ASPHALT

THE SMOOTH QUIET RIDE

ASPHALT 100% RECYCLABLE

2016 Local Roads Workshop

Perpetual Pavement

Asphalt Pavement Association of Michigan

MICHIGAN RIDES ON US Asphalt.

Asphalt Pavement Association of Michigan

Perpetual Pavements

Perpetual Pavements

Topics

- Introduction
- Design Considerations
- HMA Layers
- Michigan's Projects
- Summary
- Resources

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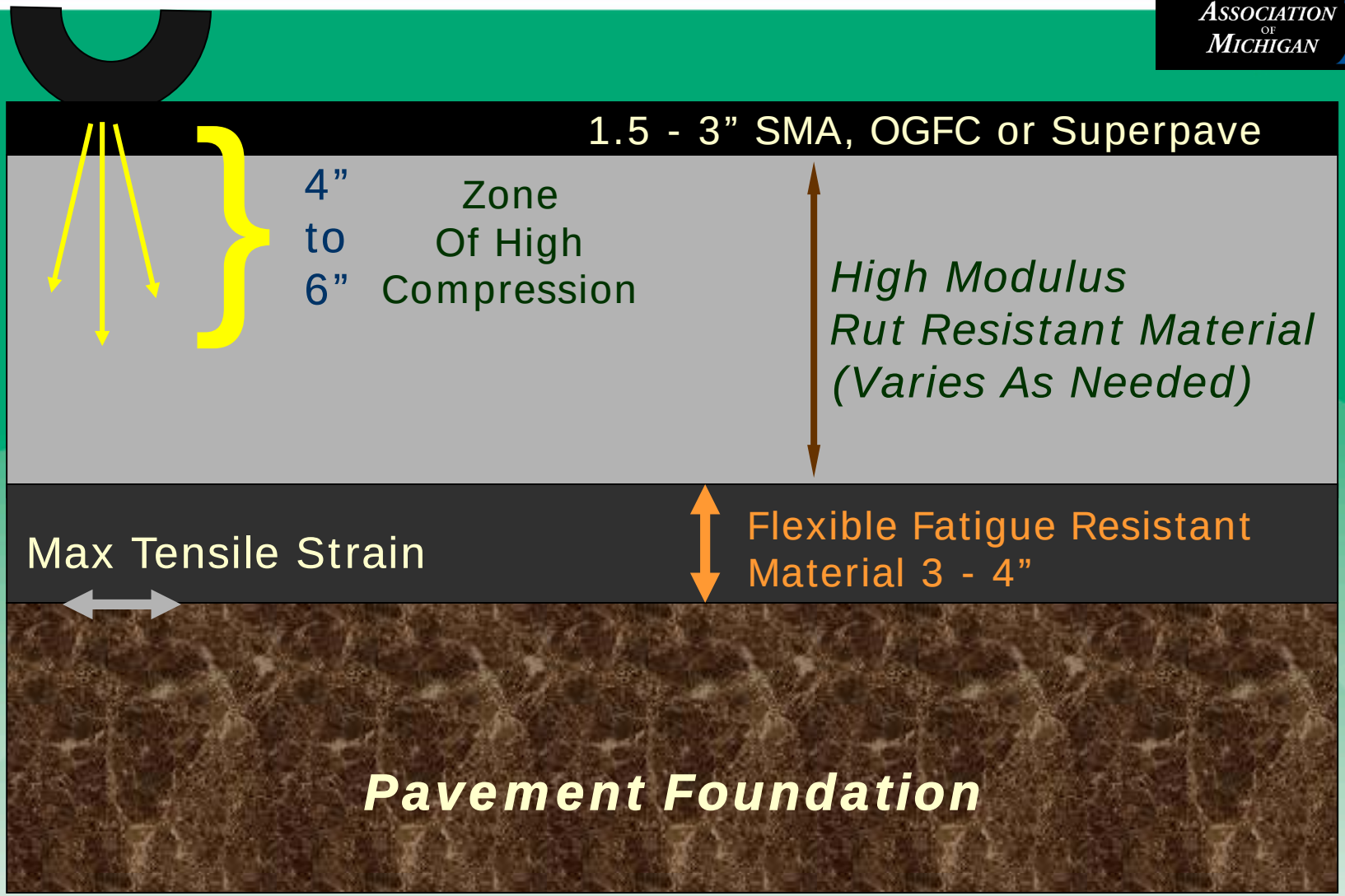
Introduction

- Not a new concept
  - Full-Depth
  - Deep Strength
  - Mill & Fill
  - Not just for Freeways

Perpetual Pavements



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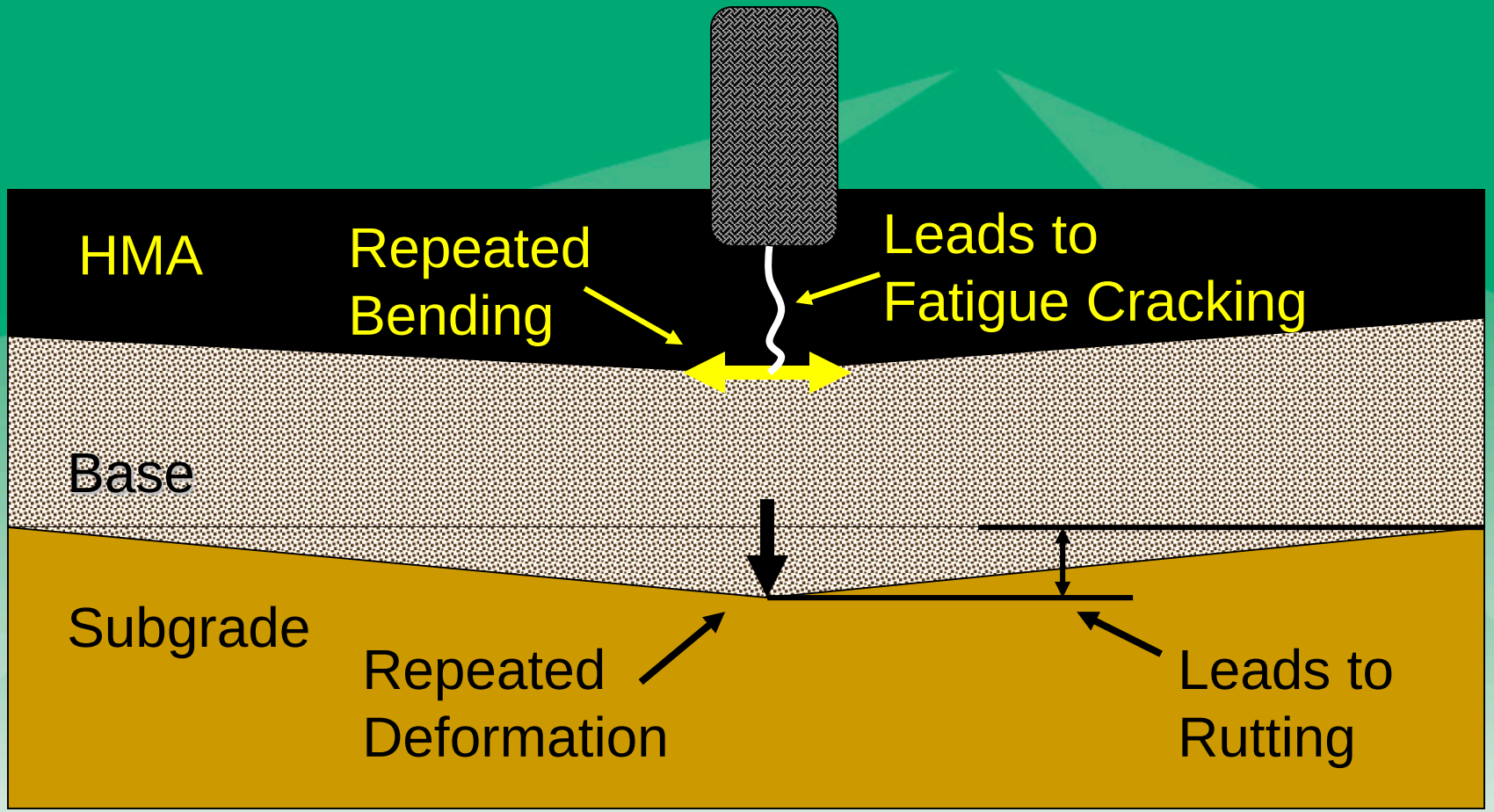
Performance Goals - Avoid These



Perpetual Pavements

- Bottom-up Design and Construction
- Foundation
  - **Stable Paving Platform**
  - **Minimize Seasonal Variability and Volume Change in Service**
  - **Adequate Drainage / Drainage Maintenance**
- Fatigue Resistant Lower Asphalt Layer
- Rut Resistant Upper Asphalt Layers

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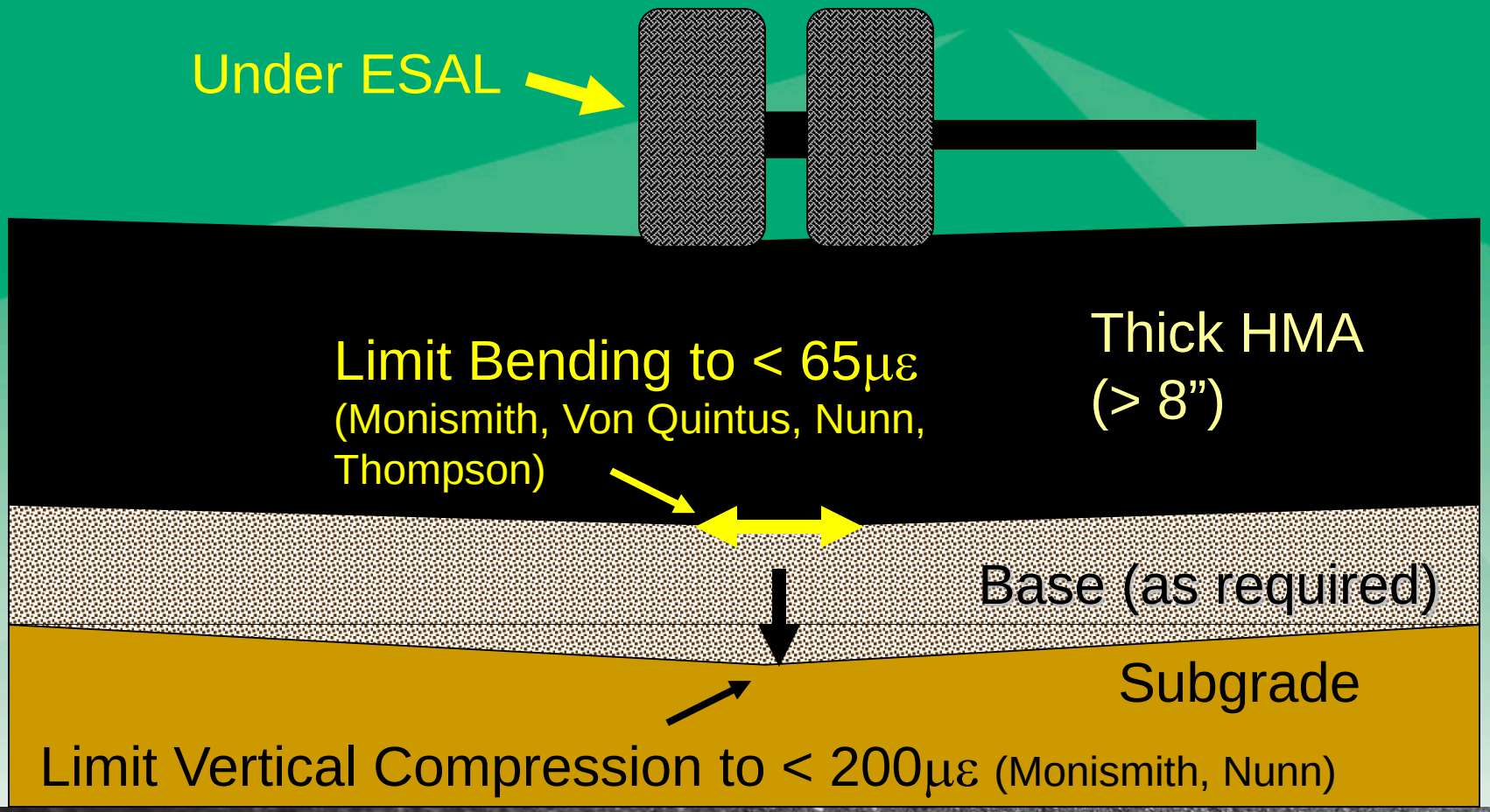
Mechanistic Performance Criteria



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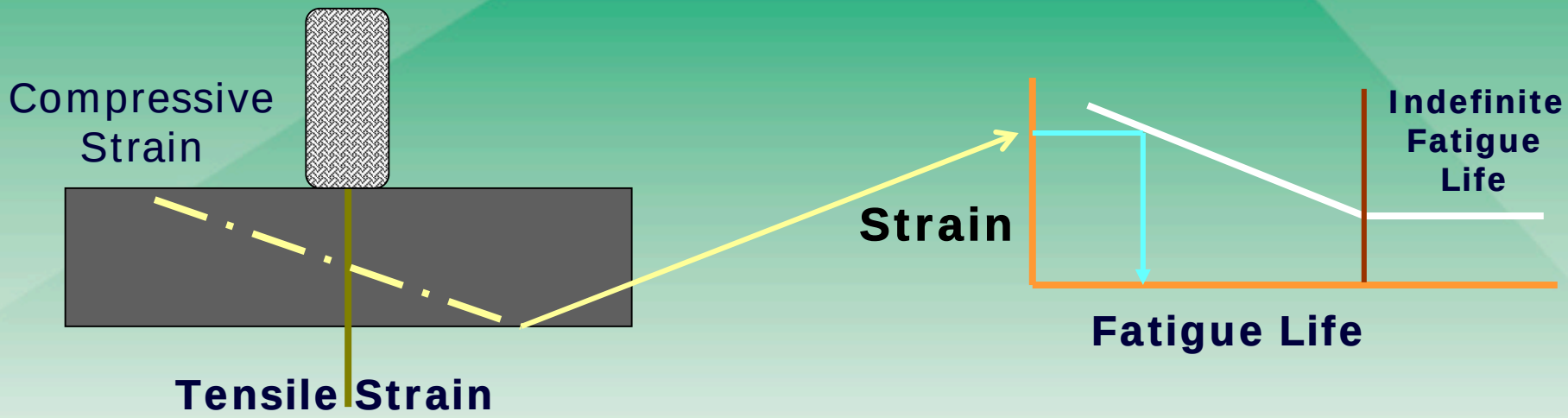
HMA Considerations

- HMA Base Layer
- Intermediate Layer
- Wearing Surface

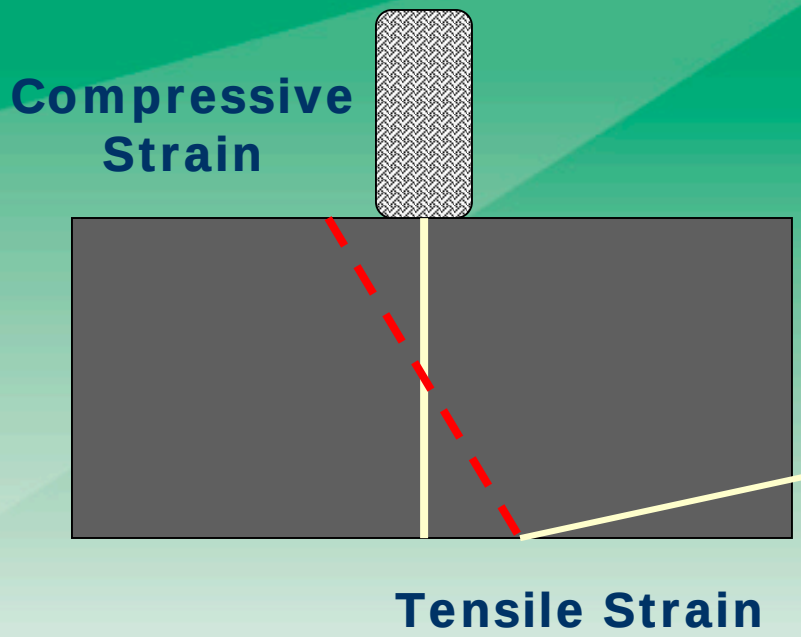
Perpetual Pavements

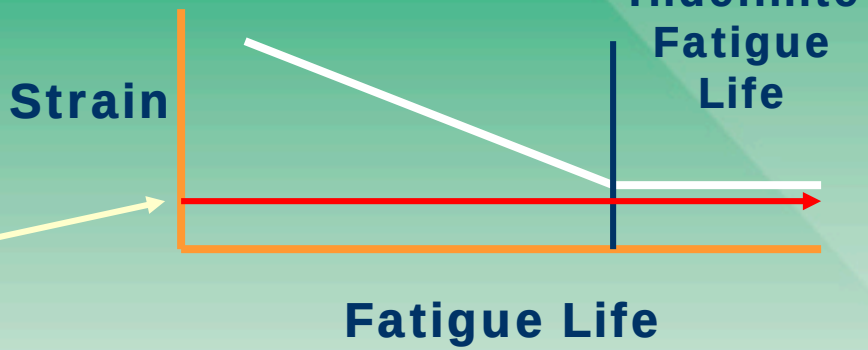
- Fatigue Resistant Asphalt Base
  - Minimize Tensile Strain with Pavement Thickness
  - Thin Asphalt Pavement = **Higher Strain**
  - Higher Strain = **Shorter Fatigue Life**



Perpetual Pavements

- Fatigue Resistant Asphalt Base
  - Minimize Tensile Strain with Pavement Thickness
  - Thicker Asphalt Pavement = **Lower Strain**
  - Strain Below Fatigue Limit = **Indefinite Life**





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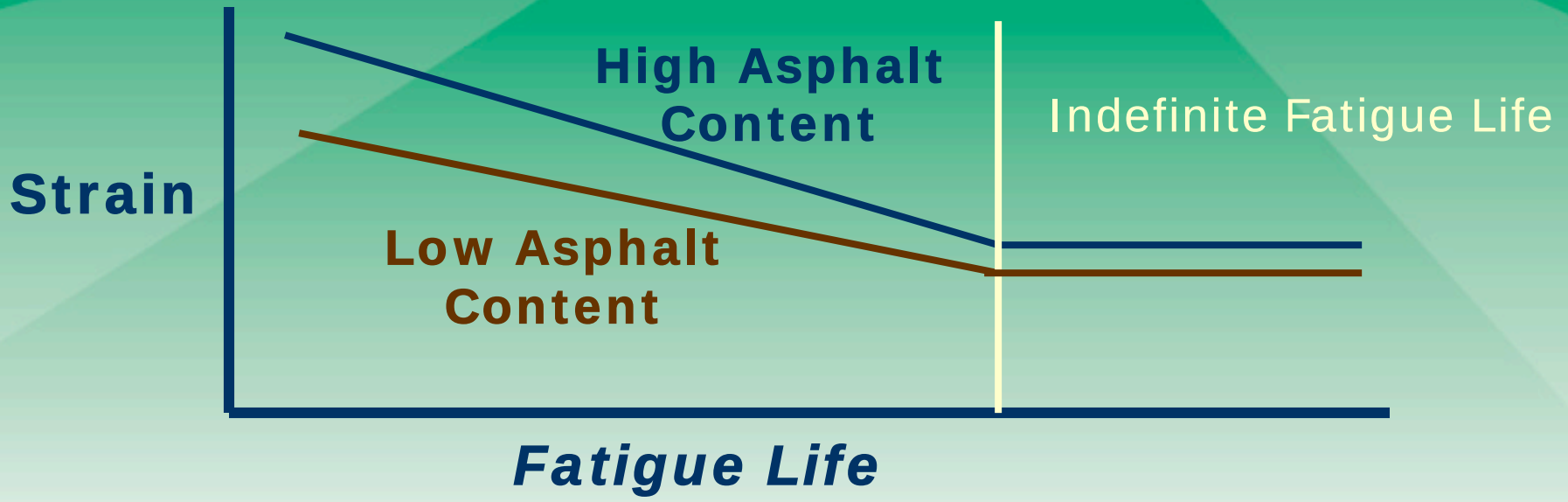
- Fatigue Resistant Asphalt Base
  - » High Effective Asphalt Content Mixes = **Greater Strain Capability**
  - » Modified Binders = **Greater Strain Capability**



Perpetual Pavements

- Rut Resistant Upper Layers
  - **Aggregate Interlock**
    - » ***Crushed Particles***
    - » ***Stone-on-Stone Contact***
  - **Binder**
    - » ***High Temperature PG***
    - » ***Polymers***
    - » ***Fibers***
  - **Air Voids**
    - » ***Avg. 4% to 6% In-Place***
  - **Surface**
    - » ***Renewable***
    - » ***Tailored for Specific Use***

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How do we know it works??

Perpetual Pavements

Performance of Washington Interstate Flexible Pavements (based on 176 mi.)

Statistic	Time Since Original Construction (years)	Thickness of Original AC (in.)	Time from Original Construction to First Resurfacing (years)
Average	31.6	9.2	12.4
Range	23 to 39	4 to 13.6	2 to 25

Perpetual Pavements

Performance of Washington Interstate Flexible Pavements (based on 176 mi.)

Statistic	Age of Current Wearing Course (years)	Current IRI (in/mi)	Current Rut Depth (in)
Range	0 to 27	25.4 to 82.6	0.04 to 0.28

Perpetual Pavements

Ohio Study of Flexible Pavements

- Examined Performance on 4 Interstate Routes
  - HMA Pavements - Up to 34 Years without Rehabilitation or Reconstruction
  - "No significant quantity of work . . . for structural repair or to maintain drainage of the flexible pavements."
  - Only small incremental increases in Present Cost for HMA pavements.

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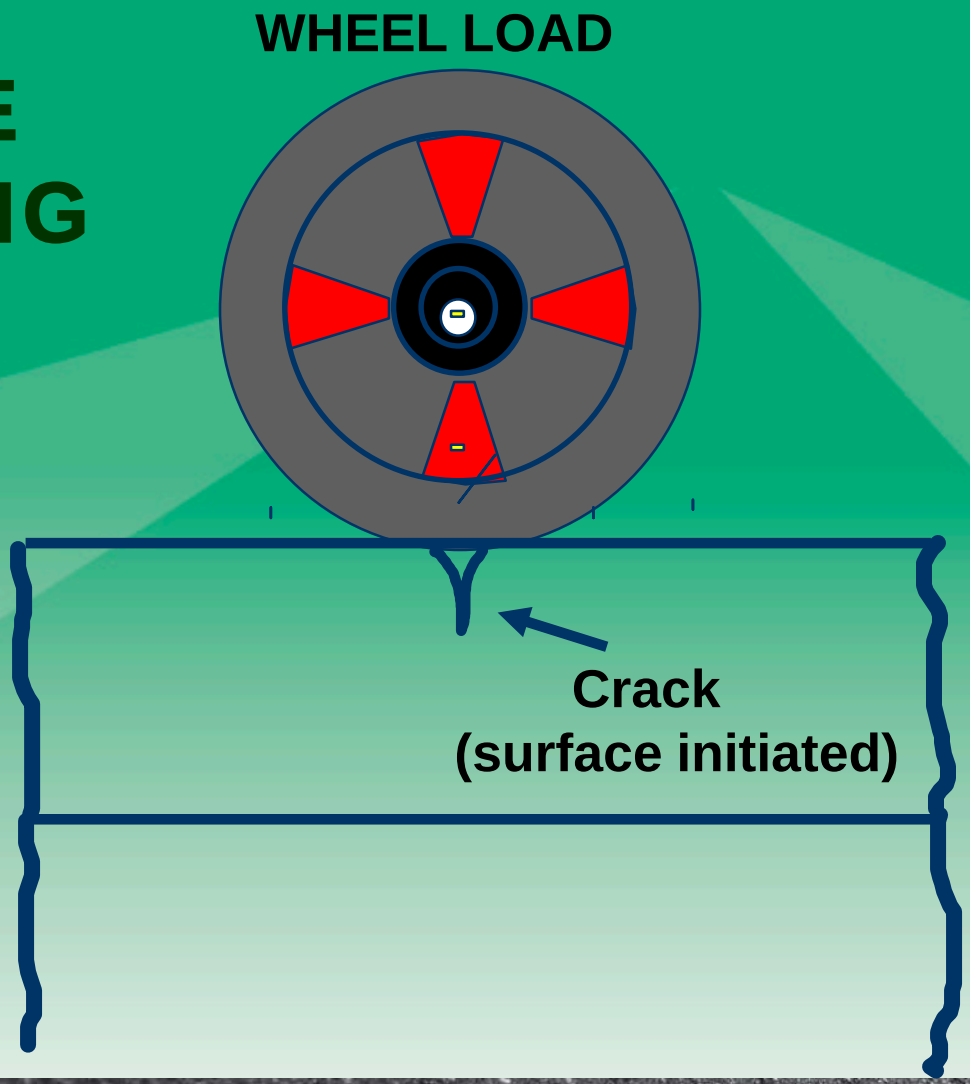
SURFACE CRACKING



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New Jersey I-287 Surface Cracking

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Washington State - Top-Down in Asphalt Pavements > 150 mm

Rehabilitation

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Possible Distresses

- *Top-Down Fatigue*
- *Thermal Cracking*
- *Raveling*

Solutions

- *Mill & Fill*
- *Thin Overlay*

Structure Remains Intact

2 - 4”

Perpetual Pavements

FHWA - Data from Long-Term Pavement Performance Study

- **Data from GPS-6 (FHWA-RD-00-165)**
- **Conclusions**
  - *Most AC Overlays ≥ 15 years before Rehab*
  - *Many AC Overlays > 20 years before Significant Distress*
  - Thicker overlays mean less:
    - Fatigue Cracking
    - Transverse Cracking
    - Longitudinal Cracking

Perpetual Pavements

MDOT Perpetual Pavement Project: US-24

- US 24 (Telegraph Rd)– M-5, south 1.25 miles, northbound lanes only
- Industry / MDOT Partnership
- State of the Art Pavement design concepts
- Constructed in 2002
- Intensive Material Sampling & Testing
- Performance Monitoring

Perpetual Pavements

MDOT Perpetual Pavement Project: US-24

- **Perpetual Pavement**
- 2.5” ,4E10 ,PG 70-28P
- 3.0” ,3E10 ,PG 70-22P
- 4.5” , 2E10,PG 58-28

  10”
- 12.” 21AA Agg. Base
- 14” Sand Subbase
- 36” Total Section

- **Regular Mdot design**
- 2.0” ,5E10,PG 70-22P
- 2.5” ,4E10,PG 70-22P
- 4.0” ,3E10,PG 58-28

  8.5”
- 6.4” ,21AA Agg.Base
- 18.4” Sand Subbase
- 33.3” Total Section

Perpetual Pavements

MDOT Perpetual Pavement Project: US-24

- **Other Design Changes** :
- Increased mat density requirement

  + 1% for Surface & Leveling Courses

  + 2% for Base course

  Base course mixture properties

  3% design air voids

  + 1% increase in minimum VMA

Perpetual Pavements

I-96 Perpetual Pavement Demonstration Project

- I-96, M39 to Schaeffer Road approximately 2.7 miles
- West Bound Express Lanes
- 3 Lanes
- Construction – Fall 2005

Perpetual Pavements

I-96 Perpetual Pavement Demonstration Project

- Very High Traffic Loads
- Average Daily Truck Traffic– 9,600
- 20 yr. ESALS, One way - 22,694,400
- 40 yr. ESALS, One way – 56,400,000

Perpetual Pavements

I-96 Perpetual Pavement Demonstration Project

- 1.5” Surface
- 2.5” Leveling
- 10” Base
  14”
- 16” OGDC Aggregate Base
  (21AA-Mod)
  (Geo Textile Fabric)
- 8” Sand Subbase Class IIA
  38” Total Pavement Section

Lime Stabilized Subgrade

Perpetual Pavements

APA Perpetual Pavement Award

The APA (Asphalt Pavement Alliance) is a partnership between NAPA, the State Asphalt Pavement Associations (SAPA) and the Asphalt Institute.

Since 2001, the APA's Perpetual Pavement Award program has recognized 100 long-life pavements in 30 U.S. states and one Canadian province.

These Roads were all at least 35 years old when honored, and have never experienced a structural failure.

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APA Perpetual Pavement Award

Award Criteria:

- Greater than 35 years
- No more than 4 inches of HMA structure added over life.
- Average interval of resurfacing of greater than 13 years.

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2007 Award Winner: M-24, Tuscola Co.

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2009 Award Winner: US-31, Ottawa and Muskegon Co.

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2015 Award Winner: M-20, Isabella Co.

Just announced in March!

Perpetual Pavements

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Summary

- 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.
- Environmentally Friendly.
- Avoids Costly Reconstruction and Disruption.

Rehabilitation

Asphalt Pavement Association of Michigan

Possible Distresses

- *Top-Down Fatigue*
- *Thermal Cracking*
- *Raveling*

Solutions

- *Mill & Fill*
- *Thin Overlay*

Structure Remains Intact

2 - 4”

Perpetual Pavements

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Resources

The Perpetual Pavement concept was first articulated in 2000 and the concept has rapidly gained acceptance.

The APA's newest technical document on the subject is Perpetual Asphalt Pavements: A Synthesis. This comprehensive publication captures the activities that have taken place over the last decade, synthesizes the information in way that is useful to providing guidance for Perpetual Pavement design and construction, and provides a vision for further research and development to refine Perpetual Pavements.

Perpetual Pavement Design Software
The APA offers two versions of its software for the design and analysis of Perpetual Pavements. Both versions of the software are available as free downloads.

PerRoad 3.5
PerRoad is uses the mechanistic-empirical design philosophy. The program couples layered elastic analysis with a statistical analysis procedure (Monte Carlo simulation) to estimate stresses and strains within a pavement. In order to predict the strains which would prove detrimental for fatigue cracking or structural rutting, PerRoad requires the following inputs:

- Seasonal pavement moduli and annual coefficient of variation (COV)
- Seasonal resilient moduli of unbound materials and annual COV
- Thickness of bound materials and COV
- Thickness of unbound materials
- Load spectrum for traffic
- Location for pavement response analysis
- Magnitude of limiting pavement responses
- Transfer functions for pavement responses exceeding the user-specified level for accumulating damage

Download PerRoad 3.5 now

PerRoadXpress 1.0
PerRoadXpress is an easy-to-use, all-on-one-screen program for designing Perpetual Pavements for low- and medium-volume roads and parking lots. The designer chooses a type of asphalt cement. PerRoadXpress then allows the designer either to use defaults for traffic and soil, or to input the actual values if they are known. Granular base thicknesses from 0 to 10 inches are included. The software quickly provides the user with a recommendation for the total thickness of asphalt pavement needed for a particular situation. PerRoadXpress was developed in response to requests by public works officials and owners of commercial property.

Download PerRoadXpress 1.0 now

http://www.asphaltroads.org/perpetual-pavement/about-perpetual-pavements/

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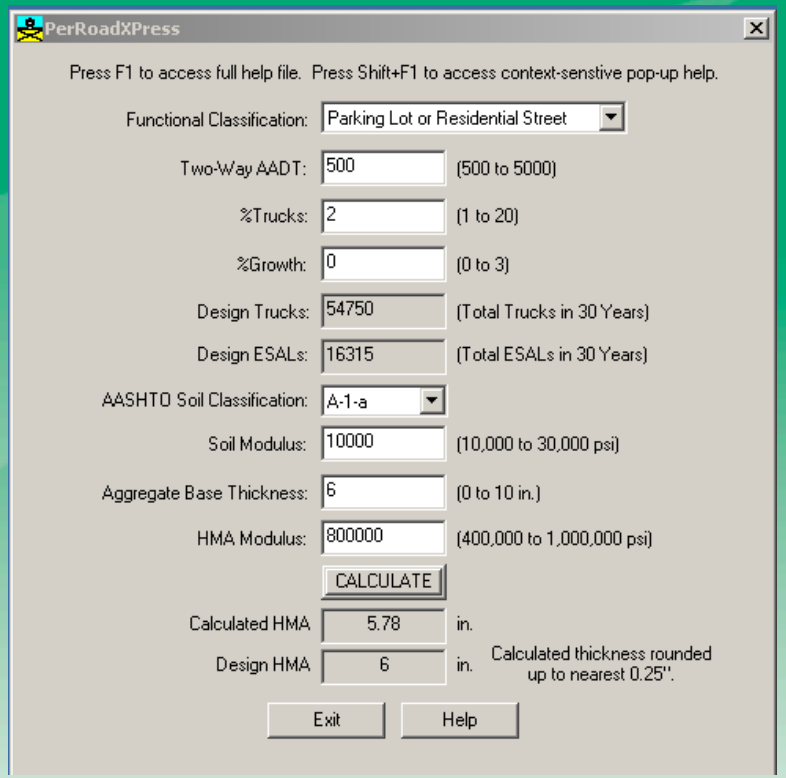
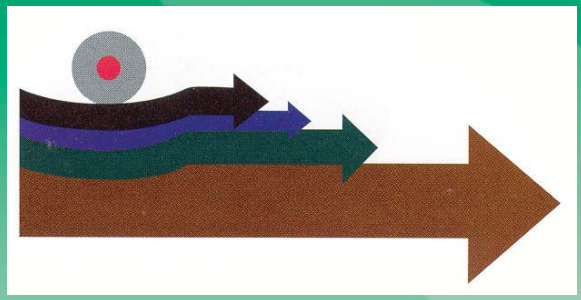
PerRoadXPress Software

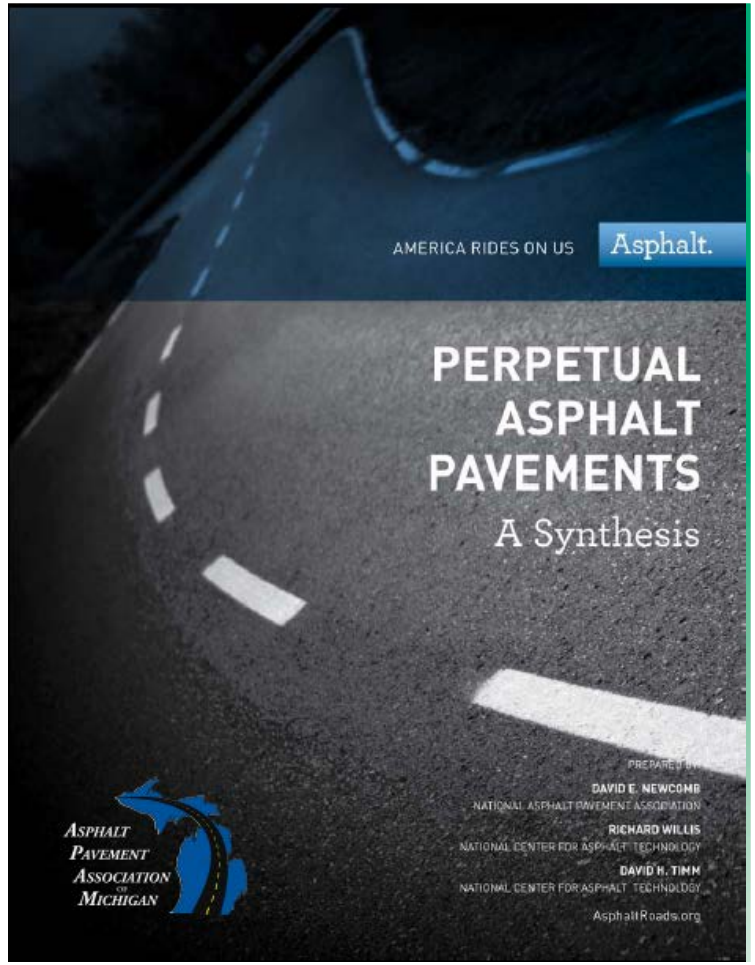


Resources



www.apa-mi.org

Perpetual Pavements



Resources

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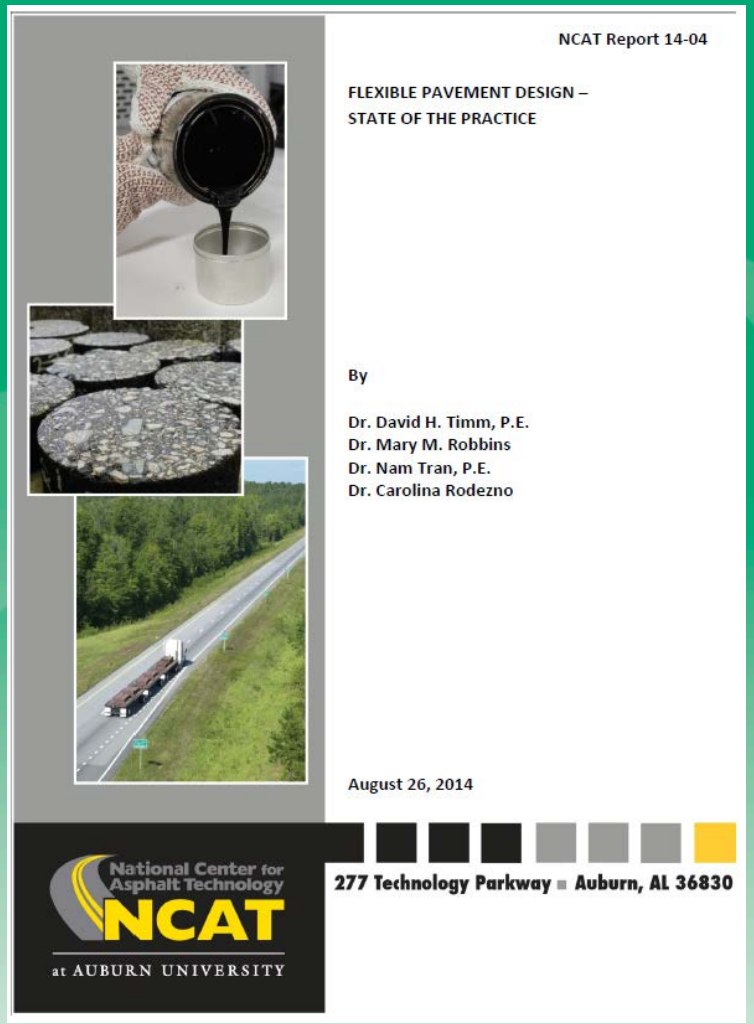
Resources



https://eng.auburn.edu/research/centers/ncat/files/reports/2014/rep14-04.pdf

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Questions?