Perpetual Pavements

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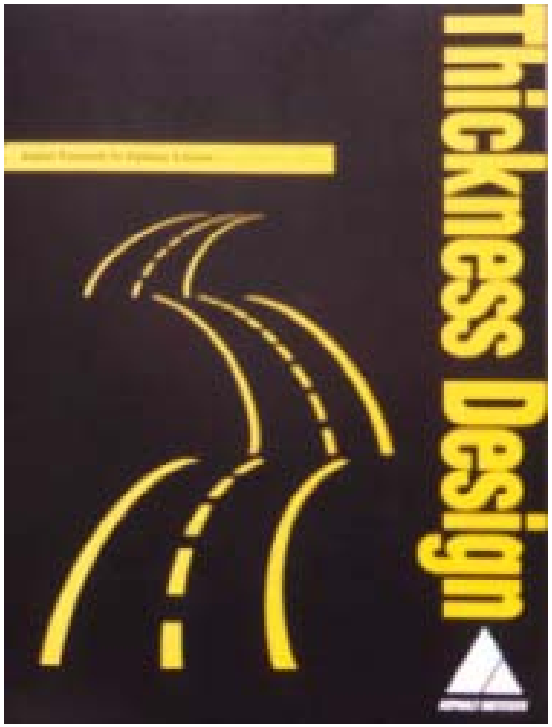
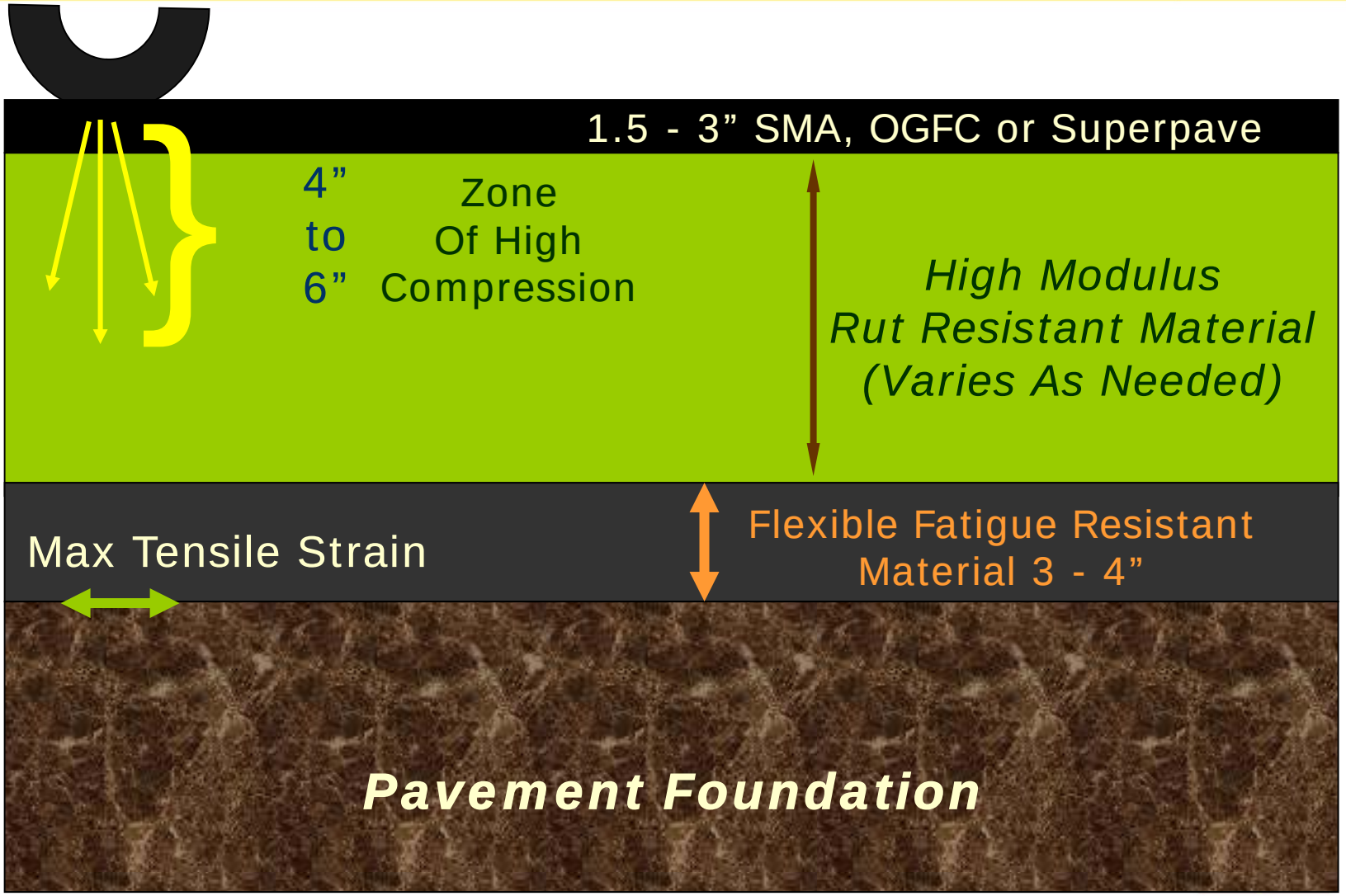
Perpetual Pavement



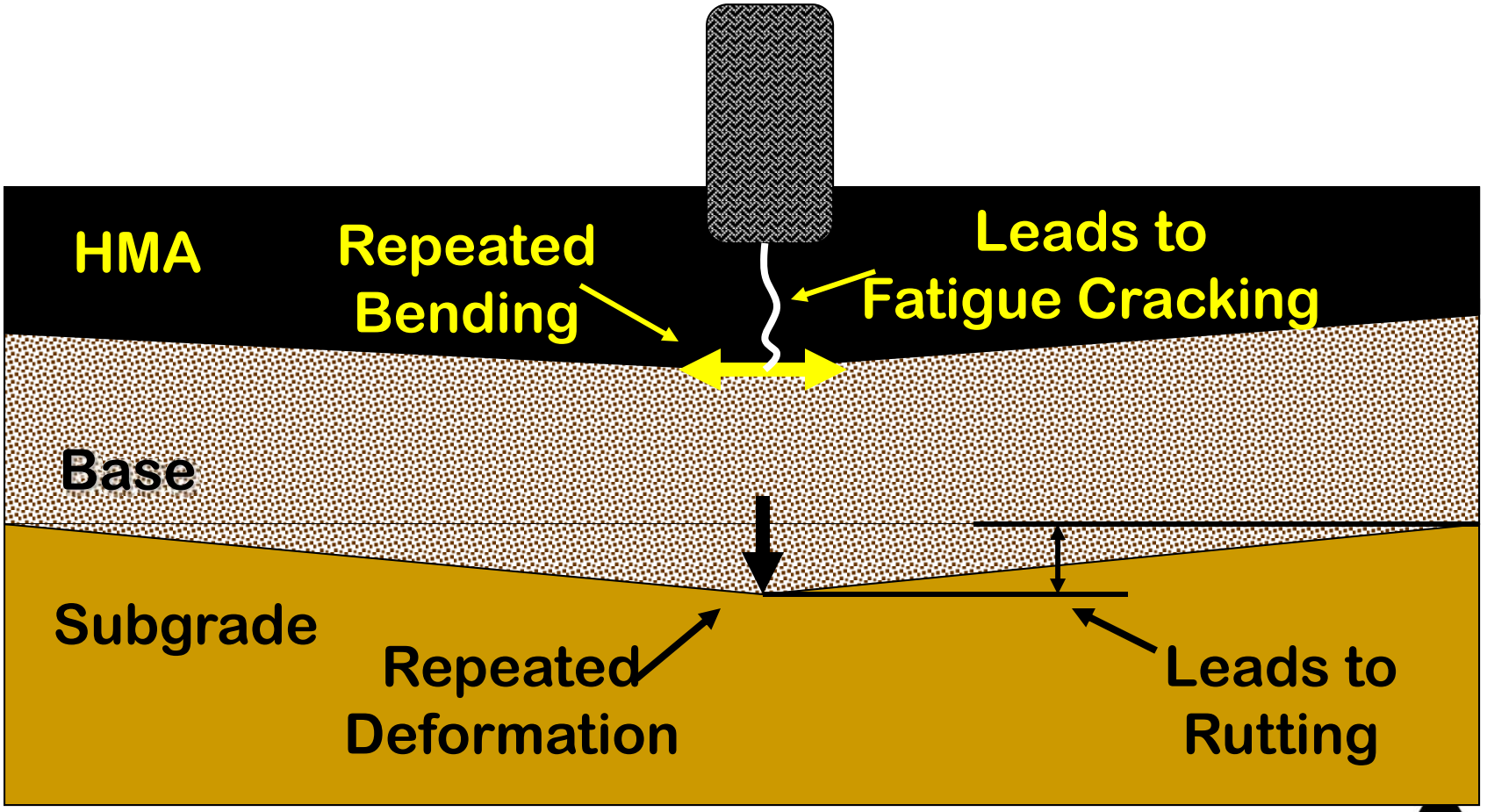
MS-1

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

Perpetual Pavement Principles

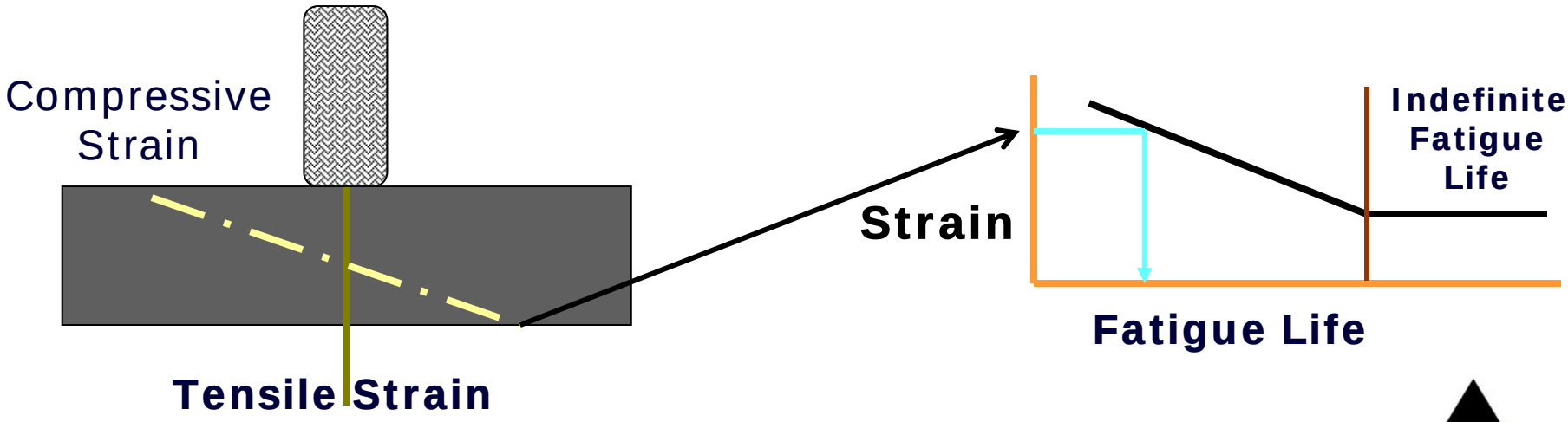


Fatigue and Rutting



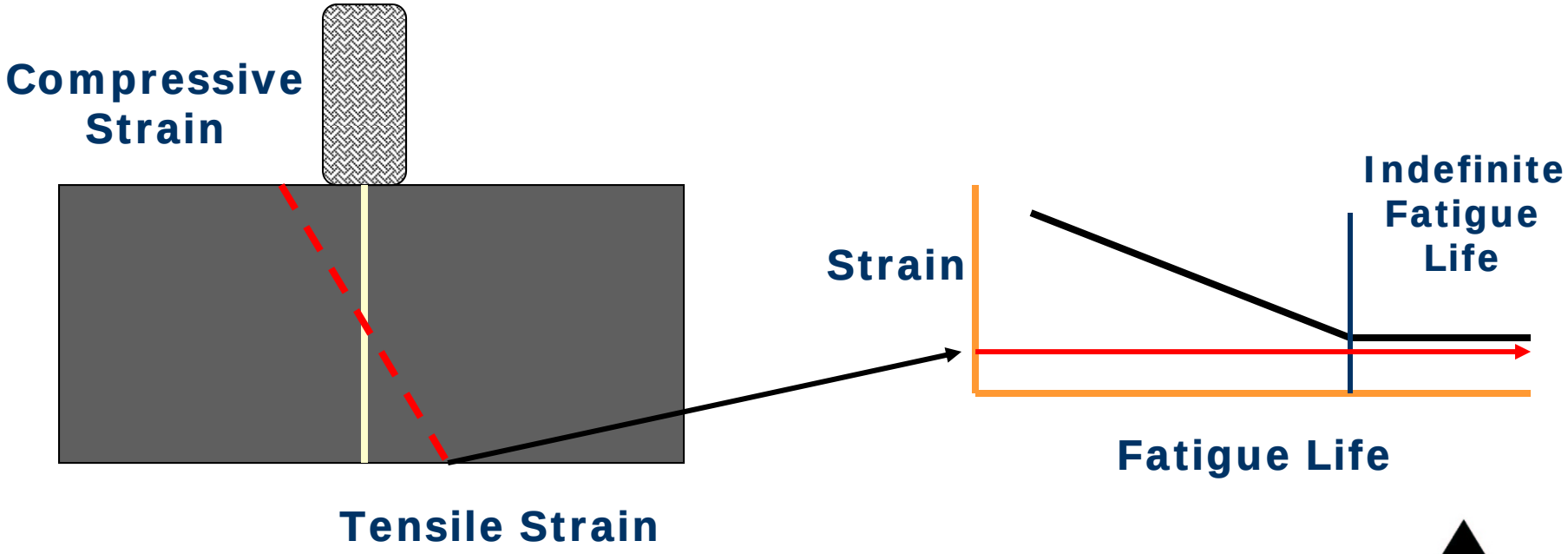
Thinner pavements – High Strain

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

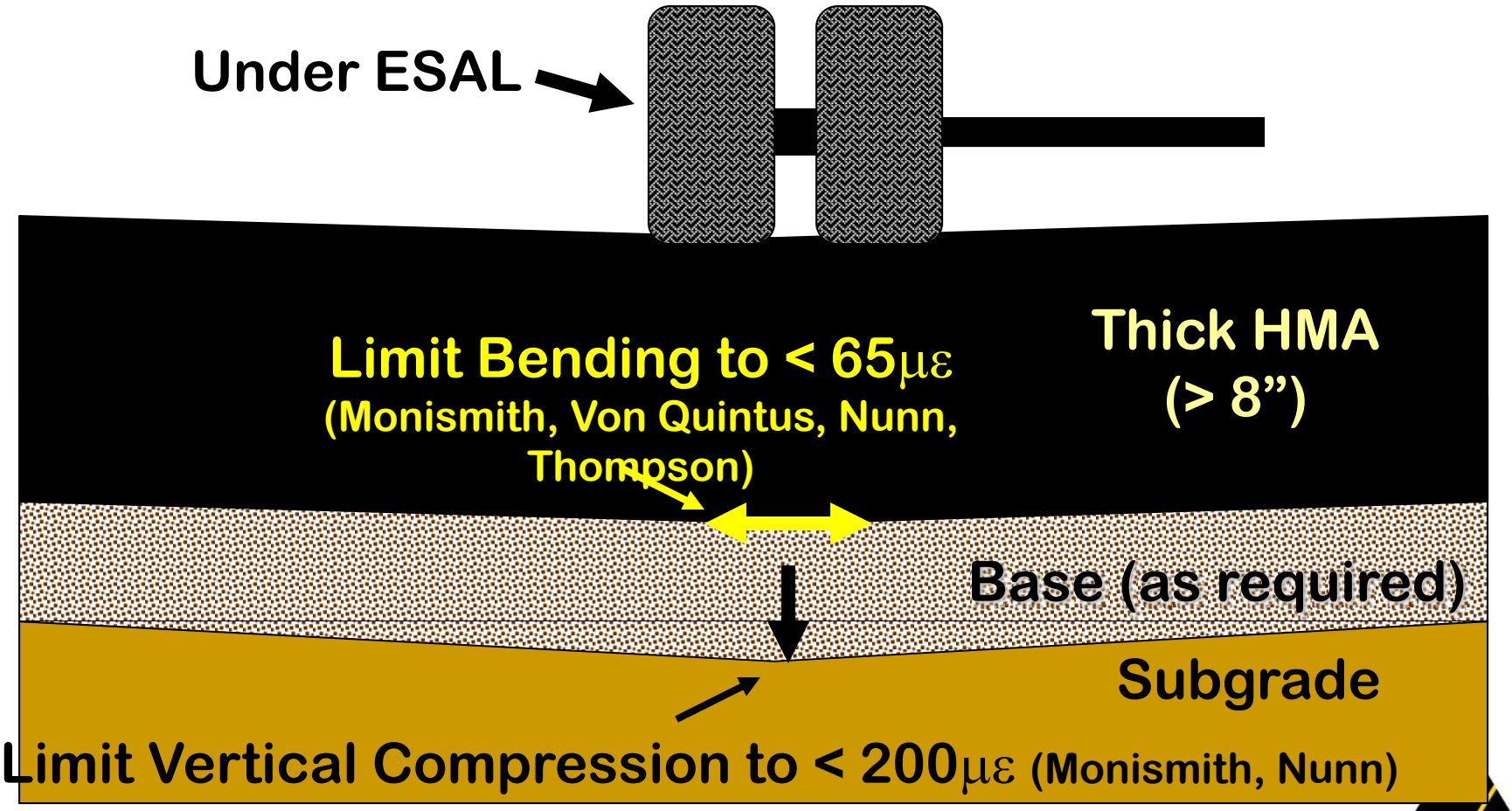


Thicker pavements – Low Strain

- 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

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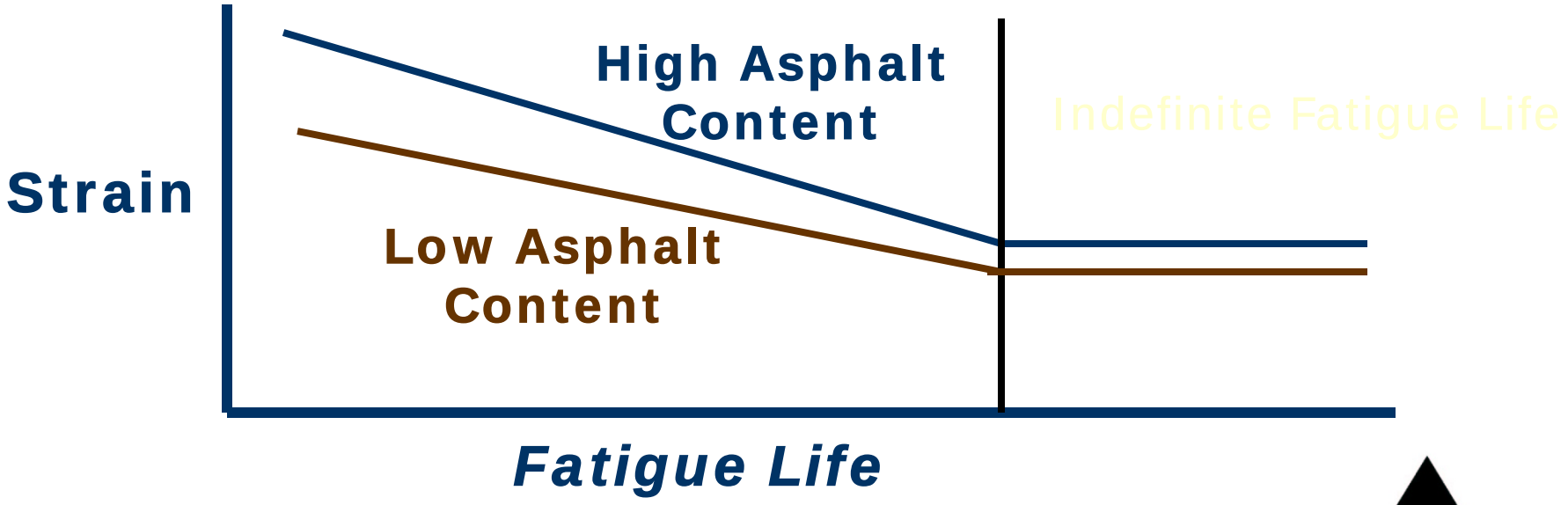
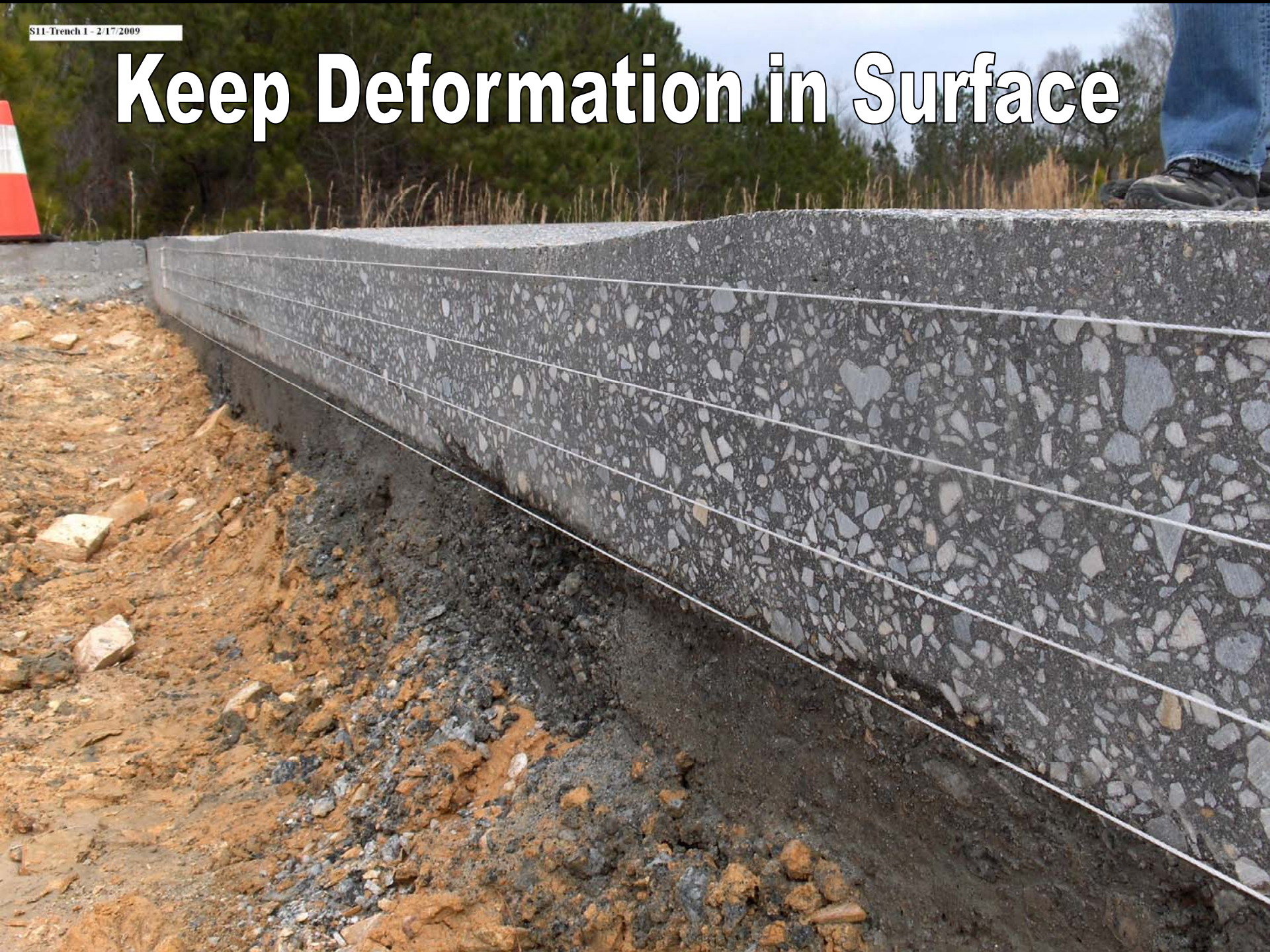
- Bottom-up Design and Construction
- Foundation
  - **Stable Paving Platform**
  - **Minimize Seasonal Variability and Volume Change in Service**
- Fatigue Resistant Lower Asphalt Layer
- Rut Resistant Upper Asphalt Layers

Fatigue Resistant Asphalt Base

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

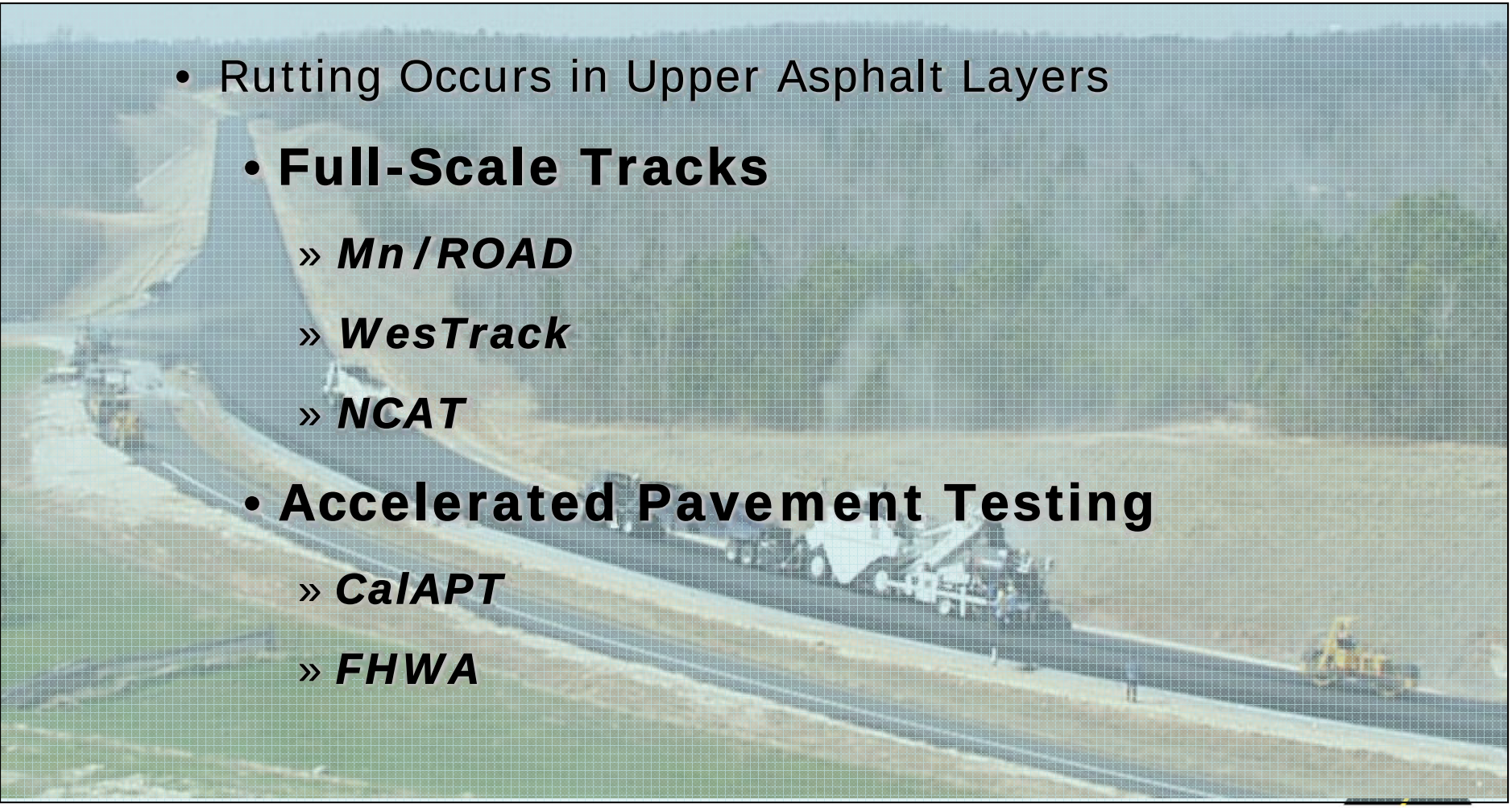



S11-Trench 1 - 2/17/2009
Keep Deformation in Surface

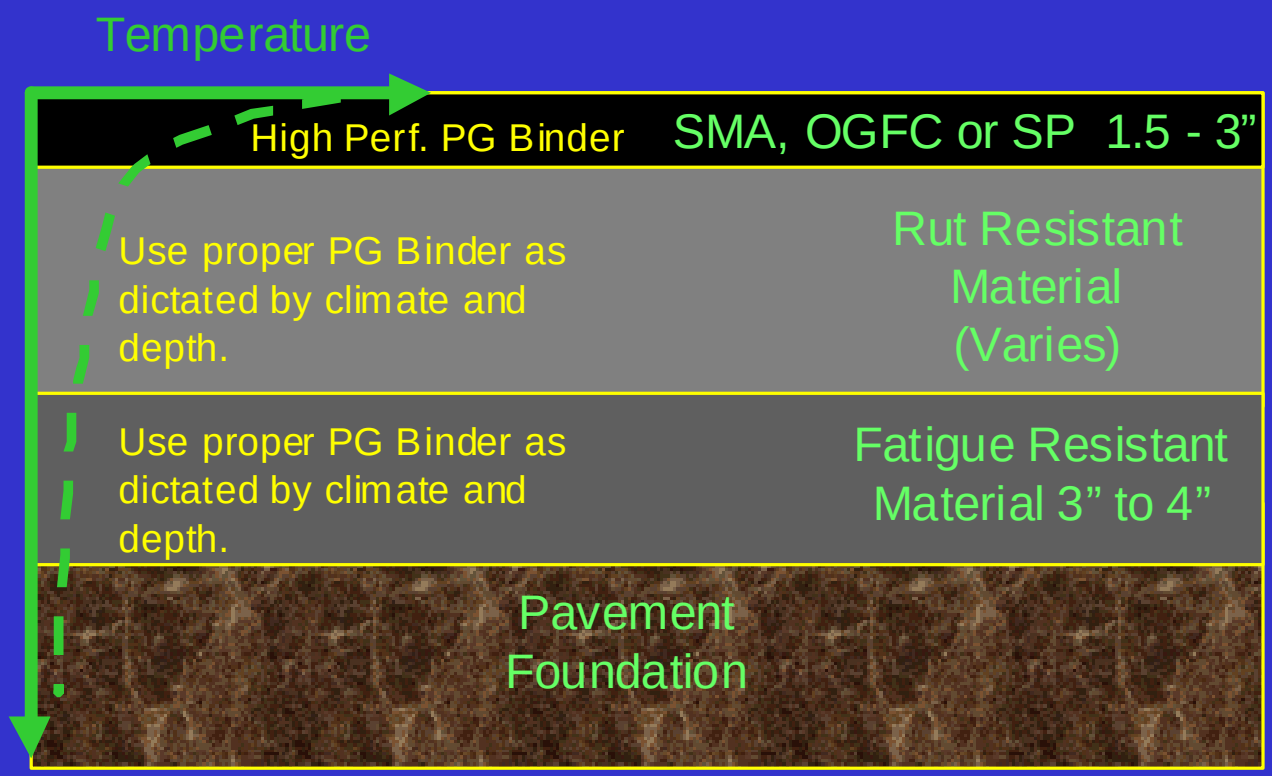
Rut Resistant Upper Layers

- **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

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

New Jersey Turnpike

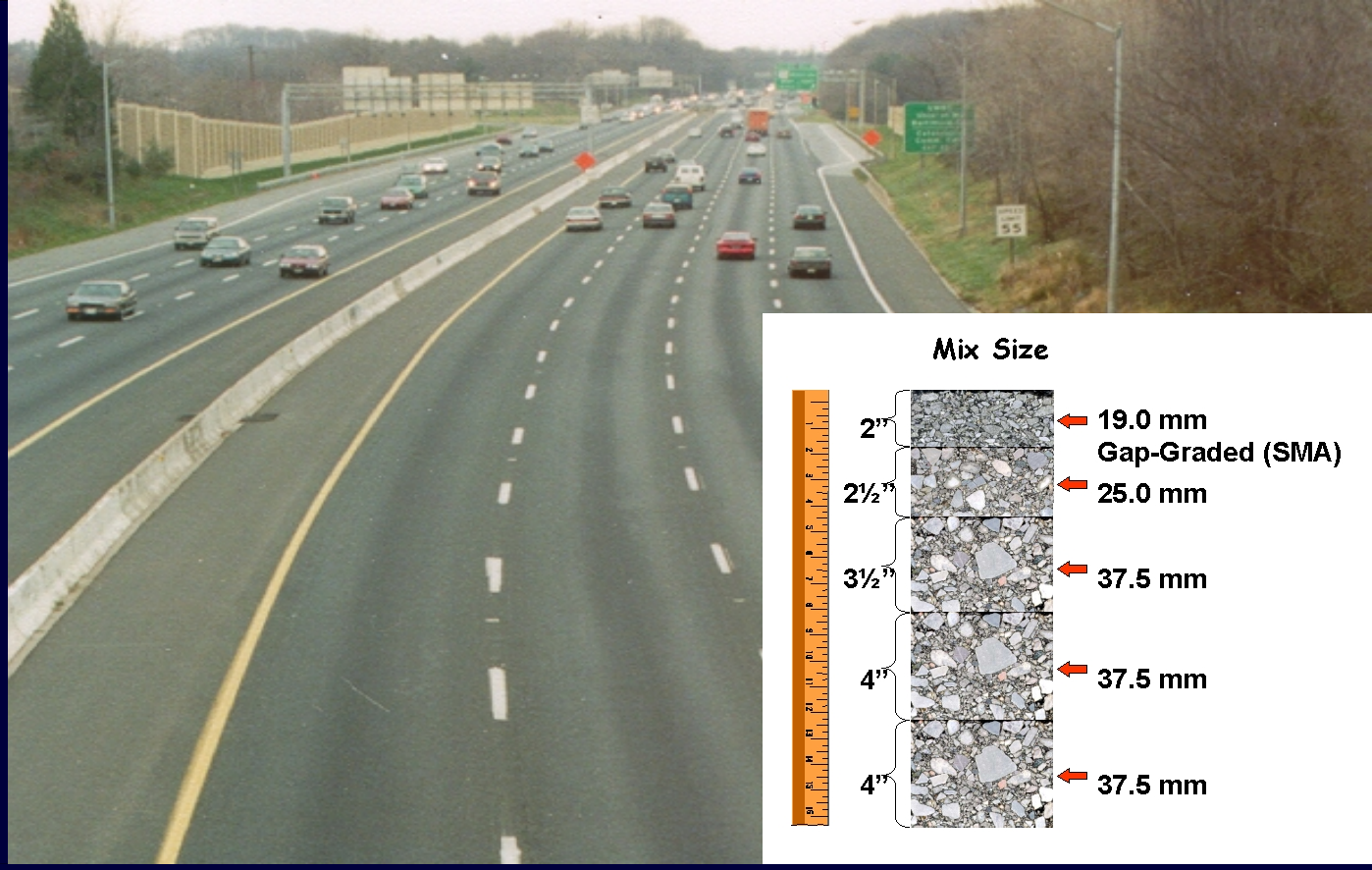
- First Perpetual Award Winner
- Built in 1950
- Has never been reconstructed
- 175,000 ADT
- 40% Trucks

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

DENSITY, %MAX

Wheelpath	Centerline
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.)

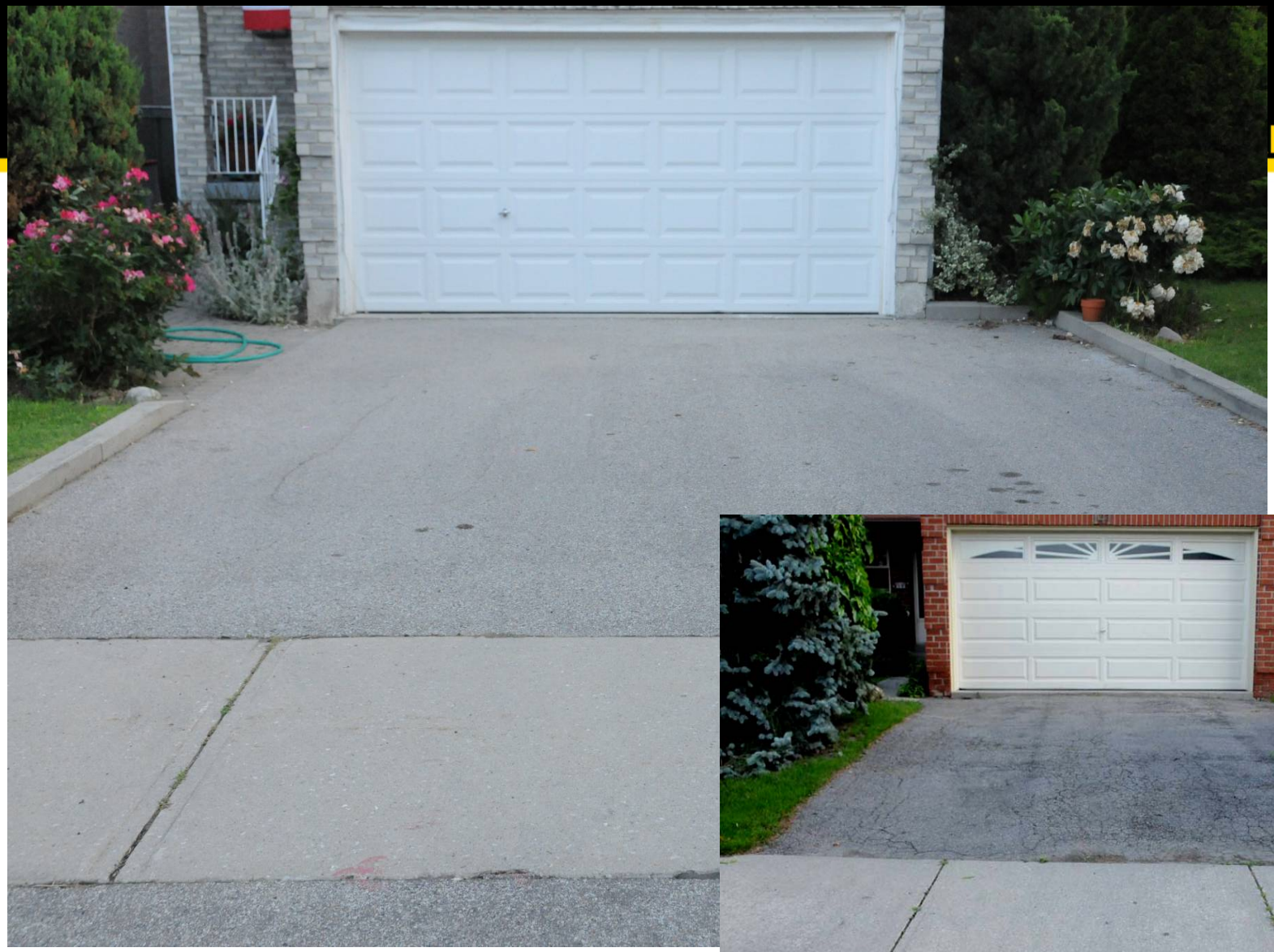
Measurement, 1/8"

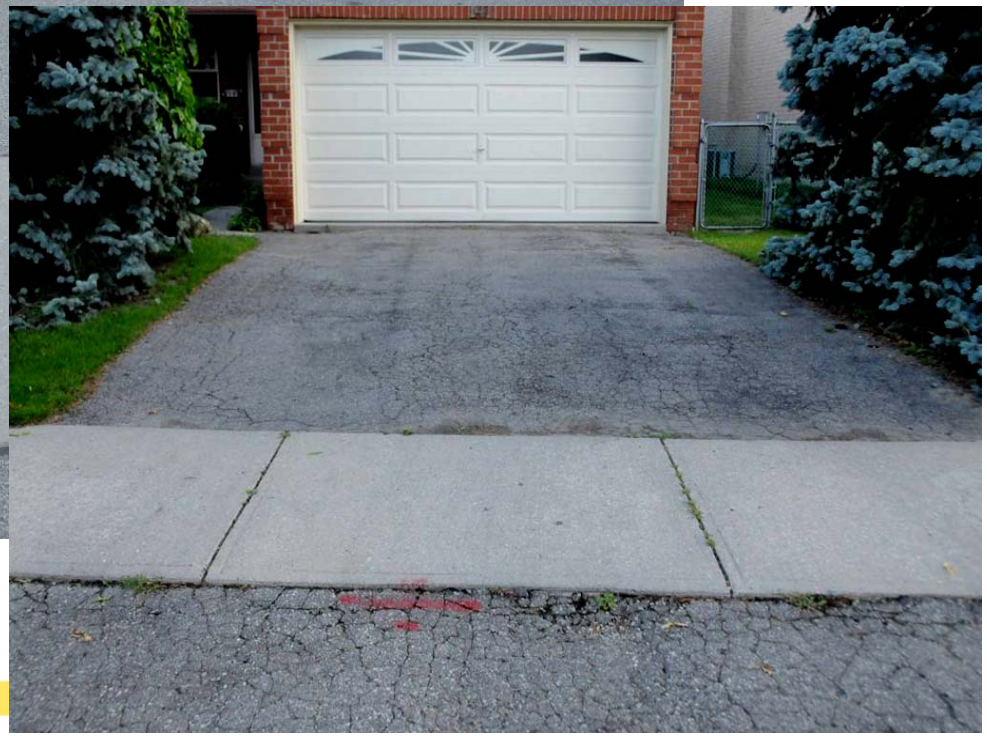
Perpetual Pavements in China

- 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?

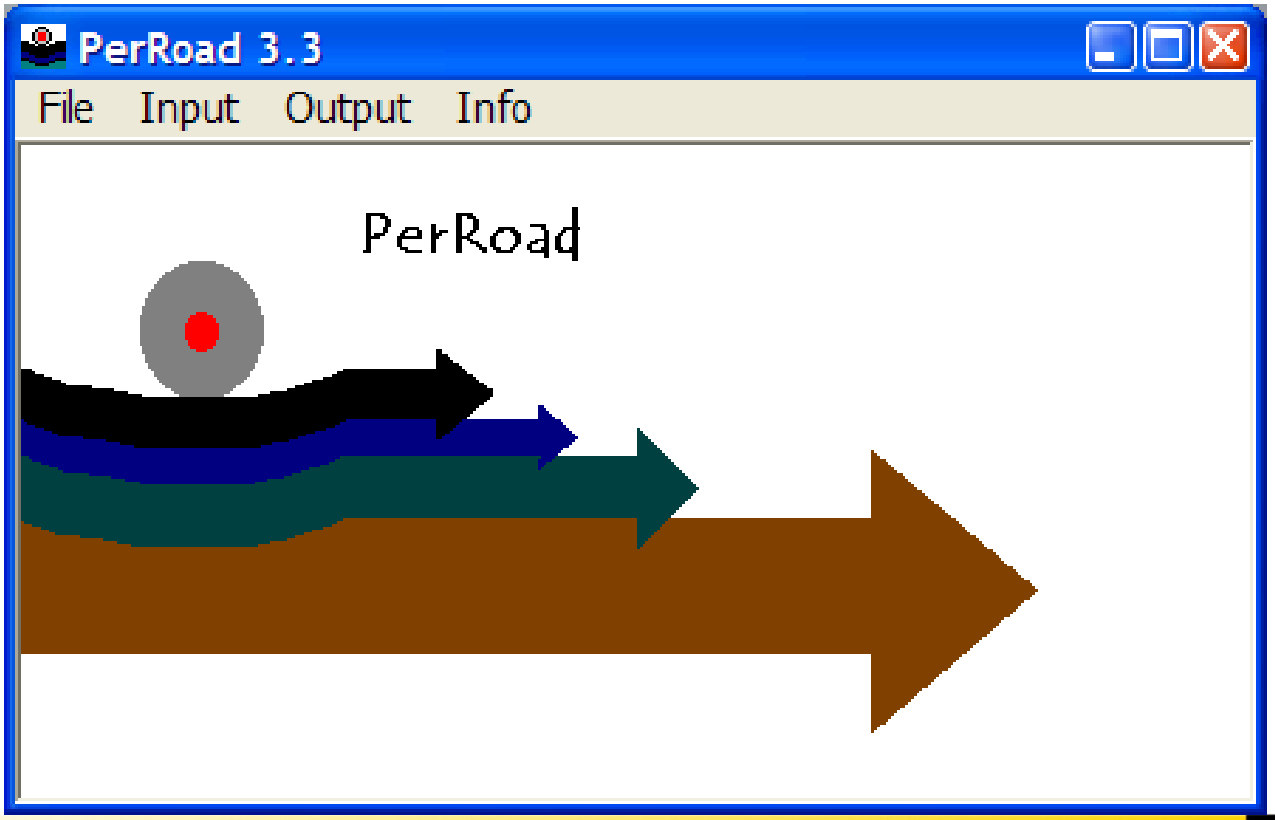
- Perpetual Pavements are not just for highway projects
- Many municipal pavements can also be designed as Perpetual Pavements
- Increasing the thickness of the hot mix layers by 25 to 35 percent will likely result in a perpetual pavement
- There are tools to allow municipalities to look at Perpetual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



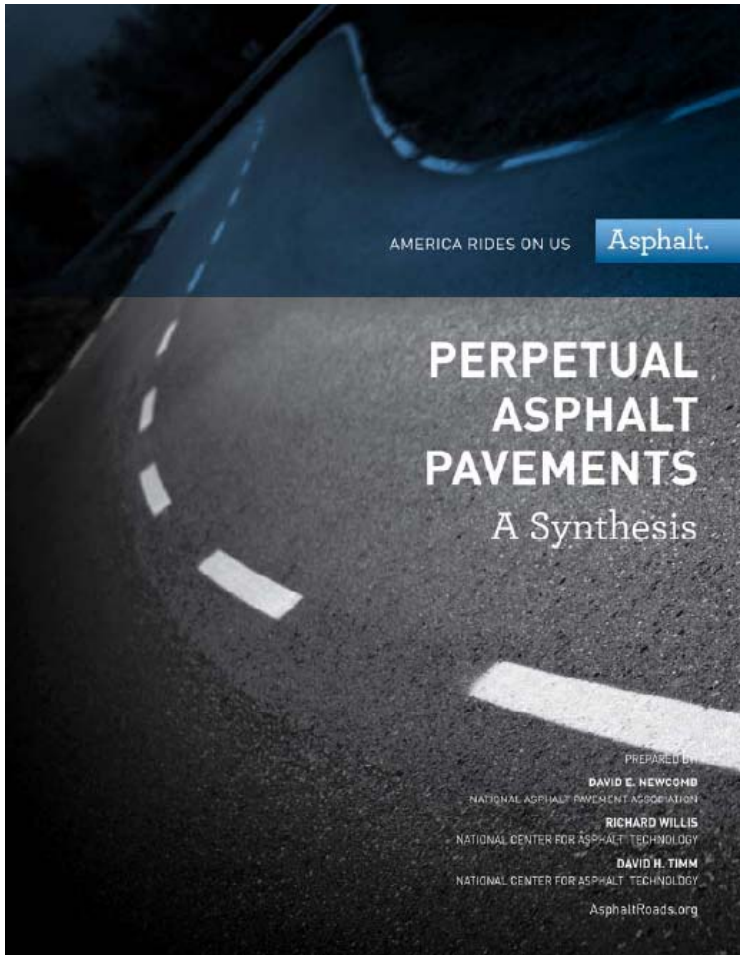


PerRoad 3.3

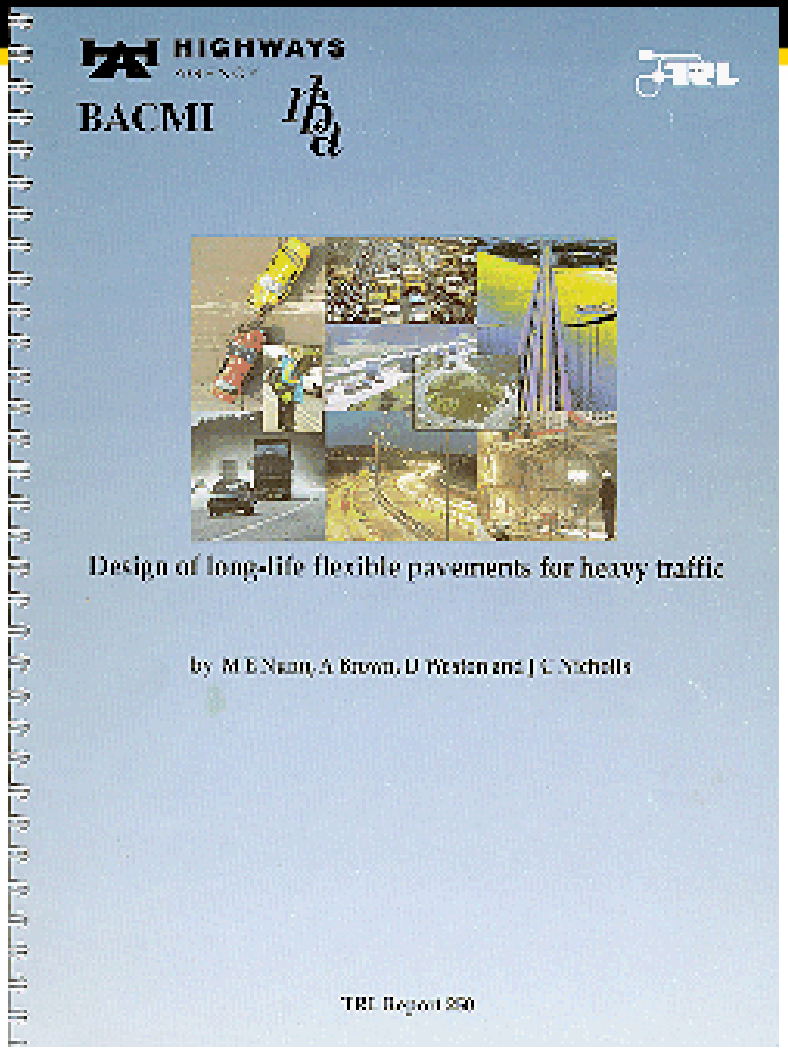
- Sponsored by APA
- Developed at Auburn University / NCAT
- M-E Perpetual Pavement Design and Analysis Tool



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

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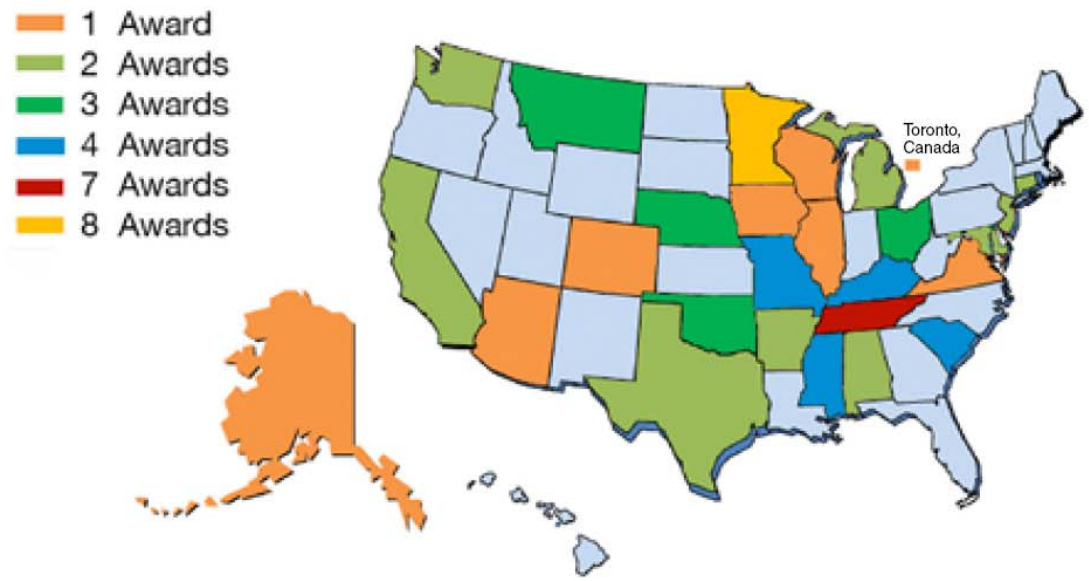
Figure 8. Distribution of Perpetual Pavement Awards



ASPHALT PAVEMENT ALLIANCE • IM-40

Source: *Perpetual Asphalt Pavements – A Synthesis*

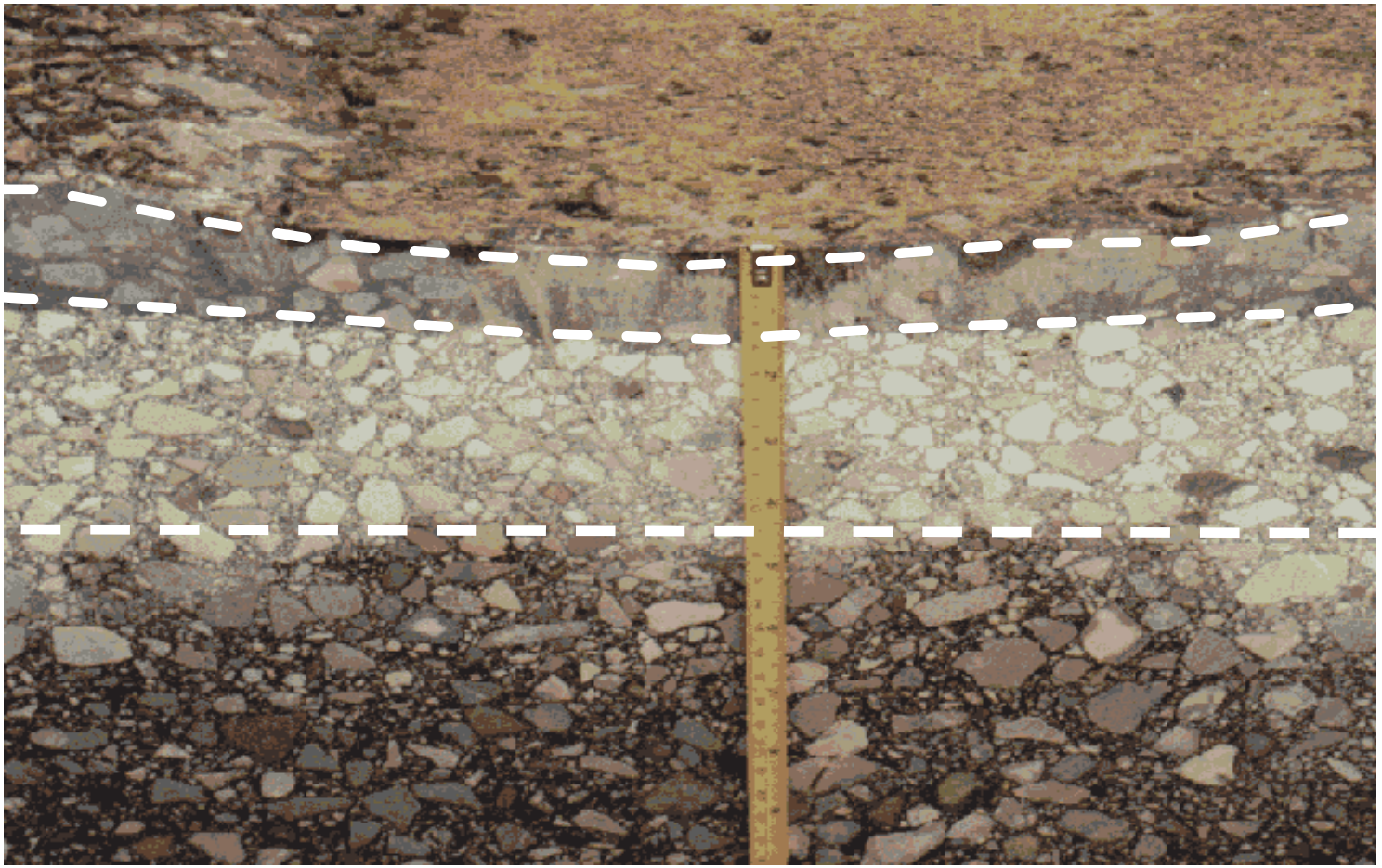
Award Criteria

- **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.**

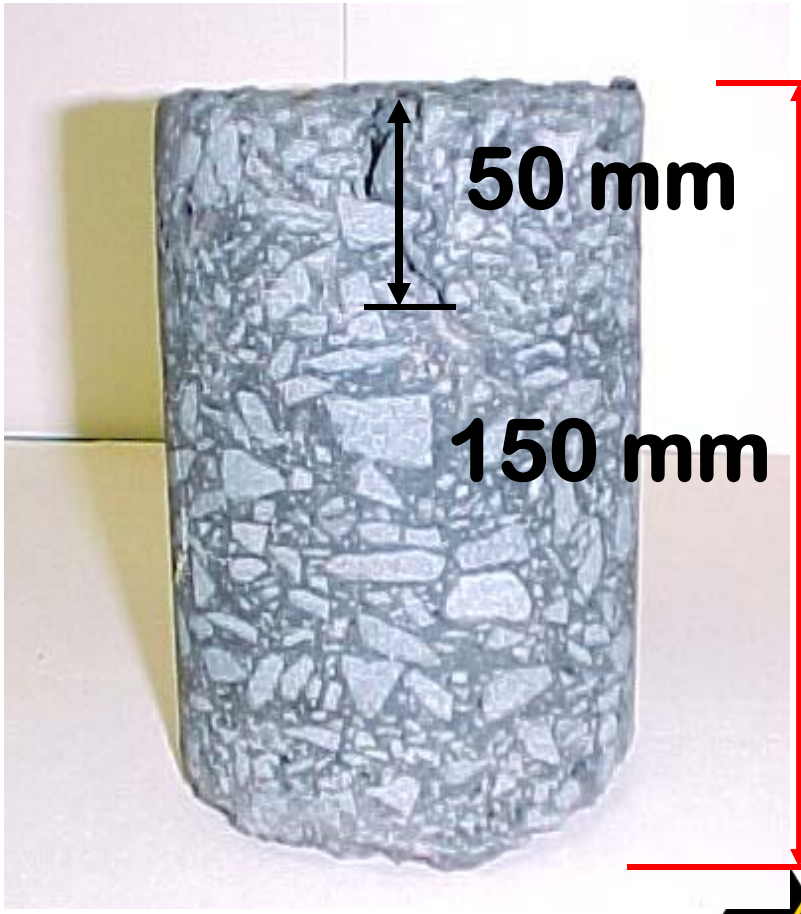
Award Criteria

- **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



Washington State - Top-Down in Asphalt Pavements > 150



TRL

TRL

Perpetual Pavement

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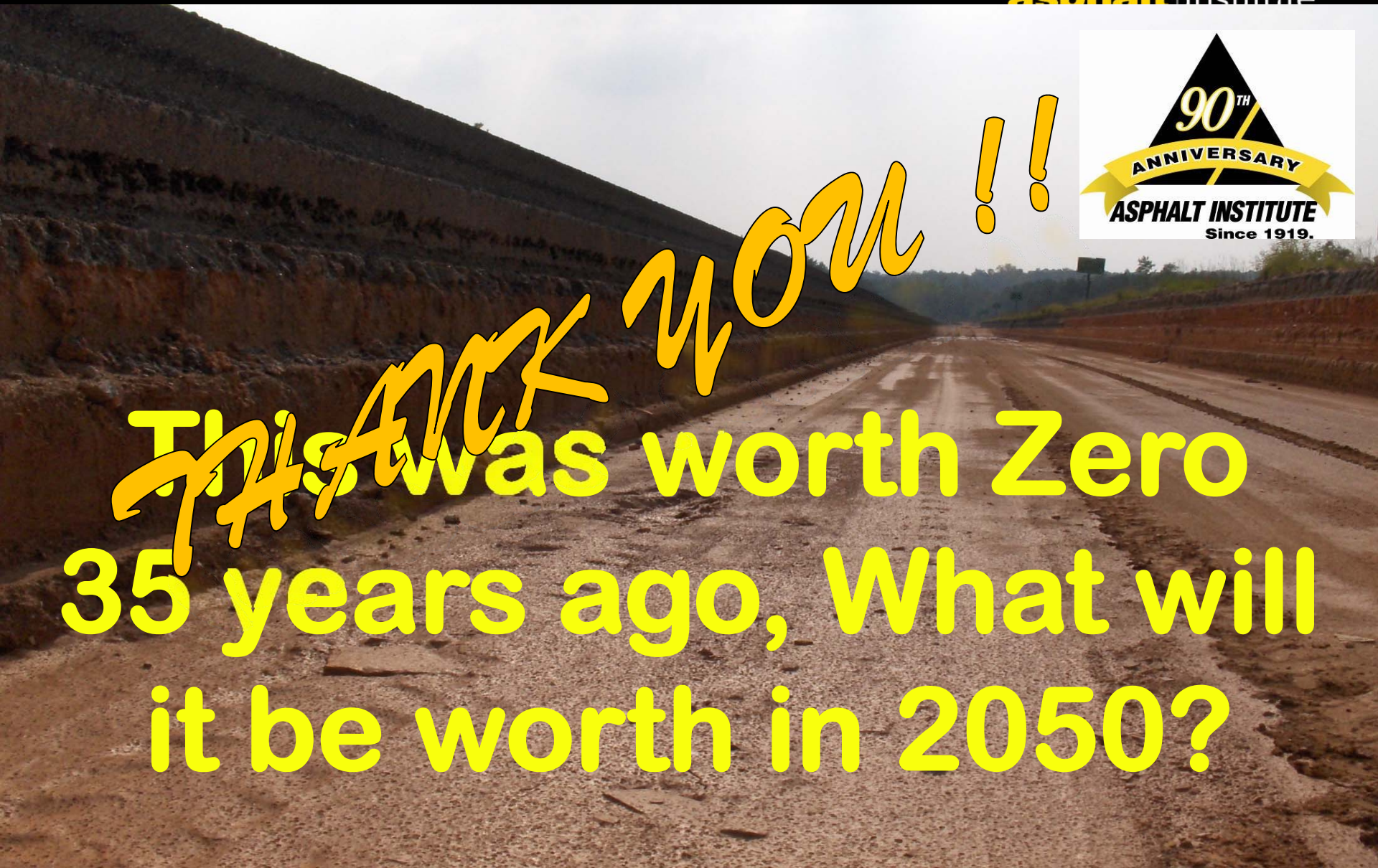
- Structure Lasts 50+ years.
  - Bottom-Up Design and Construction
  - Indefinite Fatigue Life
- Renewable Pavement Surface.
  - High Rutting Resistance
  - Tailored for Specific Application
- Consistent, Smooth and Safe Driving Surface.
- Environmentally Friendly
- Avoids Costly Reconstruction.

LCCA - Zero Salvage Value?