

Mechanistic – Empirical Design Guide:



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Rehabilitation Design

2005 Southeastern Pavement

Management & Design Conference

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Overview

- General Rehab Theory
- Characterizing Existing Pavement
 - Asphalt
 - Concrete
- Contrast with 1993 AASHTO

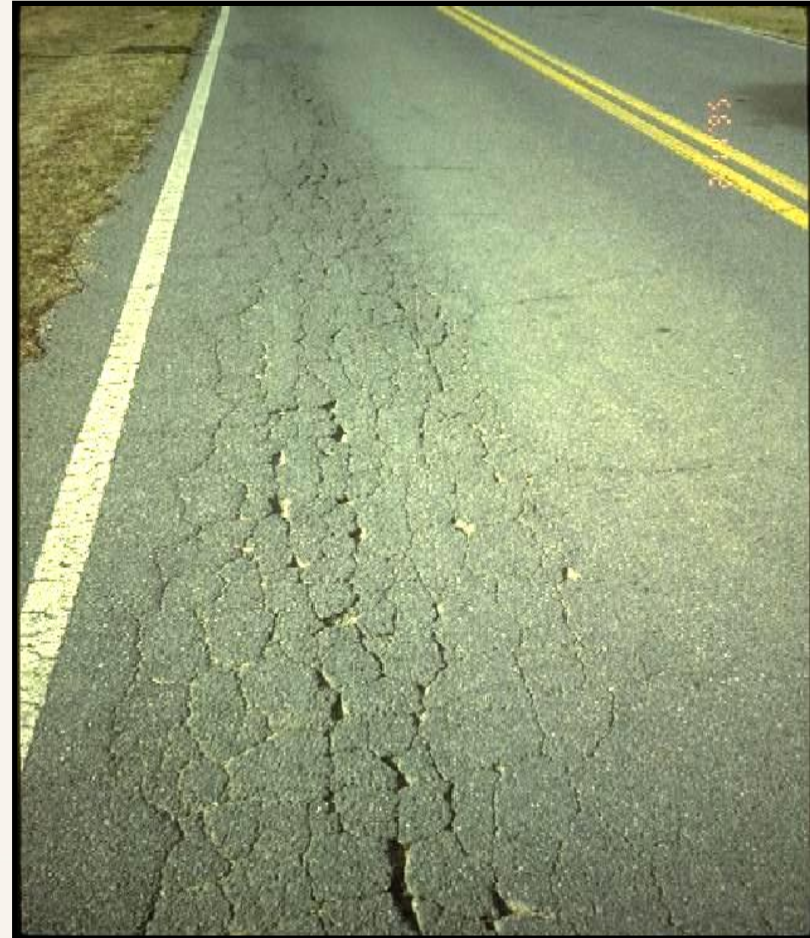
www.fhwa.dot.gov/pavement/dgit.htm

Bound Layers

- MR, E (PCC, CSB)
- E* (AC)
- Rutting (AC)
- Damage

Un-Bound Layers

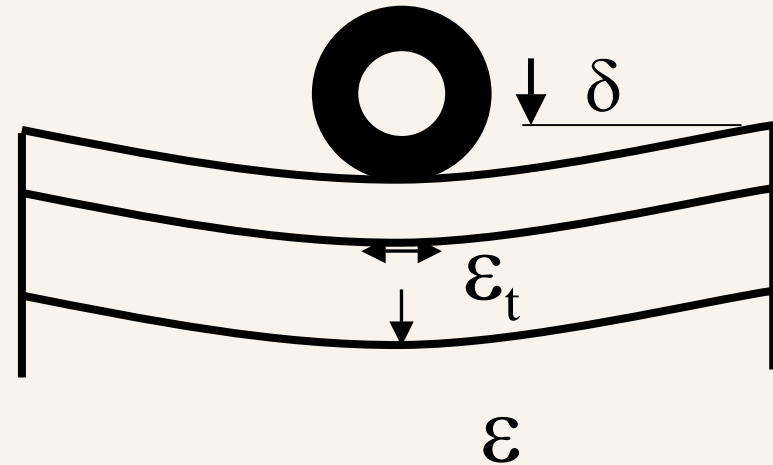
- M_r
- Rutting (AC)



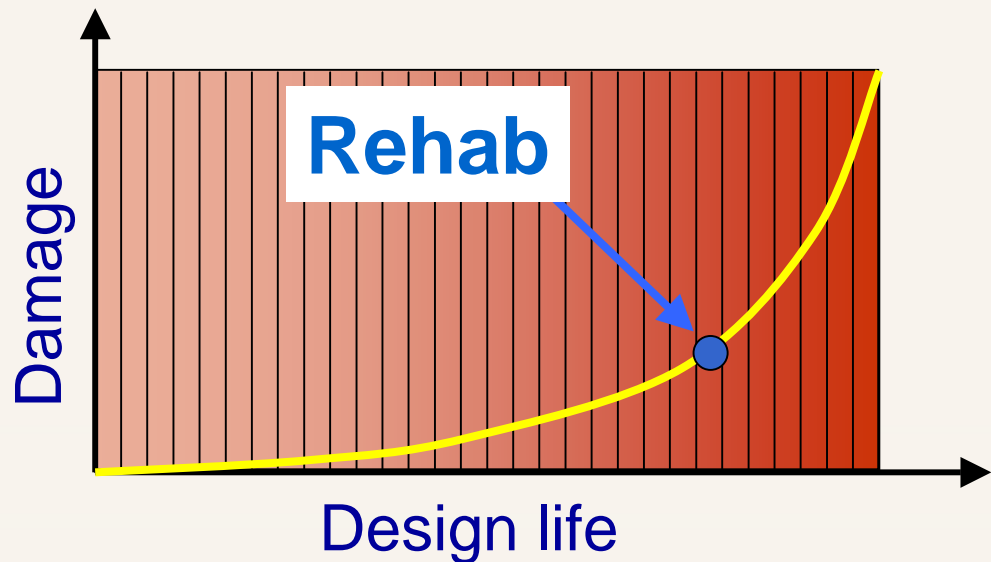
Section 1.1.8.1

Damage and Existing Modulus

- Existing Modulus
 - Stress, Strain, Deflection



- Damage



Bound Layers

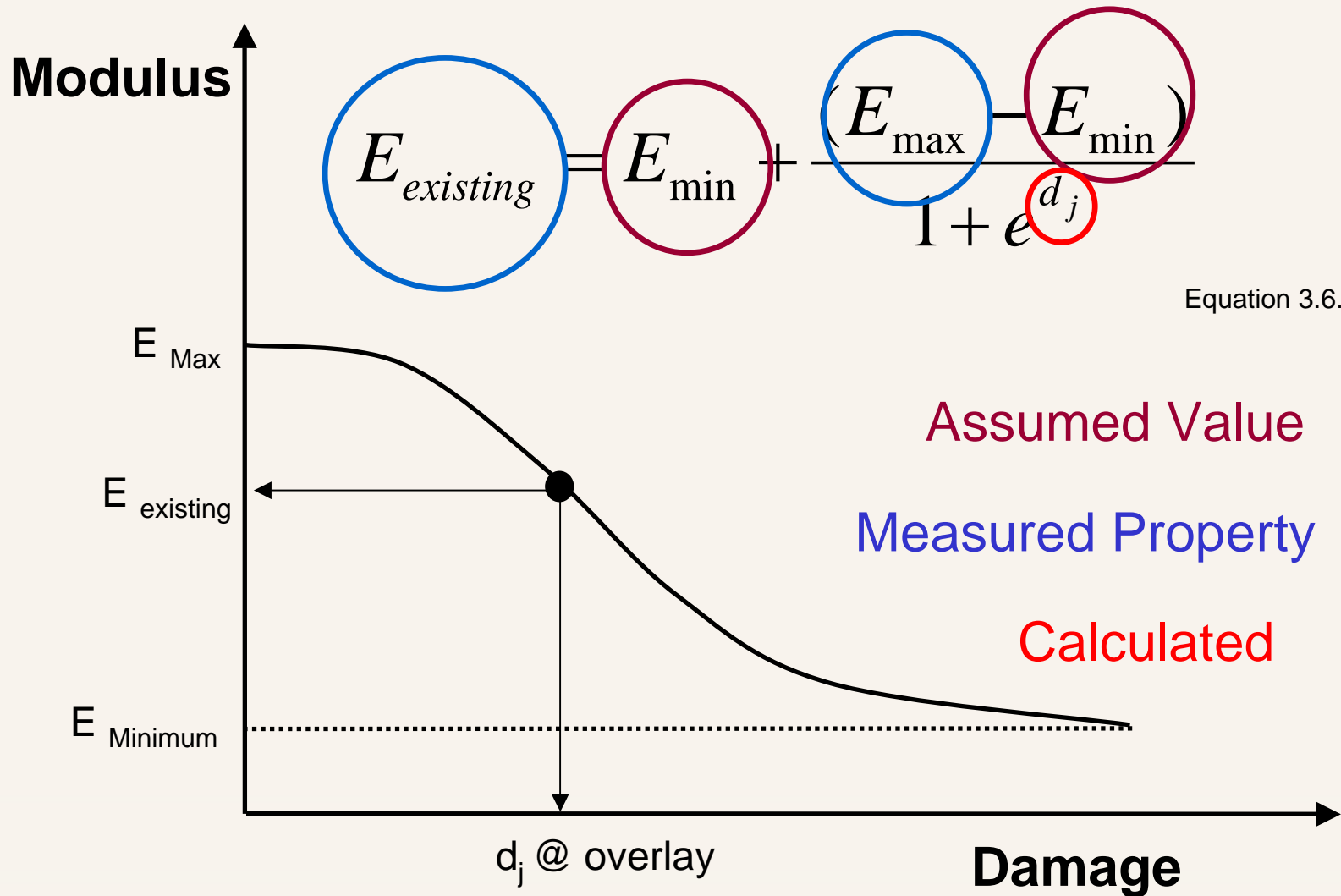


Figure 3.6.4

Existing Modulus

- Level 1: Use of FWD
- Not Specific on Backcalculation Method
- Level 2 & 3: Based on Pavement Condition

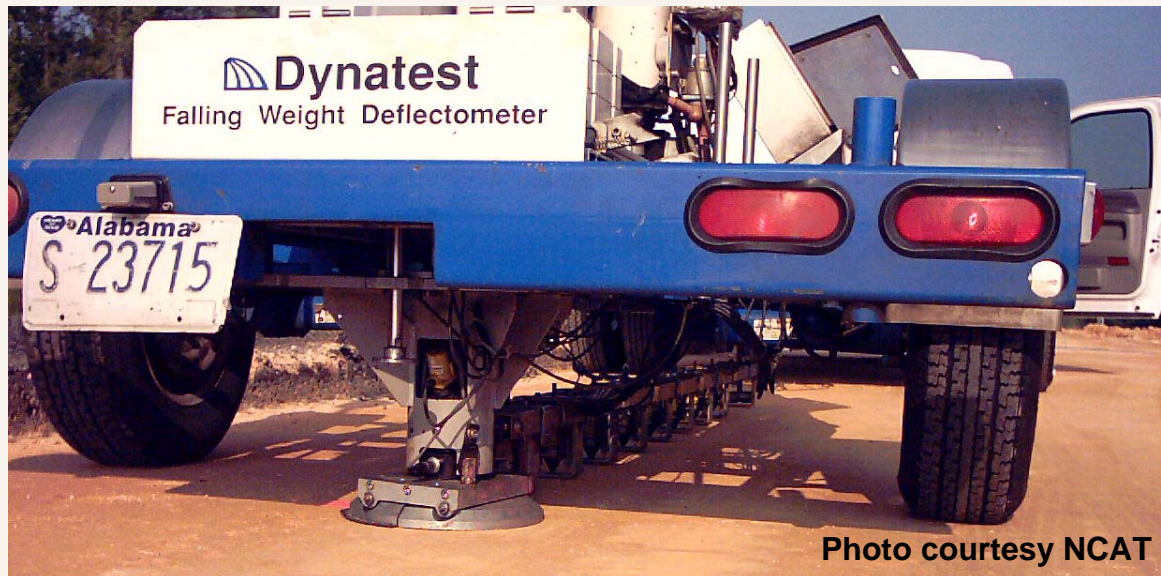


Photo courtesy NCAT

Maximum Modulus

- PCC Cores and Beams for testing E, MR
- AC Uses Witczak Equation for E^*_{max}

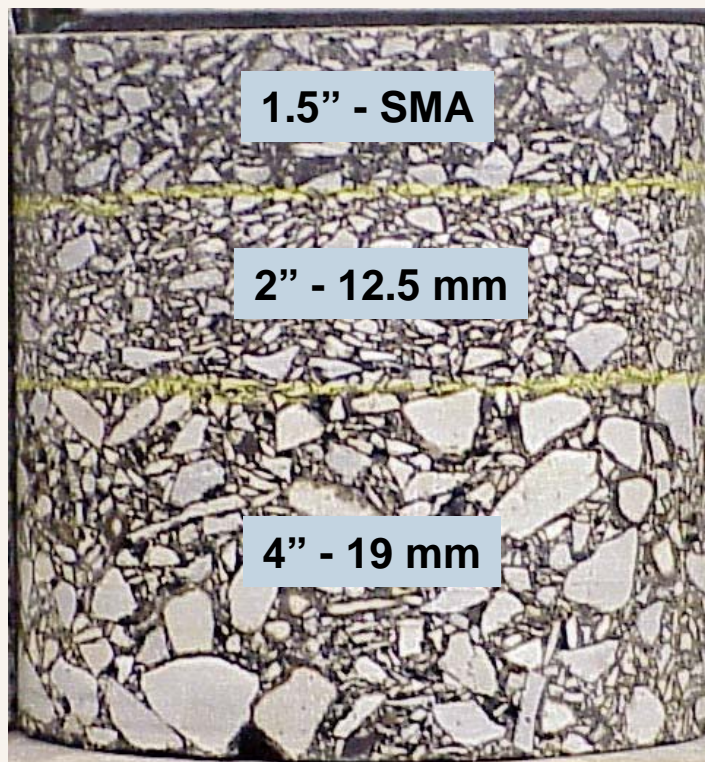
Witczak Equation for Computing E^*

f (Gradation, Volumetric, and Binder Properties)

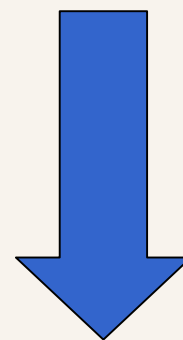
$$\log E^* = 3.75 + 0.029 \rho_{200} - 0.000001 (\rho_{200})^2 - 0.0028 \rho_4 - 0.058 V_a - 0.8022 \left(\frac{V}{V_a} \right) + \frac{3.872 - 0.000001 \rho_{38} + 0.004 \rho_{38} - 0.000002 (\rho_{38})^2 + 0.0055 \rho_{34}}{1 + e^{(-0.603 - 0.313 \log(f) - 0.393 \log(\eta))}}$$

Will be on Exam

Maximum Modulus, E^*



Several Different Mixes
Treated as a Single Layer



How do you combine
into 1 Modulus Value ?

Existing Pavement Rutting

Structure

Layers

Layer	Type	Material	Thickness (in)	Interface	Rut(in)	Crack(%)
1	Asphalt	Asphalt concrete	2.0	1		
2	Asphalt	Asphalt concrete (existing)	7.0	1	0	
3	Granular Base	Crushed stone	12.0	1	0	
4	Subgrade	SC	Semi-infinite	n/a	0	

Flexible Rehabilitation
Rehabilitation Level:
Level 1
Milled thickness (in):
0



Existing Pavement Rutting

% Rutting in Pavement Layers

Layer	HMA Thickness		
	< 4 in	4 in - 8 in	> 8 in
Asphalt	70	80	100
Granular Base	15	10	0
Subbase	10	5	0
Subgrade	5	5	0

Flexible Rehabilitation

Rehabilitation Level:
Level 3

Milled thickness (in):
0

Geotextile present on existing surface.

Pavement rating:
Fair

Total Rutting (in):
0.5

Unbound Layer - Layer #4

Unbound Material: SC Thickness(in): Last layer

Strength Properties ICM

Input Level
 Level 1
 Level 2
 Level 3

Poisson's ratio: 0.35
 Coefficient of lateral pressure, K_0 : 0.5

Material Property
 Modulus (psi)

Analysis Type
 ICM Calculated Modulus
 ICM Inputs

User Input Modulus
 Seasonal input (design value)
 Representative value (design value)

NDT Test - Modulus (psi): 24000

Correction factor: 0.62

OK Cancel

Unbound Material Characterization

back-calculated

Factor
 MD to lab M_r

Table 3.6.8

AC Rehab Options

Overlay Choice

General Information

Project Name: AC_on_AC

Description: This example is based on the SPS 1 section in Ohio. The original section had an AADTT of 200 (approx) 7 in AC (2 in Surface + 5 in Base) + 8 in Granular Base approx.

Design Life (years): 20

Existing pavement construction month: August Year: 1980

Pavement overlay construction month: September Year: 1995

Traffic open month: October Year: 1995

Overlay

Asphalt Concrete Overlay

AC over AC

AC over AC

AC over JPCP

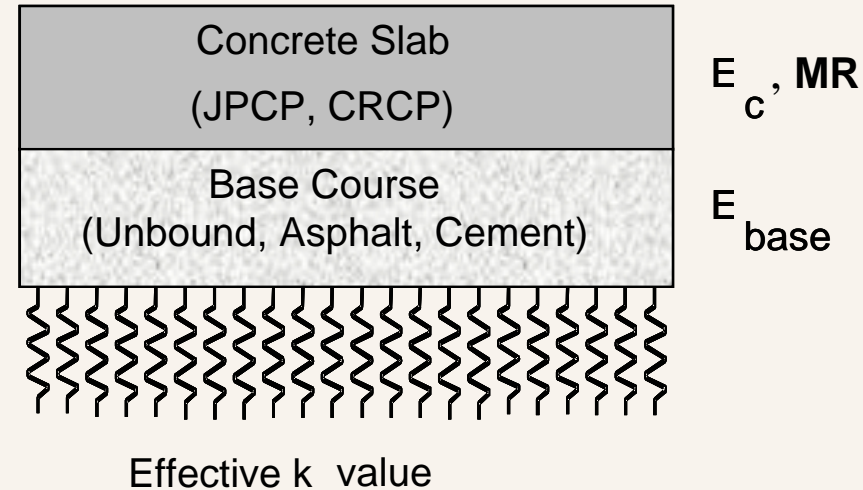
AC over CRCP

AC over JPCP (fractured)

AC over CRCP (fractured)

PCC Rehabilitation Options

- JPCP Restoration
- Bonded Overlay
 - Monolithic section
- Unbonded Overlay
 - New PCC over strong base
- PCC Over AC
 - New PCC over damaged AC base

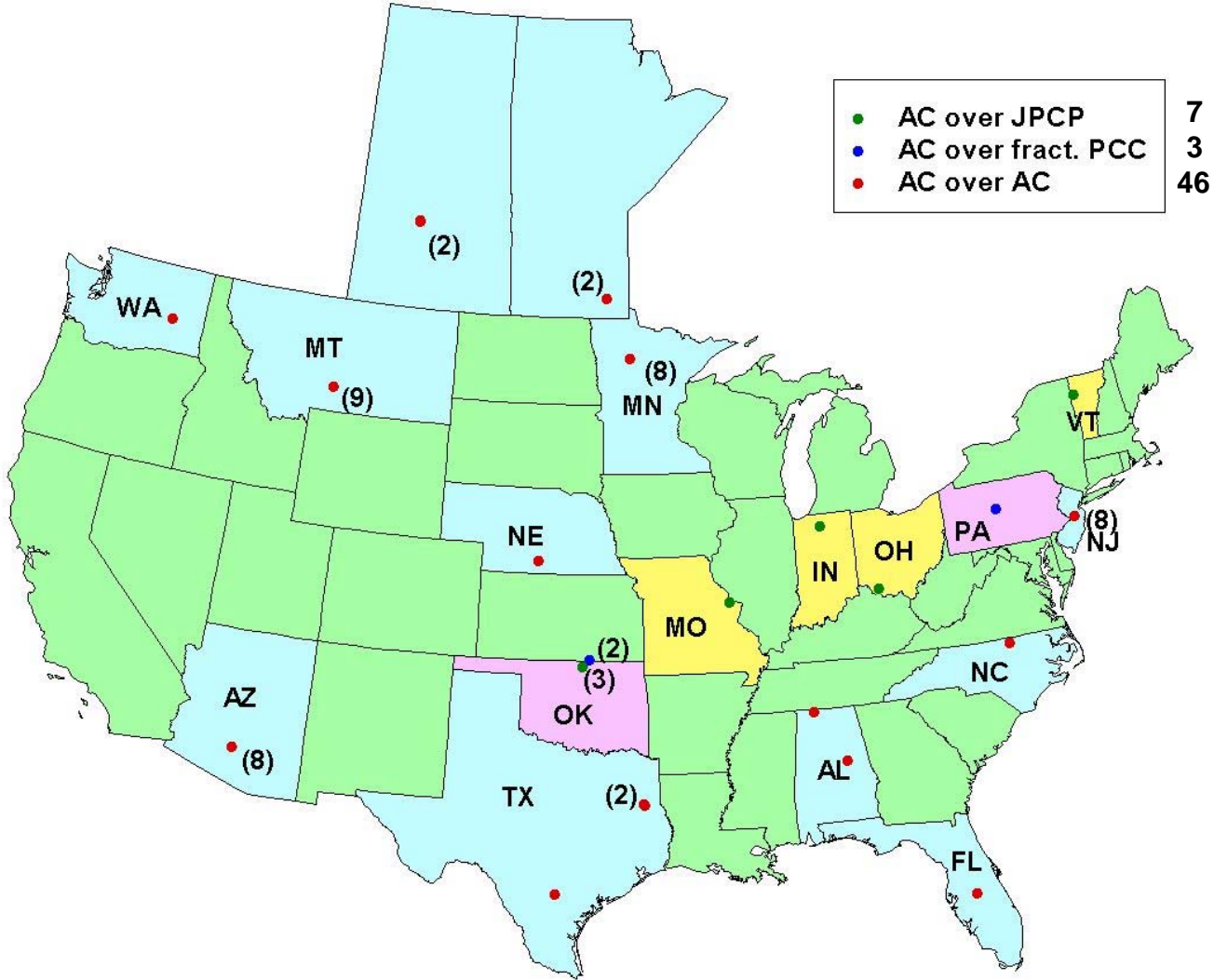


Not included in DG

- CRCP Restoration
- JRCRP
- Ultra-thin whitetopping

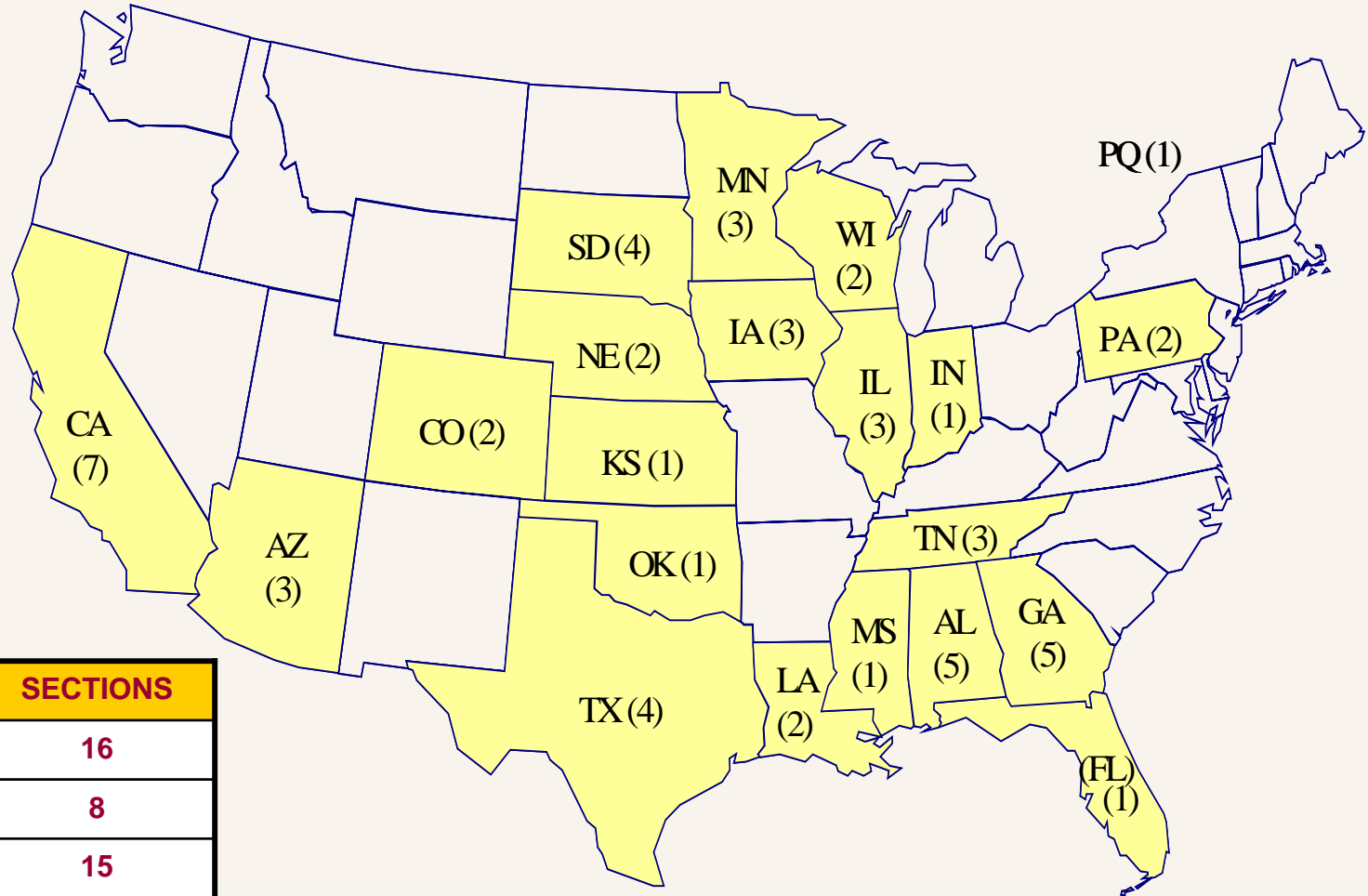


Asphalt Calibration Sites



Appendix EE-2: Figure 1

PCC Calibration Sites



TYPE OF REHAB	SECTIONS
Unbonded JPCP	16
Unbonded CRCP	8
Restored JPCP	15
Bonded PCC	3
TOTAL	42

Advantages Rehabilitation Design

- Consistent with New Design
- Considers Continued Damage to the Existing Pavement

Limitations of Rehabilitation Design

- Limited Data for Calibration
 - Rubbilized Pavements
 - Bonded PCC Overlays

Summary

- Two Parts to MEPDG
 - NCHRP 1-37a Report
 - Software
- Full presentation available

www.fhwa.dot.gov/pavement/dgit.htm

<http://www.trb.org/mepdg>





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