accuracy depends upon predictive accuracy of all other Distress
Step 5. Validation

• Questions needing answers
  ▪ Does the calibration factors produce consistent results throughout the State?
  ▪ How many sites needed?
  ▪ How often to re calibrate?
Are the States Ready to Implement the Guide?
Questionnaire Responses

48 States Responded
## What’s Being Used in 2003

<table>
<thead>
<tr>
<th>Design Procedures</th>
<th>DOTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972 AASHTO Guide</td>
<td>3</td>
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<tr>
<td>1986 AASHTO Guide</td>
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<tr>
<td>1993 AASHTO Guide</td>
<td>26</td>
</tr>
<tr>
<td>Agency’s own pavement design guide or combination of AASHTO/Agency design procedures</td>
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## Current Knowledge of New M-E Guide

<table>
<thead>
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<th>Knowledge Level</th>
<th>DOTS</th>
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<tbody>
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<td>Heard the term, but know little</td>
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</tr>
<tr>
<td>Attended introduction workshop/presentation</td>
<td>21</td>
</tr>
<tr>
<td>Participated in JTFP/NCHRP Panel</td>
<td>14</td>
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<tr>
<td>Attended workshop and/or presentation &amp; Participated in JTFP or NCHRP Panel</td>
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</table>
Receptiveness to the 1-37A

Yes, all for it

Yes, but need convince

Neutral

No, not until proven

No, not at all
Implementation Plan
Data Collection to Support Calibration

YES

NO

Reply

Alaska

Hawaii
Workshop Summary

- Capabilities of 1-37A Guide
- Understanding M-E basics
- Limitations of current practice
- Need for change
- NCHRP 1-37A status
- NCHRP 1-37A software
- Implementation steps
- FHWA support