Sustainable Pavement Management practices

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ASPHALT PAVEMENT ASSOCIATION OF OREGON

Pavement Management Challenges

- Historic-manage the system to optimize serviceability with the available resources
- Today-manage the system to optimize serviceability with the available resources in an environmentally sustainable and responsible manner

environmental sustainability

ASPHALT:

the environmentally sustainable pavement

- Perpetual Pavements
- Stormwater management / porous pavement
- Recycled materials / RAP
- Warm Mix Asphalt
- Rehab strategies to reduce material useage
- Env. Impacts and Carbon Footprints

environmental sustainability

www.pavegreen.com

Question # 1

- How long can an asphalt pavement last?

Perpetual Pavement

- Structure Lasts “forever”
  - » 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

Rehabilitation

Possible Distresses
- Top-Down Fatigue
- Block Cracking
- Raveling

Solutions
- Mill & Fill
- Thin Overlay

Structure Remains Intact

1" - 4"

High Quality SMA, OGFC or Superpave

20+ Years Later

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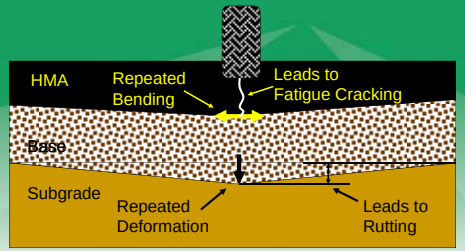
Perpetual Pavements

Performance Goals - Avoid These



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Question # 2

- What distress type results from the dreaded bottom up fatigue crack?

Perpetual Pavements

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

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Perpetual Pavements

New Jersey I-287 Surface Cracking

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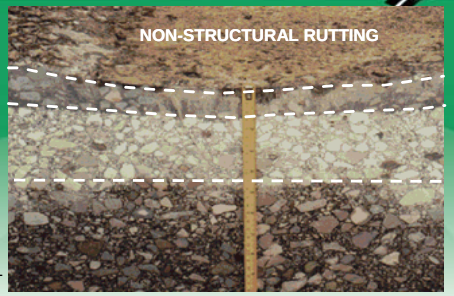
Perpetual Pavements



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Perpetual Pavements

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

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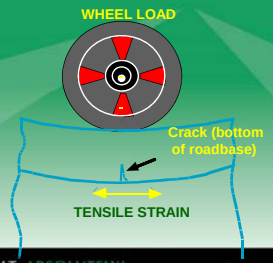
Perpetual Pavements

FATIGUE CRACKING



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Perpetual Pavements

Professor Monismith
University of California, Berkeley
1972 AAPT Proceedings

"Moreover, based on recent studies, it was assumed that strains less than 70 x 10^{-6} would cause no fatigue damage."

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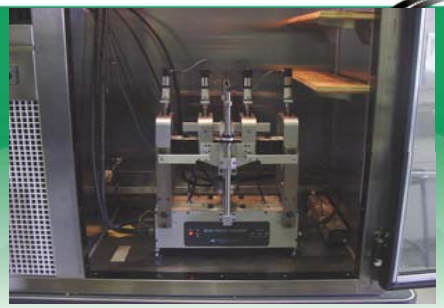
Question # 3

- Why didn't Professor Monismith perform a fatigue test at 70 micro strain?

Perpetual Pavements



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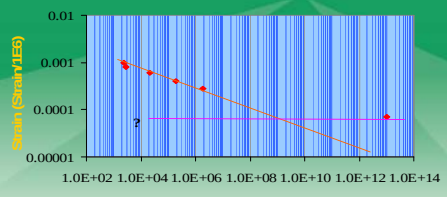
Perpetual Pavements

Traditional Fatigue Plot



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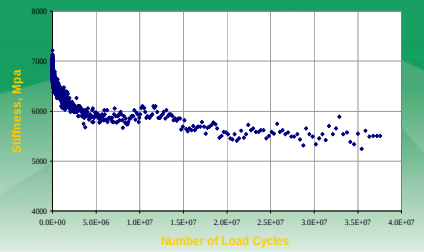
Perpetual Pavements

100 Micro Strain Test



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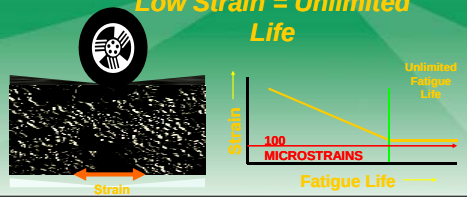
Perpetual Pavements

Fatigue Theory for Thick Pavements

High Strain = Short Life

Low Strain = Unlimited Life



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Question # 4

- Can a local road or city street be designed to be Perpetual or is this just for highways?

Perpetual Pavements

Perpetual Pavements for the "rest of us"

Basic Concept

- Will *not* handle "indefinite numbers and weights of trucks
- *Will* handle design vehicles indefinitely
- Able to manage pavement "for the life of the facility" without need for full depth repairs

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Perpetual Pavements

Example

Section	AASHTO Structural Number	AASHTO ESAL's	Mechanistic Fatigue Life
3" Asphalt 12" AB	~ 2.5	100,000 ±	110,000
4" Asphalt 9" AB	~ 2.5	100,000 ±	245,000
5" Asphalt 6" AB	~ 2.5	100,000 ±	540,000
Material Cost for each ~ 2.0 – 2.15 ft²			

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Guide Concepts for Local Agencies

- Asphalt Pavements with thickness > 5-6" on sound bases will develop distress Top Down
- To enhance fatigue response use higher binder content in bottom lifts
- To improve density/compaction construct thick base lifts (3" minimum)

Common Recycled Materials in Asphalt Pavements

- Shingles
- Crumb / Tire Rubber
- Glass
- Slag
- Foundry sand
- All are in different stages of utilization / evaluation

recycled pavement

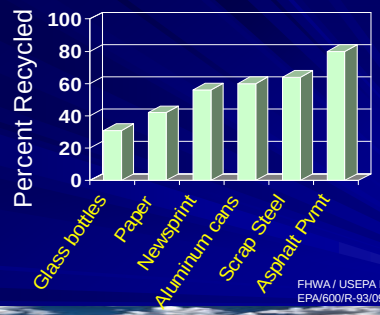
Question # 5

- What is the nations # 1 recycle material?

Reclaimed Asphalt Pavement "RAP"

- Removed and/or reprocessed pavement materials containing asphalt and aggregates
- Over 80 percent of the asphalt pavement, removed each year for widening and resurfacing, is re-used
- Represents close to 100 million tons / year
- RAP is the Nation's No. 1 recycled material in both total amount and percentage recycled

recycled pavement

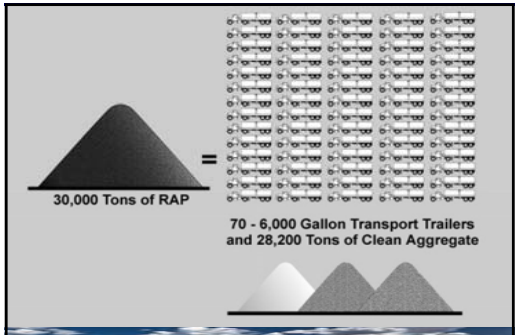


recycled pavement

Benefits of using "RAP"

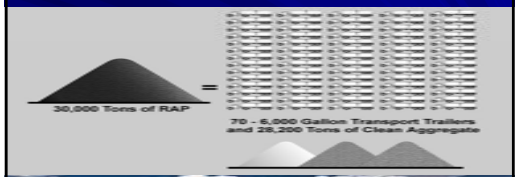
- Sustainable-reduces demand for new materials
- Saves energy
- Reduces carbon output
- Improves performance
- Saves money

recycled pavement

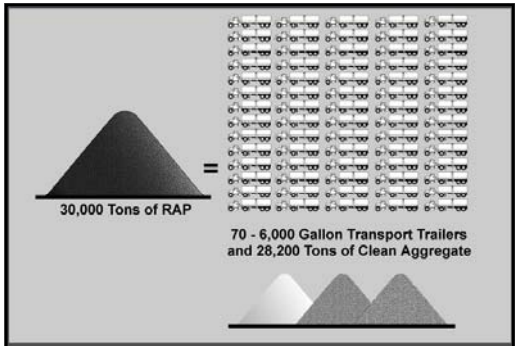


RAP: sustainable & carbon neutral

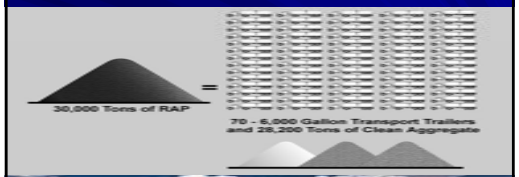
The entire annual CO2 / greenhouse gas emissions / carbon footprint from a typical hot-mix plant (~ 2,500 tons) are totally offset by the use of 20 - 25% RAP in pavement mix designs -- accomplished by minimizing acquisition of energy intensive (natural) raw materials such as aggregate and petroleum asphalt.



RAP: sustainable & carbon neutral



30,000 tons of RAP contains 1,800 tons of asphalt worth $800,000 and aggregate worth over $300,000. If a contractor gives a 50% "credit" in their bid the owner/agency will save $6-7 per ton of mix over the price of 100% virgin mix



RAP: Save money

RAP Performance

- Many studies show RAP mixes improve Rut resistance
- Some studies show slight increase in cracking
- When softer binder used crack resistance is found to be equal to or better than new mix
- RAP mixes generally improve resistance to moisture damage

RAP Standard of Practice

- ODOT allows 30% in all Level 2 and 3 mixes
- Local agencies should not establish more restrictive RAP practice
- ODOT working on specs to allow higher RAP content
- May require softer binder grade, separated sizes

Raise the Roof with Shingles

- Roofing shingles comprised of:
  - Polymer modified asphalt
  - Fiberglass or felt fibers
  - Grit – angular fine aggregate
  - Mineral filler

Example

- Roofing shingles contain ~ 20% asphalt
- Use 5% shingles in HMA, reduce 1% asphalt
- Reduce 0.1 ton AC/ton HMA
- Reduce cost by $4.50/ton HMA

RAS performance

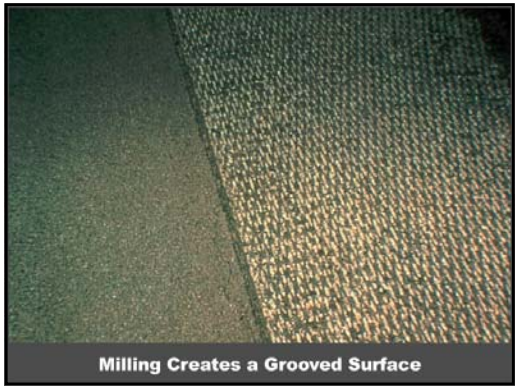
- Asphalt with RAS will improve high temperature performance (rutting)
- Some evidence of improved crack resistance owing to the presence of the fibers
- Oregon DOT plans to construct test sections this year

Not What We're Looking For!

Rehab Strategies

- The most cost effective sustainable approach involves mill and fill for pavement rehab
- Removes surface distress
- Prepares surface for overlay
- Maintains grade
- Generates RAP for future use

milling asphalt pavement



Milling Creates a Grooved Surface

Milling Ensures Proper Water Drainage

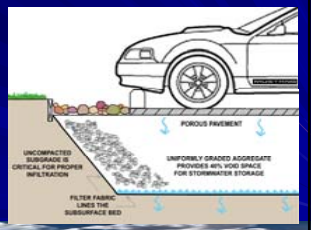
Economics of Mill and Fill

- 2 inch mill and fill – 30% RAP $7.95/SY
- 1" level, 2" overlay – 30% RAP $10.85/SY
- Mill and fill is cheaper, better and more sustainable (net gain in RAP for future use)
- For road with gravel shoulders savings is greater
- If you add value of extra RAP generated savings is greater

Porous Pavements

Why Porous Pavements?

- **Reduce impervious surface**
- **Recharge ground water**
- **Improve water quality**
- **Eliminate need for detention basins**
- **Provide useful purpose in addition to storm water management (parking lot, trail, street)**



EPA Small MS4 Stormwater Program Overview

- ***Applicable controls could include preventative actions such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.***

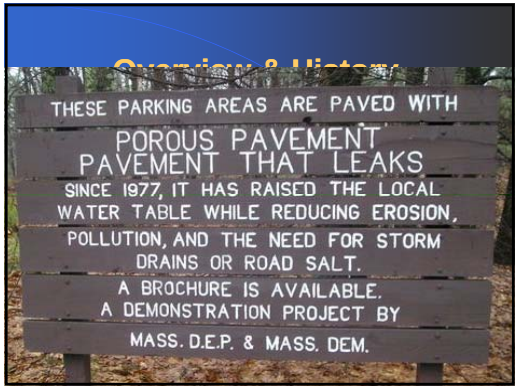
http://www.epa.gov/npdes/pubs/fact2-0.pdf

Water Quality

Total Suspended Solids (% Removal)	Total Phosphorus (% Removal)	Total Zinc (% Removal)	Total Petroleum Hydrocarbons in the Diesel Range (% Removal)
99	38	96	99

Question # 6

- What pavement type has the longest successful history of use in porous applications?

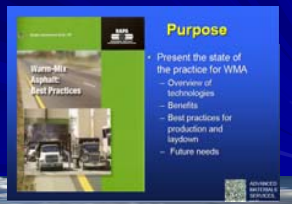


Pringle Creek Community – Porous Asphalt Streets

The completed project came out very nice, owner is extremely happy

Warm Mix Asphalt

- Technologies that allow production and placement of asphalt at reduced temperatures



Advantages of Lower Temperatures

- Lower fumes and emissions
- Lower energy consumption
- Improved working conditions
- Reduced aging of binder
- Improved compaction
- Extended haul and paving season

WARM MIX Foaming system

What are “Foamed” or “Foam” WMA Systems?

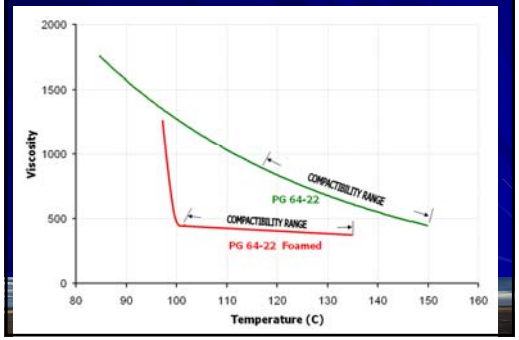
- Water injection into asphalt cement as a way of producing WMA mixes
- No chemicals used
- Standard water used as additive
- No additional cost per ton from additives beyond one-time capital cost of equipment

Foaming Process

- Hot liquid is sprayed and intermixed with a very fine mist of atomized water (2% by wt. of AC)
- Temporarily lowers viscosity of binder to allow better coating of aggregates.
- Mix temperatures are typically 35^{0}F – 50^{0}F cooler than conventional mixes
- Improves workability and compaction

61

Viscosity / Temperature (Approx.)



Warm Mix in Oregon

- More than 10 plants in Oregon modified to produce warm mix
- Uses foaming technology
- All 3 plants in Eugene have converted
- ODOT did 4 test sections in 2009
- Many other agencies did test projects and have developed permissive specifications

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- Porous pavements manage stormwater
- Build all new pavements to manage at the surface (Perpetual)
- Asphalt pvmts accept recycled goods / are recycled (RAP)
- HMA pavements are environmentally preferred
  - Less energy to construct, low carbon footprint, speed of construction, very low emissions
- Warm Mix lowers energy consumption & emissions
- Mill and fill with high RAP content is most sustainable approach to providing high quality pavement
- RAP can offset the entire annual HMA GHG emissions

greening the blacktop

Question # 7

- Can an Asphalt Pavement ever really be Green?

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Sustainable Pavement Management