Planning for the 2002 Design Guide

Southeast Asphalt User/Producer Group Mtg.
Hilton Head Island, South Carolina
Harold L. Von Quintus, P.E.
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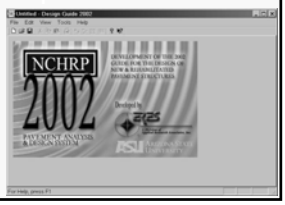
Presentation Overview

1. Points to Remember
2. Questions/Products
3. Plan to Address Inputs & Local Issues



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Point 1!

The 2002 Design Guide ***FAR EXCEEDS*** the 1993 AASHTO Design Guide in all areas, but simplicity.

- The method is based on tools that ***EQUAL OR EXCEED*** state-of-the-art!

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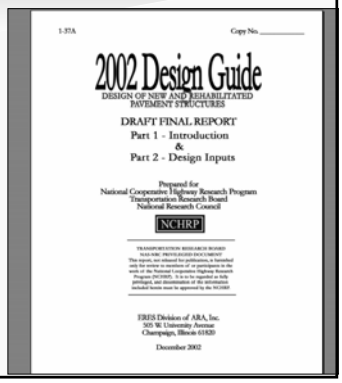
Point 2!

The hierarchical input procedure allows a user to use the Guide with ***NO*** major investment.



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Point 3!

It's a design-analysis procedure with

- ***Global*** Correlations to estimate selected inputs.
- Default values.
- Calibration factors – ***LTPP***

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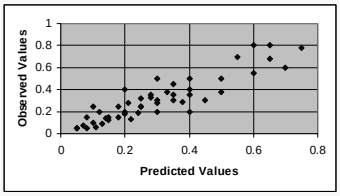
Point 4!

The accuracy or error of the new method ***HAS BEEN*** quantified.

How accurate is our existing pavement design procedure – the 1993 AASHTO Design Guide?



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Point 5!

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- Is thickness design process.
- *BUT* can be used to determine/evaluate other design features.

Flexible Pavements
- Asphalt binder grade
- HMA mix type
- Air Voids/Density
- Drainage

Example: Effect of Air Voids

6" HMA
12" Crushed Stone
12" Aggr. Subbase
A-5 Soil

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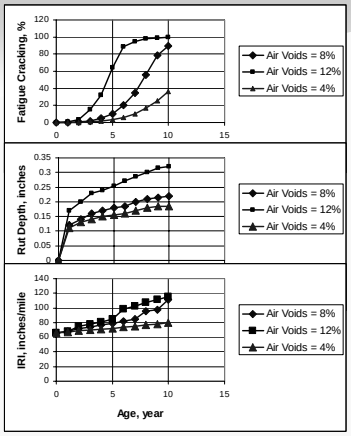

Point 6!

It Ties Together:
- Structural Design
- Mixture Design
- Construction

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

Material and Construction Specifications

Questions & Products

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Questions & Products

What do I need & how do I use the software?

- Management video.
- Guide text & appendices.
- User's Manual in support of software.
- Training course on software execution.

Questions & Products

How accurate are the predictions to my local conditions & materials?

- Expert input mode
- Local calibration procedure
- Test procedures (lab & field) to determine inputs.

Inputs & Local Issues

1. Accumulate basic data
2. Compare to traditional designs
3. Conduct sensitivity analysis

What can I do to get started?

- Design Criteria
- Traffic
- Materials/Soils
- Climate
- Rehab. – Pavement Evaluation

Input Levels 1, 2, 3

You want me to determine WHAT????

Thermal conductivity, Poisson's ratio, Creep compliance, Dynamic modulus, etc.

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Design Criteria

Bottom Initiated Fatigue Cracks

Surface Initiated Fatigue Cracks

IRI

Thermal Cracking

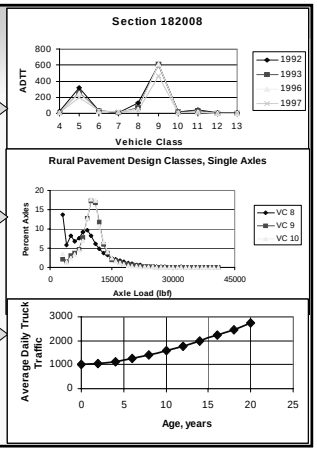
Total Rutting & HMA Rutting

Truck Traffic

Truck volume distribution

Axle weight distribution

Truck Traffic Projections



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Build Truck Traffic Library

1. AVC Data
2. WIM Data

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Accumulate Traffic Data:

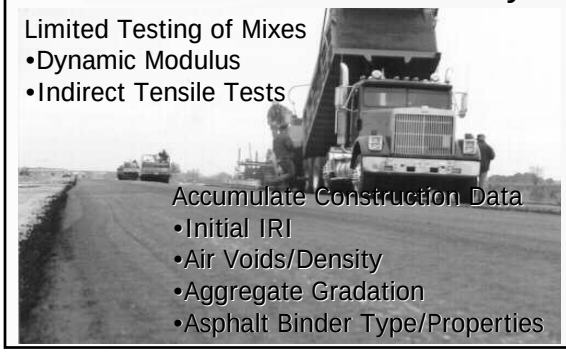
- Truck volumes
- Axle weights
- Regional & seasonal effects

Materials Testing: HMA Characterization

- Dynamic modulus, master curve
- IDT creep compliance master curve
- IDT strength
- Density/Air voids
- Aggregation Gradation
- Asphalt binder PG properties

Materials Testing: HMA Materials Library

Limited Testing of Mixes
- Dynamic Modulus
- Indirect Tensile Tests



Accumulate Construction Data
- Initial IRI
- Air Voids/Density
- Aggregate Gradation
- Asphalt Binder Type/Properties

Materials Testing: Unbound Base/Soils

- Resilient modulus, or
- Strength Values
  - CBR,
  - R-Value, or
  - Dynamic Cone Penetration

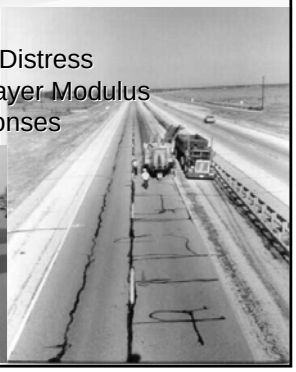
Materials Testing: Unbound Base & Soils Materials Library

Accumulate Construction Data:
- Density/Moisture Content
- Gradation
- Atterberg Limits

Limited Resilient Modulus Testing

Damage in Existing Structure

Estimated from:
- Amount & Severity of Distress
- Back-Calculation of Layer Modulus
- Computation of Responses



Agency Implementation & Local Issues

2002 Calibration-Validation Process

- **Used *BEST* Available Data.**
- **No Materials Testing – Relied on existing databases for all inputs – LTPP.**

Can we do better?

Input Element	Input Level		
	1	2	3
Material Properties	Lab Testing	Equations	"Guessed" Value

Implementation Issue:

Too much error?
Applicability of error?

- ***Yes*** – Confirm default values.
- ***No*** – Re-calibrate.

Are our design standards & materials similar to ***LTPP*** sites?
- Pavement types
- Rehab strategies
- Materials/Mixtures

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Implementation Issue

Remember point 1, no major investment is needed for Level 3 inputs, ***BUT*** you are going to get out of the program based on what you put into it!

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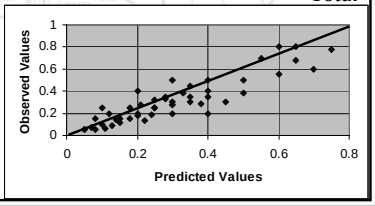
Implementation Issue

Remember Point 4:
All prediction models have errors;
BUT where does the error come from?

$$Observed = \Pr edicted \pm e_{Total}$$



Implementation Plan

Procedures to determine inputs – become equipped to do:

- Axle load spectra (TMG).
- Deflection testing & back-calculation of layer modulus.
- Repeated load/cyclic testing; materials characterization.

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Implementation Plan

Local confirmation of default values & calibration factors:

- Build library of material properties & traffic factors (Confirm Level 2 inputs).
- Build library of default values (Confirm Level 3 inputs).
- Use LTPP as a starting point.

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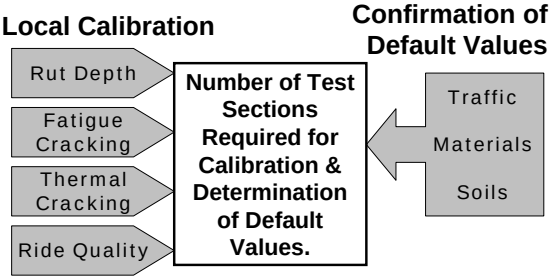
Dual Purpose Plan



Implementation Plan, Other Issues & Topics:

- Comparison to conventional designs
  - **Define the differences.**
- Sensitivity of performance to design features
  - **Identify the most sensitive design features.**
- Resources and time for implementation
  - **4 to 5 years.**

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Future Improvements

NCHRP 9-30 Experimental Plan for Calibration & Validation of HMA Performance Models for Mix & Structural Design

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NCHRP 1-42 Top-Down Cracking of HMA Layers

NCHRP 1-41 Selection of a Reflection Cracking Model for HMA Layers

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Future Improvements – NCHRP 9-30 Products

- M-E Database
- Experimental Plan & Factorial for Mix Characterization

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In Summary:

- You can use the 2002 Design Guide using current practice.
- Will the errors or bias of the predictions apply to your conditions & materials?

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2002 Design Guide:

The future of pavement design.

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Thank you for your attention!

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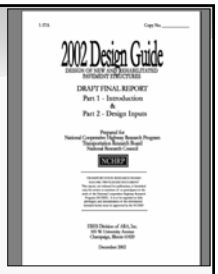
Implementation Plan

1. Training on design procedure.
2. Procedures to determine input parameters.
3. Lab & field equipment.
4. Verification & confirmation of:
   - Default values.
   - Calibration factors.



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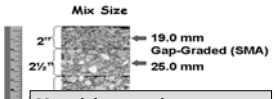
Implementation Plan Focus

- Use of the software.
- Determination of the inputs.
- Applicability of the methods & default values to my local conditions/materials.



Material properties.
Recycling of materials.
Innovative materials.
Design features.
Traffic features.

Other Implementation Products for Calibration

- LTPP database.
- NHI Course 131064 – Introduction to Mechanistic-Empirical Design Procedures.
- Agency test sections.
- APT and ALF sites.
- Test tracks – WesTrack, NCAT, MnRoads, etc.
- NCHRP 9-30, Experimental Plan for Validation of HMA Prediction Models.

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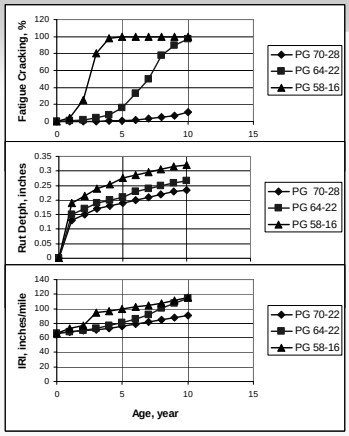
Effect of Asphalt Binder Type

6" HMA
12" Crushed Stone
12" Aggr. Subbase
A-5 Soil



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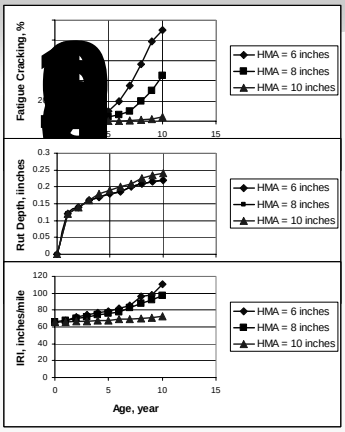
Effect of HMA Thickness

HMA
12" Crushed Stone
12" Aggr. Subbase
A-5 Soil



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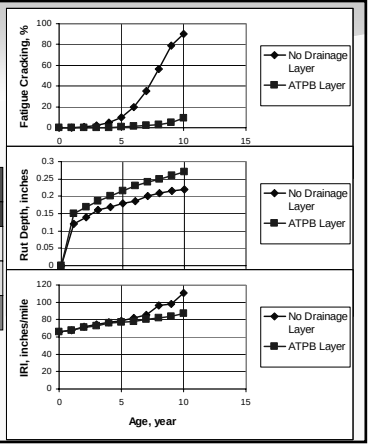
Effect of Drainage Layer

6" HMA
4" ATPB
8, 12" Crushed Stone
12" Aggr. Subbase
A-5 Soil



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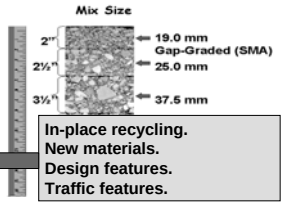
Implementation Plan Focus

- Determination of the inputs.
- Use of the software.
- Applicability of the methods & default values to my local conditions/materials.



In-place recycling.
New materials.
Design features.
Traffic features.

Reduce uncertainty by using level 1 inputs.

$$e_{Level1} \leq e_{Level2} \leq e_{Level3}$$

Input Element	Input Level		
	1	2	3
Material Properties	**Lab Testing**	Regression equations	Default; "Best Guessed" Value

Components of the Error Term?

Implementation Plan Topics

1. Training on design procedure.
2. Procedures to determine input parameters.
3. Obtain lab & field equipment.
4. Verification & confirmation procedure.
   - Default values
   - Calibration factors

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Implementation Plan

Training & Communication are essential!

- Structural Design
- Traffic
- Construction
- Materials Characterization
- Pavement Monitoring

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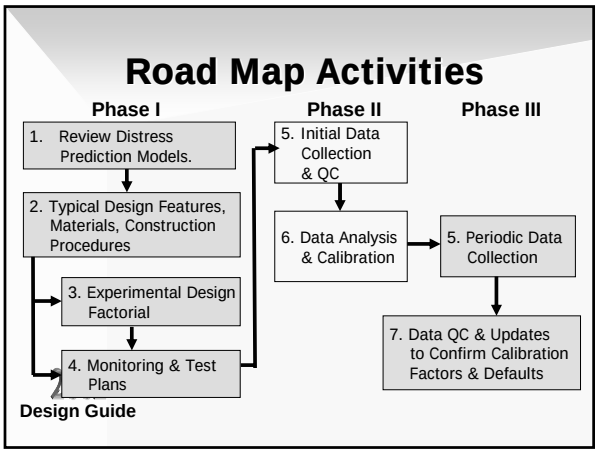
Summary: Road Map of Implementation Plan Activities

Phase I - Planning

→ **Phase II – Initial Data Collection & Analyses**

→ **Phase III – Annual Data Collection, Analyses, & Confirmation**


Road Map Activities
Phase I
Phase II
Phase III
1. Review Distress Prediction Models.
2. Typical Design Features, Materials, Construction Procedures
3. Experimental Design Factorial
4. Monitoring & Test Plans
5. Initial Data Collection & QC
6. Data Analysis & Calibration
5. Periodic Data Collection
7. Data QC & Updates to Confirm Calibration Factors & Defaults
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