



# Perpetual Pavements

Design and Construction Concepts

# Empirical Design

- AASHO road test procedure (1958)
- Updated in 1993 AASHTO Pavement Guide
- Pavement designed to fail after a certain number of load repetitions
- Increased number and size of loads require thicker pavements

# Mechanistic Design

Moving toward design tools based on:

- Strengths of materials
- Stress-strain relationships

# Endurance Limit Theory

- Research by Monismith and McLean at Cal-Berkeley (2) indicates that HMA exhibits an “endurance Limit” (strain level) below which fatigue damage does not accumulate.

# Endurance Limit Theory

Thompson and Carpenter, University of Illinois, (1) conclude:

- Data supporting the concept of an endurance limit” for HMA have been presented for a wide variety of mixtures,
- Each mixture may have an individual endurance limit, but in no case has it been shown that a value lower than 70 micro-strain is required
- Data indicating that overloads do not significantly alter the existence of an endurance limit have been presented

# Actual pavement performance

- The Transportation Research Laboratory (UK), Michael Nunn (3) reported that heavy duty HMA pavements in the UK did not show fatigue damage , even after carrying loads far in excess of their original design
- Similar experience in Washington, Ohio and other US states.

# Washington State Performance Data

- Study of Asphalt Pavements
- I - 90 Spokane to Seattle
- No Reconstruction of Any Pavement for Structural Reasons

# Ohio Performance

- Flexible pavements on Ohio's Interstate highways conservatively designed for 20 year life, after nearly 40 years of service, have never required replacement or major rehabilitation.
- In fact the Ohio DOT has never even done a LCCA for major rehabilitation of a flexible section.

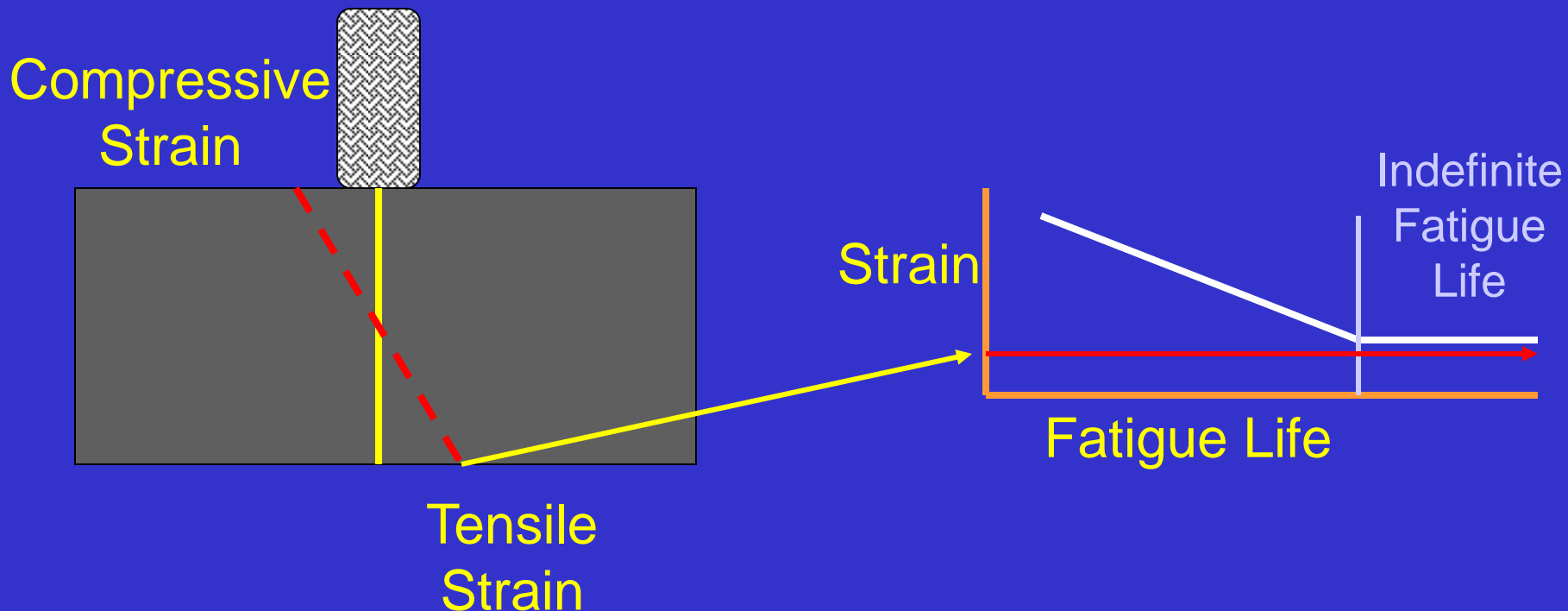


# Conclusion

- It should be possible to design and build HMA pavements that will never fail in fatigue and will have indefinite structural life
- The Perpetual Pavement Concept

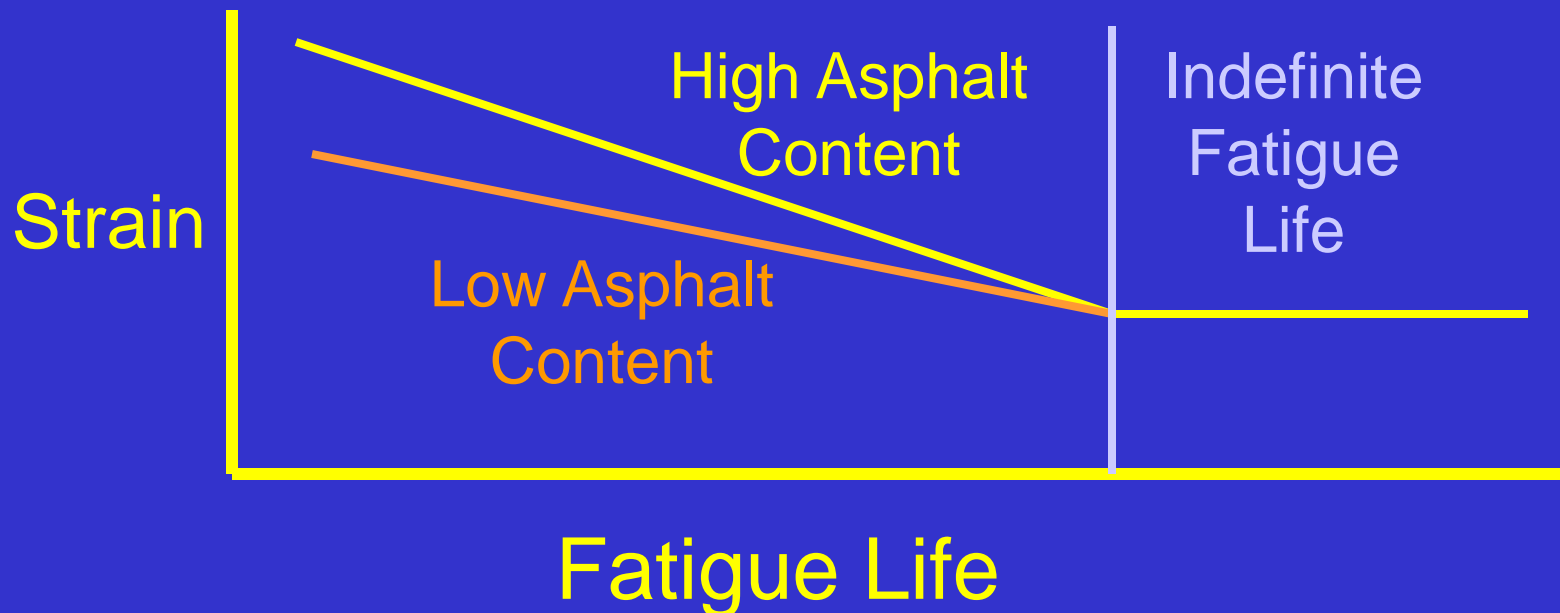
# Pavement Design Concepts

- Fatigue Resistant Asphalt Base
  - Minimize Tensile Strain with Pavement Thickness and/or higher strength
  - Thicker/stronger Pavement = Lower Strain
  - Strain Below Fatigue Limit = Indefinite Life



# Pavement Design Concepts

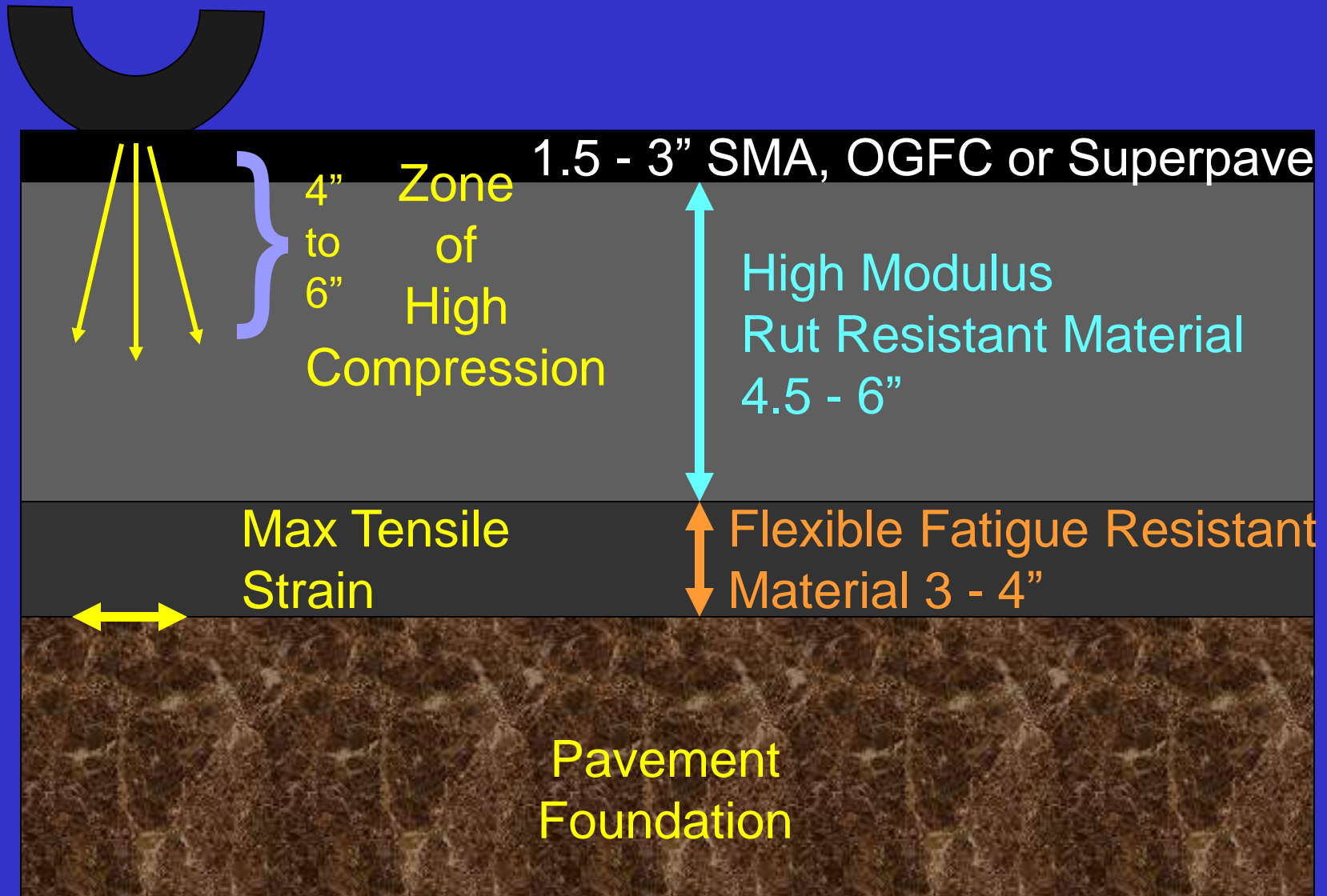
- Fatigue Resistant Asphalt Base
  - High Asphalt Content Mixes = Greater Strain Capability
  - Modified Binders = Greater Strain Capability



# Pavement Design Concepts

- Bottom-up Design and Construction
- Foundation
  - Stable Paving Platform – prepared, drained
  - Minimize Seasonal Variability and Volume Change in Service
- Fatigue Resistant Lower Asphalt Layer
- Rut Resistant Upper Asphalt Layers

# Pavement Design Concepts



# Design Concepts

## Existing

*Designed to fail after load repetitions*

*Empirical design principles employed*

*2 - layer design*

## Perpetual Pavement

*Designed to withstand ultimate load*

*Mechanistic design principles employed*

*3-layer design system*

Absolutely Asphalt ...For Cost, For Convenience, For Comfort !!

# Perpetual Pavement

- Structure Lasts 50+ years.
  - Bottom-Up Design and Construction
  - Indefinite Fatigue Life
- Renewable Pavement Surface.
  - High Rutting Resistance
  - Tailored for Specific Application
- Consistent, Smooth and Safe Driving Surface.
- Avoids Costly Reconstruction.

# Perpetual Pavement

## Summary

### **build a Perpetual Pavement**

*By designing for the fatigue limit of the material rather than traffic repetitions.*

*By employing mechanistic design principles.*

*By using a 3-layer design*

**Absolutely Asphalt ...For Cost, For Convenience, For Comfort !!**



# The Ohio Demonstration Project

- Relocated US 30 at Wooster
- Open to traffic December , 2005
- 16 ½ inch thick HMA, 3-layer design
- Fully instrumented, for environmental factors, loads, deflection
- Materials and design assumptions to be evaluated through research.

# The Ohio Demonstration Project

US 30 Perpetual Pavement  
Demonstration Project



JUN 21 2005

# The Ohio Demonstration Project

## **Instrumentation:**

- Weigh-in-motion scales
- Deflection measurement
- Load cells
- Strain gages at every level of the pavement
- Temperature and moisture measurement throughout

# The Ohio Demonstration Project



# PerRoad Express

- PerRoadXpress is an easy-to-use, all-on-one-screen program for designing Perpetual Pavements for low- and medium-volume roads and parking lots.
- <http://www.eng.auburn.edu/users/timmdav/PerRoadXPress.msi>

# For more Information

- [www.flexiblepavements.org](http://www.flexiblepavements.org)



- *Ohio Asphalt* magazine

# References

1. Fatigue Design Principles for Long Lasting HMA Pavements, Thompson and Carpenter
2. Technology of Thick Lift Construction: Structural Design Considerations, Monismith and McLean, Proceedings, AAPT, Vol. 41, 1972
3. Long Life Flexible Pavements, proceedings Eighth International Conference on Asphalt Pavements, 1997

# Questions?

- About Perpetual Pavement?
- Anything else?

