MEPDG PCC Local Calibration

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2011 National Concrete Consortium

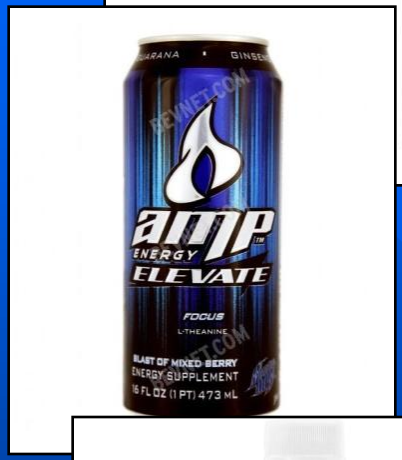
Fall Meeting

Rapid City, South Dakota

Warning

Dry

Material Ahead



You've been warned!

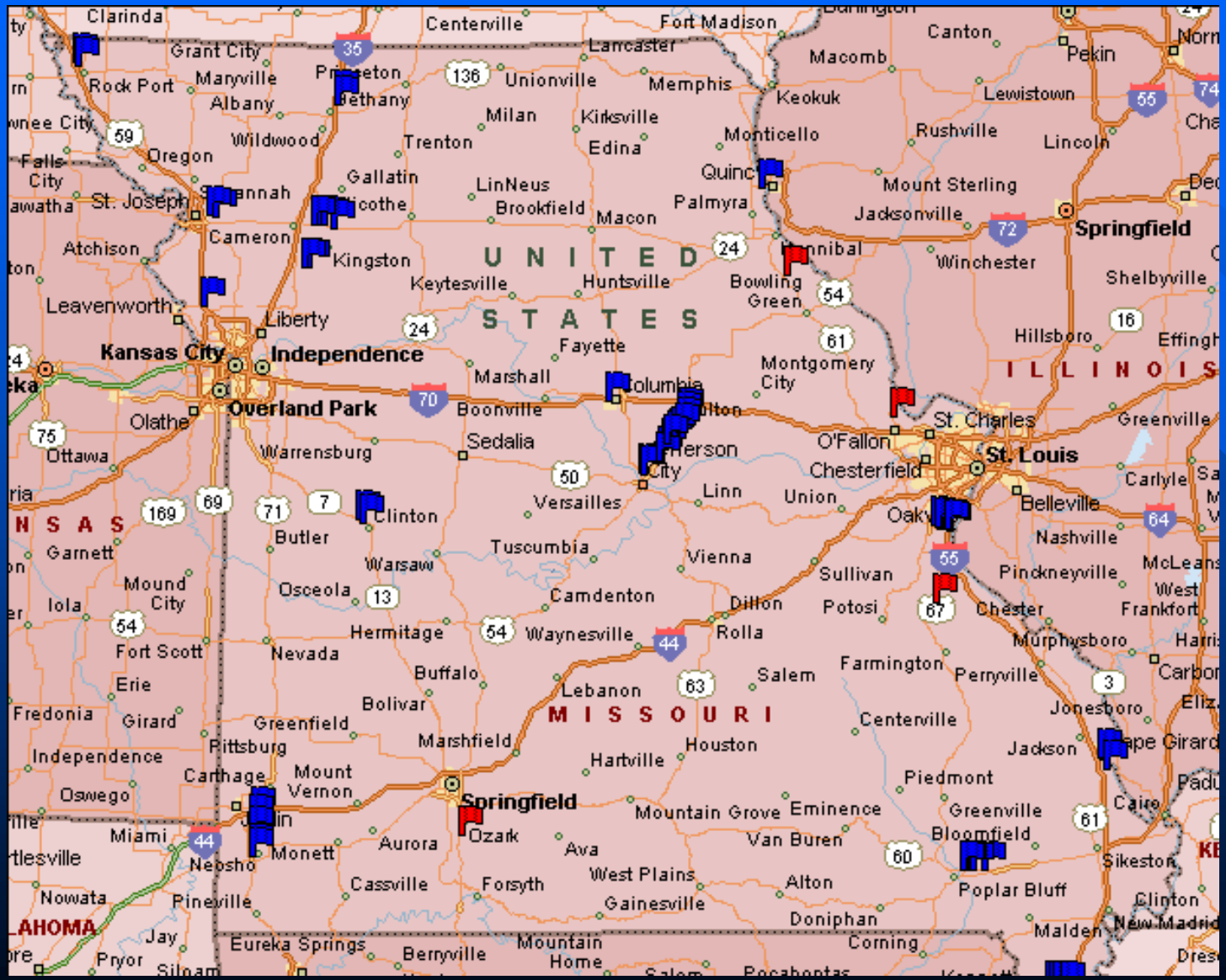
M-E Pavement Design Guide

- MEPDG nationally calibrated and validated with largest pavement data collection ever.
- MEPDG incorporated best available design models.
- MoDOT adopted use of MEPDG in 2004 for new pavement design.
- AASHTO adoption occurred in November 2007.

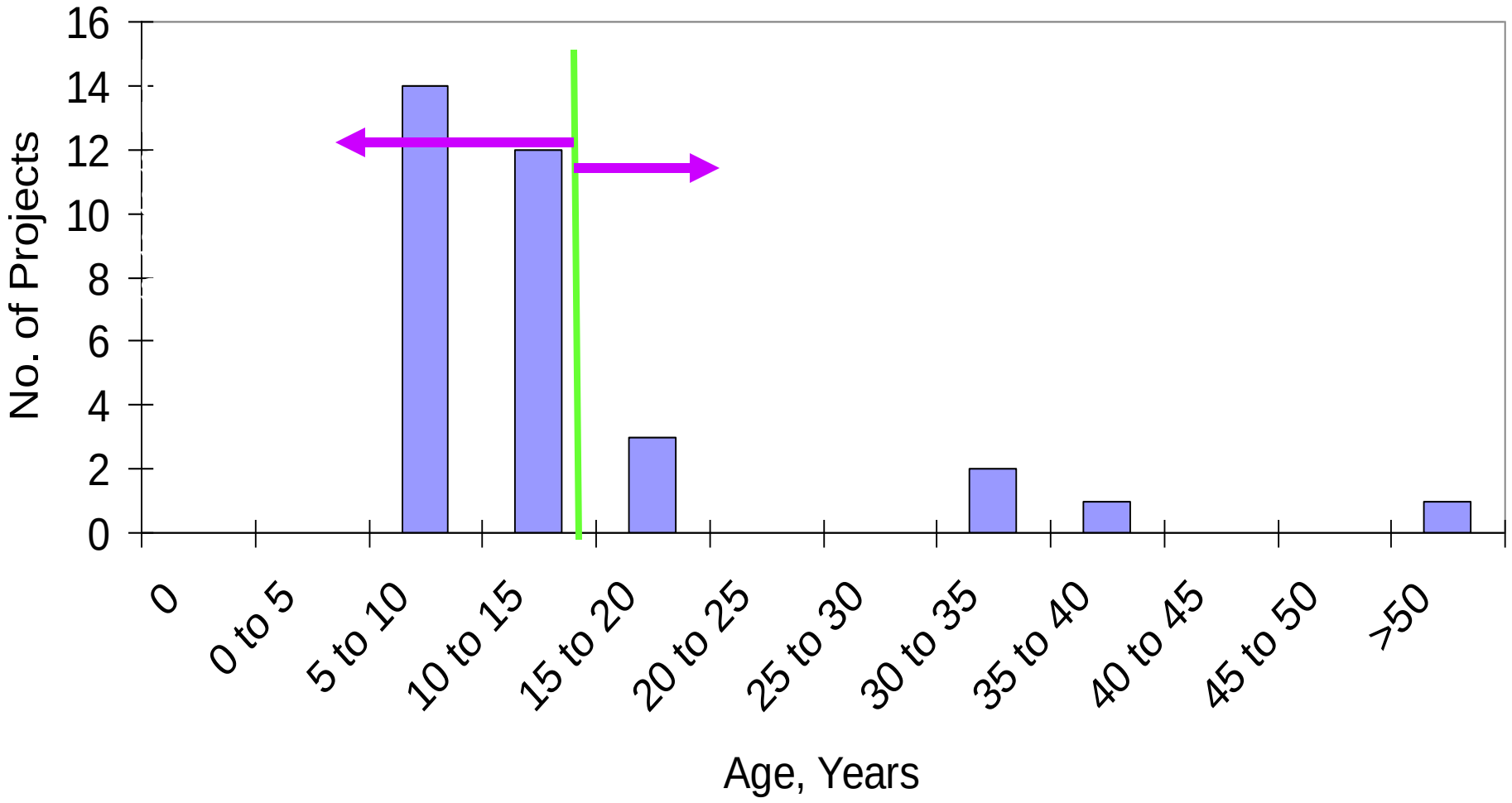
Distress Model Calibration

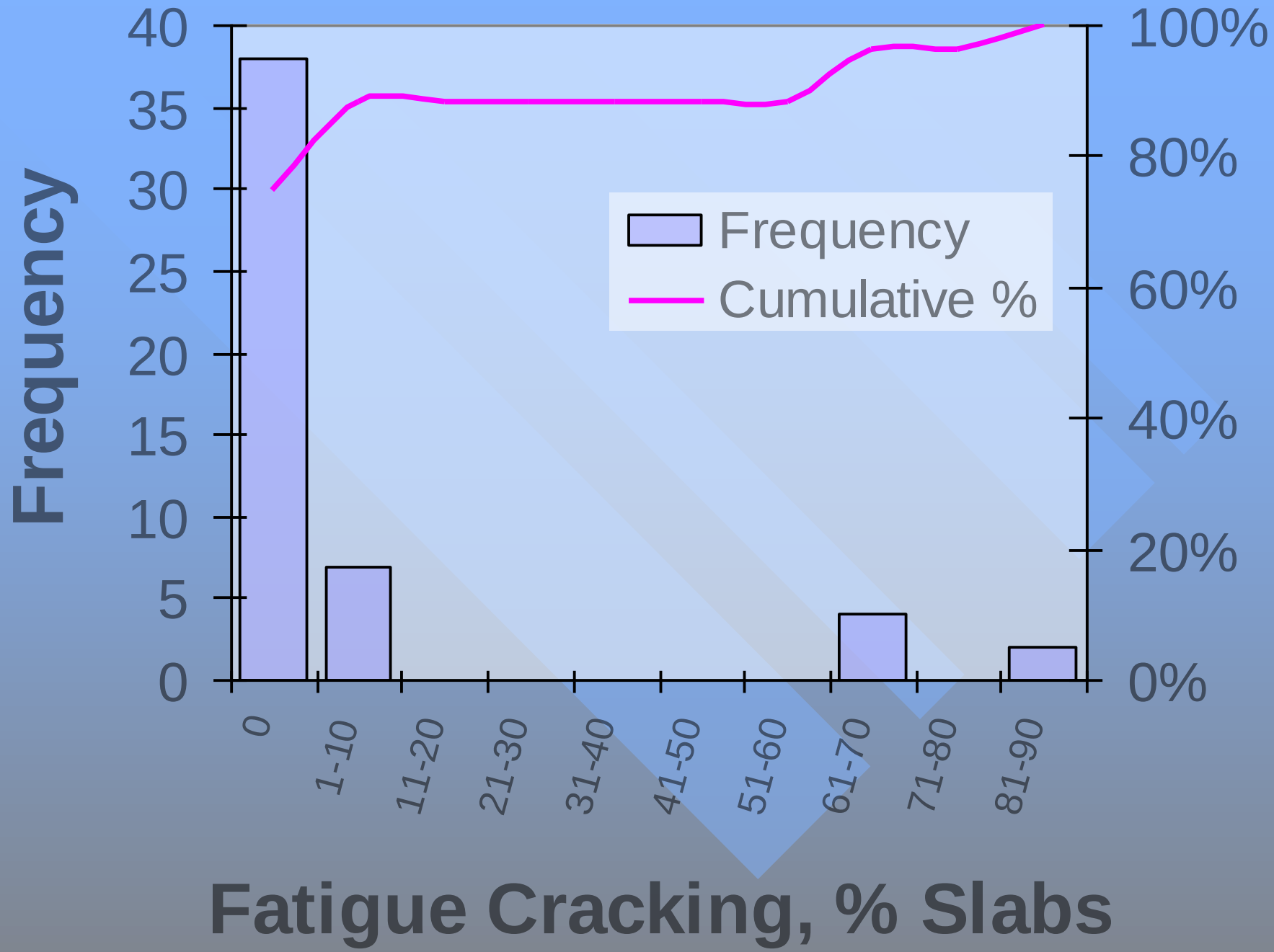
- MEPDG already has nationally (globally) calibrated distress models.
- Distress models had to be adjusted or locally calibrated for existing conditions.
- JPCP distress models
  - Slab cracking
  - Faulting
  - IRI

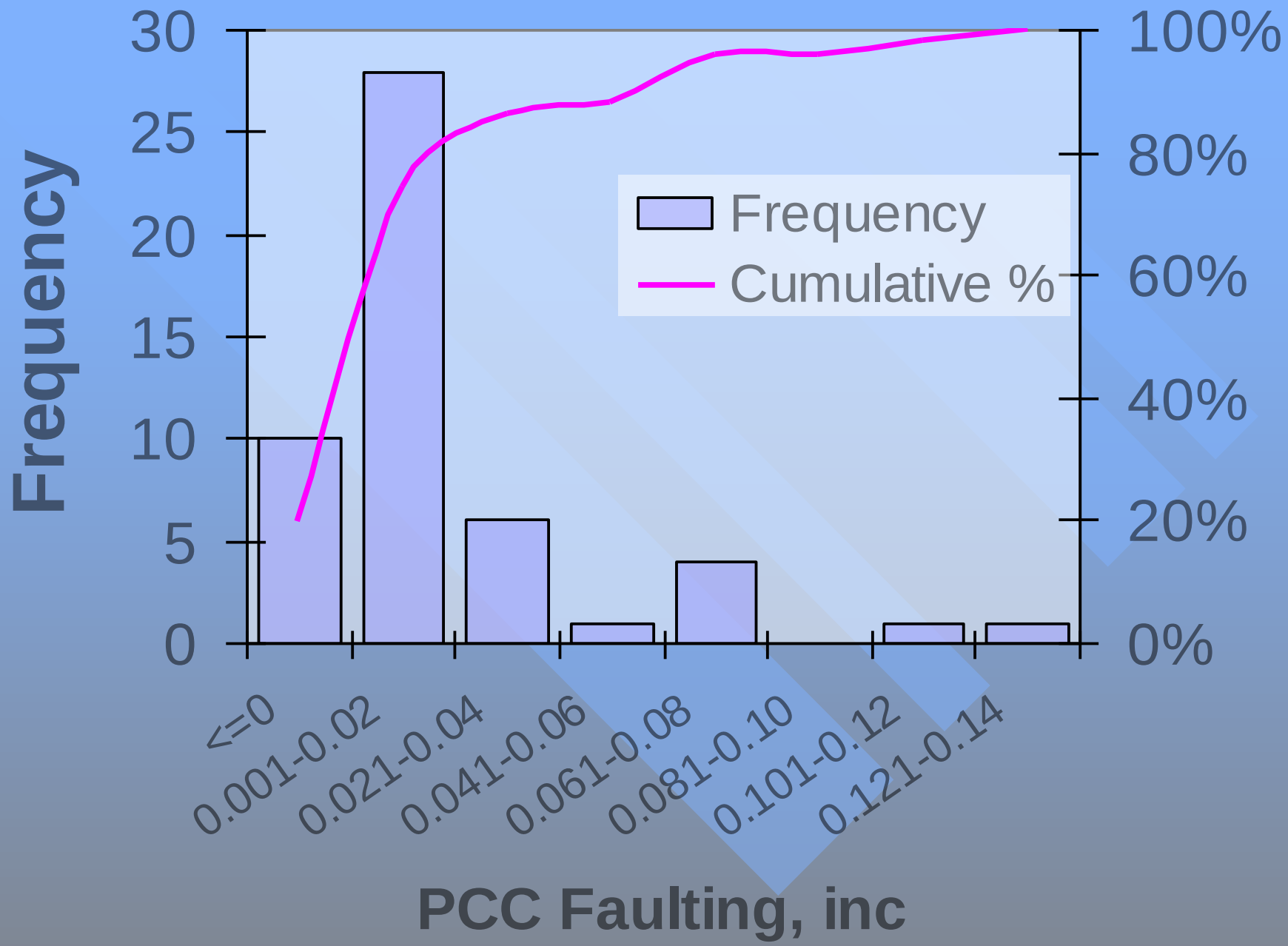
JPCP Sections Selected for Local Calibration

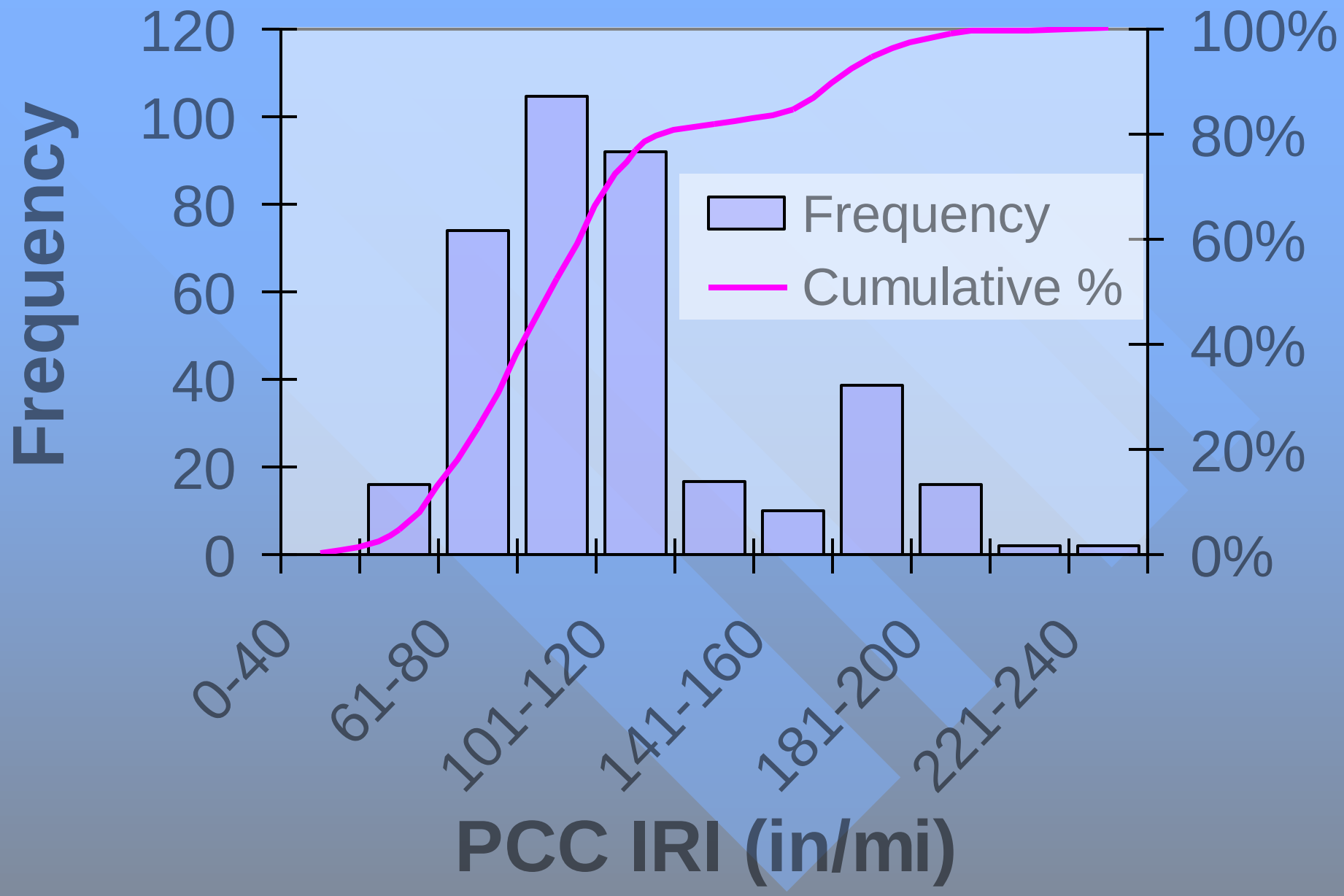


Age of New JPCP Pavement Sections




Frequency
40
35
30
25
20
15
10
5
0
100%
80%
60%
40%
20%
0%
Frequency
Cumulative %
0
1-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
81-90
Fatigue Cracking, % Slabs


Frequency
30
25
20
15
10
5
0
100%
80%
60%
40%
20%
0%
Frequency
Cumulative %
<=0
0.001-0.02
0.021-0.04
0.041-0.06
0.061-0.08
0.081-0.10
0.101-0.12
0.121-0.14
PCC Faulting, inc

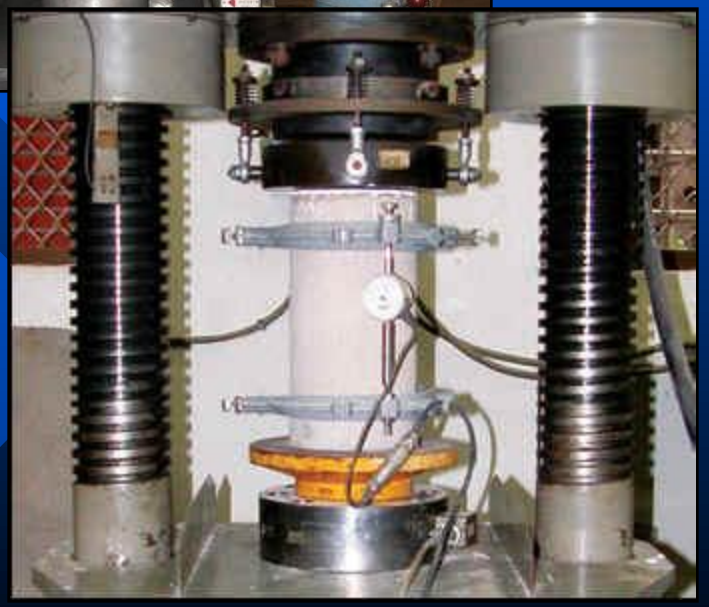

Frequency
120
100
80
60
40
20
0
100%
80%
60%
40%
20%
0%
Frequency
Cumulative %
0-40
61-80
101-120
141-160
181-200
221-240
PCC IRI (in/mi)

PCC Mixes Tested

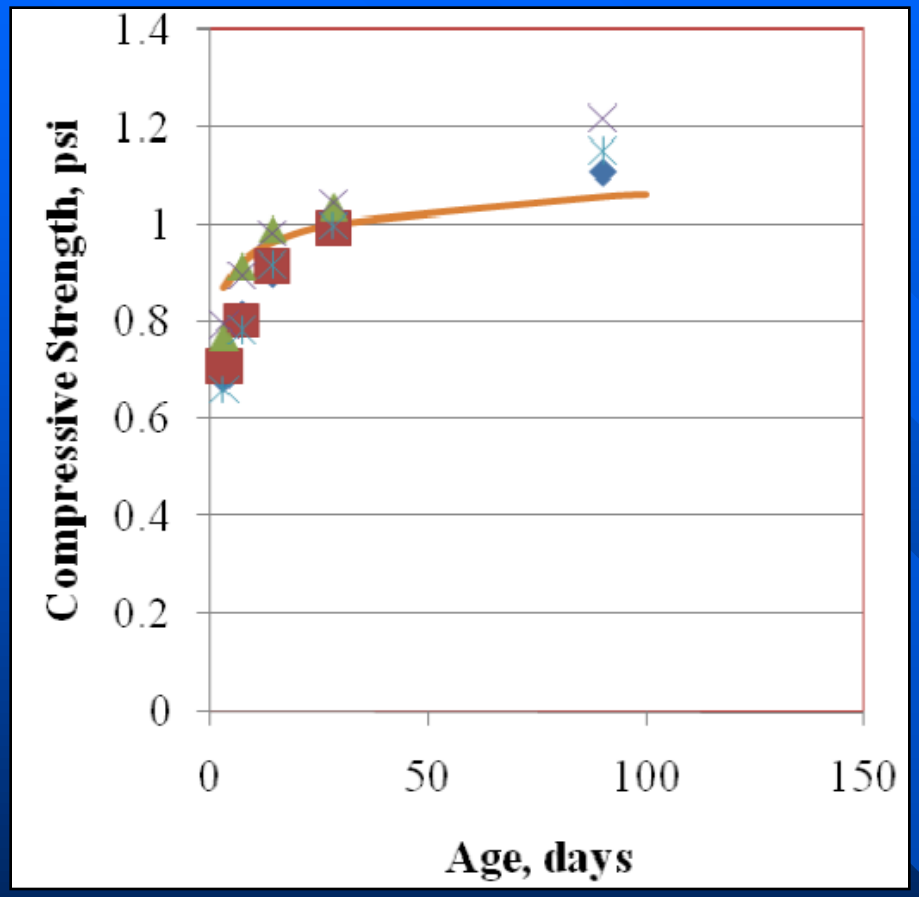
Location	Gradation Type	Cement Content	Flyash Content	w/cm Ratio
I-44 in Laclede Co.	B	479	85	0.38
US 412 in Dunklin Co.	B	445	111	0.41
I-435 in Jackson Co.	B Opt.	510	90	0.43
MO 367 in St. Louis Co.	D	441	110	0.39
US 63 in Randolph Co.	D Opt.	432	108	0.39
I-35 in Clinton Co.	F	517	91	0.38

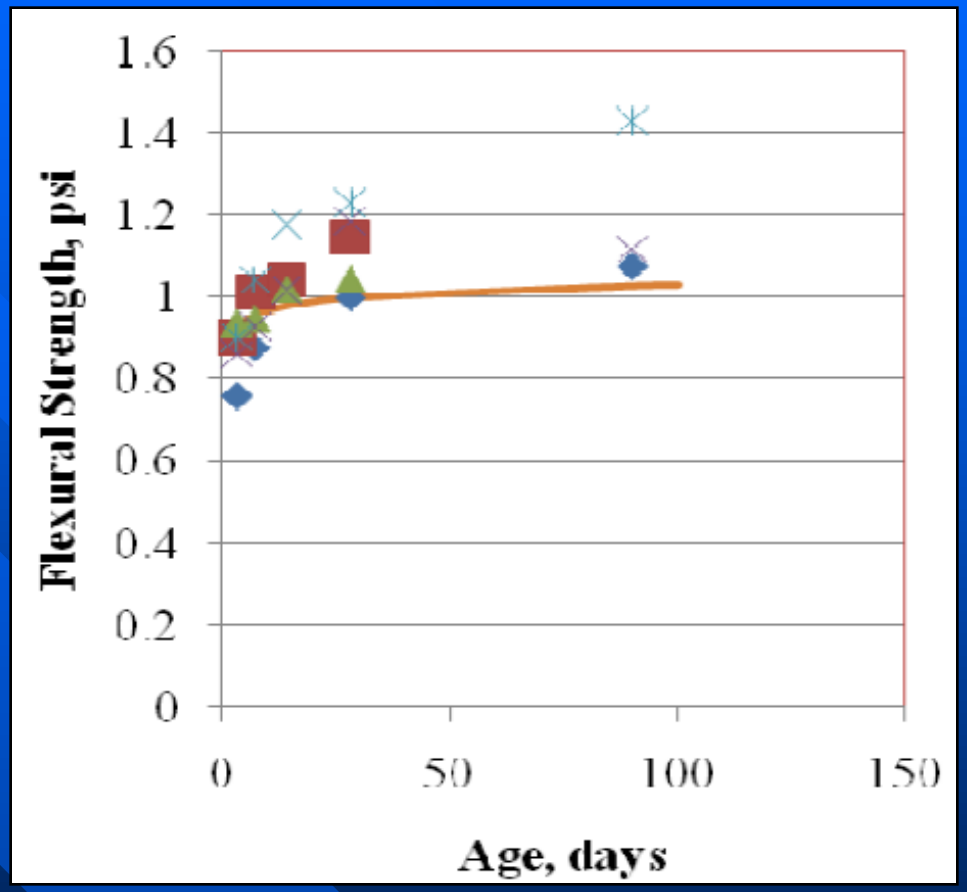
PCC Testing

- Compressive strength
- Flexural strength
- Modulus of rupture
- Elastic modulus
- Coefficient of thermal expansion (CTE)



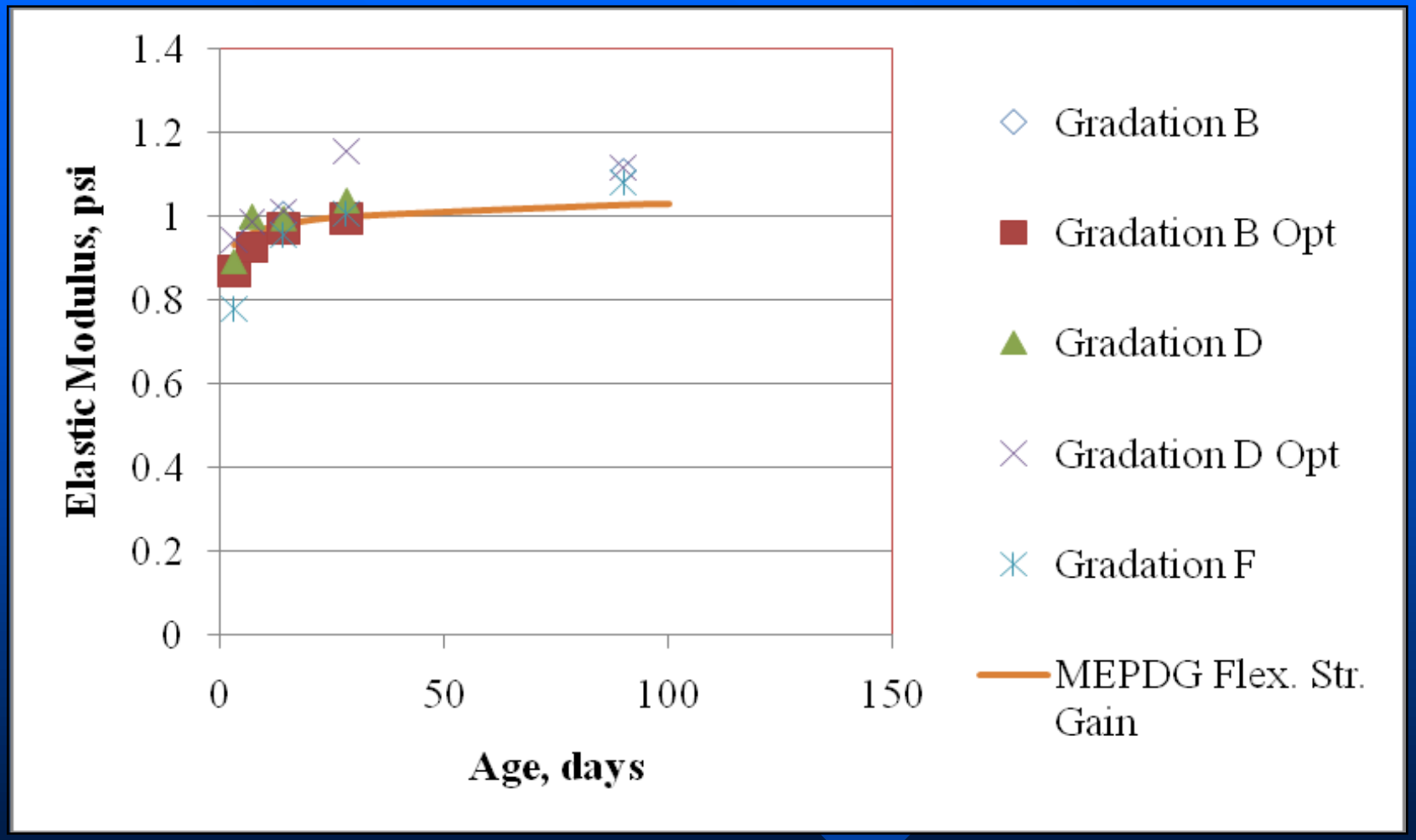
Strength Gain Curves





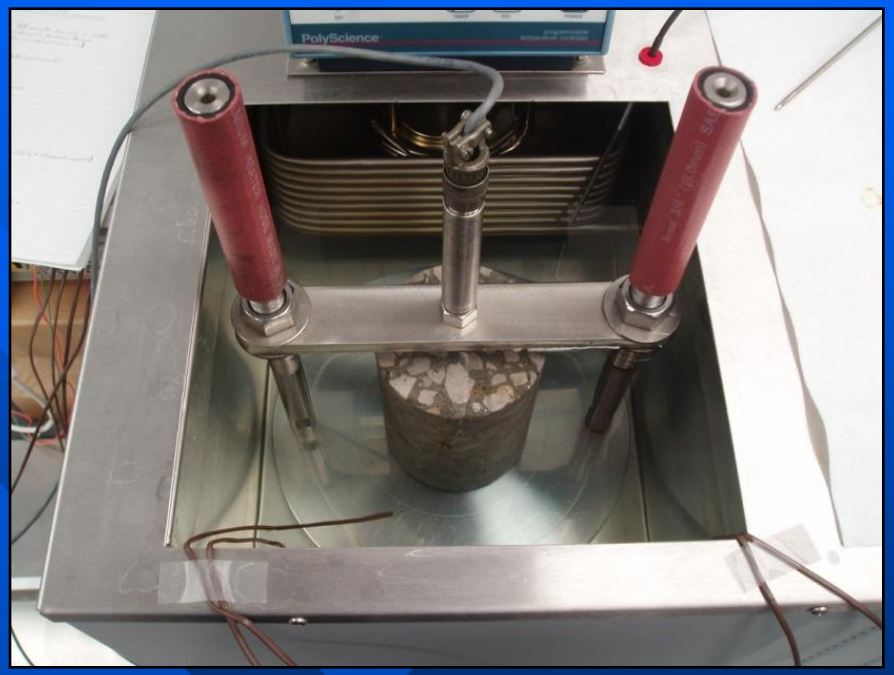
Gradation B
Gradation B Opt
Gradation D
Gradation D Opt
Gradation F
MEPDG Str. Gain

Modulus Gain Curves

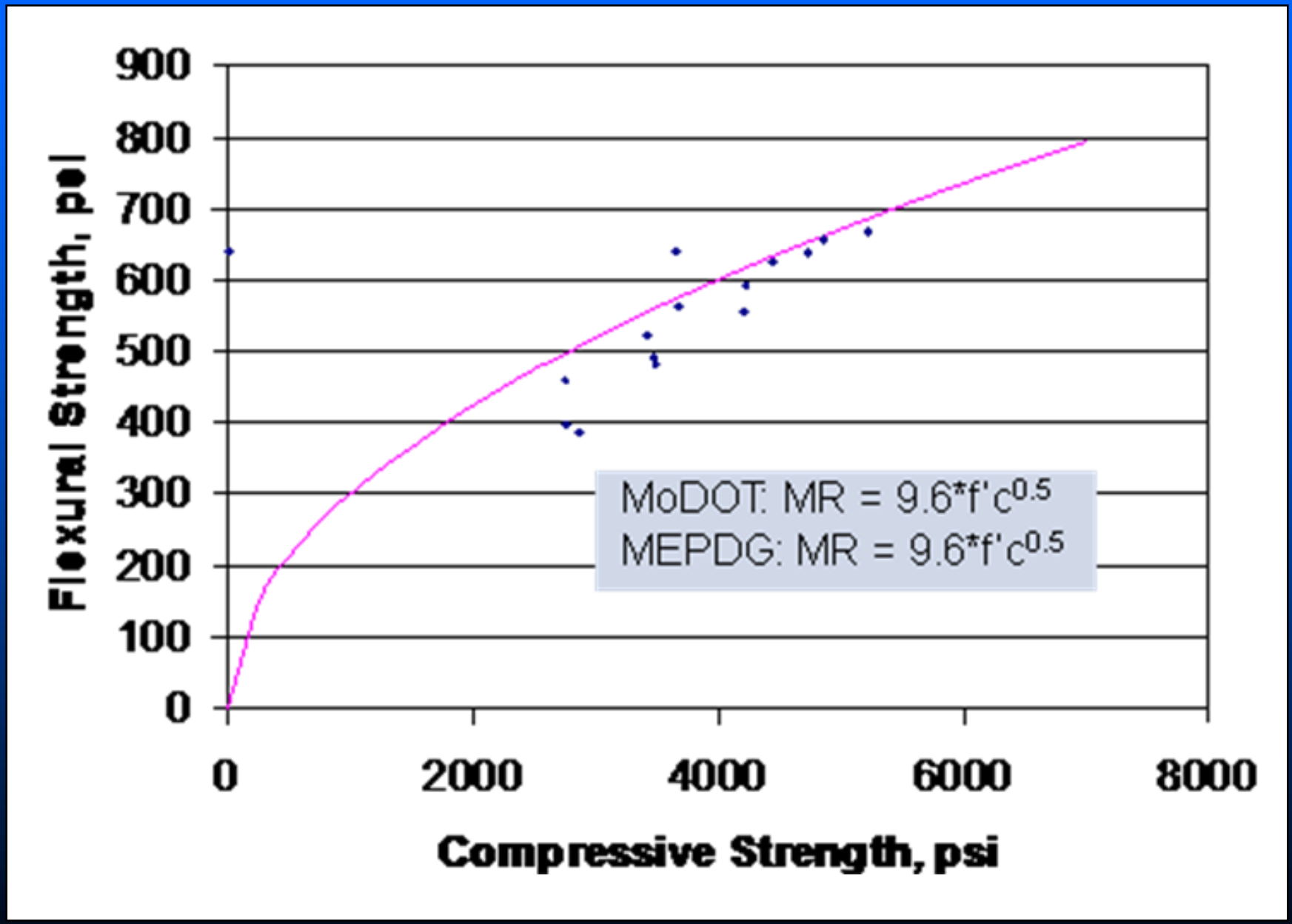


CTE Testing

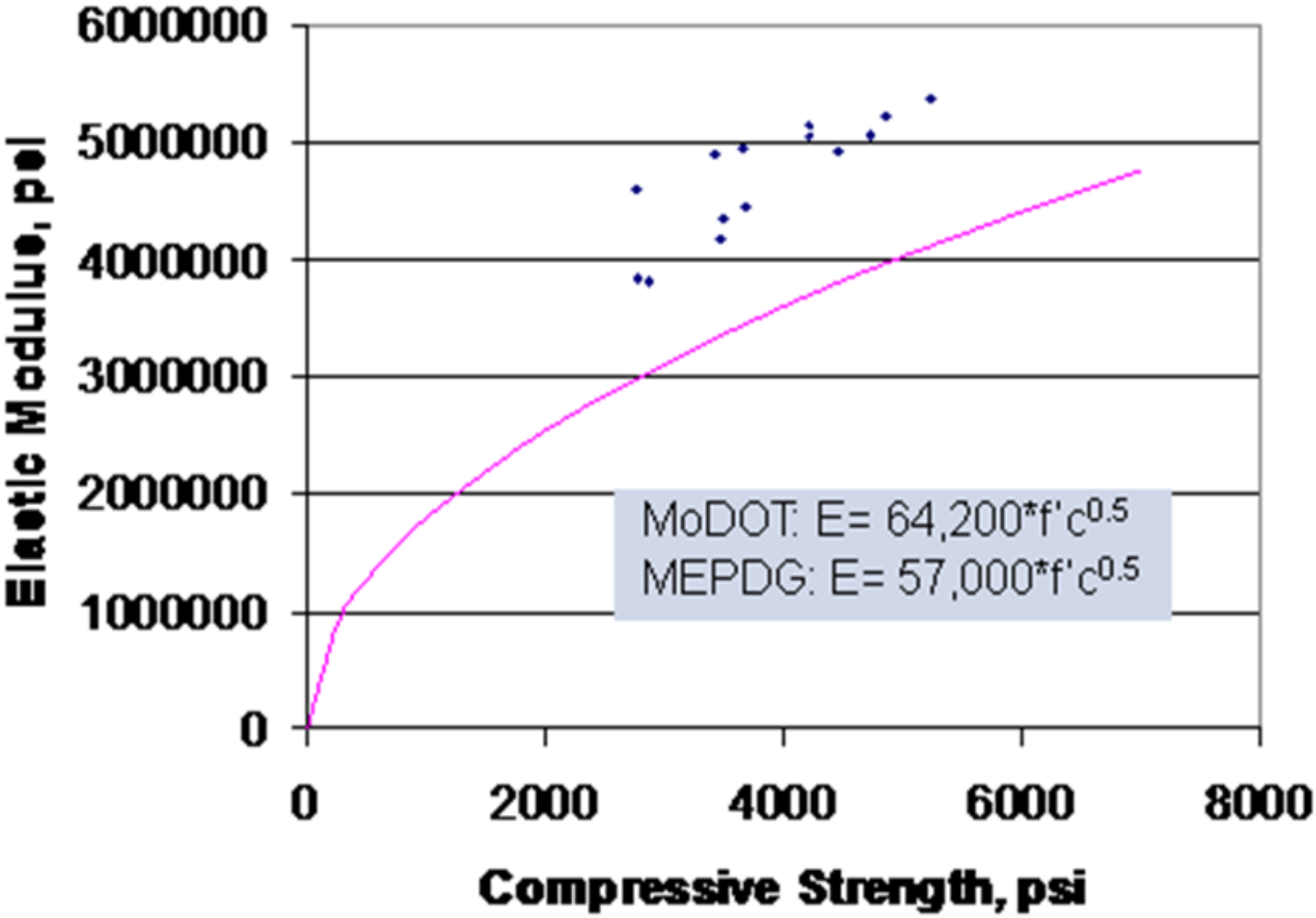
- CTE of Gradation B = 5.4 in/in/^{o}F
- CTE of Gradation D = 5.0 in/in/^{o}F
- CTE of Gradation F = 4.75 in/in/^{o}F



Flexural Strength Correlations



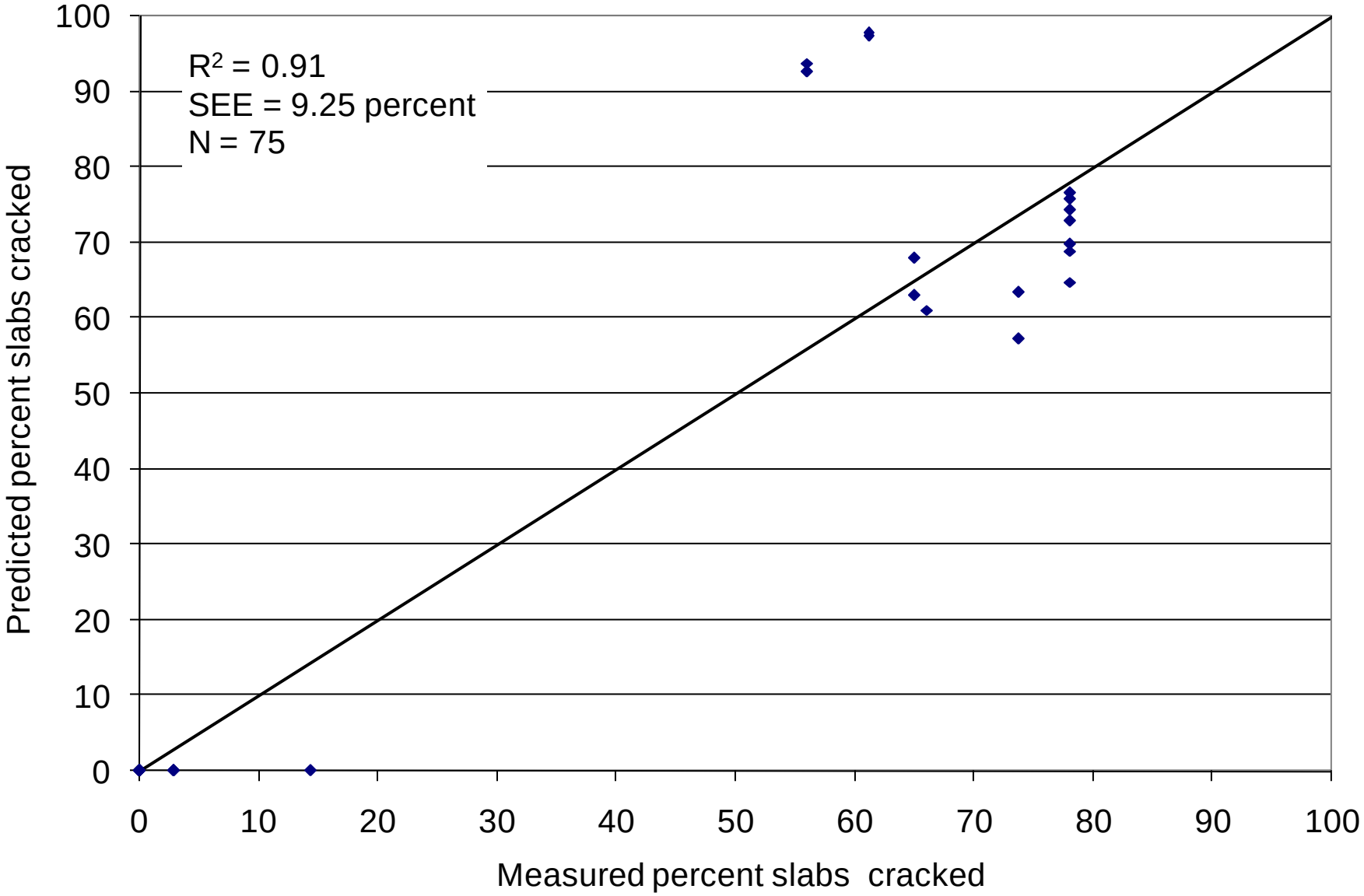
Elastic Modulus Correlations



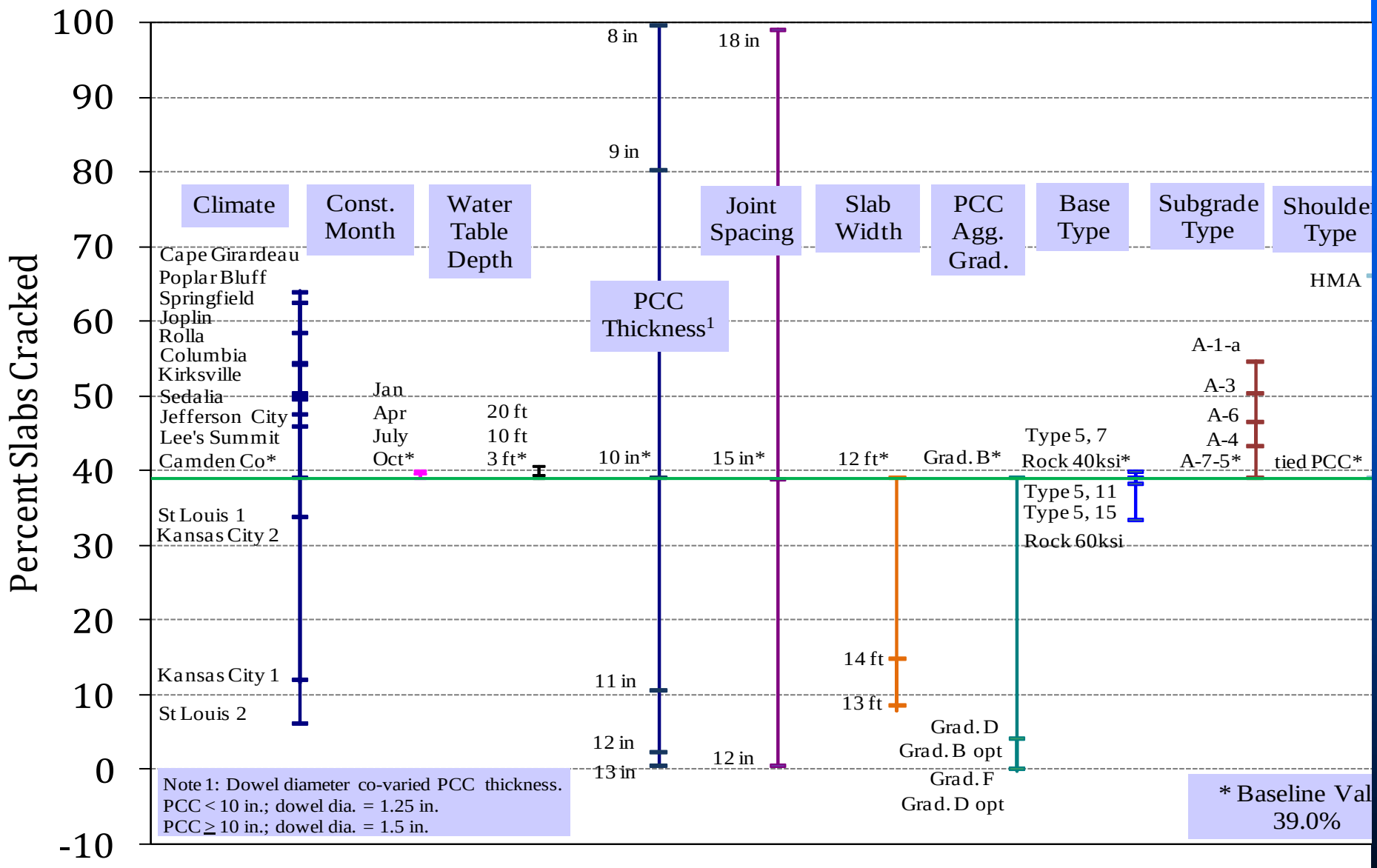
PCC Materials Characterization

- The following MEPDG defaults were confirmed
  - Strength and modulus gain
  - Level 3 strength and modulus values
  - Compressive to flexural strength correlations
- MoDOT specific compressive strength to elastic modulus relationship recommended
- Laboratory CTE values for typical MoDOT mixes were lower than the national averages
  - Additional CTE testing and verification with an independent laboratory recommended to confirm

Slab Cracking Model Validation



Cracking Sensitivity Analysis (Global)



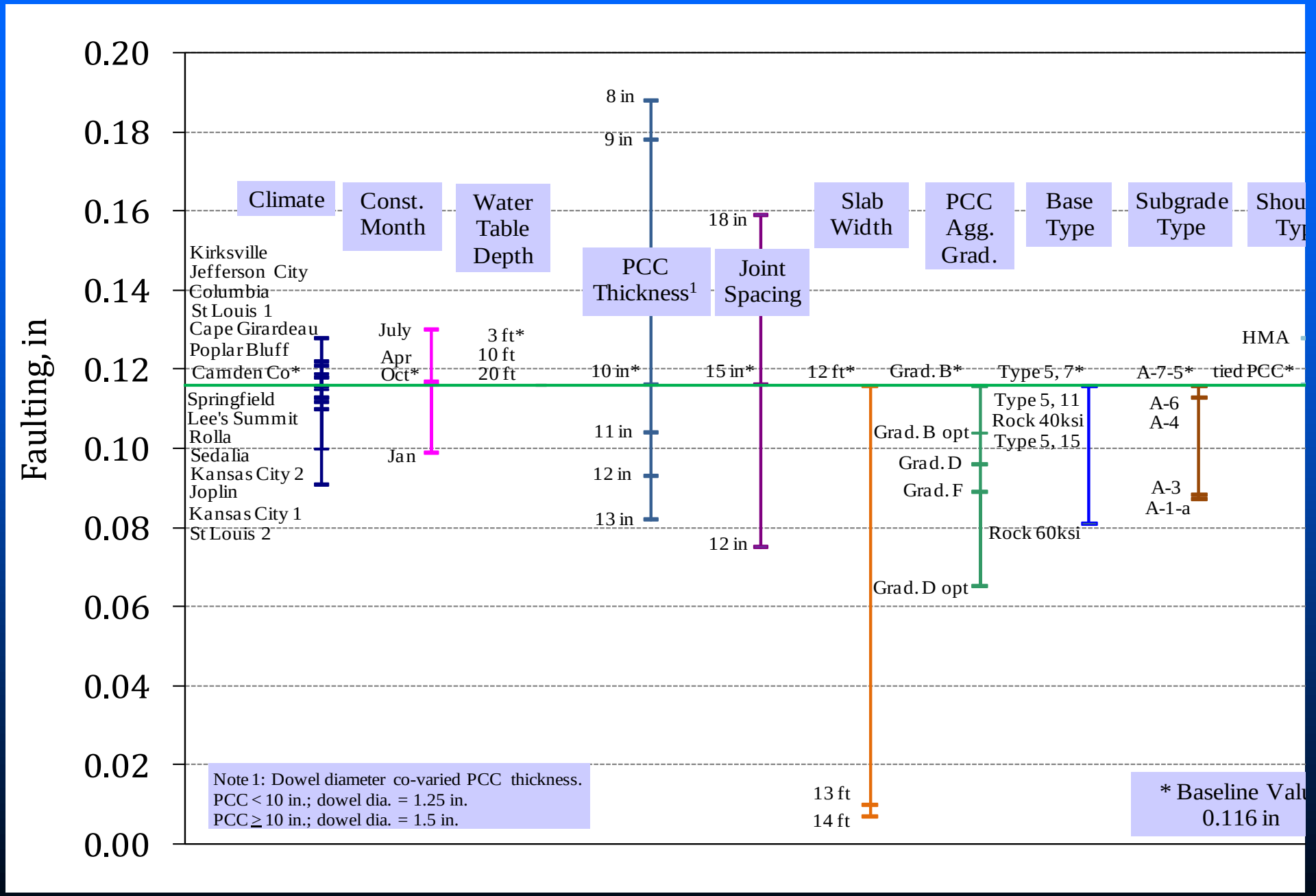
Slab Cracking Summary

- Approximately 78% of all the measured slab transverse cracking ranged from 0 to 6 %.
- Excellent correlation (R^2 = 0.91) between measured and predicted cracking.
- Recalibration not required at this time.

Faulting Model Validation

Measured Transverse Joint Faulting, in	MEPDG Predicted Transverse Joint Faulting, in	
	0 - 0.03 in	**0.03 – 0.05**
0 - 0.03	81%	2%
0.03 – 0.05	3%	0%

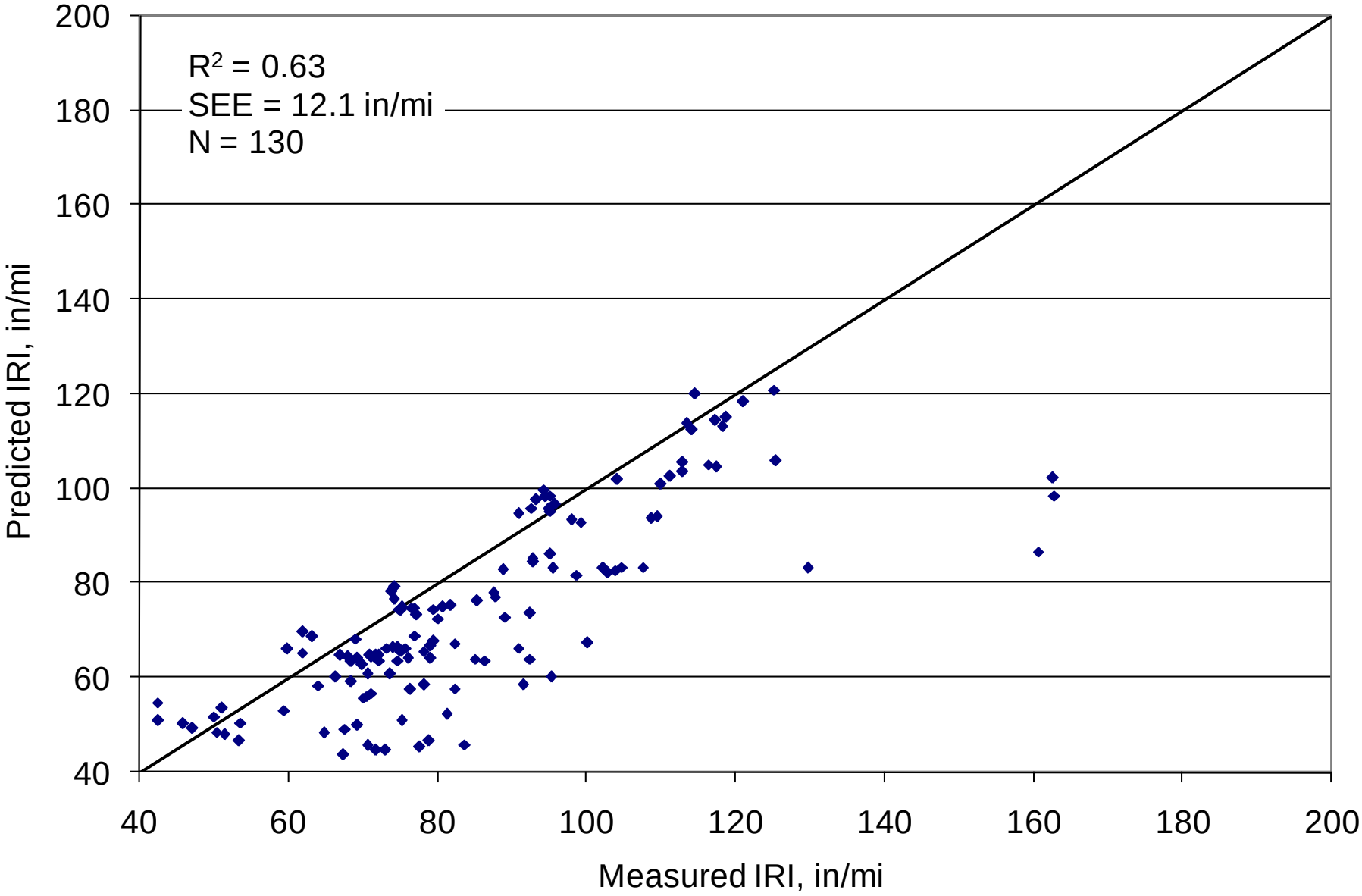
Faulting Sensitivity Analysis (Global)



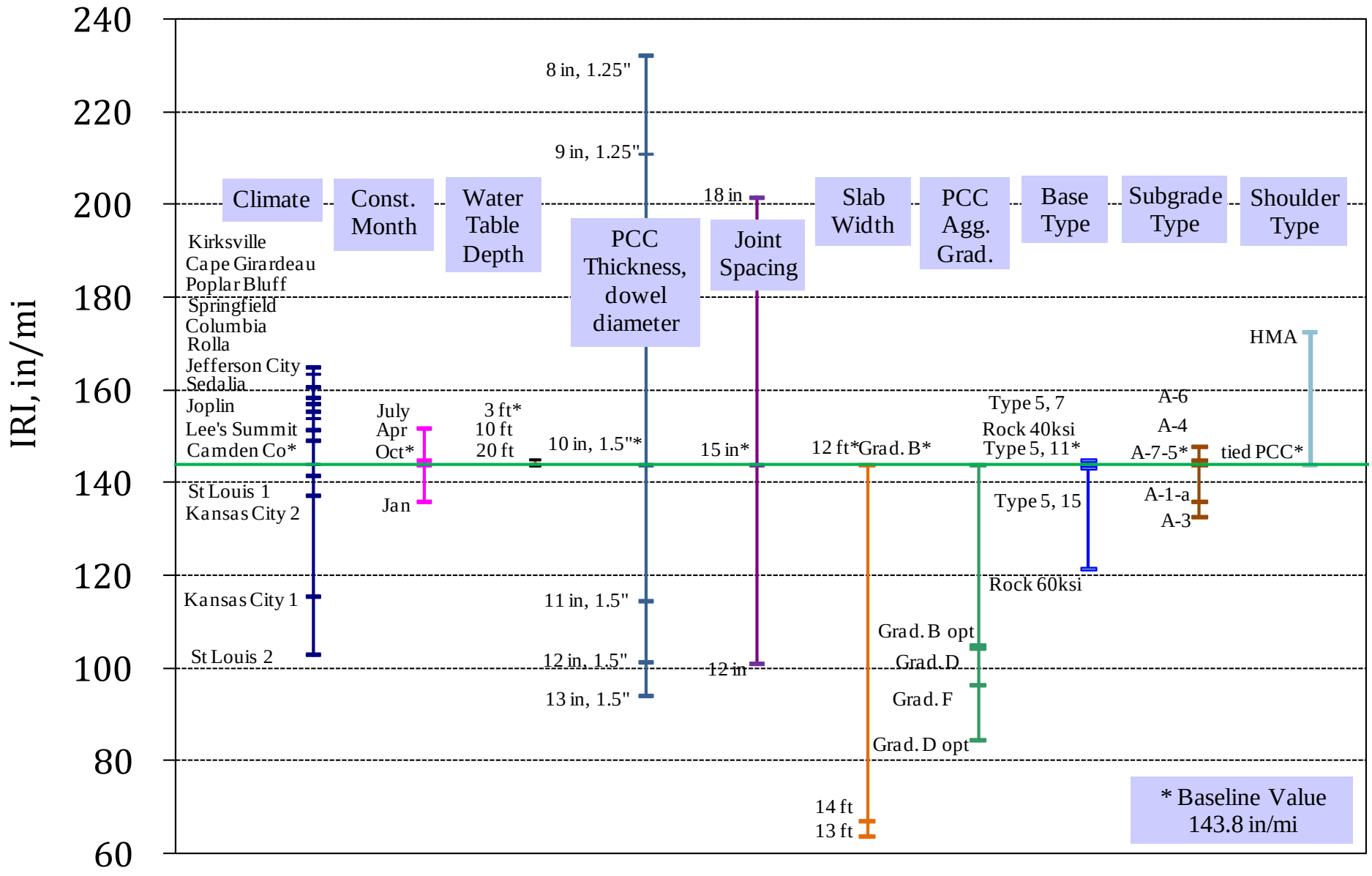
Faulting Summary

- A majority (~94%) of measured and predicted transverse joint faulting fell in the same grouping.
- Data with higher levels of faulting was not available.
- Recalibration of JPCP Faulting model is not required at this time.

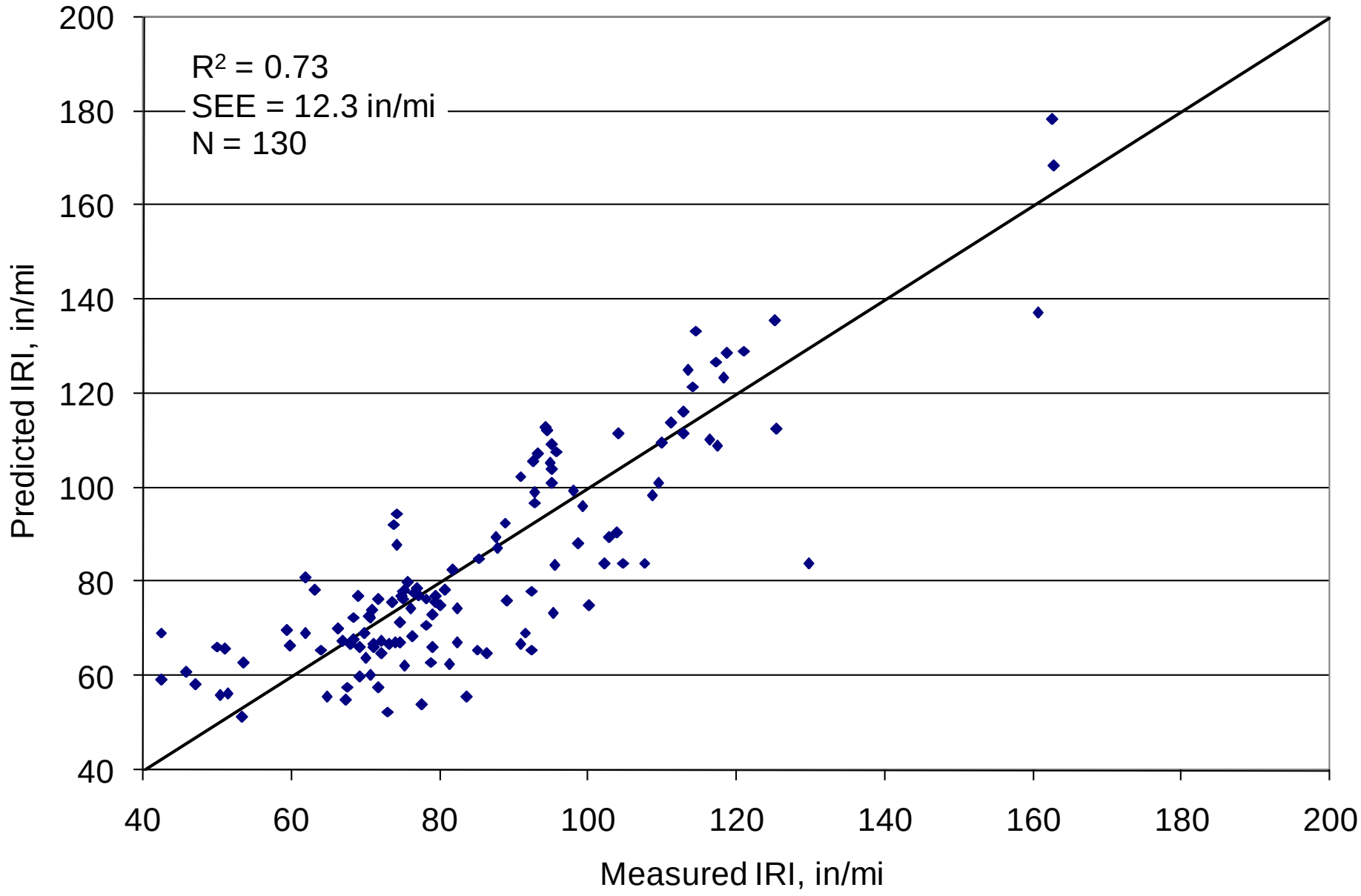
IRI Model Validation



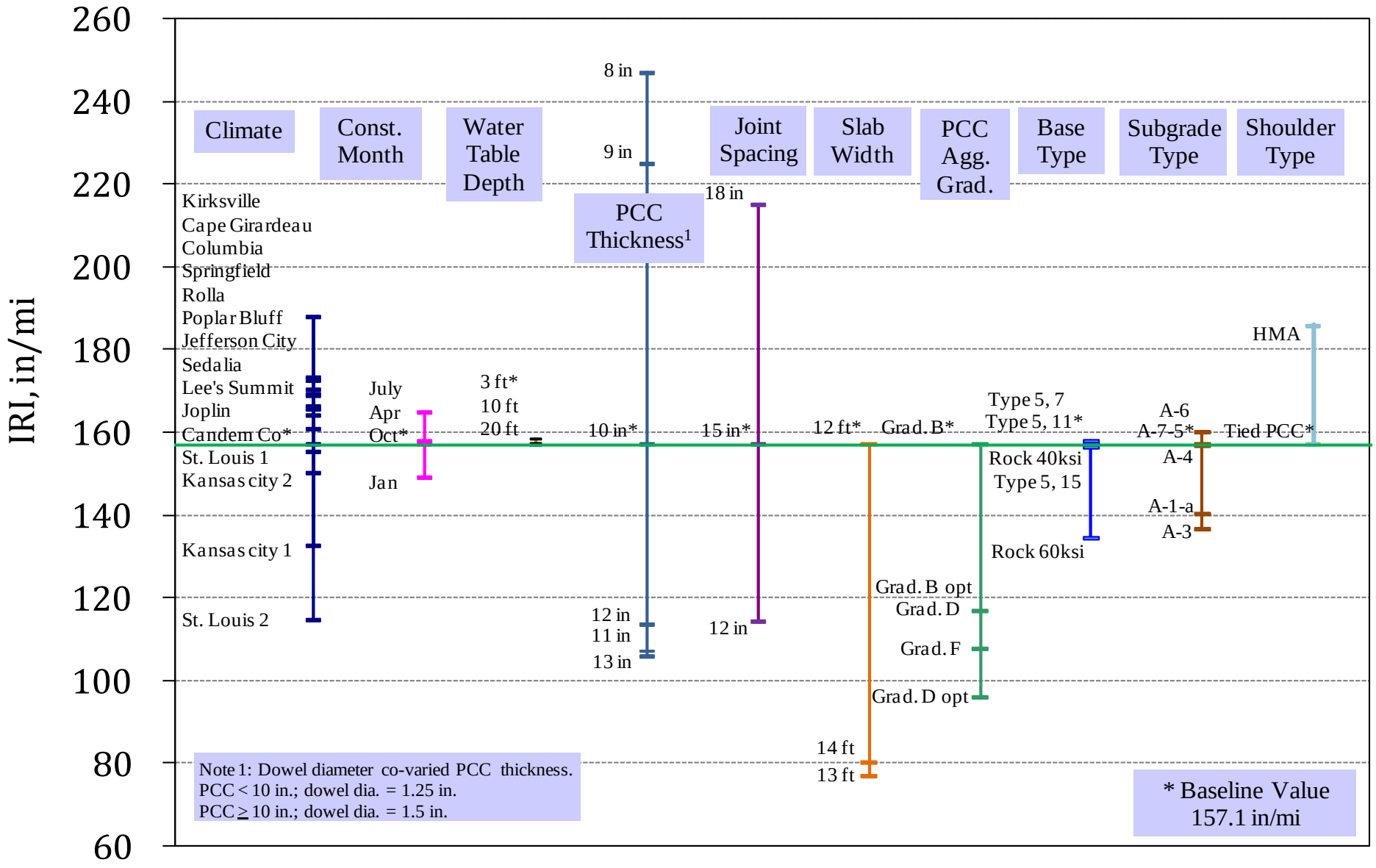
Sensitivity Analysis (Global Calibration)



Recalibration of JPCP IRI Model



Sensitivity Analysis (Local Calibration)



IRI Summary

- Significant bias in nationally calibrated model.
- No significant bias and improved model statistics after local calibration.
- Ranking of influencing factors from sensitivity analysis:
  - PCC slab thickness
  - Joint spacing and slab width
  - PCC mix properties
  - Climate

Thank You!

Questions?

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