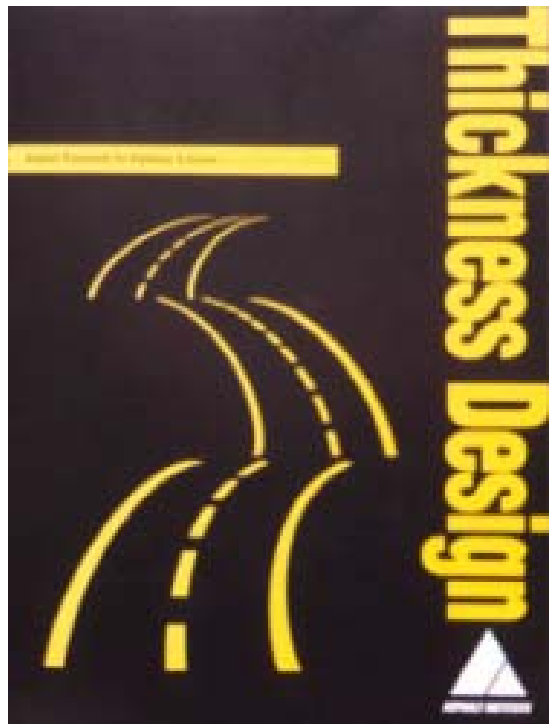


Perpetual Pavements

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Perpetual Pavement

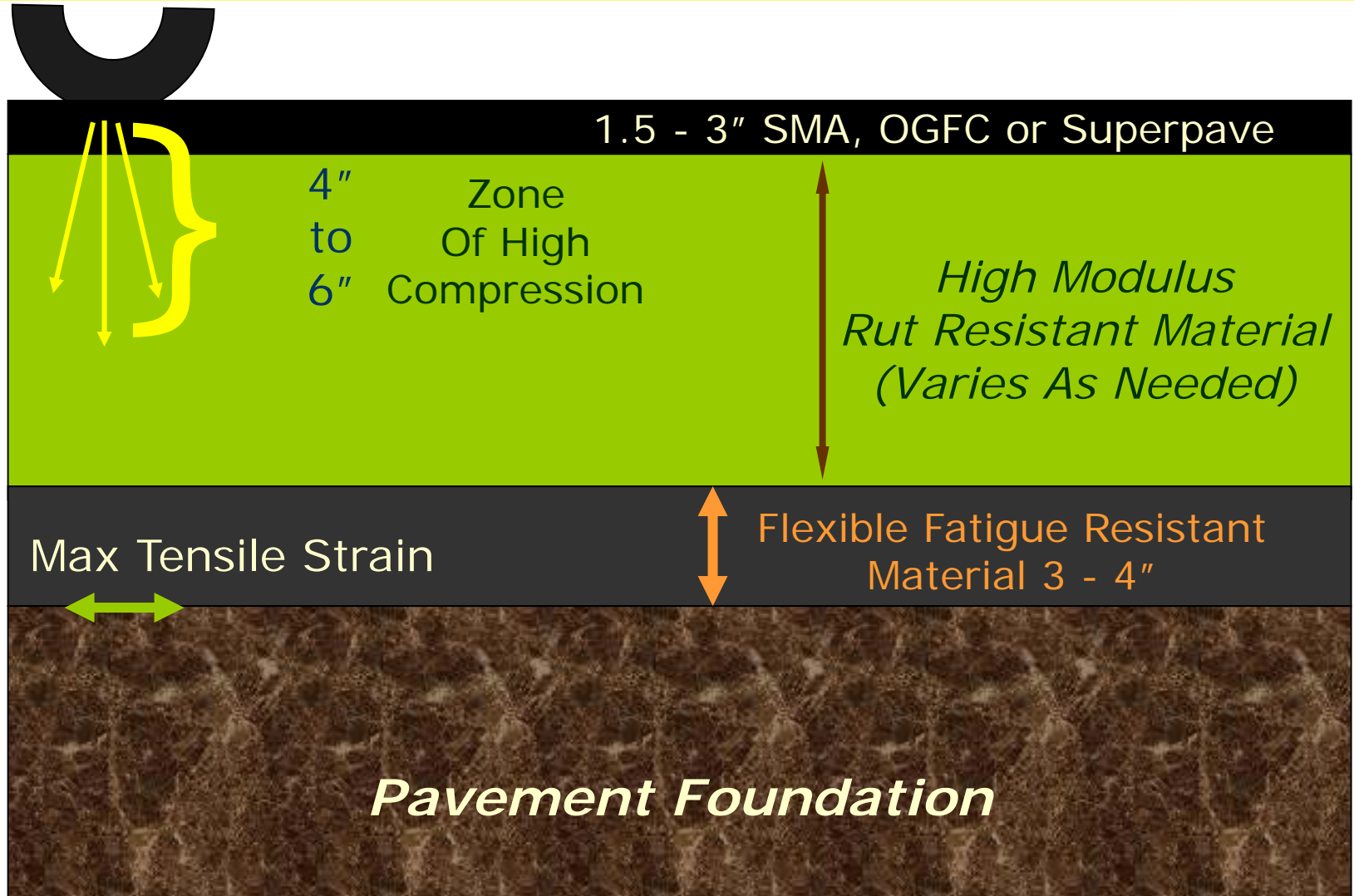


MS-1

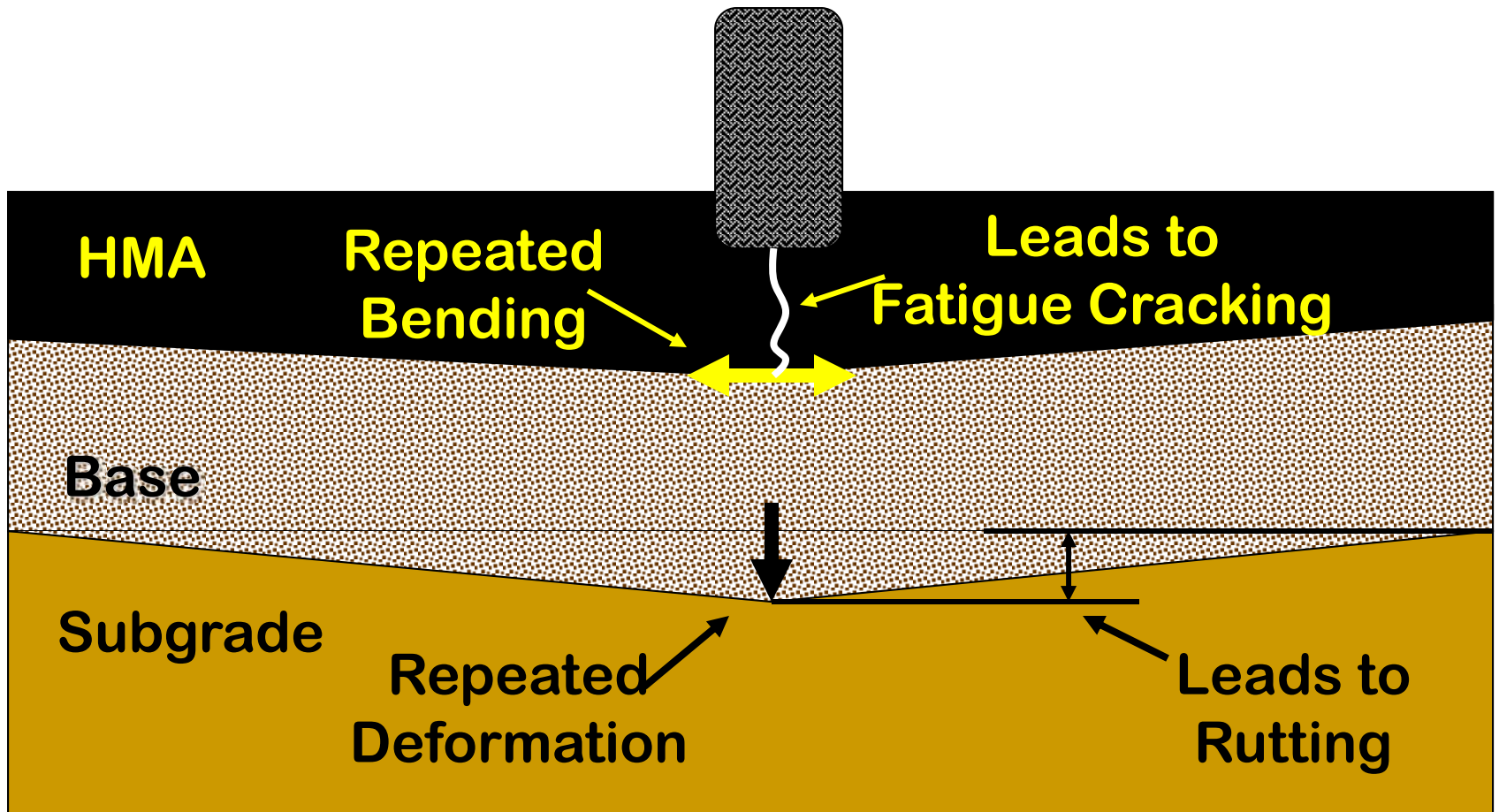
- Not a new concept
 - Full-Depth
 - Deep Strength
 - Mill & Fill



Perpetual Pavement Principles

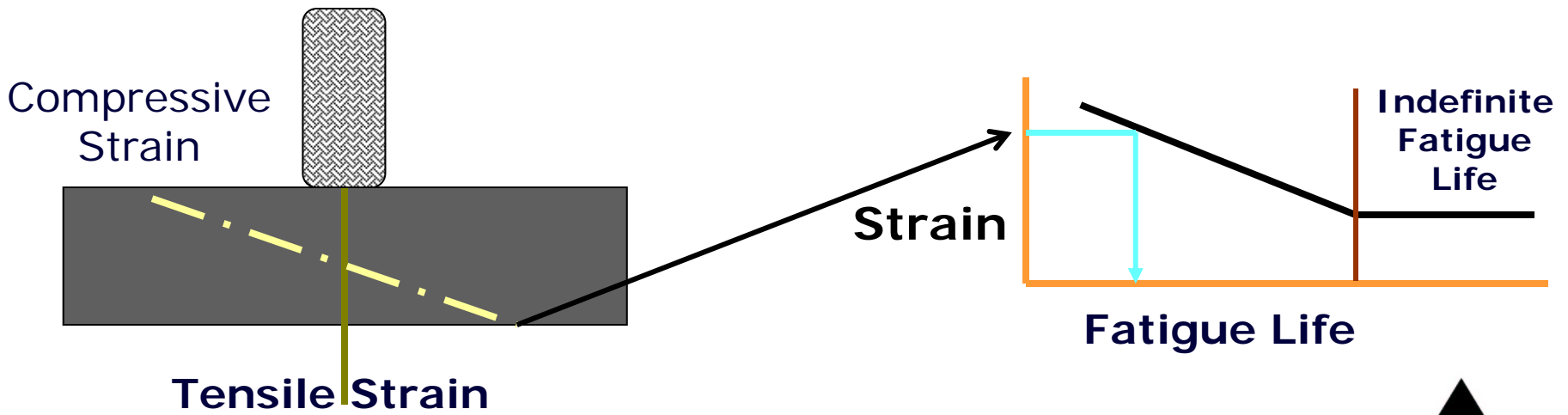


Fatigue and Rutting



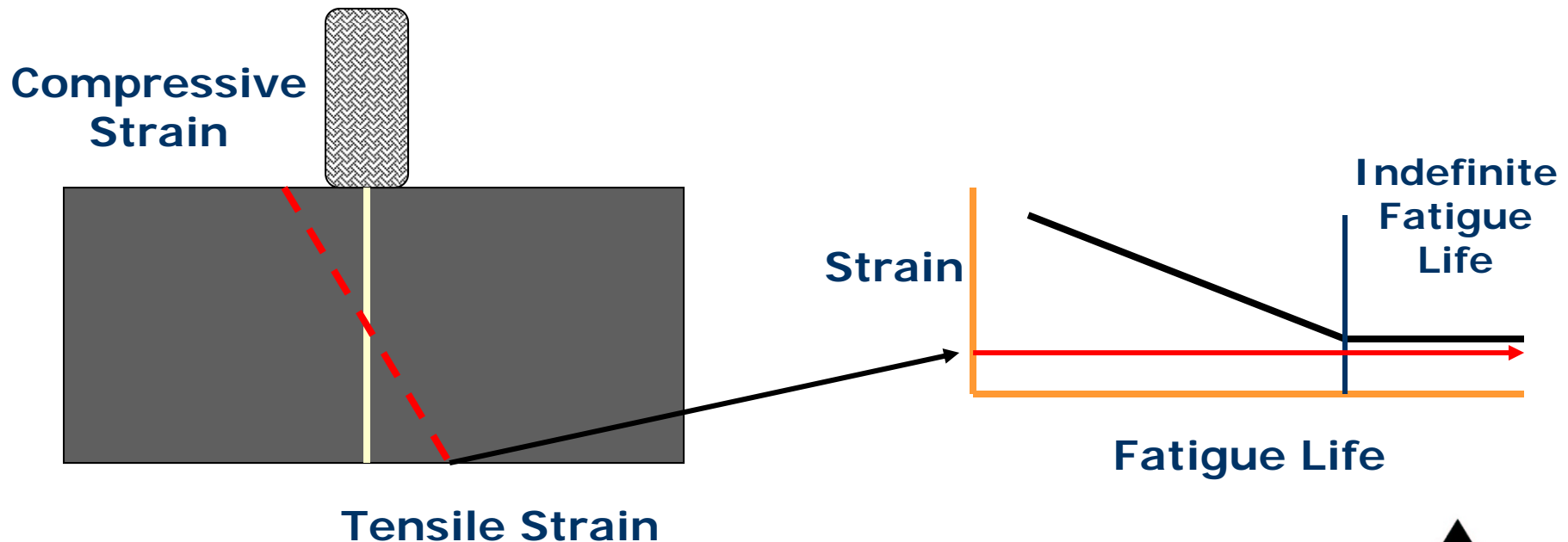
Thinner pavements – High Strain

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

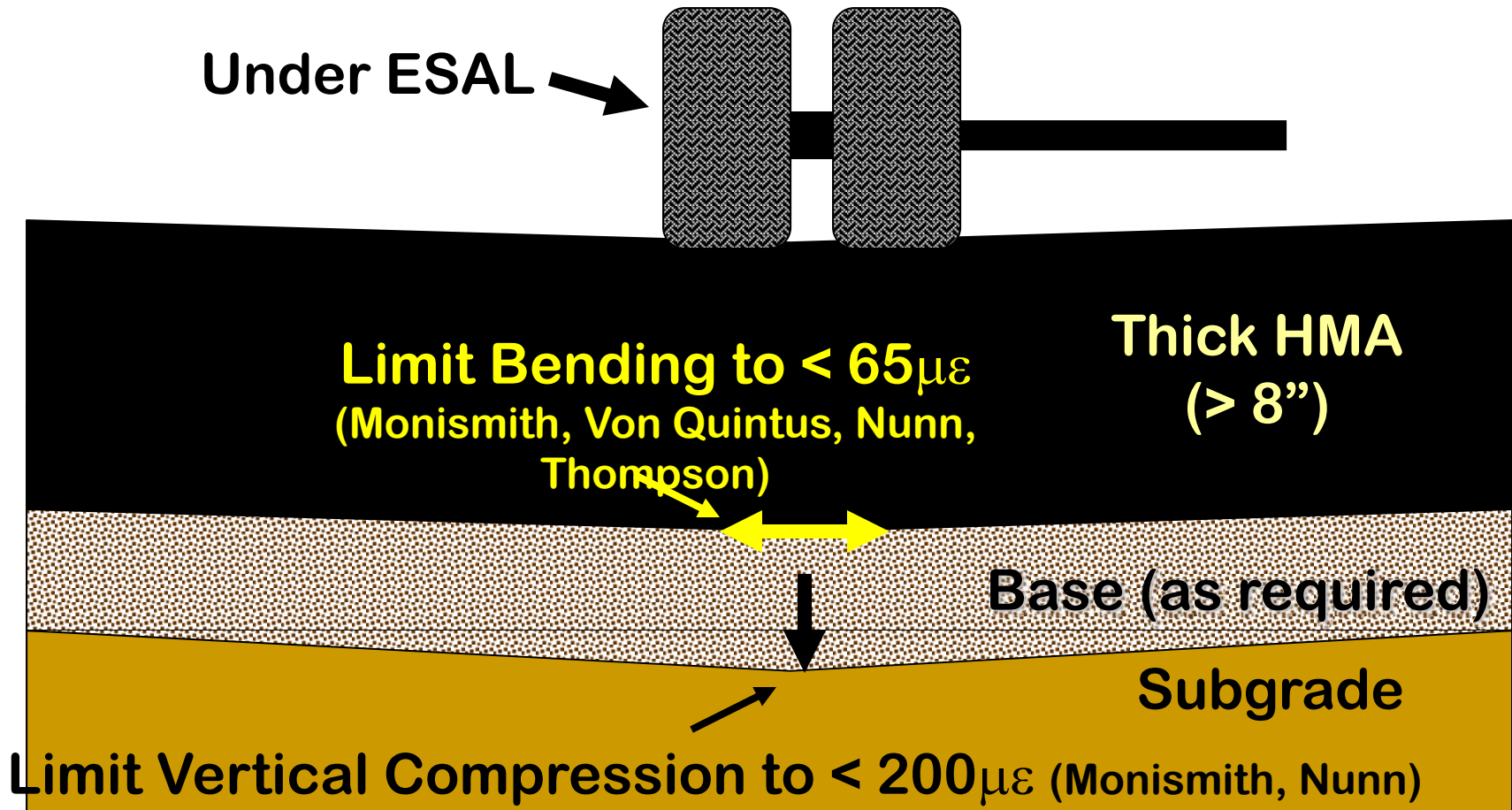


Thicker pavements – Low Strain

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



Mechanistic Performance Criteria



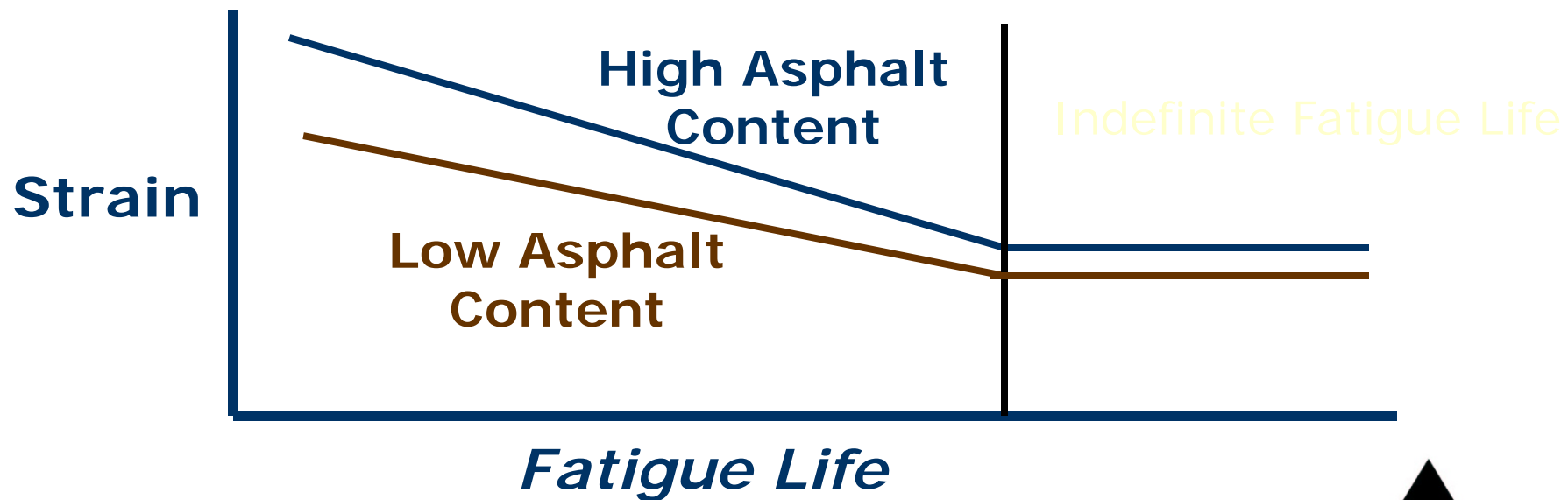
It starts with the Base

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

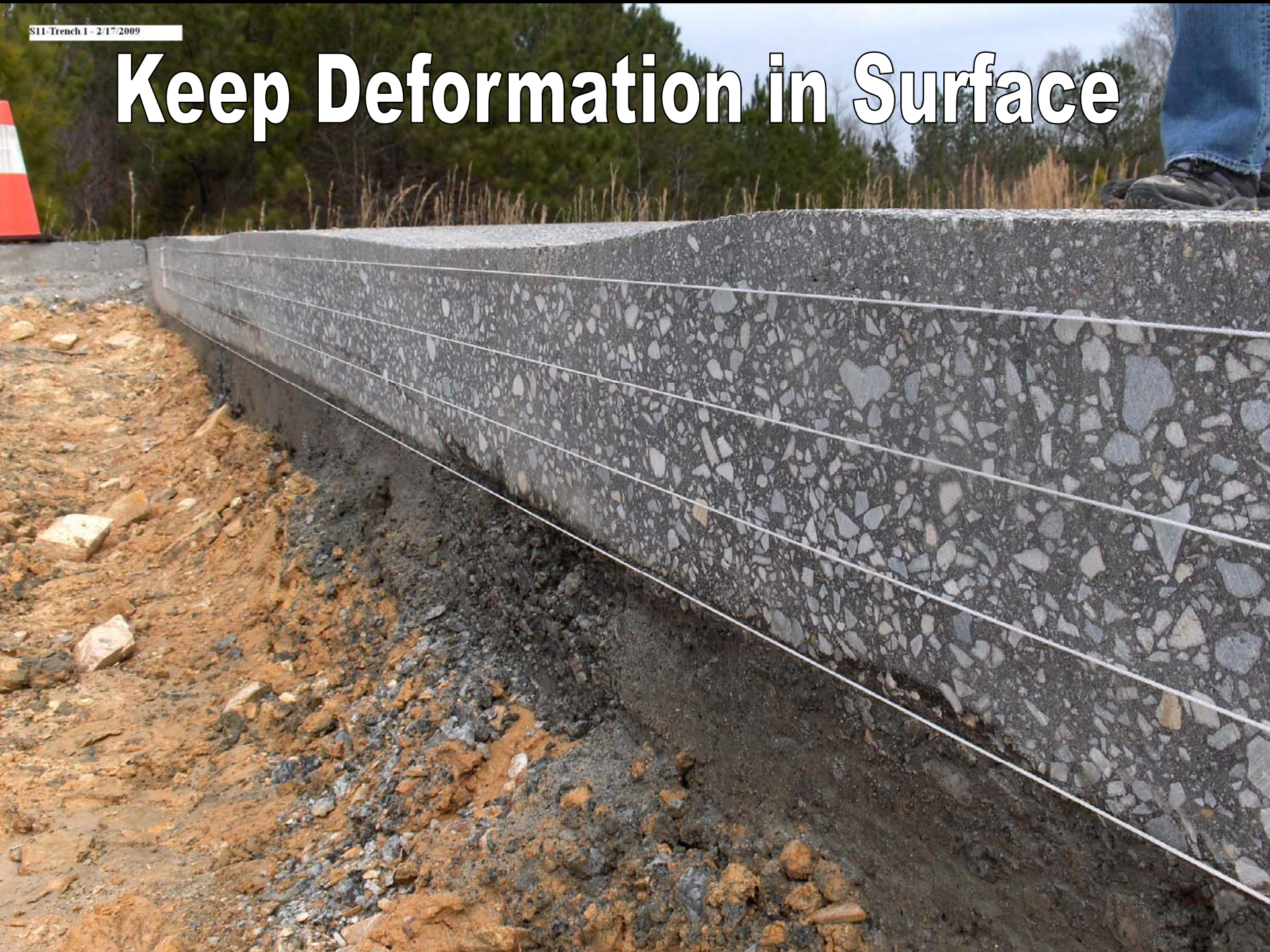


Fatigue Resistant Asphalt Base

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



Keep Deformation in Surface



Rut Resistant Upper Layers

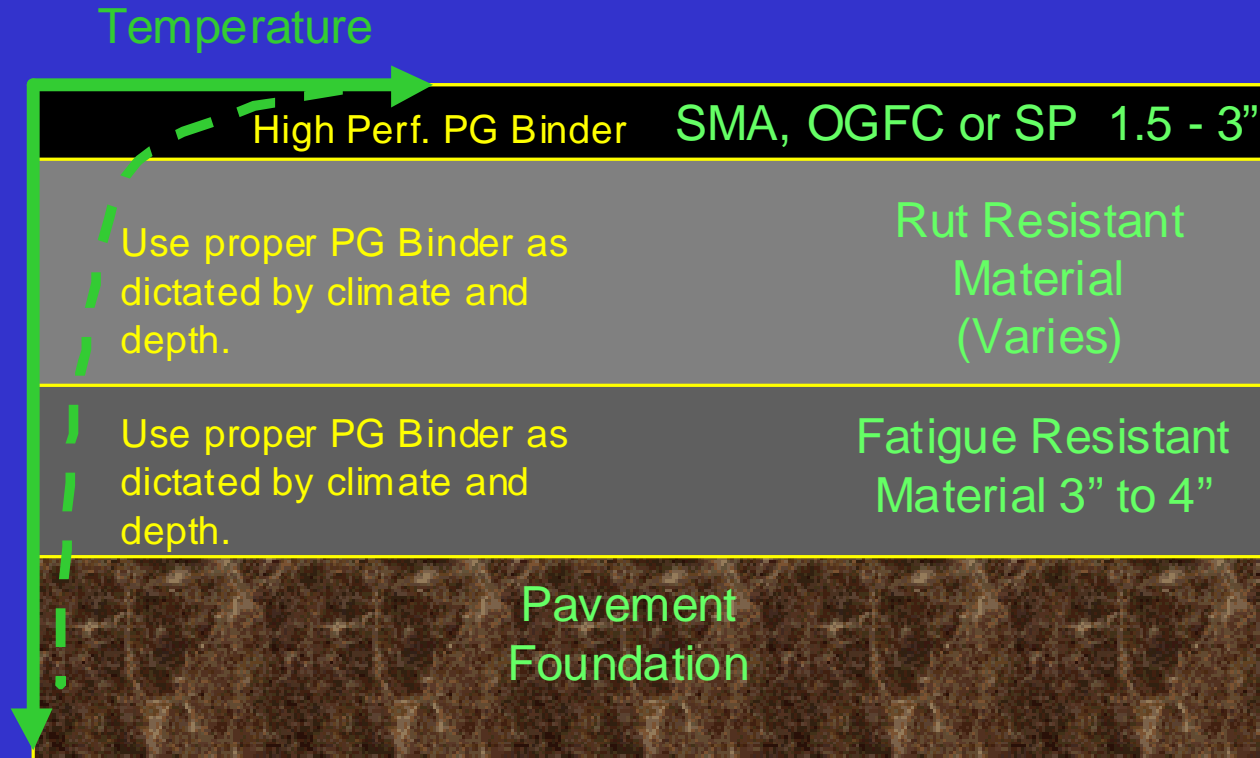


- **Aggregate Interlock**
 - » *Crushed Particles*
 - » *Stone-on-Stone Contact*
- **Binder**
 - » *High Temperature PG*
 - » *Polymers*
 - » *Fibers*
- **Air Voids**
 - » *Avg. 4% to 6% In-Place*
- **Surface**
 - » *Renewable*
 - » *Tailored for Specific Use*



Rut Resistant Upper Layers

- Rutting Occurs in Upper Asphalt Layers
 - **Full-Scale Tracks**
 - » *Mn/ROAD*
 - » *WesTrack*
 - » *NCAT*
 - **Accelerated Pavement Testing**
 - » *CalAPT*
 - » *FHWA*



Impact of Temperature Gradient on Asphalt Grade.

Low Temperature Cracking

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- Historical Performance
- Maintenance
- Maintain Mix Volumetrics
- Use proper Binder Grade



New Jersey Turnpike



- First Perpetual Award Winner
- Built in 1950
- Has never been reconstructed
- 175,000 ADT
- 40% Trucks

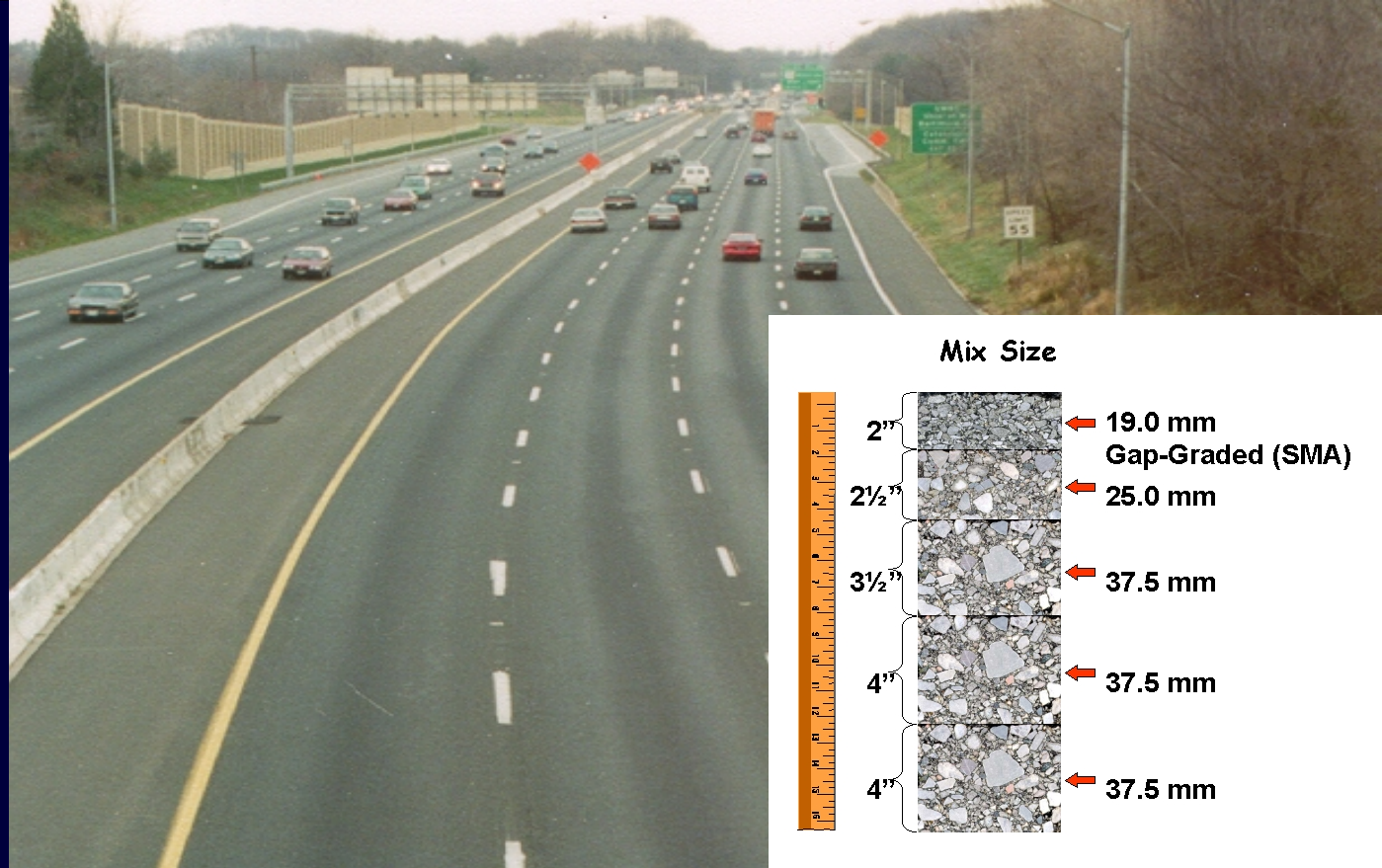


LOCATION
 I-695, NBL,
 Baltimore Beltway

COMPLETION DATE
 1993

19 mm GG
 AC-20 w/ fibers

TRAFFIC
 AADT - 175,000
 Trucks - 19%



PERFORMANCE DATA - 1999

<u>DENSITY, %MAX</u>	
<u>Wheelpath</u>	<u>Centerline</u>
99.0	98.4
98.0	96.0
97.5	95.5

PG BINDER GRADE

70-22

PAVEMENT DEFORMATION

ARAN average, 0.12"
 ARAN change, 0.04" (4 yr.)

Measurement, 1/8"



Perpetual Pavements in China

- Unregulated Loads
- 150,000-250,000# + Loads
- Will not purchase US or European Trailers
 - Build their own to accommodate loads
 - Use our wheel/axle configuration
- Perpetual Pavement Design by John D 'Angelo's Team
- **~15 inches**



Where can it be used?

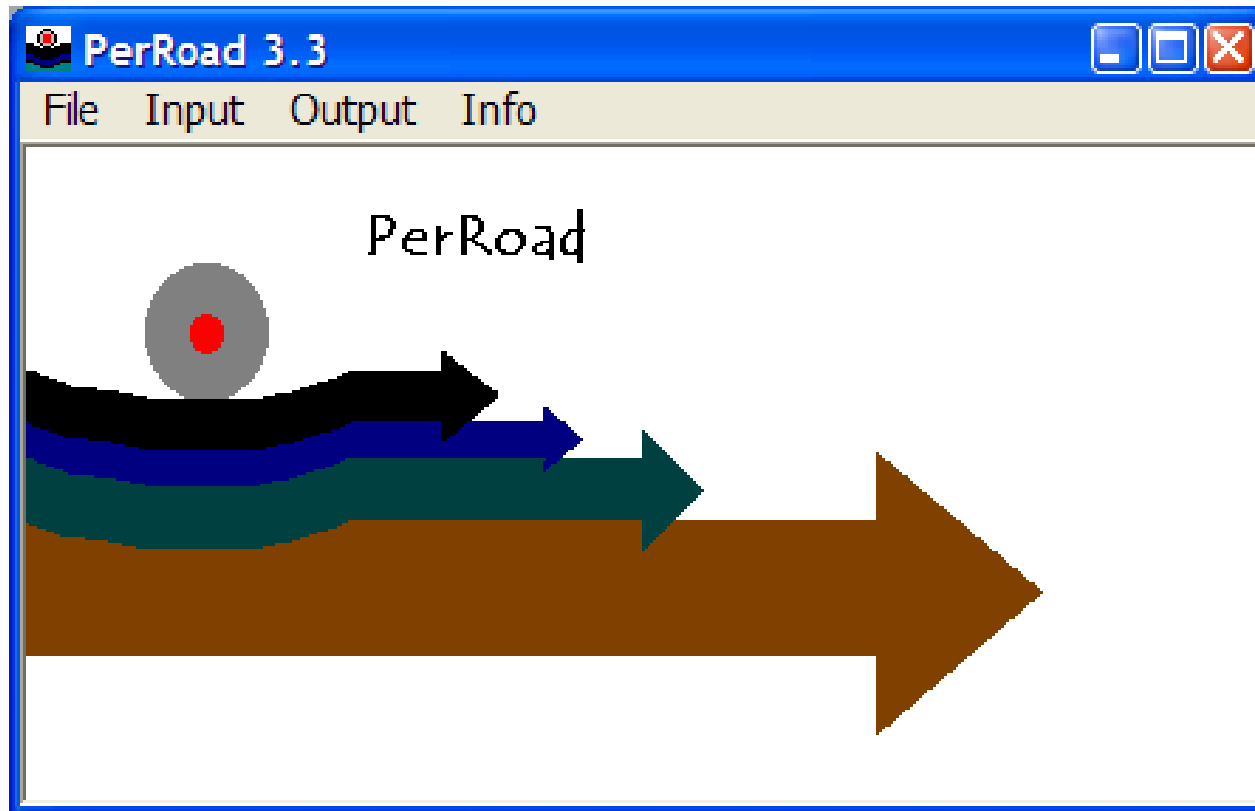
- Perpetual Pavements are not just for highway projects
- Many municipal pavements can also be designed as Perpetual Pavements
- Increasing the thickness of the hot mix layers by 25 to 35 percent will likely result in a perpetual pavement
- There are tools to allow municipalities to look at Perpetual Pavement options
- **PerRoad v3.3** and **PerRoadXPress v1.0** are both available free of Charge



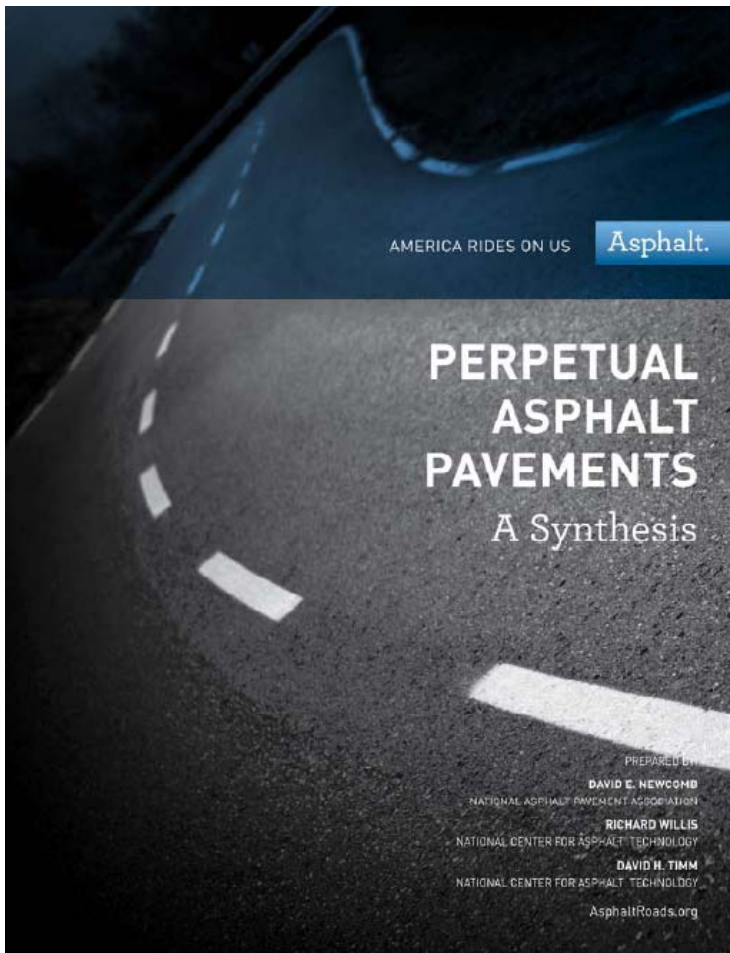


PerRoad 3.3

- Sponsored by APA
- Developed at Auburn University / NCAT
- M-E Perpetual Pavement Design and Analysis Tool

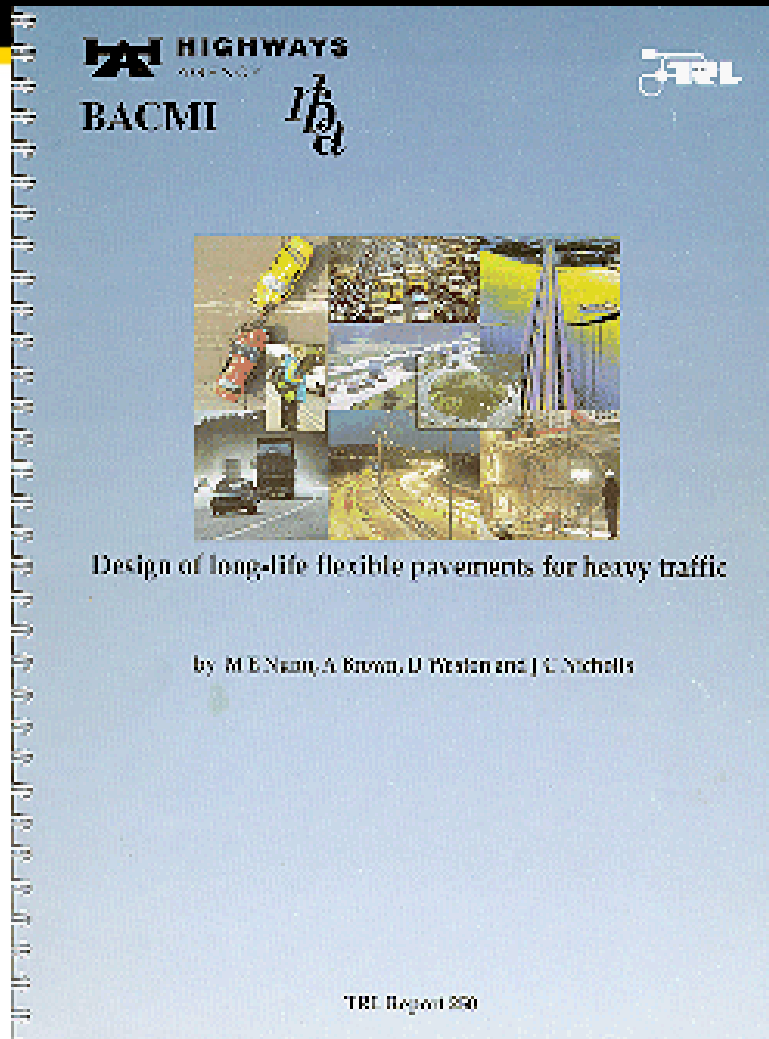


Hot Off the Presses!



http://www.asphaltroads.org/documents/Perpetual_Pavement_Synthesis.pdf





TRL Report 250 Nunn, Brown, Weston & Nicholls

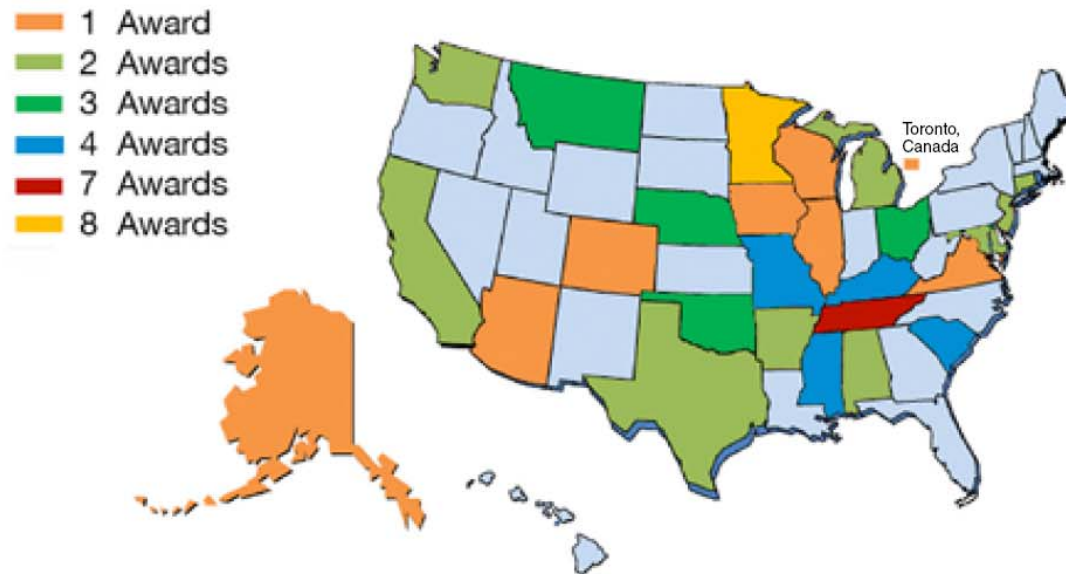
Design of Long-Life Flexible Pavements for Heavy Traffic

<http://www.trl.co.uk>



Perpetual Pavement Award Winners

Figure 8. Distribution of Perpetual Pavement Awards



Award Criteria

- **Pavement must be a minimum of 35 years old.**
- **Pavement must have hot-mix or warm-mix asphalt binder and surface layers.**
- **No rehabilitation or series of rehabilitations over the preceding 35 years that has increased the total pavement thickness by more than 4 inches.**



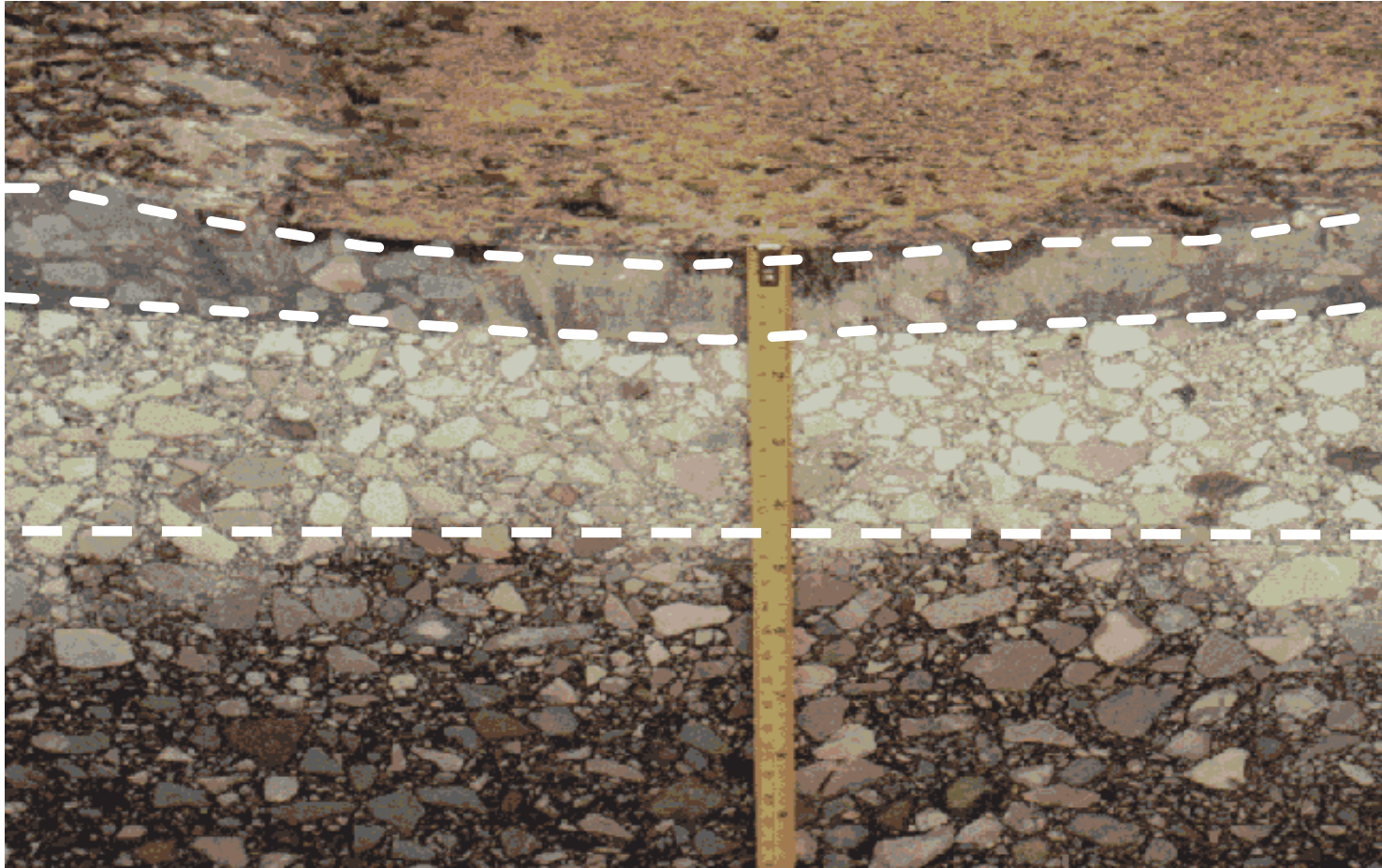
Award Criteria

- **Resurfacing intervals of no less than 13 years on the average.**
- **Minimum project length is two miles for all roadway types.**
- **In the case of “stage construction,” the 35-plus year time frame against which the award criterion is evaluated begins when all stage construction is completed.**



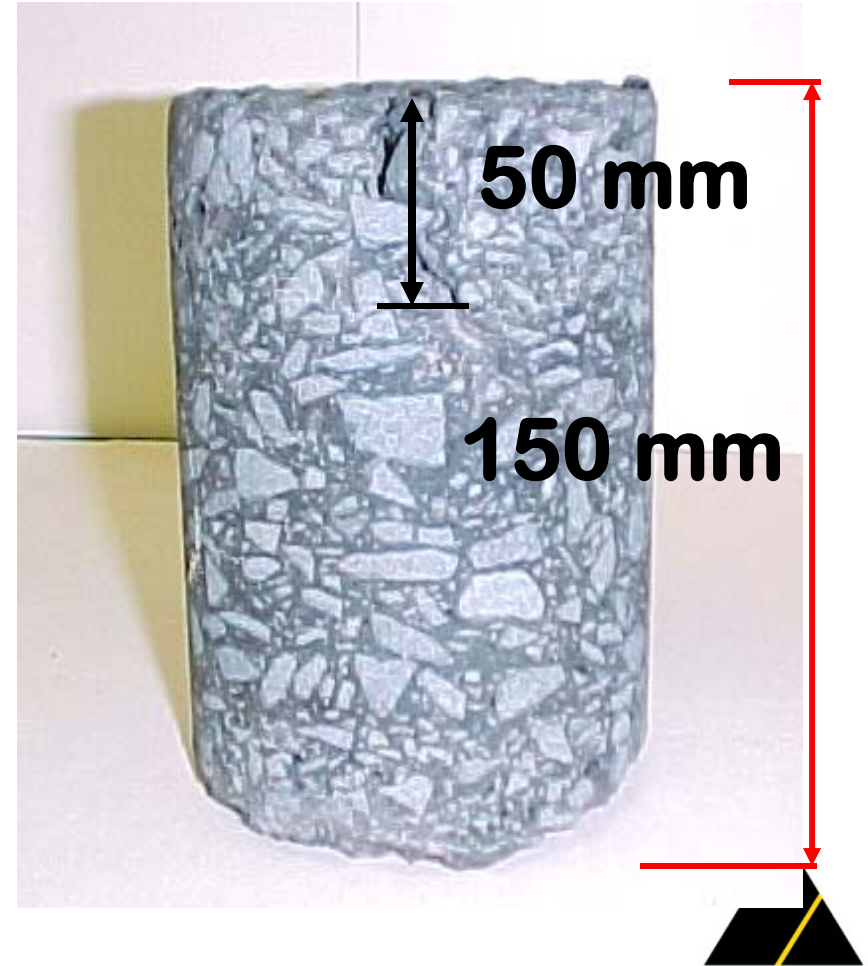
Tacked layers are very important

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Washington State - Top-Down in Asphalt Pavements > 150

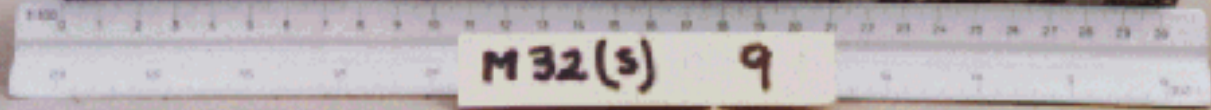
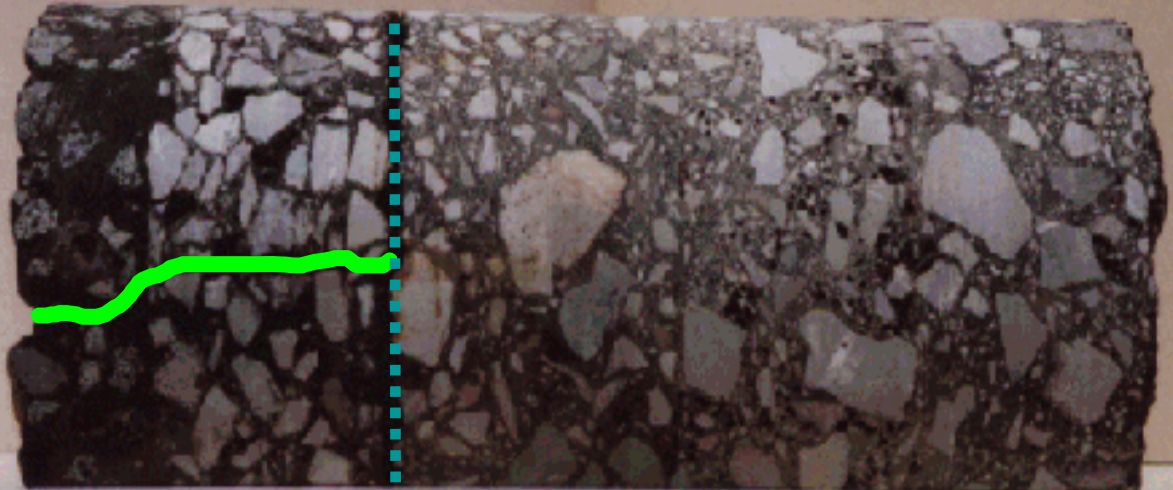
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TRL



M32 CORE





TRL

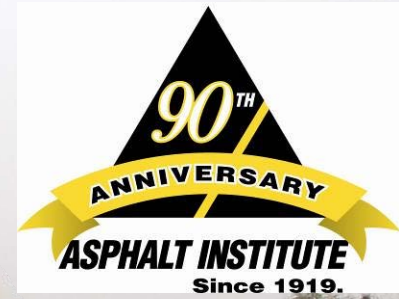
Perpetual Pavement

- › 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.
- › Environmentally Friendly
- › Avoids Costly Reconstruction.



LCCA - Zero Salvage Value?

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THANK YOU !!

This was worth Zero
35 years ago, What will
it be worth in 2050?