Driving Indiana's Economic Growth

2008 ROAD SCHOOL

MEPDG

For Local Governments
MEPDG

M - Mechanistic
E - Empirical
P - Pavement
D - Design
G - Guide

Development of the PDG

1. 2002 Pavement Design Guide
2. 200X Pavement Design Guide
3. 20XX Pavement Design Guide
4. MEPDG
What Is It?

• Climate
• Materials
• Traffic
• Structure

Response → Damage → Accumulation → Distress

HOW DOES IT WORK?

Inputs

<table>
<thead>
<tr>
<th>Structure</th>
<th>Materials</th>
<th>Traffic</th>
<th>Climate</th>
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Both mean and standard deviations inputs are required

Selection of Trial Design

Structural Responses ($\sigma$, $\varepsilon$, $\delta$)

Performance Prediction
Distresses / Smoothness

Design Reliability

Performance Verification
Failure criteria

Design Requirements Satisfied?

Yes

Final Design

No

Revise trial design
Primary Distresses in MEPDG

- Fatigue Cracking
- Thermal Cracking
- Longitudinal Cracking
- Rutting

MEPDG DESIGN

- Level 1
  - Highest Reliability
- Level 2
  - Medium Reliability, but Practical
- Level 3
  - Default Values
Is it For Local Roads & Streets?

- SUPERPAVE Lesson Learned
  - Misunderstood in the Late 90’s
  - Meant for **ALL** Roads **NOT** Only Superhighways

- MEPDG
  - **ALL** Pavements
  - Structure is Designed for the Traffic, Climate, Materials, and Structure at the Site
Pavement Cross Section

1.5"

AC 1

2.5"

AC 2

4"

GB

4"

GB

6"

Compacted Subgrade

Natural Subgrade

GWT 10 ft

THICKNESS

Traffic
Traffic Mix & Classification

FHWA Vehicle Classes; 1 through 13
TRUCKS

Incremental Fracture Damage & Distortion

(Load-Related Cracking, Rutting, Faulting, Punchouts)

Climate

Weather Station

Precipitation

Temperature

Solar radiation

Wind speed

Relative humidity

Groundwater Table

Depth

PAVEMENT and SUBGRADE

Moisture gradients

Temperature gradients

Freeze/thaw cycles

MATERIAL PROPERTIES

Influence on layer stiffness
Materials

Pavement Cross Section

1.5"
AC 1

2.5"
AC 2

4"
GB

4"
GB

6"
Compacted Subgrade

Natural Subgrade
GWT 10 ft

GWT
TREATED SUBGRADE

GRANULAR BASE
Analysis

- Climate Inputs
- EICM
- Material Properties
- Transfer Functions
- Predicted Performance
- Mechanistic Analysis
- Traffic
Structure

MECHANISTIC ANALYSIS

FLEXIBLE
- Fatigue cracking
- Thermal cracking
- Permanent deformations
- IRI factor

BRAND X
- Faulting and fatigue cracking
- Curling and warping
- Drying shrinkage
- Punchouts
- IRI factor
- Initial crack width

Compacted Subgrade

Natural Subgrade

Pavement Cross Section

AC 1

AC 2

GB

GB

Compacted Subgrade

Natural Subgrade

GWT 10 ft
**Reliability**

90 %

Vs

50 %

**Freeze and Thaw**

- Frozen State
- Equilibrium State
- Thawing

$M_r$ (psi)

1 mil

32 k

16 k

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
FWD Testing

MEPDG Implementation

- major enhancement to current technology; however the technology is still evolving:
  - Do not expect perfect predictions
    - Need to locally calibrate to actual field performance
    - Need to have a well defined nationally coordinated approach to develop planned model enhancements
Why Local Calibration?

- Climate Regimes
- Construction & Material Specifications
- Maintenance/Preservation Strategies
- Policies

Calibration: Transfer Functions

- Pavement Response
  - Stresses
  - Strains
  - Deflections

- Pavement Distress
  - Fatigue Cracks
  - Rutting/Faulting
  - Thermal Cracks

Calibration is a key.
DARWin ME Development

- Transfer version 1.0 from NCHRP to AASHTO
- Release Darwin ME 2.0 - ?
  - Dependent on Issues Identified
  - Dependent on Funding Level

THE END

THANK YOU