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MEPDG: Implementation in Idaho

MEPDG—Implementation in Idaho

Prepared By:
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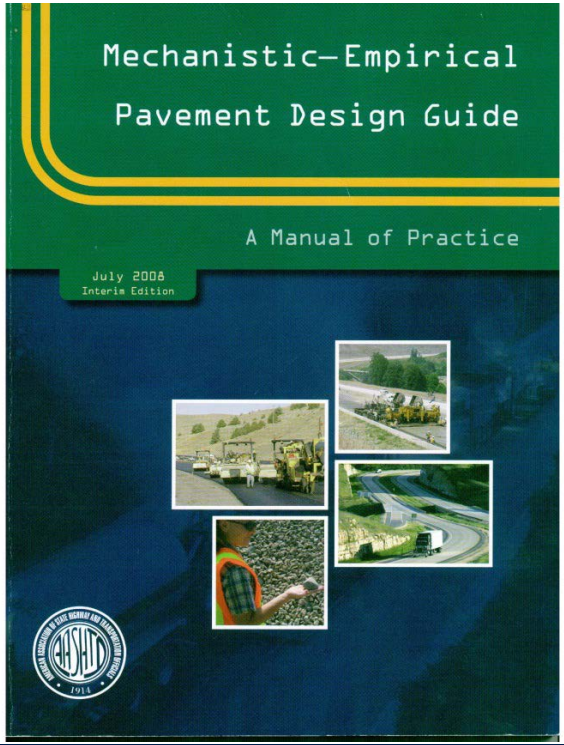
Outline

1. Introduction
2. Idaho's Roadmap
3. User Guide & Training
4. Local Calibration
5. Comparative New & Rehabilitation Design



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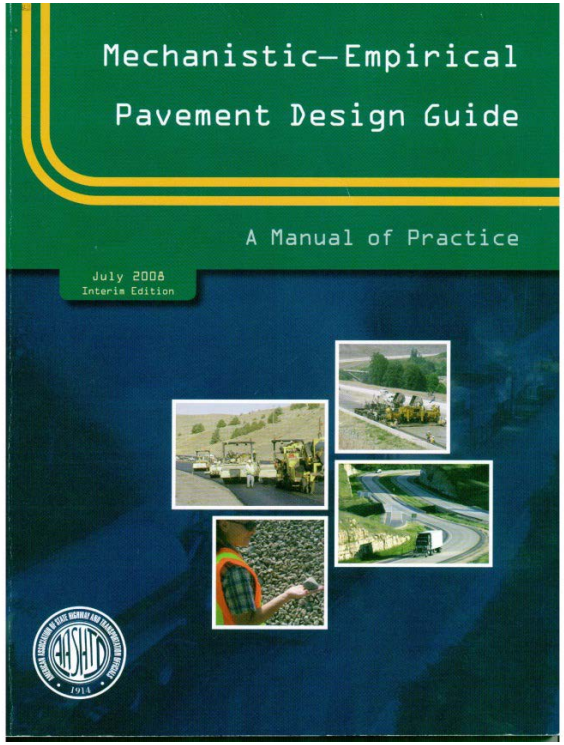
Introduction

What is the MEPDG?

- Mechanistic-Empirical Pavement Design Guide
- Analysis/Design Procedure based on pavement responses that have been correlated to observed distresses.
- Associated AASHTO software program: ME Design.



AASHTOWare Pavement ME Design

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MEPDG Analysis/Design Process

Inputs

Subgrade Analysis

Climate Analysis

Materials Properties

Traffic Analysis

Mechanistic Analysis

Modify Design

Trial Design

Pavement Response Model (stress, strain)

Damage Accumulation Over Time

Calibrated Damage-Distress/IRI Models

Outputs

Meet Performance Criteria?

No

Yes OK

Temp Ck

Long Ck

Alligator Ck

Rut

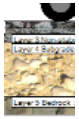
IRI

Example HMA Design: Performance

Design Inputs

Design Life:	20 years	Existing construction:	August, 1985	Climate Data Sources	43.516, -112.067
Design Type:	AC over AC	Pavement construction:	September, 2005		43.834, -111.881
		Traffic opening:	October, 2005		42.92, -112.571

Design Structure



Layer type	Material Type	Thickness (in.):
Flexible	AC Overlay	4.0
Flexible	Existing AC	3.0
NonStabilized	Crushed gravel	5.3
Subgrade	A-1-a	30.0
Bedrock	Highly fractured and weathered	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	12.2
Air voids (%)	5.5

Traffic

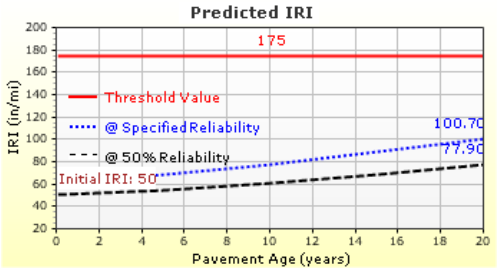
Age (year)	Heavy Trucks (cumulative)
2005 (initial)	1,353
2015 (10 years)	2,887,450
2025 (20 years)	7,904,430

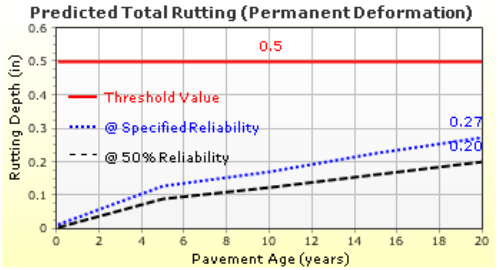
Design Outputs

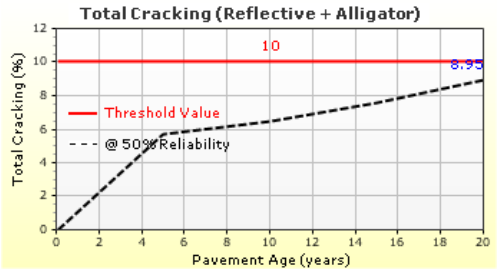
Distress Prediction Summary

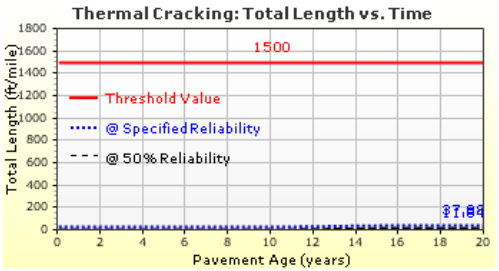
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	175.00	100.70	85.00	100.00	Pass
Permanent deformation - total pavement (in.)	0.50	0.27	85.00	100.00	Pass
Total Cracking (Reflective + Alligator) (percent)	10	8.95	-	-	Pass
AC thermal cracking (ft/mile)	1500.00	37.88	85.00	100.00	Pass
AC bottom-up fatigue cracking (percent)	15.00	1.17	85.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	5000.00	2500.83	85.00	98.88	Pass
Permanent deformation - AC only (in.)	0.50	0.27	85.00	100.00	Pass

Distress Charts









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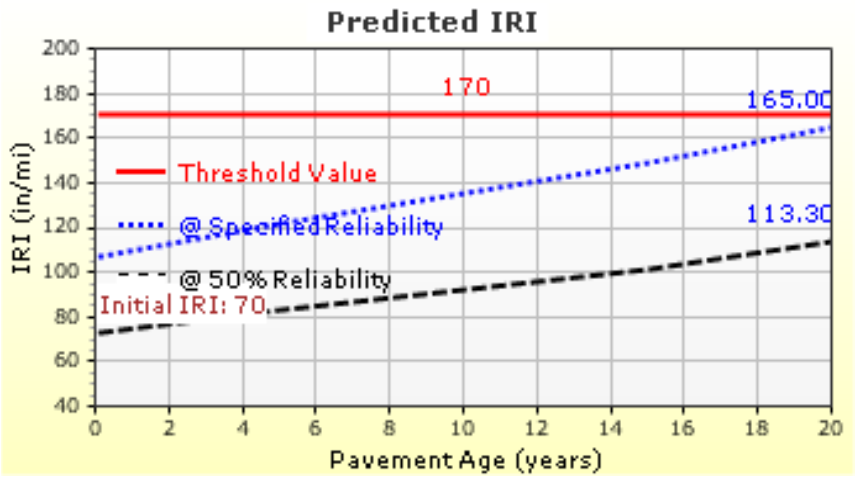
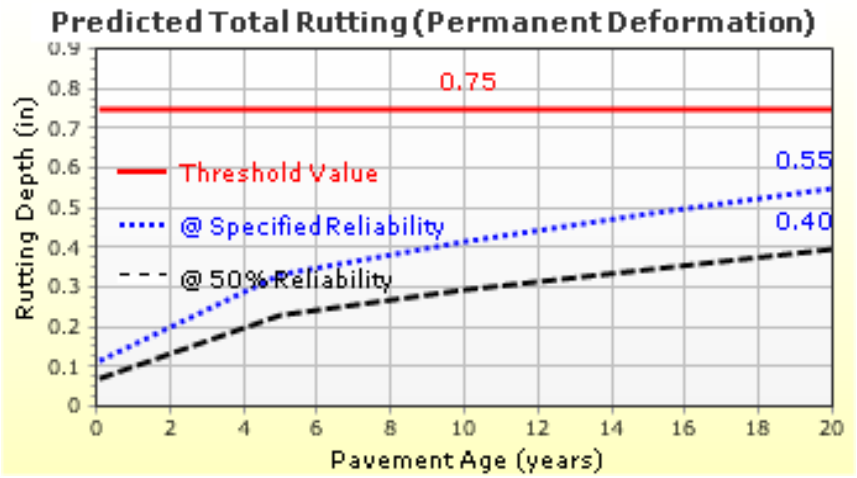
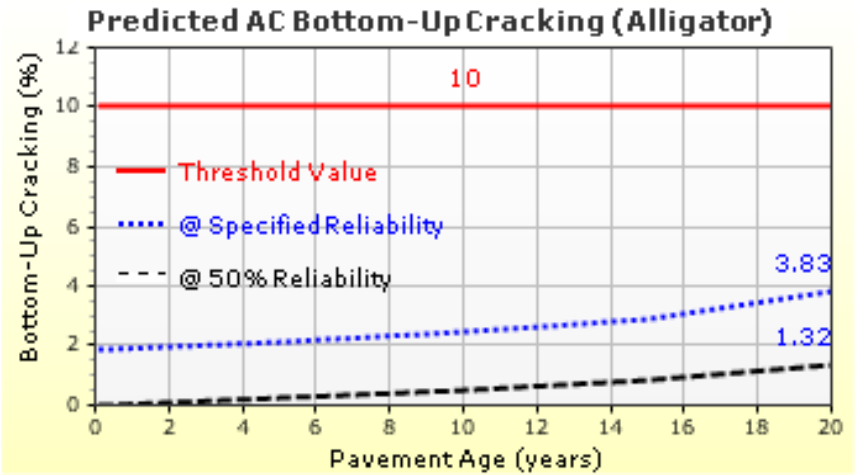
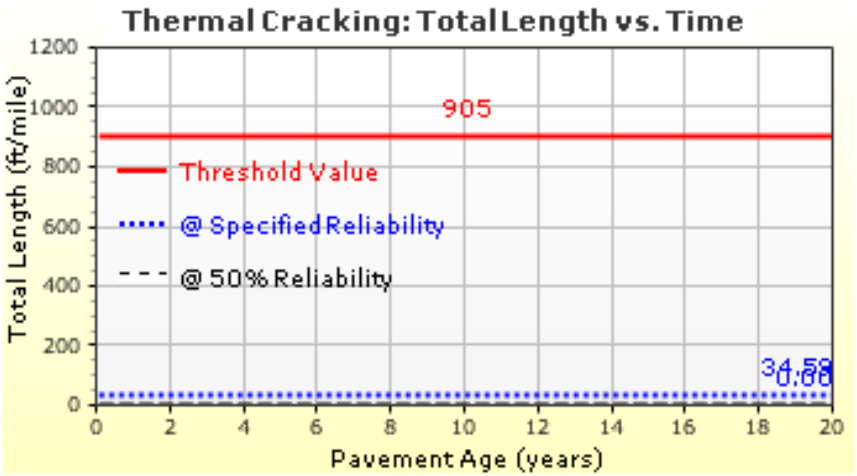
Example HMA Design: Performance

Distress Charts









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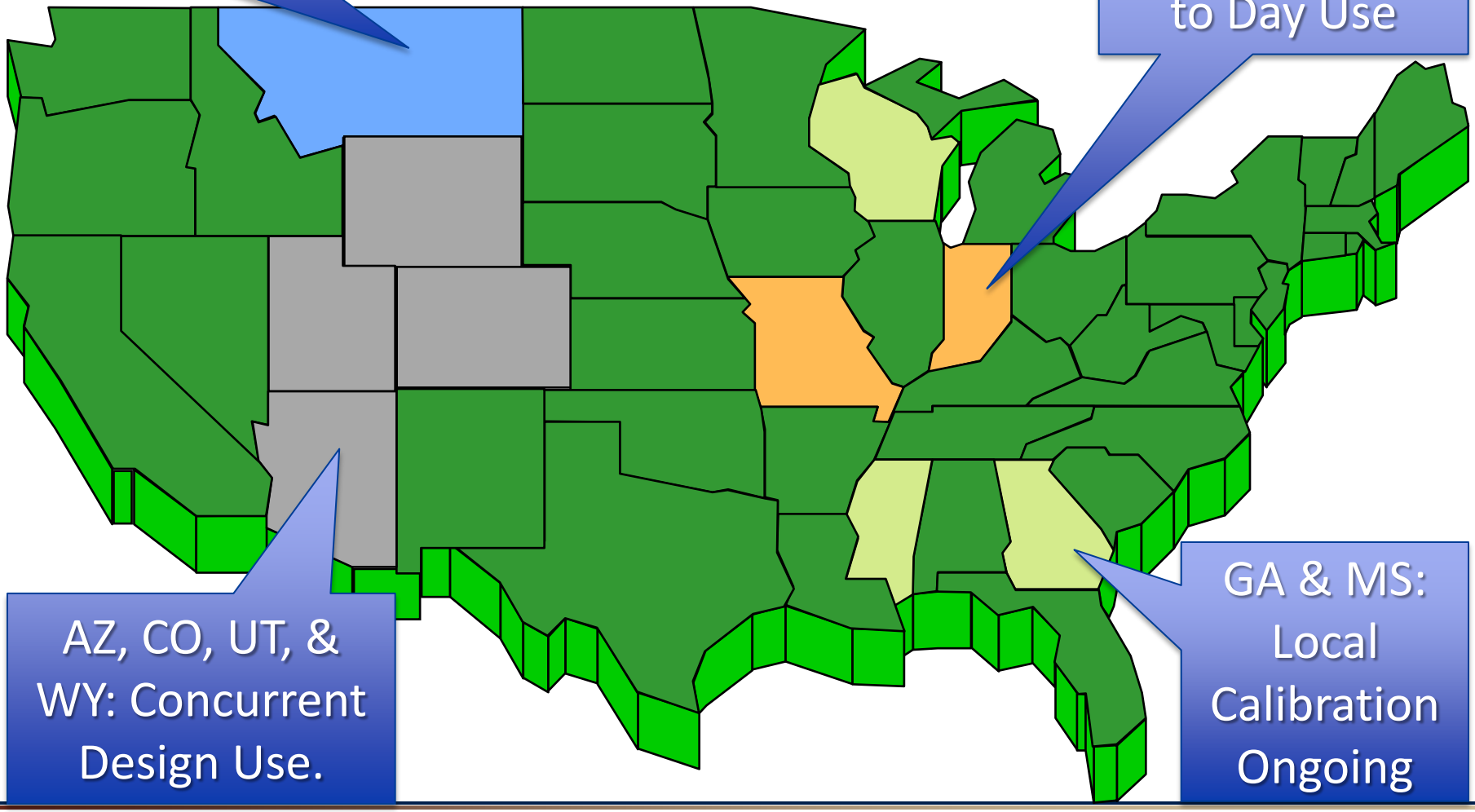
Example MEPDG Implementation



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Introduction

Interesting Applications

- **Missouri:** Over $900 million in Alternative Bid projects competing HMA & PCC designs.

- **Indiana:** During 2009 Indiana designed projects using AASHTO 93 & MEPDG & found several million in savings. Alternative bid projects have resulted in contractors / consultants who are proficient in MEPDG.

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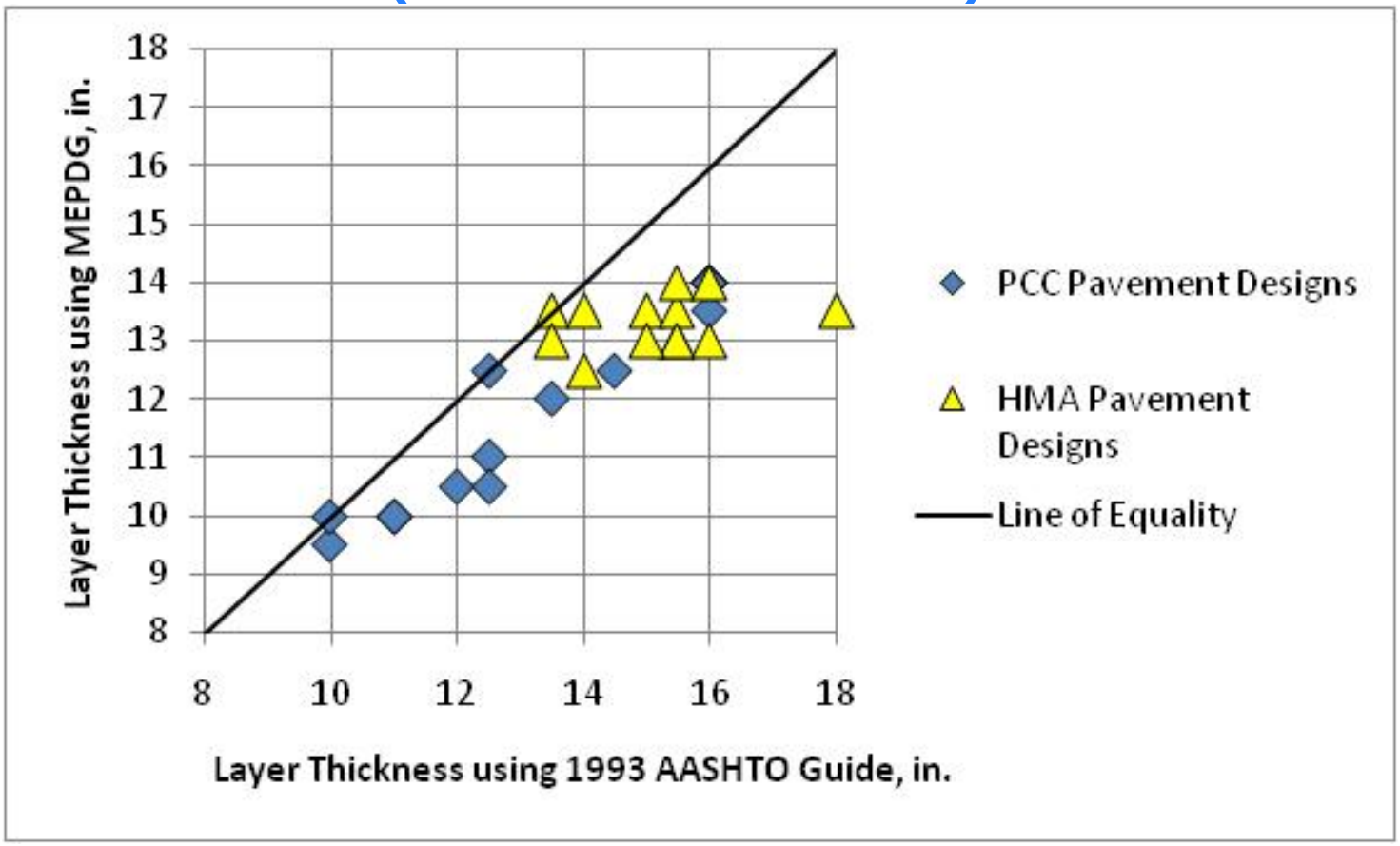
Introduction

Common Finding: AASHTO ME Design thickness lower for heavy traffic as compared to the 1993 AASHTO Design Guide.

(Indiana Data Below)



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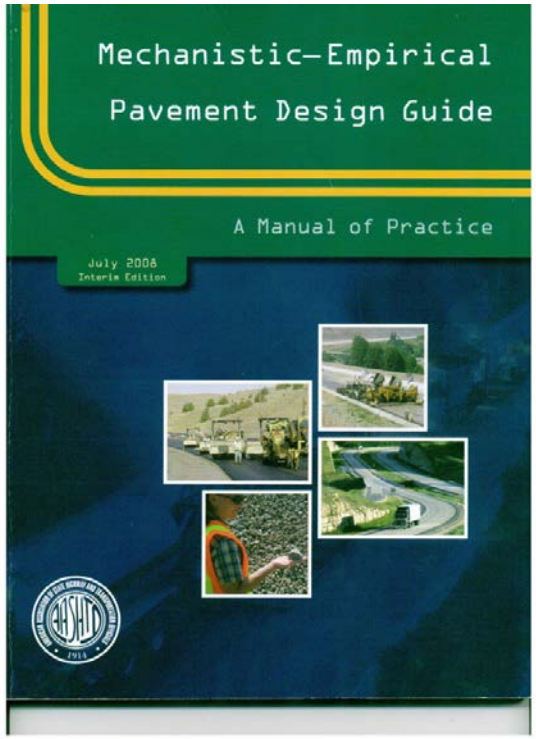
Introduction

Available Documents:

1. MEPDG Manual of Practice (Engineering Manual)
2. ME Design Software (HELP)



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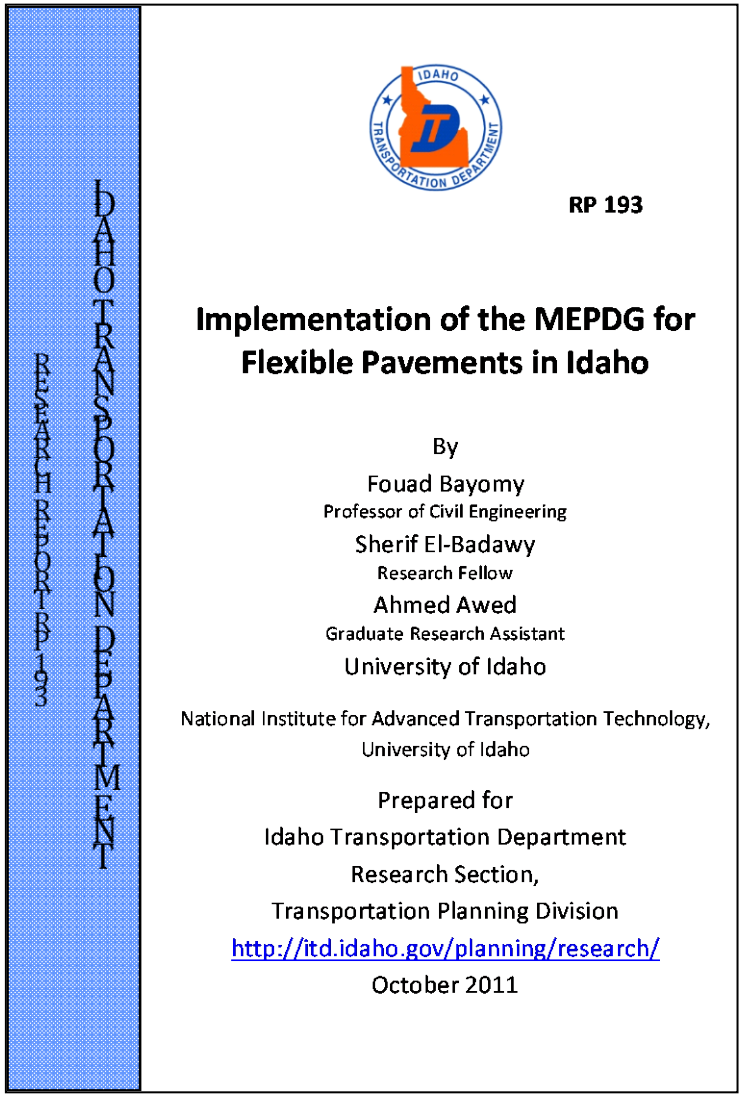
Introduction

Available Documents:

3. University of Idaho Research Report on Implementation
4. Idaho MEPDG User Manual
5. Idaho's Implementation Plan or Roadmap



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3. User Guide & Training
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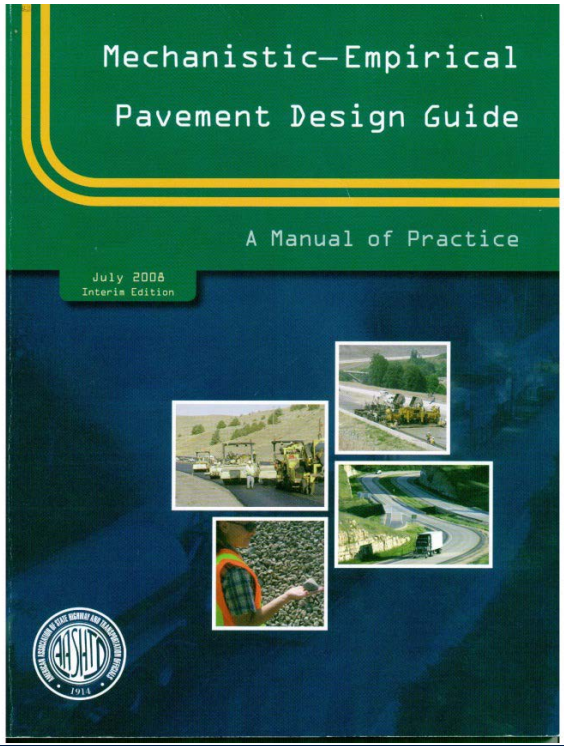

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Idaho's Roadmap

Objective:

Identify the activities needed to verify and/or calibrate the transfer functions to ITD's policies and materials, and streamline a design process enabling ITD personnel to use ME Design with confidence for routine pavement design

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Idaho's Roadmap

Scope:

- All service levels of roadways: interstates, freeways, major arterials, & collectors.
- New designs: HMA and PCC pavement – common design strategies currently used in Idaho.
- Rehabilitation designs: common rehabilitation strategies currently used in Idaho.

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Idaho's Roadmap

End Products:

1. **USER'S GUIDE:** A software and engineering manual tailored to ITD: input procedures, sensitivity, procedures, software, examples, comparative designs.

2. **TRAINING PROGRAM:** Application in the software use and in determining traffic, materials & soils, climate, and design factors.

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Idaho's Roadmap

End Products:

3. **INPUT LIBRARIES**: Recommend defaults and procedures to obtain proper inputs for use in designing asphalt, concrete and rehabilitated pavements.

4. **LOCAL CALIBRATION**: Verify the global calibration factors and if needed, determine local calibration factors for Idaho.

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Idaho's Roadmap

Stages of Implementation:

- ✓ Prepare preliminary user's guide and assemble initial inputs for immediate use of the software.
2. Fill in the data gaps and build input libraries.
3. Determine local calibration coefficients.

IDAHO TRANSPORTATION DEPARTMENT

RESEARCH REPORT

RP ###

Road Map for Implementing The AASHTO Pavement ME Design Software for Idaho Transportation Department

By
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Prepared for
Idaho Transportation Department
Research Program
Division of Highways, Resource Center
http://itd.idaho.gov/highways/research/

July 2013

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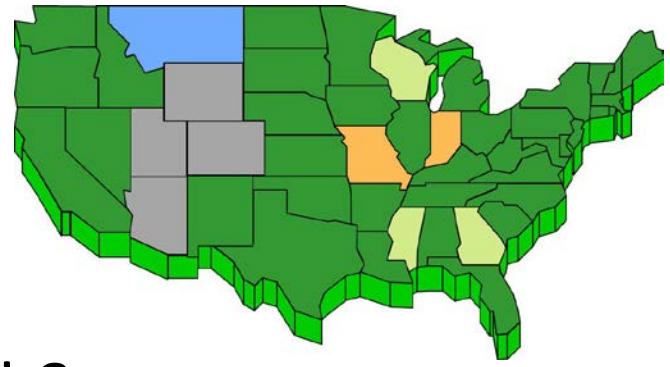
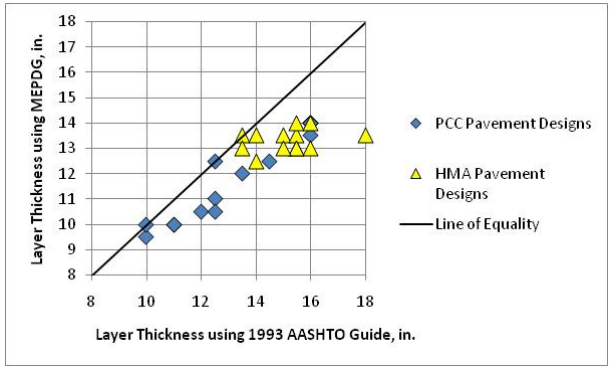
Idaho's Roadmap



Steps to Implementation:

1. Review experience & lessons learned by other agencies.
2. Prepare preliminary User Manual & become familiar with software.
3. Complete concurrent or comparative designs.
4. Establish default values for inputs specific to Idaho.



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Idaho's Roadmap

Steps to Implementation:

5. Complete local calibration – define coefficients of the distress transfer functions.
6. Finalize User's Guide.
7. Execute training program.
8. Update input libraries established by ITD.

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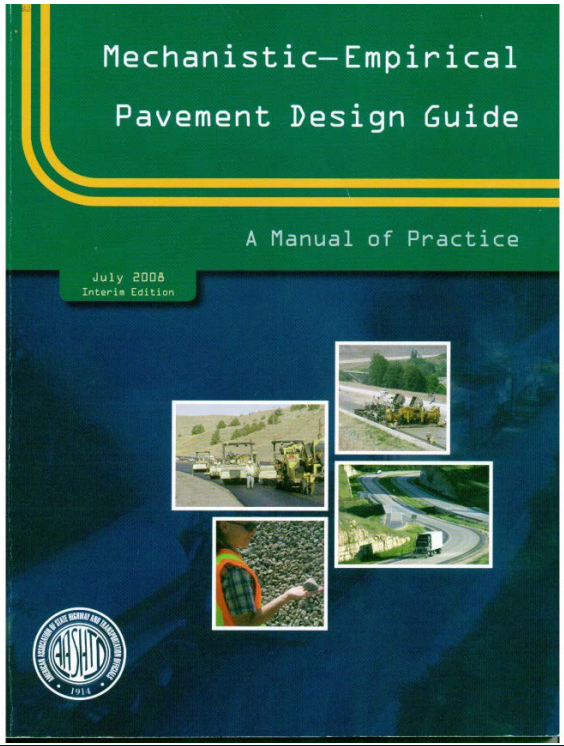

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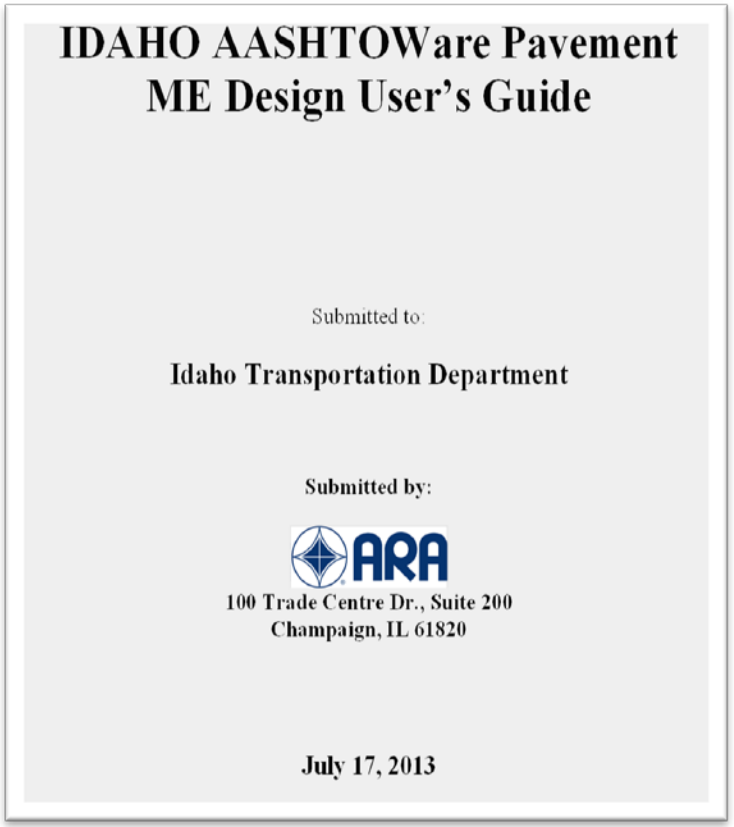
IDT User's Guide

1. Overview of the MEPDG & Software & Installation of Software.
2. General Information Inputs
3. Performance Criteria Inputs
4. Design Reliability Input
5. Traffic Inputs
6. Climate Inputs
7. Structures and Material Inputs


IDAHO AASHTOWare Pavement ME Design User's Guide

Submitted to:

Idaho Transportation Department

Submitted by:

ARA

100 Trade Centre Dr., Suite 200
Champaign, IL 61820

July 17, 2013

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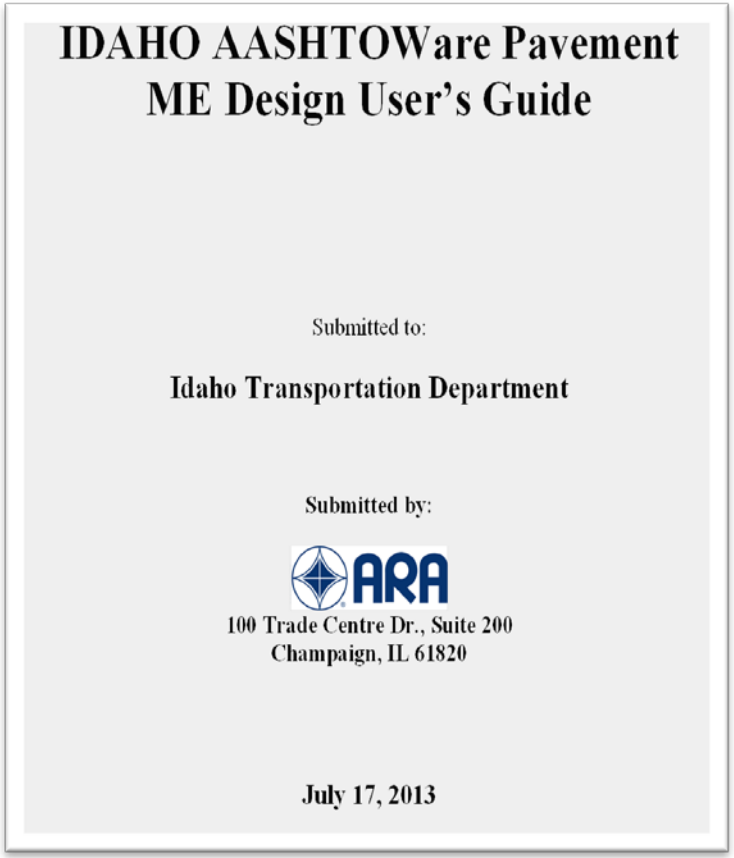
IDT User's Guide

8. JPCP Design Features
9. Rehabilitation Inputs
10. Reconstruct Pavement & Rehabilitation Designs
11. Sensitivity Analysis
12. DARWIN-ME Outputs Used for Performance Assessment
13. References
14. Example Designs (HMA, JPCP, Overlays, CPR)



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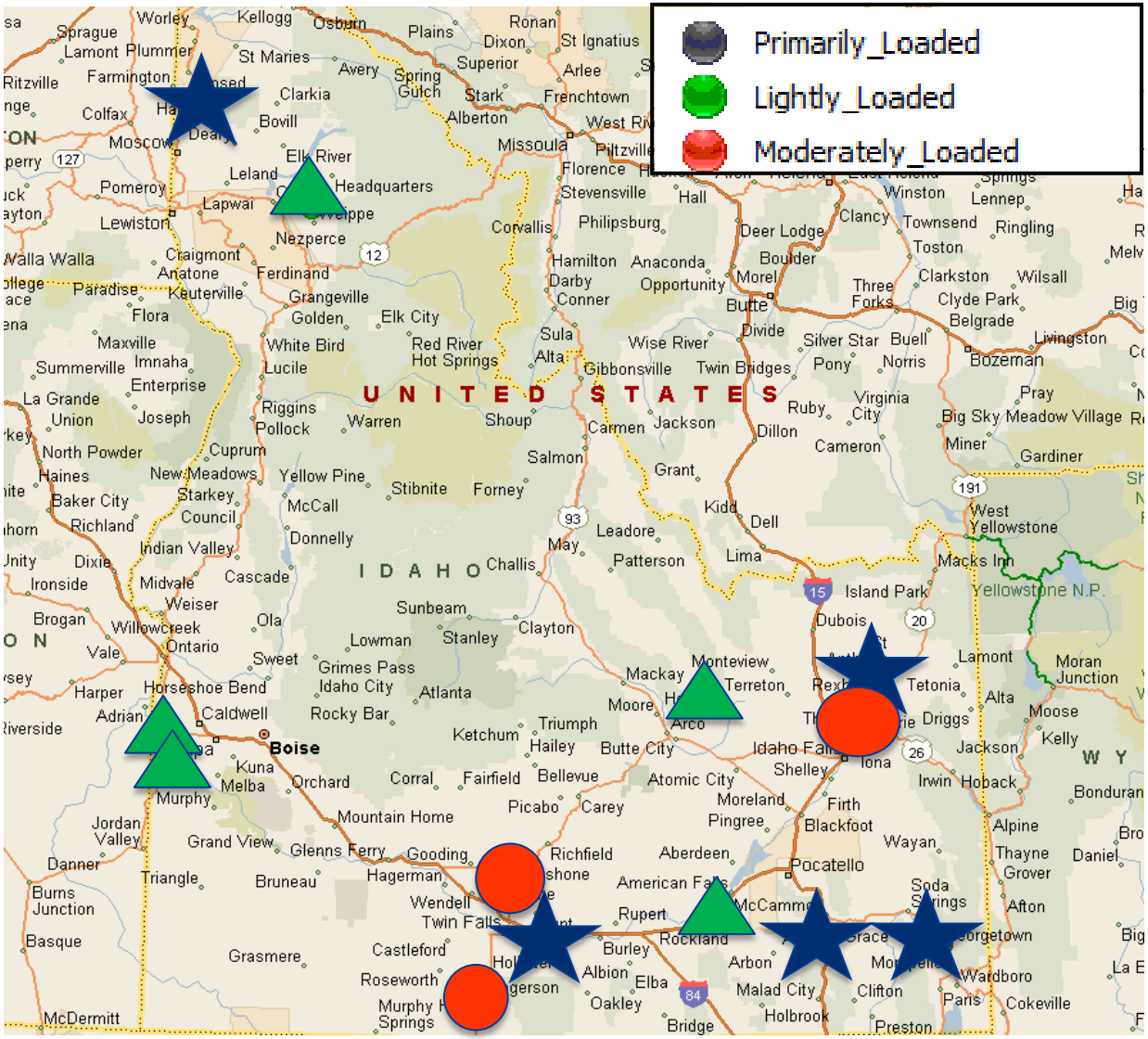
WIM Sites - Truck Weight Road Group Categories



Non-LTPP WIM Sites Only

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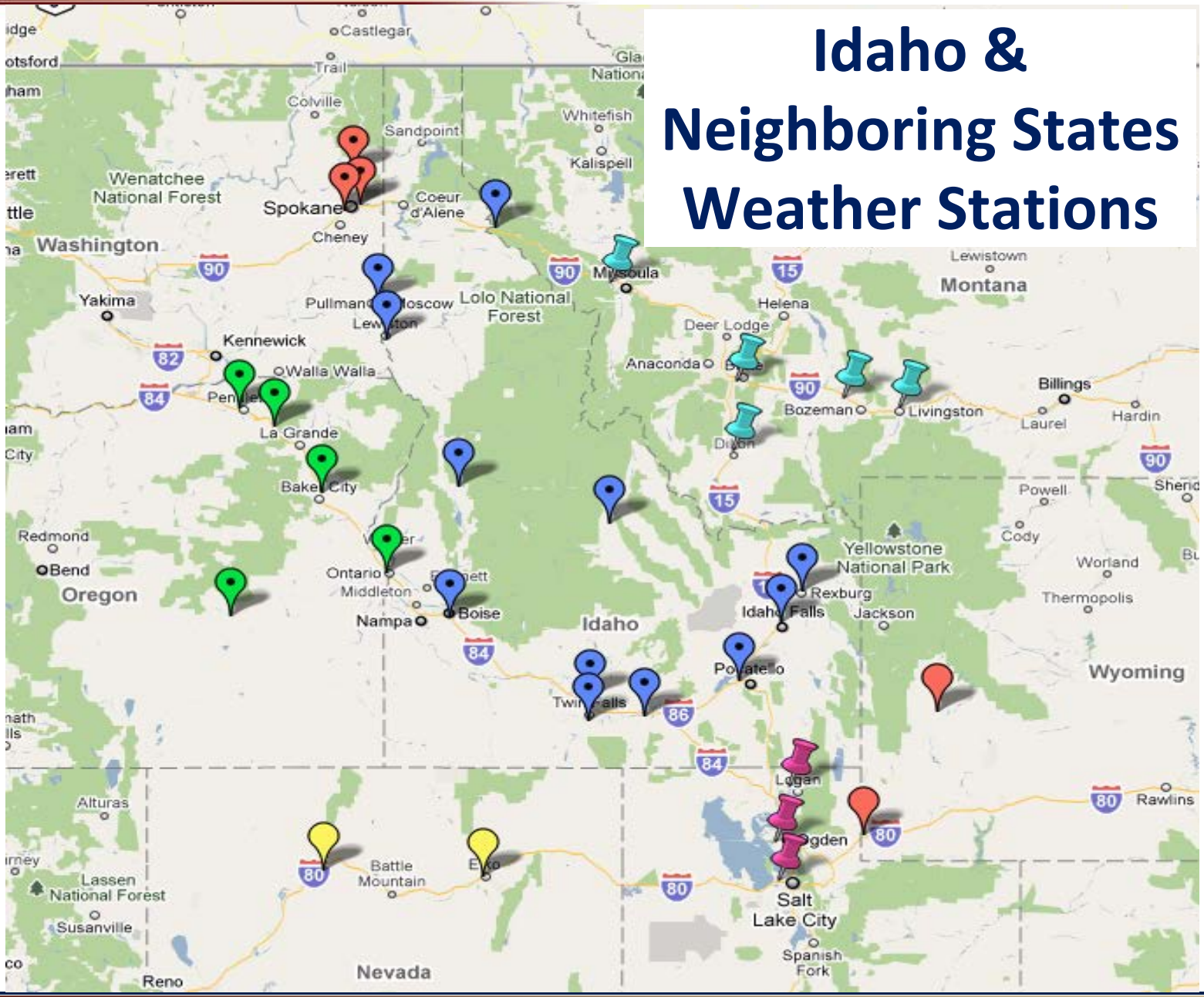
Idaho & Neighboring States Weather Stations



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Training

- Provide comprehensive training on use of the ME Design procedure.
  - Use of the software.
  - Engineering principals and concepts.
  - Limitations.
  - Case studies for new, reconstruction, and rehabilitation.

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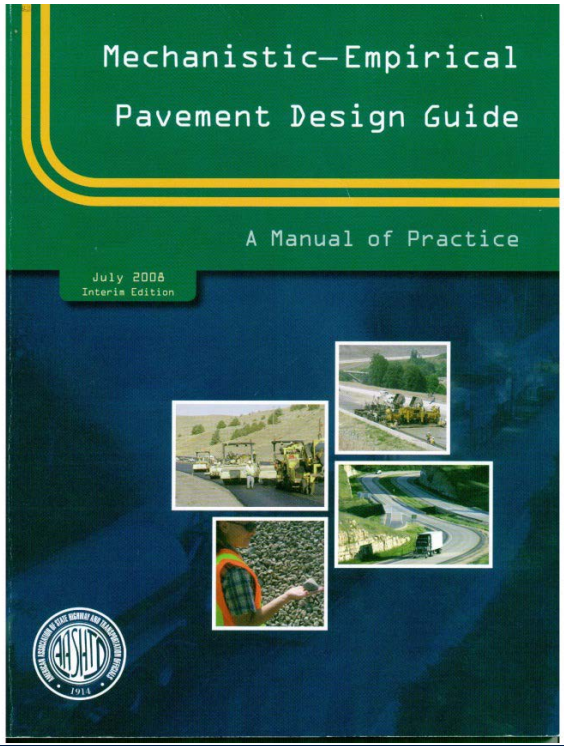

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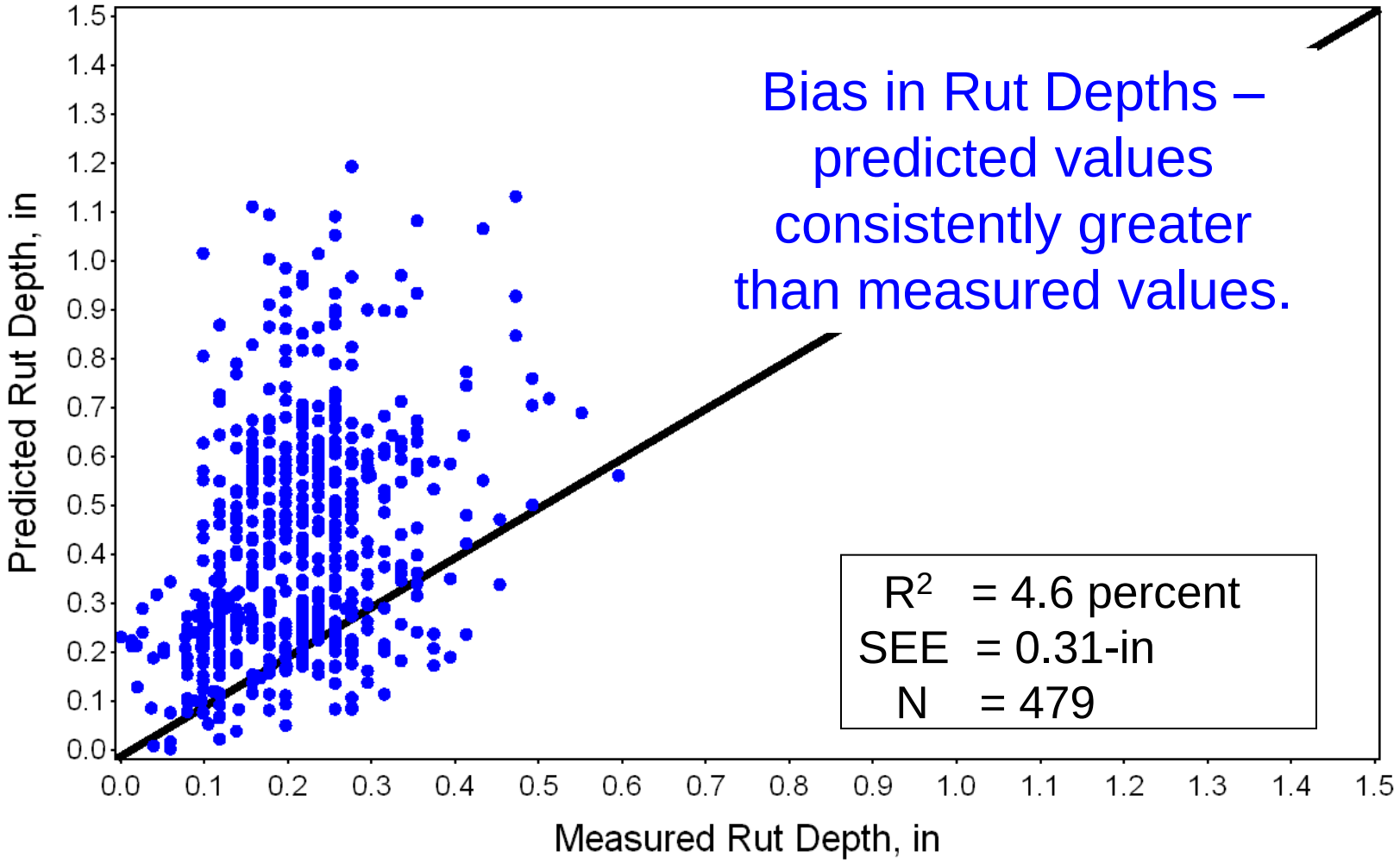
Local Calibration – Rut Depth Example



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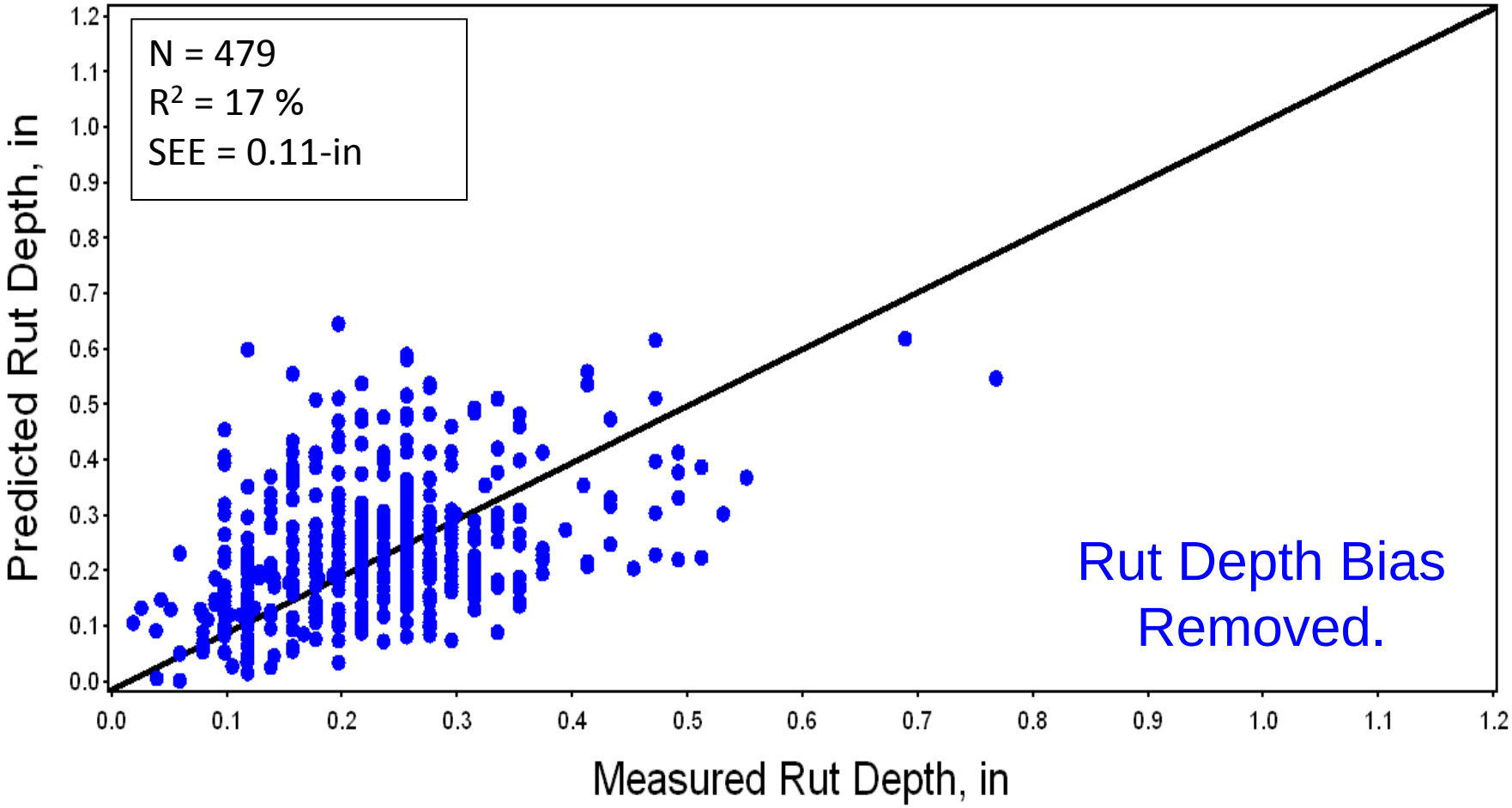
Local Calibration – Rut Depth Example



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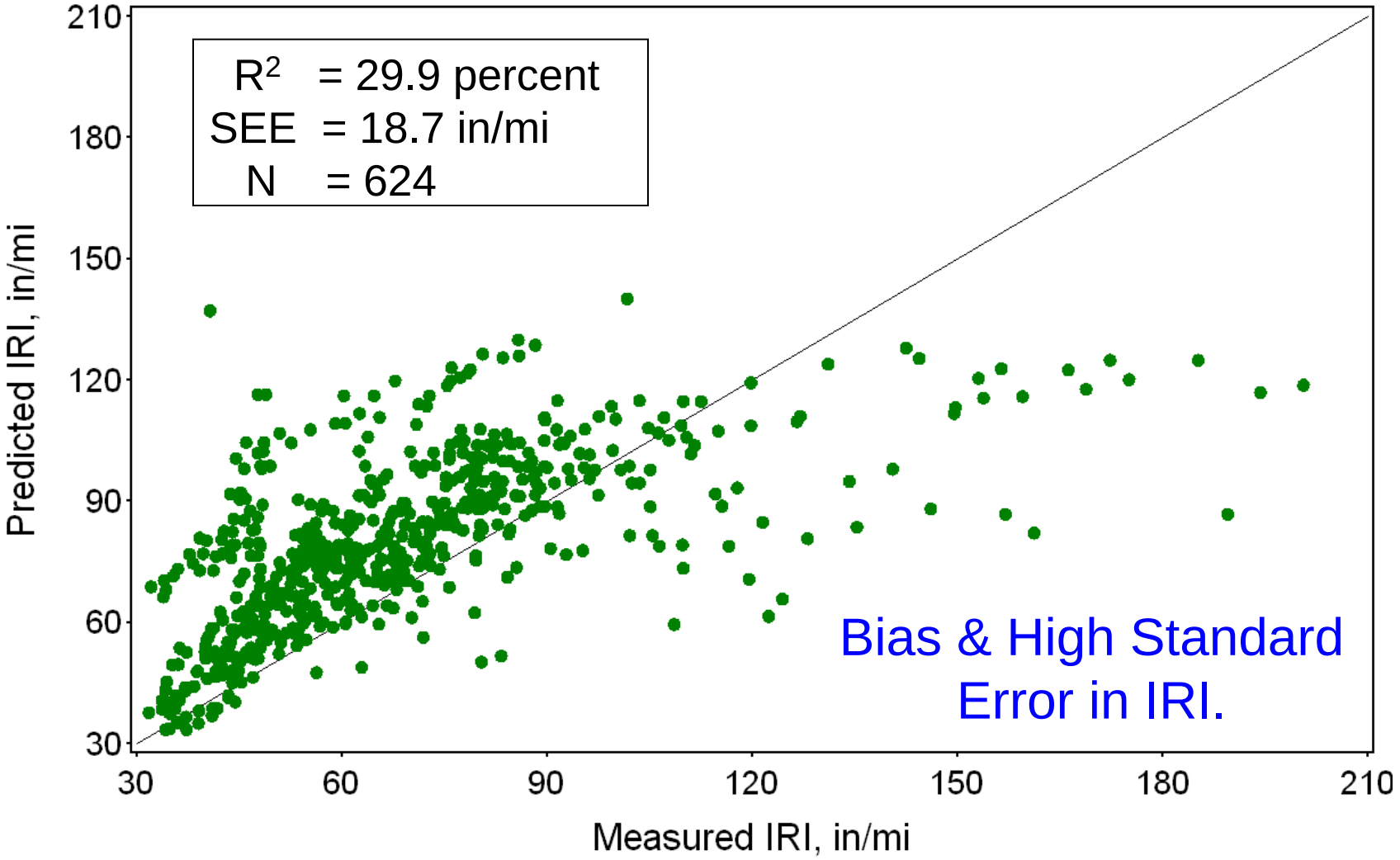
Local Calibration – IRI Example



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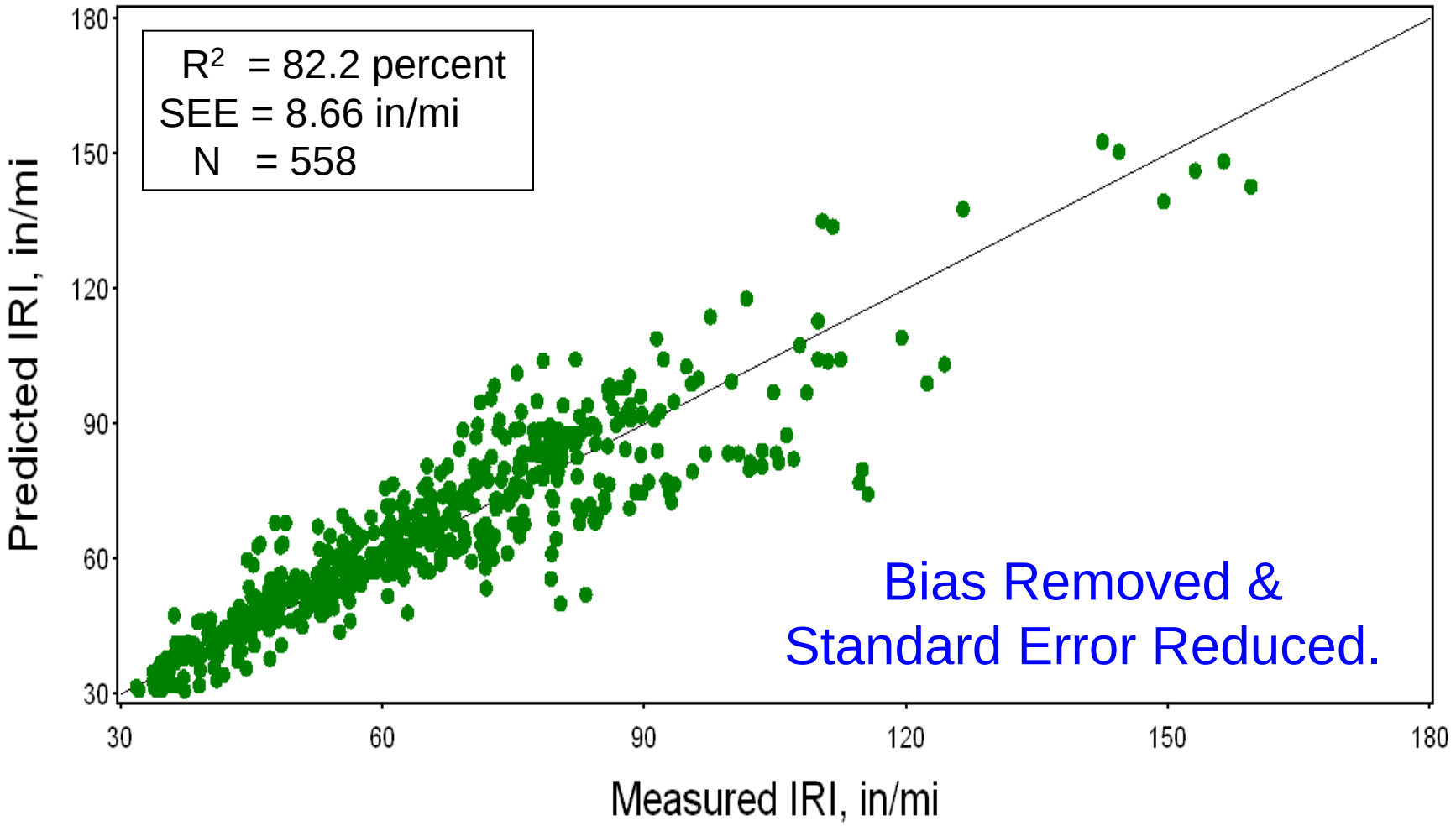
Local Calibration – IRI Example



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Is Local Calibration Needed?

- Local Calibration Process:
  1. Selection of appropriate inputs and design criteria for individual test sections.
  2. Validation of distress & IRI models: Are the global calibration factors appropriate for Idaho? **Probably Not!**
  3. Local Calibration Recommend Approach: Utilize LTPP data and other asphalt sections and conduct calibration analyses to remove bias (over or under prediction).

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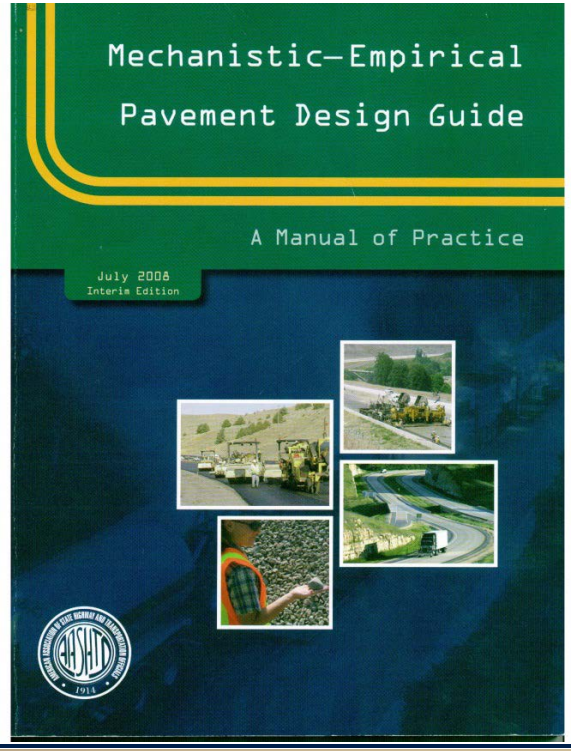

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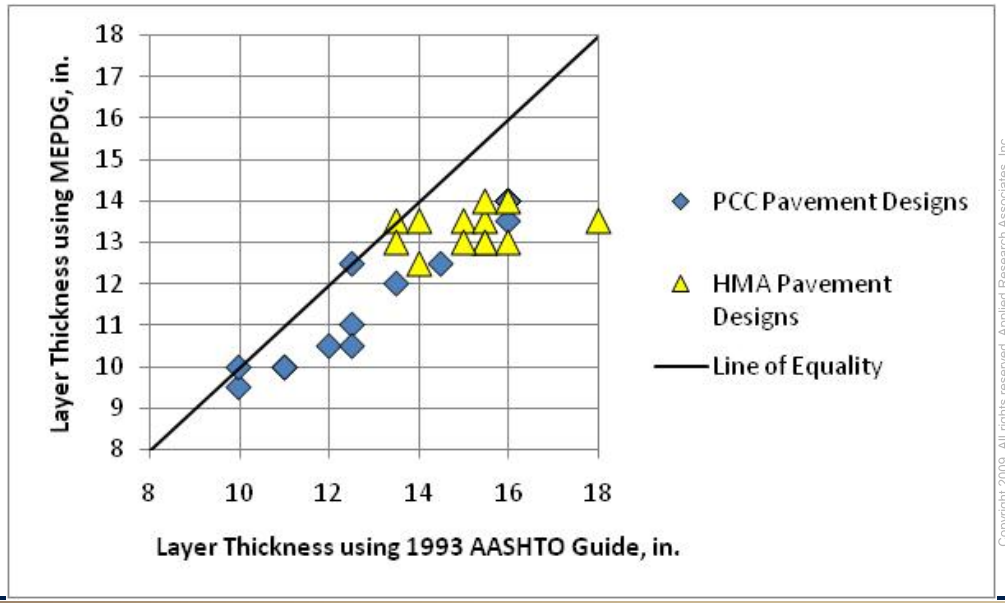
Comparative Designs

New Designs

- ME Design generally results in slightly thinner sections for high truck volumes.
- ME Design for low truck volumes will vary depending on material inputs.



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Comparative Designs

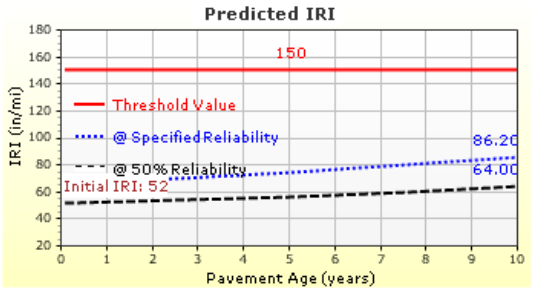
Rehabilitation

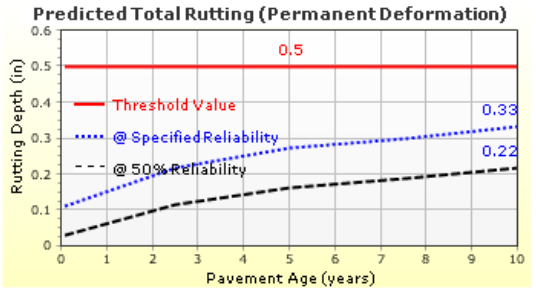
- Highly variable in comparison to agency's rehabilitation design procedure.

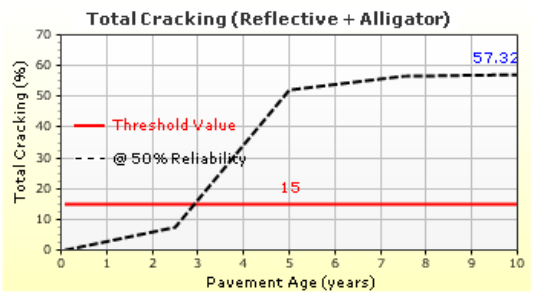
Distress Prediction Summary

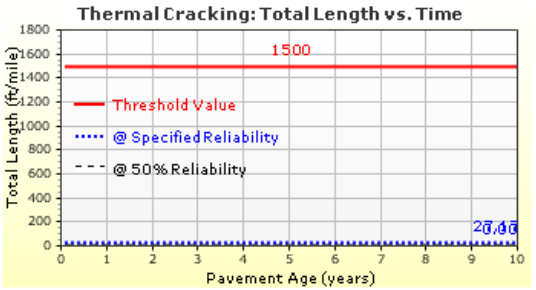
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	150.00	86.20	90.00	100.00	Pass
Permanent deformation - total pavement (in.)	0.50	0.33	90.00	99.92	Pass
Total Cracking (Reflective + Alligator) (percent)	15	57.32	-	-	Fail
AC thermal cracking (ft/mile)	1500.00	27.17	90.00	100.00	Pass
AC bottom-up fatigue cracking (percent)	15.00	13.98	90.00	91.54	Pass
AC top-down fatigue cracking (ft/mile)	4000.00	2782.28	90.00	97.22	Pass
Permanent deformation - AC only (in.)	0.50	0.26	90.00	100.00	Pass

Distress Charts









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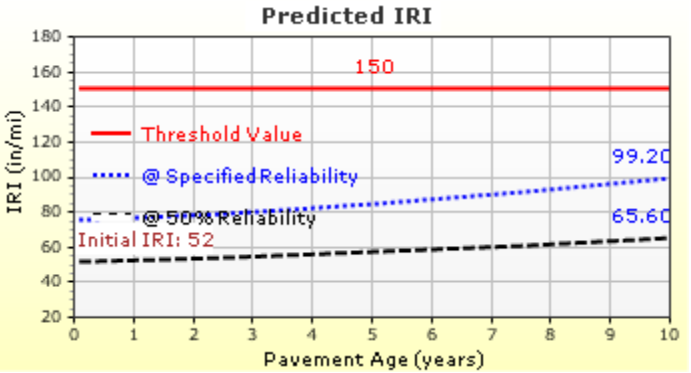
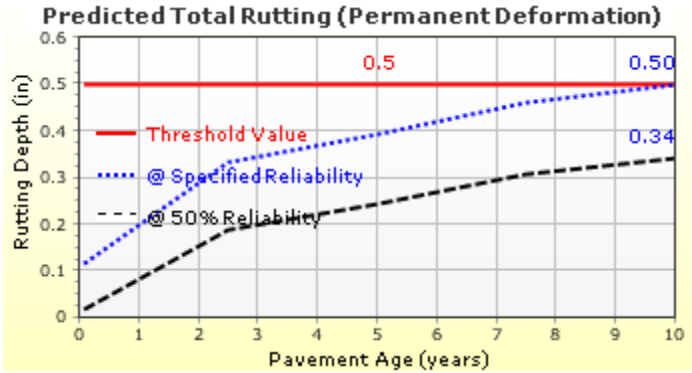
Structural overlay required for agency procedure but no structural overlay from ME Design.

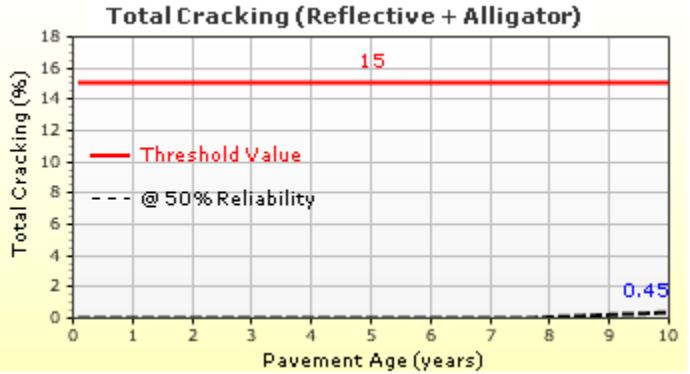
Distress Prediction Summary

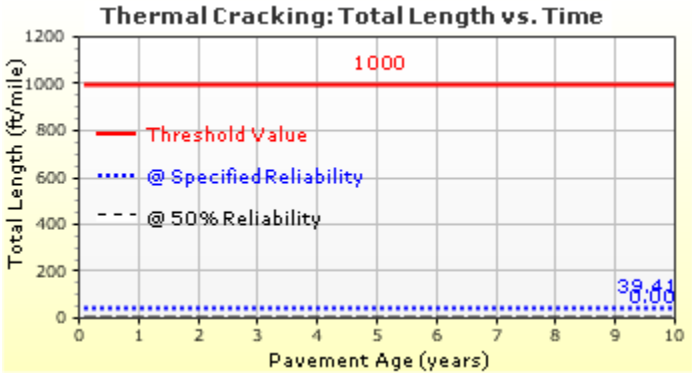
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	150.00	99.21	97.00	100.00	Pass
Permanent deformation - total pavement (in.)	0.50	0.50	97.00	97.13	Pass
Total Cracking (Reflective + Alligator) (percent)	15	0.45	-	-	Pass
AC thermal cracking (ft/mile)	1000.00	39.41	97.00	100.00	Pass
AC bottom-up fatigue cracking (percent)	10.00	4.22	97.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	3000.00	693.51	97.00	100.00	Pass
Permanent deformation - AC only (in.)	0.50	0.50	97.00	97.13	Pass

Distress Charts









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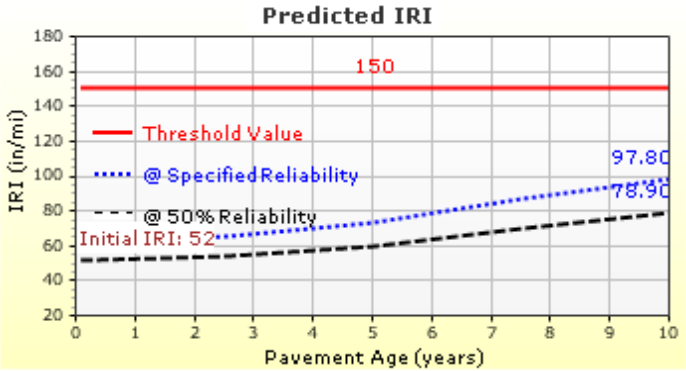
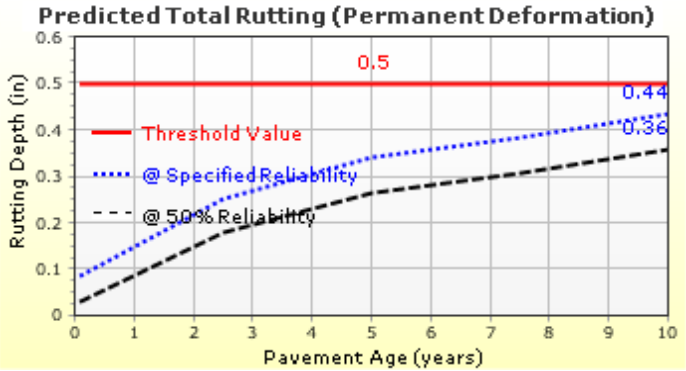
Non-structural overlay from agency procedure but structural overlay from ME Design.

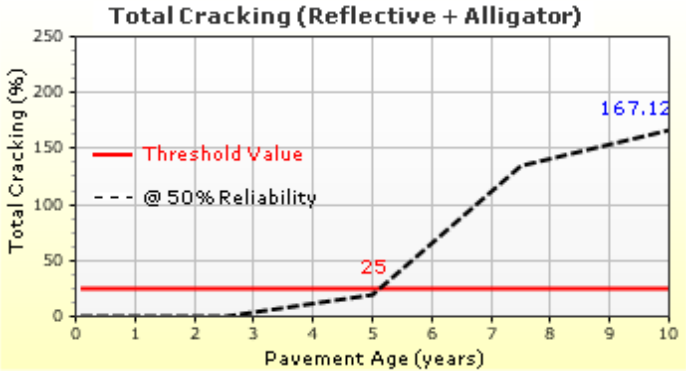
Distress Prediction Summary

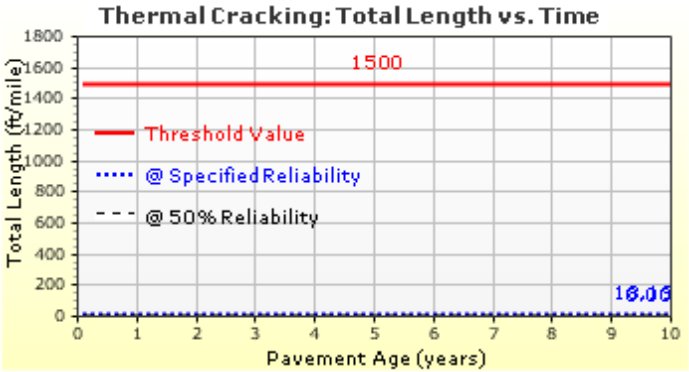
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	150.00	97.84	80.00	99.92	Pass
Permanent deformation - total pavement (in.)	0.50	0.44	80.00	93.09	Pass
Total Cracking (Reflective + Alligator) (percent)	25	167.12	-	-	Fail
AC thermal cracking (ft/mile)	1500.00	18.19	80.00	100.00	Pass
AC bottom-up fatigue cracking (percent)	25.00	109.84	80.00	0.02	Fail
AC top-down fatigue cracking (ft/mile)	4000.00	3520.27	80.00	85.38	Pass
Permanent deformation - AC only (in.)	0.50	0.36	80.00	99.52	Pass

Distress Charts









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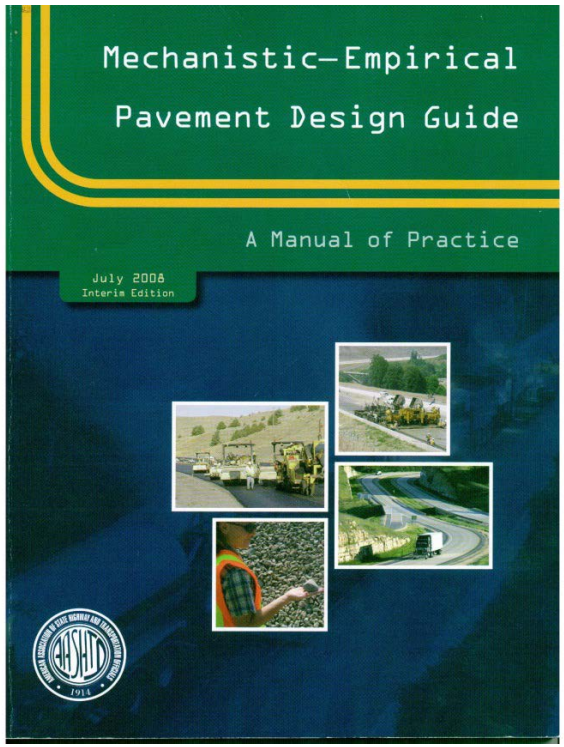
Questions



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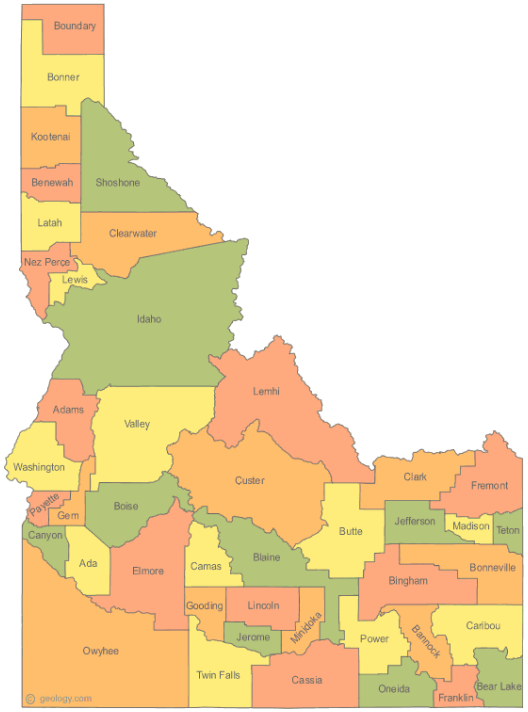

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Outline of Presentation

Topic		Focus of Individual Topics	Time, minutes
1	Introduction	Title and purpose of presentation.	1
1.1	MEPDG Overview	Provide a brief overview of the MEPDG for attendees or participants that have not used it and identify or focus on some of the important points.	4
1.2	MEPDG Implementation in the U.S.	Summarize the implementation and status of use by other agencies in the U.S. Also note how that use is being used to benefit Idaho.	3
2	Idaho's Roadmap	Introduce the roadmap and how it is being used.	1
2.1	Objective & Scope	Overview the objectives of the implementation process and scope of the MEPDG use, as well as the end products that are expected.	2
2.2	Available Documentation	Identify and briefly list the documents that are available to understand the MEPDG and its use in Idaho, as well as nationally. Refer to work done by the University of Idaho and its report.	4

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Outline of Presentation

Topic		Focus of Individual Topics	Time, minutes
2.3	Steps to Implementation	Identify and briefly discuss the different steps to implementing the MEPDG in Idaho and note which steps have already been completed or in the process of being completed	5
3	User Guide & Training	Summarize and identify the important points of the draft user guide, which has been completed.	3
4	Local Calibration	Identify the importance of validation and local calibration of the transfer functions – adequately predicting observed distresses.	4
5	MEPDG Use: New Design & Rehabilitation	Overview the use of MEPDG in Idaho and show some results of the predicted versus measured distress from LTPP sites located in Idaho.	6
6	Summary	Ending comments.	2

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MEPDG Design/Analysis Process

Foundation Analysis

Climate

Materials Properties

Traffic Analysis

Inputs

Modify Design

Trial Design

Pavement Response Model

Damage Accumulation Over time

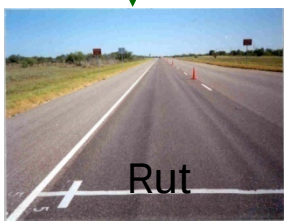
Mechanistic Analysis

Calibrated Damage-Distress/IRI Models

No

Meet Performance Criteria?

Yes



Outputs

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