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Perpetual Pavement Developments

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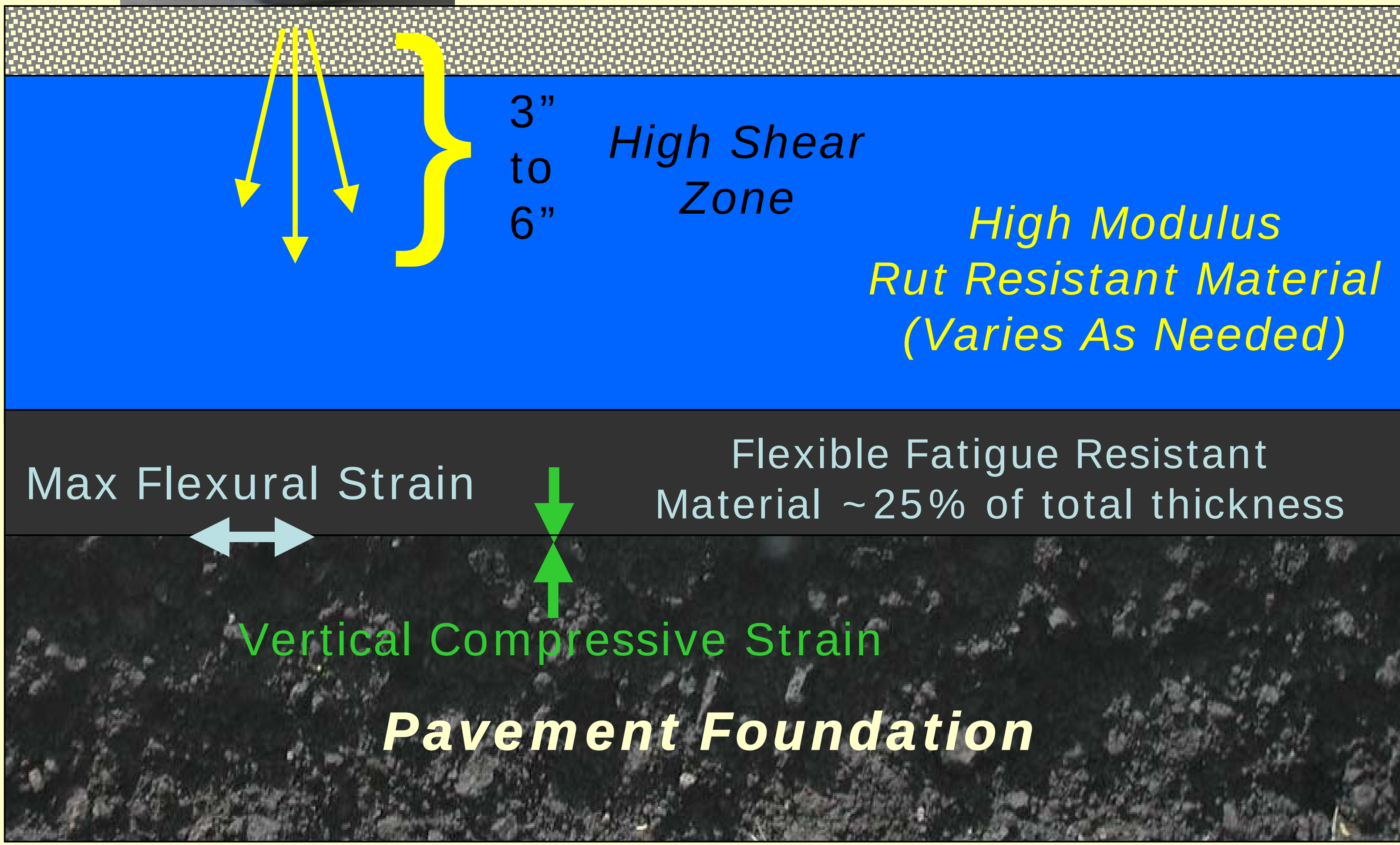
Perpetual Pavement



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Texas Perpetual Pavement Projects (in order of letting)

- I-35, McLennan County (Waco District)
- I-35, LaSalle County (Laredo District)
- I-35, LaSalle County (project awarded, not yet under construction)
- I-35, Hill County
- US 281, Hidalgo County (2 projects, Pharr District)
- I-35, Laredo District

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Typical Sections

Waco	Cotulla
1.5 in PFC	3.0 in SMA
2.0 in SMA	3.0 in 19 mm SP
3.0 in 19 mm SP	8.0 in 25 mm SP
10.0 in 25 mm SP	2.0 in 12.5 mm 2% air voids
4.0 in 19 mm 2% air voids	
6.0 in crushed stone	

Problems with TxDOT PP Designs

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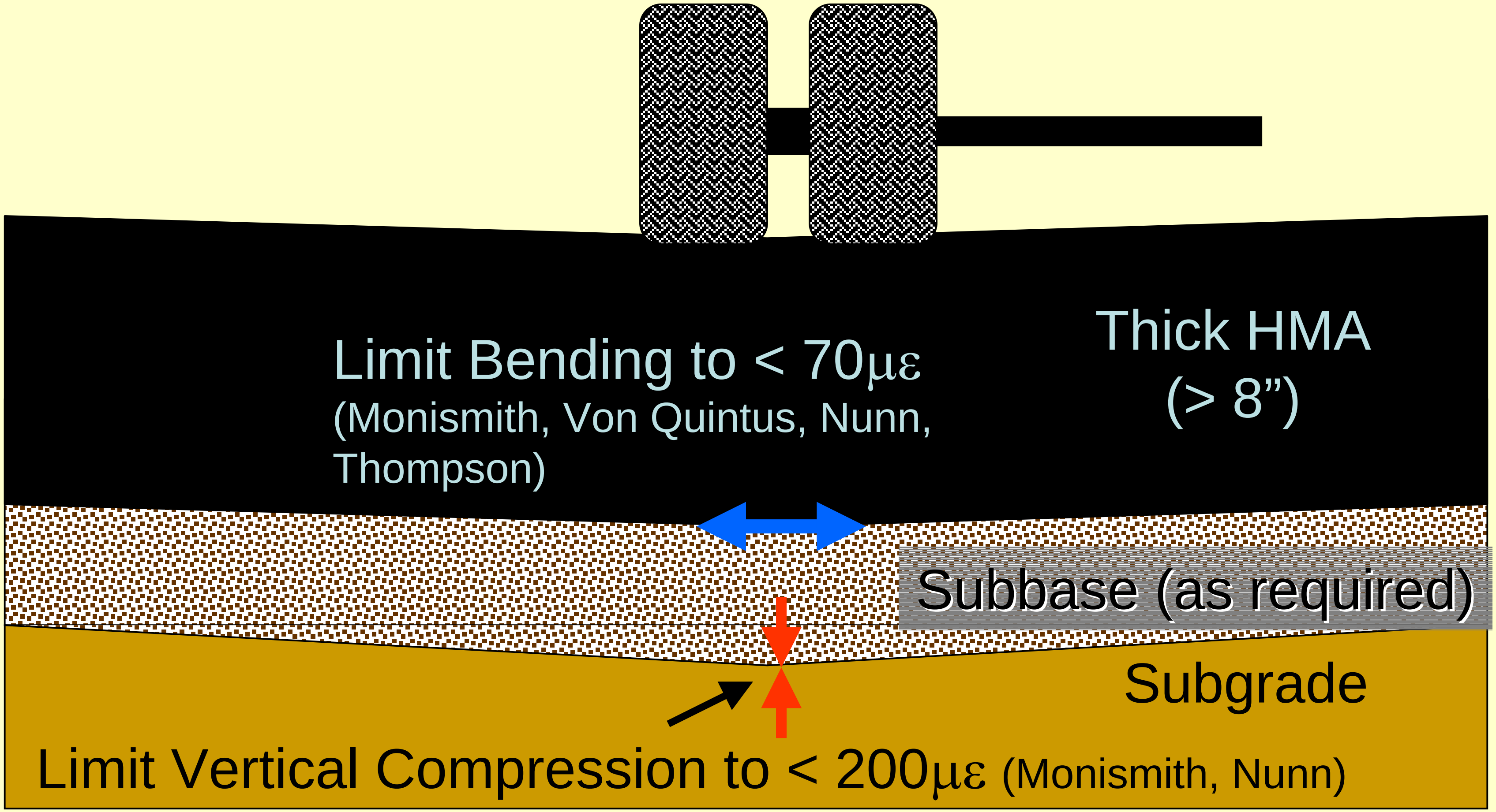
- Using empirical/pseudo-mechanistic design procedure
  - Results in excessive thickness
  - Doesn't account for benefits of improved materials and mixtures
- To date, concept has not been applied to converted PCC pavements
  - TxDOT has been slow to use rubblization
  - What assumptions should be made for properties of rubblized concrete?

Mechanistic Performance Criteria



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Confirmation of Fatigue Criterion

- Laboratory testing at the University of Illinois and the Asphalt Institute laboratories
- *AASHTO TP8 Standard Test Method for Determining the Fatigue Life of Compacted Hot Mix Asphalt (HMA) Subjected to Repeated Flexure*
- Commonly known as “Beam Fatigue Test”

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Compacted Beam for Fatigue Testing

Beam Fatigue Fixture

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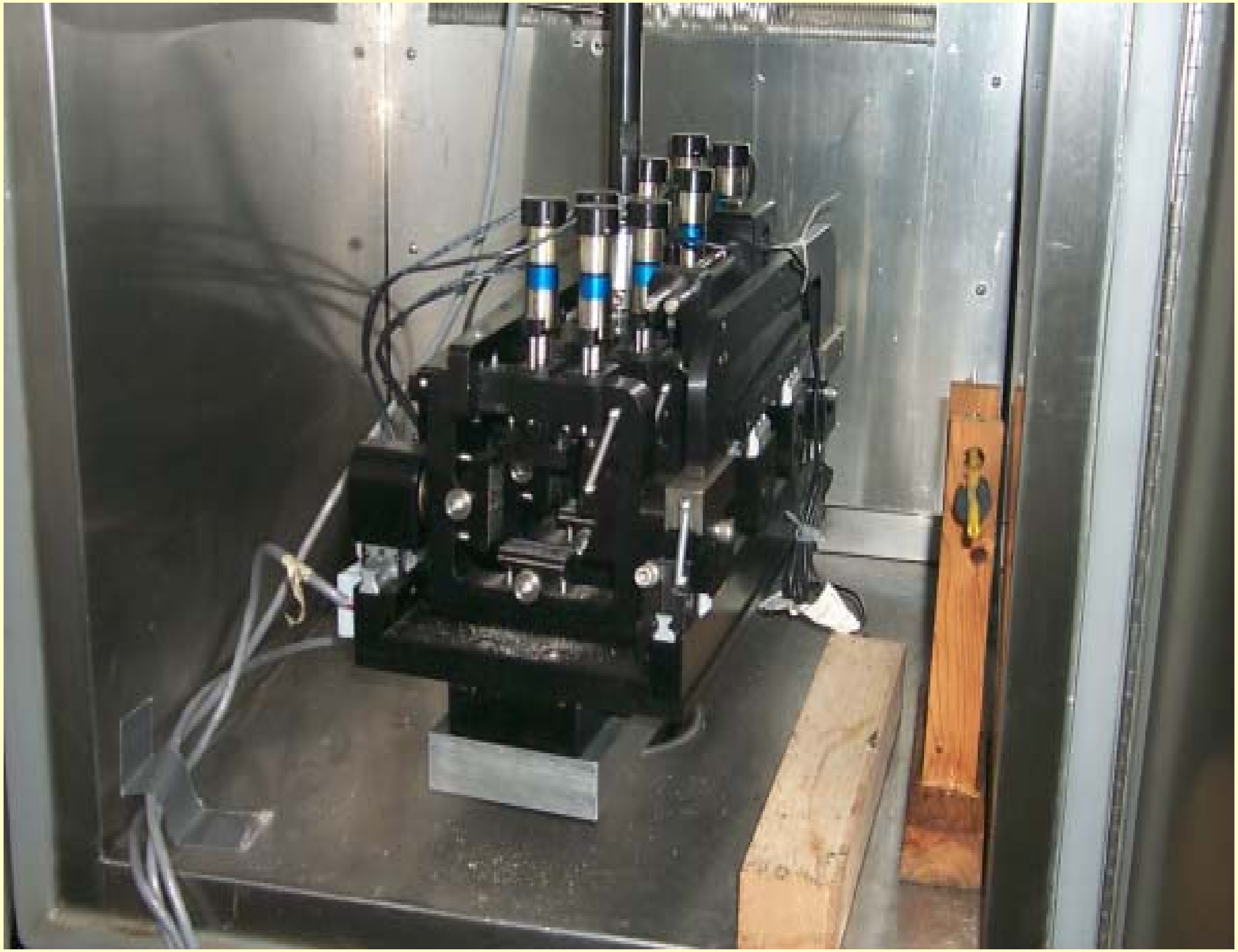

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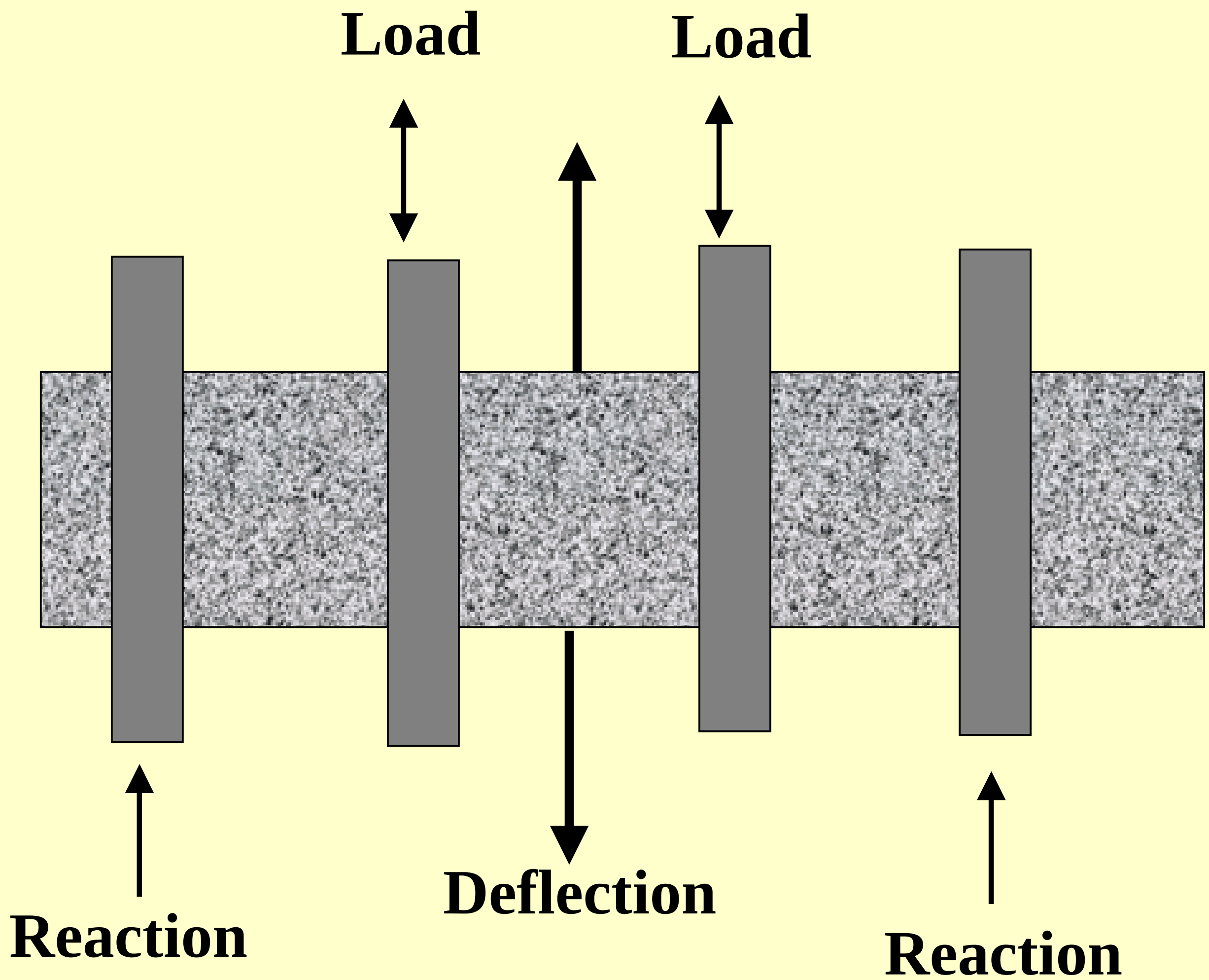
Mechanics of Beam Fatigue Test



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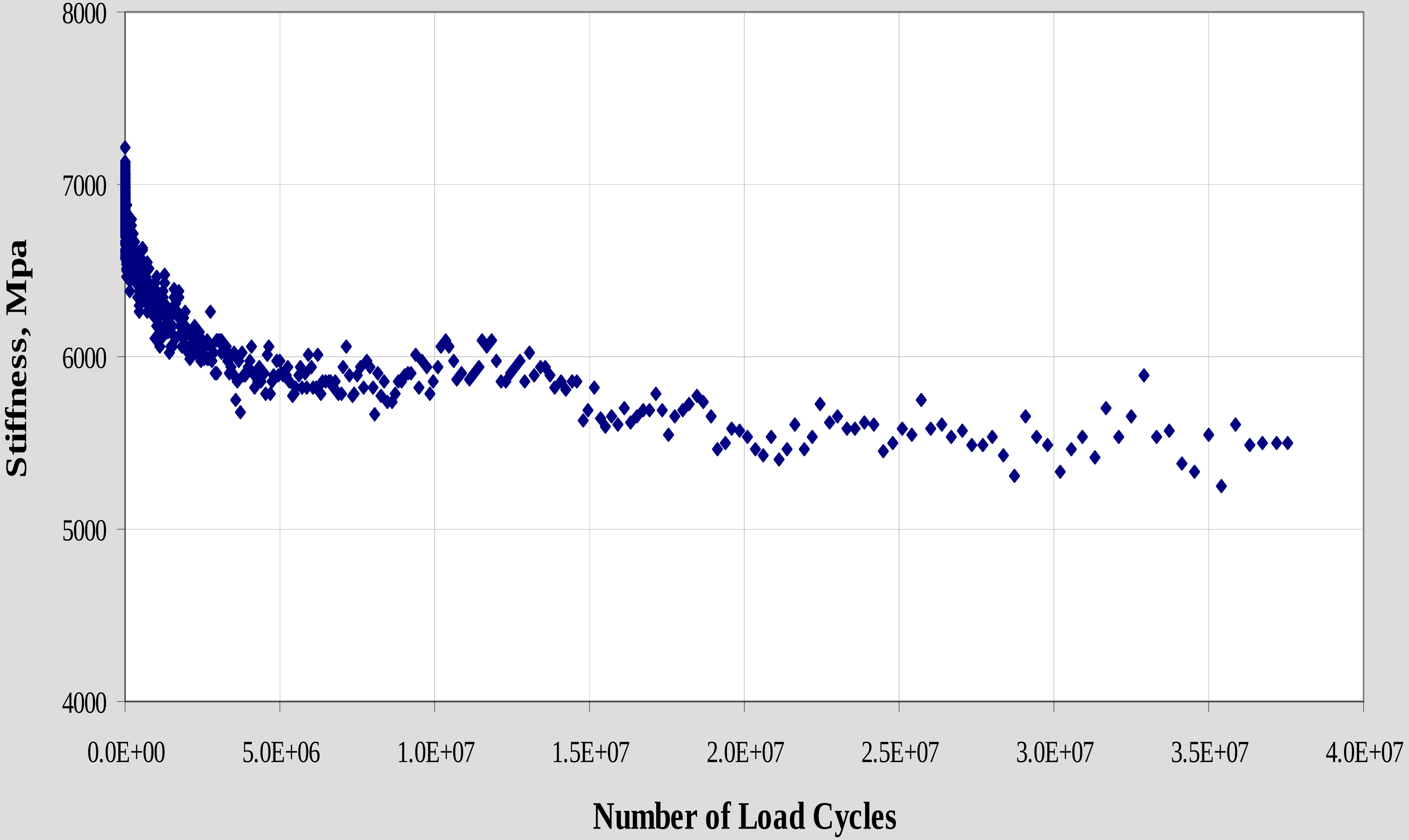
University of Illinois Study
Conclusion

- Strain levels below 100 micro-strain (TM) greatly extend fatigue life
- Strain levels below 100 TM do not require a specially designed mixture to prevent fatigue cracking

U of I Tests To Date

Mix	A.C. %	Voids %	Strain	N_f
19.0 mm	4.6	4.0	100	7.7 Billion
19.0 mm	4.6	4.0	70	600 Billion
9.5 mm	5.4	4.0	70	8 Trillion

70 Micro Strain Test



Note: “Failure” is defined at 50% of initial stiffness, ~ 3600MPa

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Objectives of Asphalt Institute Research

- *Support Perpetual Pavement Methodology*
- Validate infinite fatigue life at low strain levels
- Determine strain level at which mixtures will not develop fatigue damage
- Identify differences in fatigue performance of different materials
  - "Rich" fatigue-resistant mixture
  - Modified asphalt binders

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Test Matrix

			AC Content	
Mix	Air Voids	Strain Levels (υε)	Optimum	Optimum+
19-mm Superpave (coarse-graded)	7% for Optimum AC Content < 7% for Opt+	800	X	X
		400	X	X
		200	X	X
		100	X	X
		70	X	X

Test Parameters

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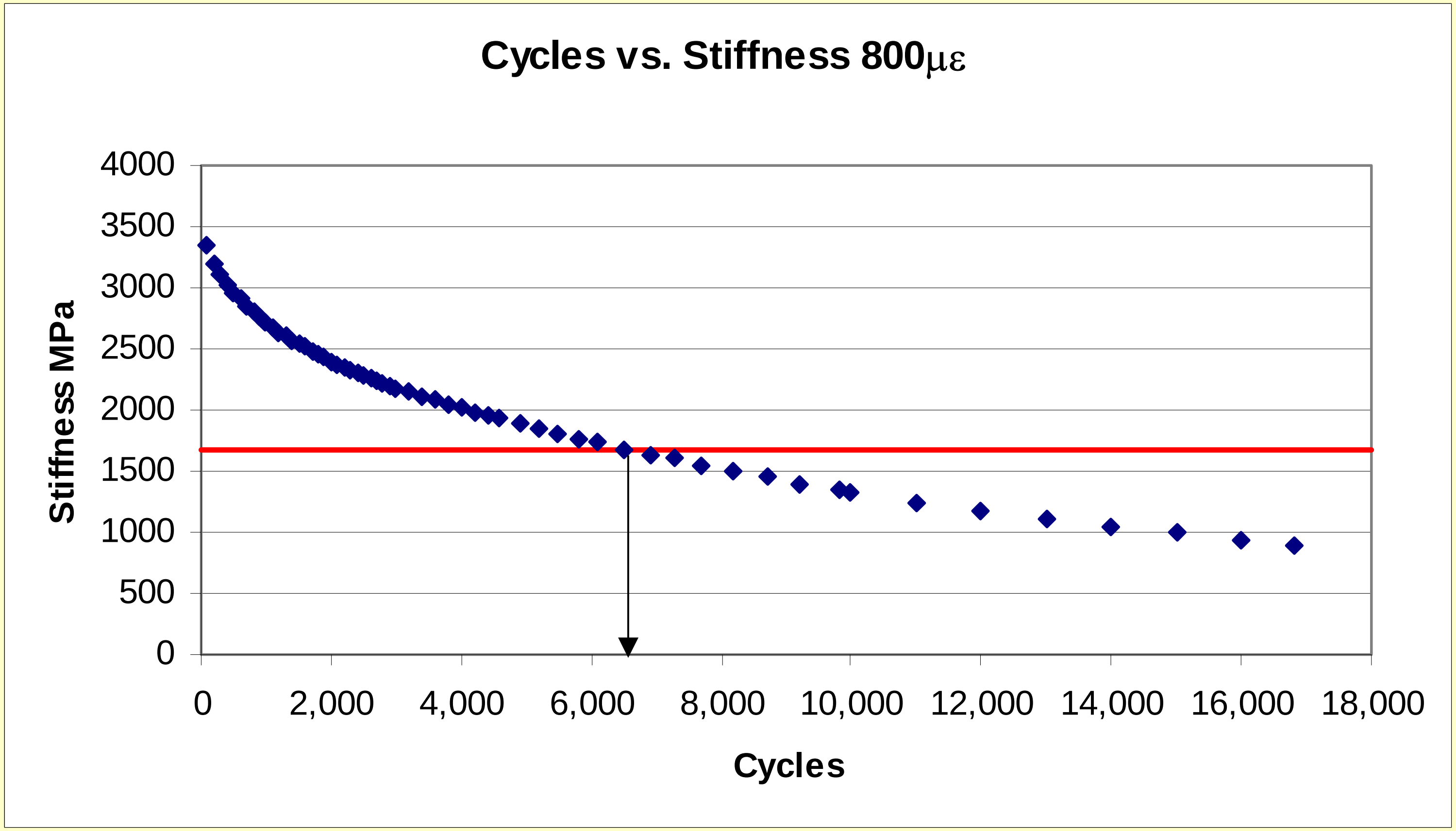
- Test temperature: 20° C
- Test Termination Criteria: 25% of Original Stiffness **<u>or</u>** 4,000,000 Cycles
- Failure Defined as 50% Initial Stiffness (after conditioning)

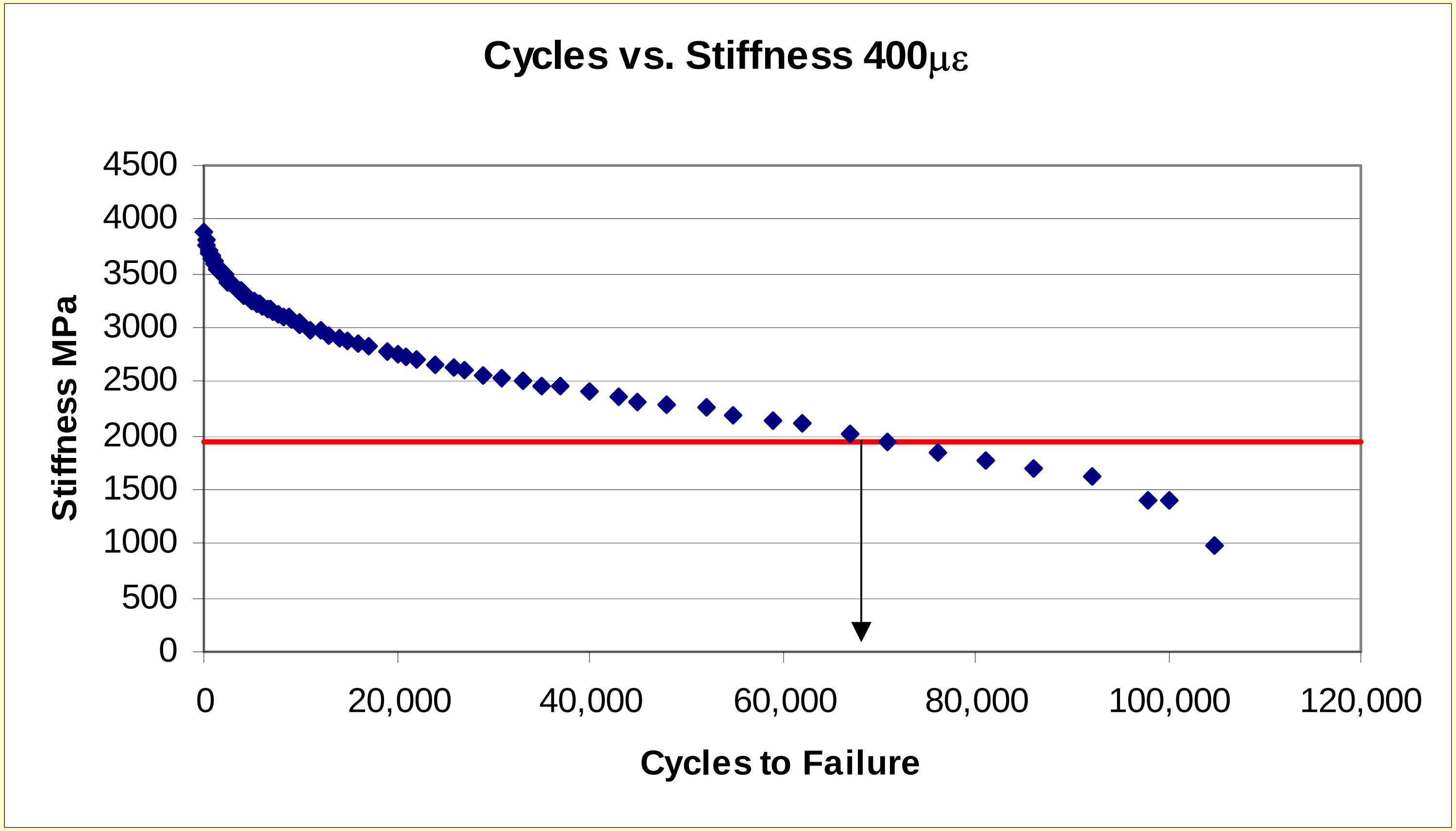
Note: 4,000,000 Cycles Simulates 40,000,000 ESAL's

  - Leahy, 1994 AAPT

Typical 800με Stiffness Data

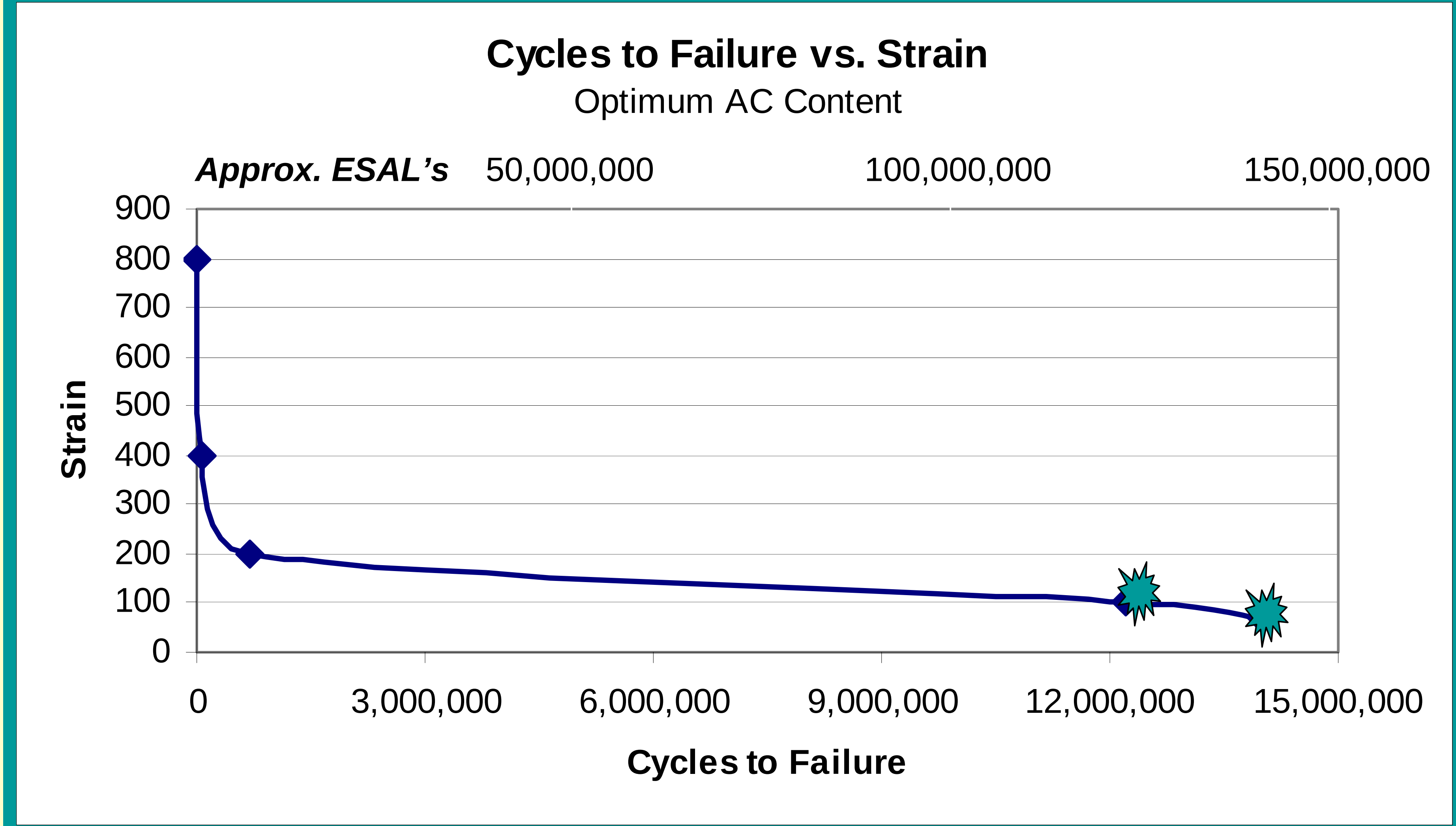


Typical 400με Stiffness Data



Note that fatigue life increased ~10X by halving the strain

Interim Data, Optimum Pb



Interim Data (cont.)

- As expected the number of cycles to failure significantly increases at low strain levels
- This data appears to validate the concept of indefinite fatigue life at low strain levels

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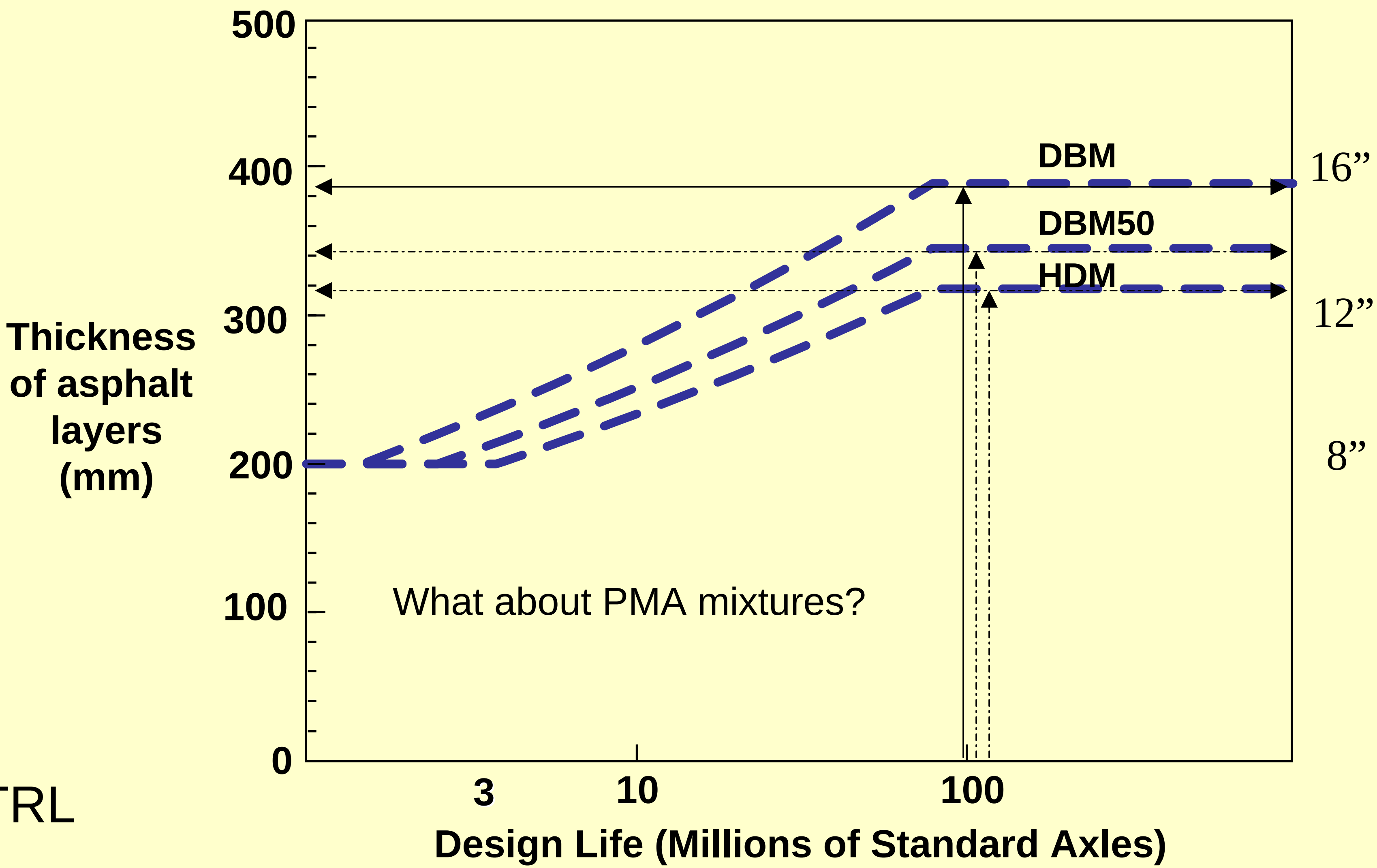
What can be done to satisfy these mechanistic criteria?

- Stiffen the foundation
- Increase total HMA thickness
- Increase mixture stiffness
- Increase HMA flexural strength

PMA benefits?

TRL Design Chart



TRL

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Where PMA fits in:

- Binder stiffness directly affects mixture stiffness
  - Doubling binder stiffness increases mixture stiffness 35-50%
- Modified binders may also be more resistant to cracking
  - Higher limiting flexural strain?
- Modified tack coats may improve friction at lift interfaces
  - Laboratory study at LTRC indicated that modified tacks provided greater shear strength at layer interface than unmodified

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Where PMA fits in:

- Binder stiffness directly affects mixture stiffness
  - Doubling binder stiffness increases mixture stiffness 35-50%
- **Modified binders may also be more resistant to cracking**
  - **Higher critical flexural strain?**
- Modified tack coats may improve friction at lift interfaces
  - Laboratory study at LTRC indicated that modified tacks provided greater shear strength at layer interface than unmodified

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Next Phase of AI Research

- Modified asphalt binder
  - PG 76-22, modified w/elastomer
- Fine-graded mixture
- ?

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Questions?

Answer:

Yes, I really did catch it! 67 lb wahoo off Port Aransas.