ASPHALT PAVEMENT SUSTAINABILITY & RESILIENCY

PAPA BUS TOUR
JULY 2019
JOSEPH SHACAT, DIRECTOR OF SUSTAINABLE PAVEMENTS

NATIONAL ASPHALT PAVEMENT ASSOCIATION

PAPA

NAPA Overview

Mix Producers

Paving Contractors, Equipment Producers, & Suppliers

1,100 Member Companies

Research & Engineering
Education & Member Services

Federal Advocacy
- Highway & Airport Investment
- EH&S Regulatory Issues

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Let's start with Sustainability

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"Nor indeed would a farmer, however old, hesitate to answer any one who asked him for whom he was planting: '...I should not merely receive these things from my ancestors, but **should also hand them on to the next generation**.'"

- Cicero, *On Old Age*, 44 B.C.

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What is Sustainability? The U.N. says…

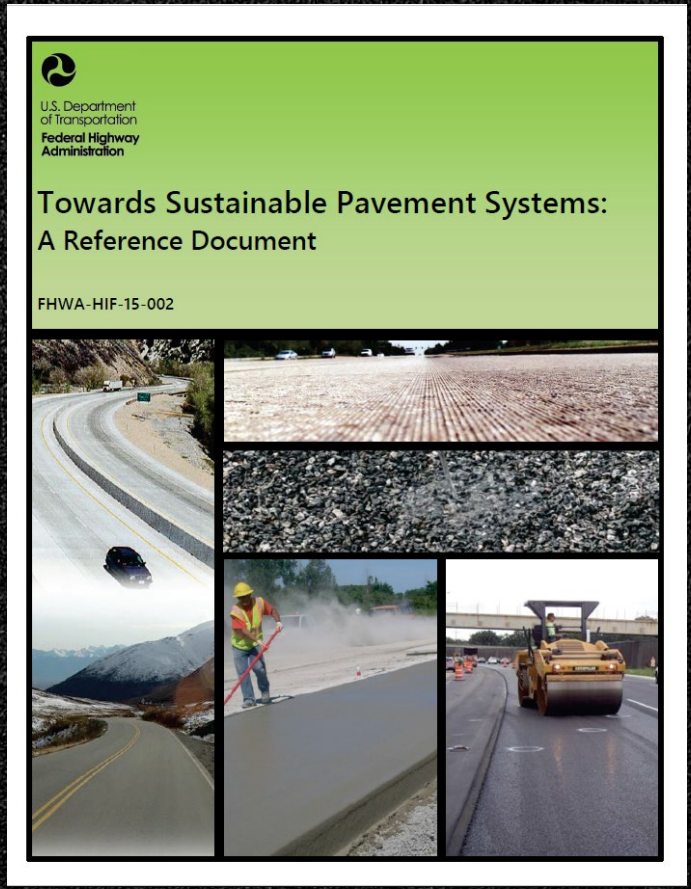
"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

- *United Nations, World Commission on Economic Development: Our Common Future, "Bruntland Report" (1987)*

What is a sustainable pavement? FHWA says…

Sustainable pavements should:

- Achieve the engineering goals for which they were constructed
- Preserve and (ideally) restore surrounding ecosystems
- Use financial, human, and environmental resources economically
- Meet human needs such as health, safety, equity, employment, comfort, and happiness



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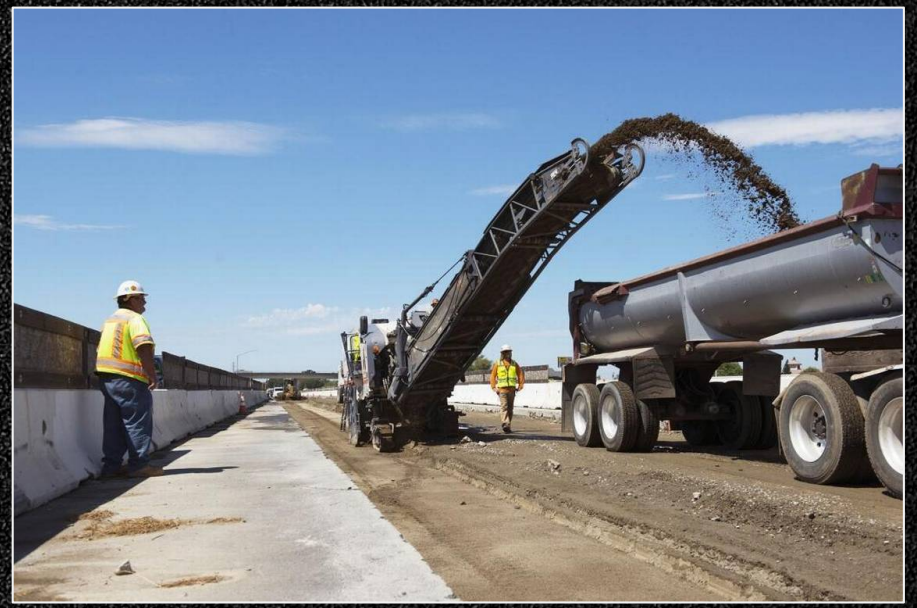
Reclaimed Asphalt Pavement

99+% of pavements are recycled

- 76.2 million tons of RAP used (2017)
  - 21.5 million barrels of oil
  - 72+ million tons of aggregate
  - $2.1 billion in savings
- Pennsylvania
  - 3.2 million tons of RAP (2018)
  - Average percent RAP used
    - 15.9% (2018); 14.7% (2017)



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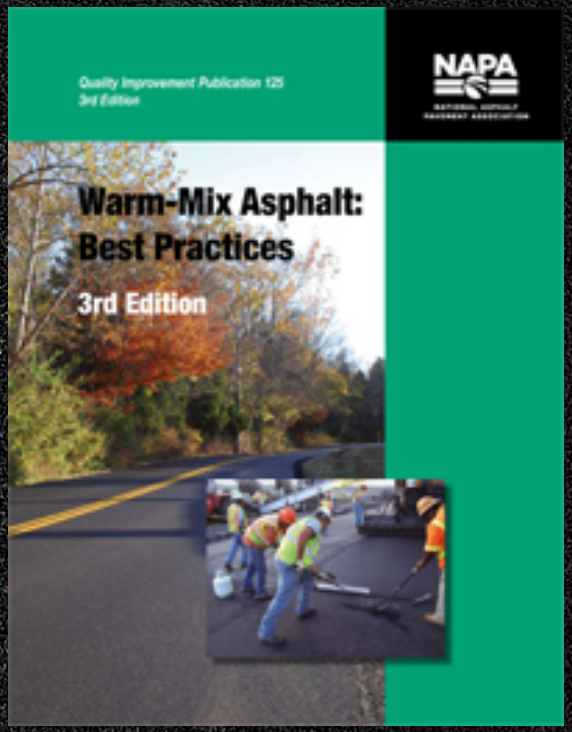
Warm Mix Asphalt

Developed in Europe to reduce CO_2 emissions

- 147.7 million tons of WMA (2017)
  - 38.9% of total market
- Pennsylvania
  - 13.2 million tons in 2017
    - 65% at reduced temp.
  - 18% chemical additive 2018
    - 55% chemical additive 2017



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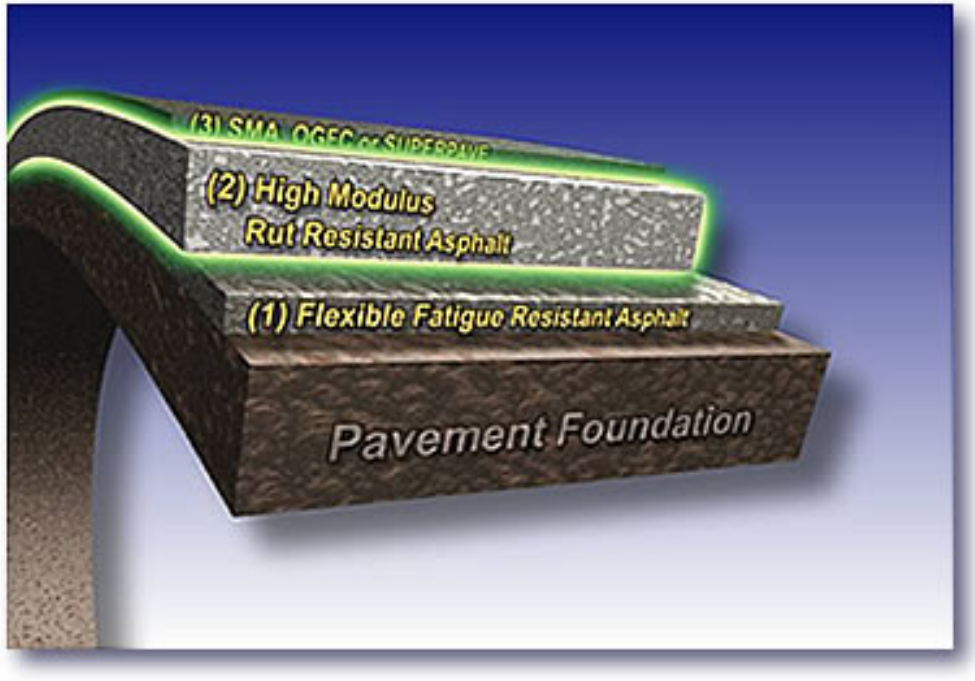
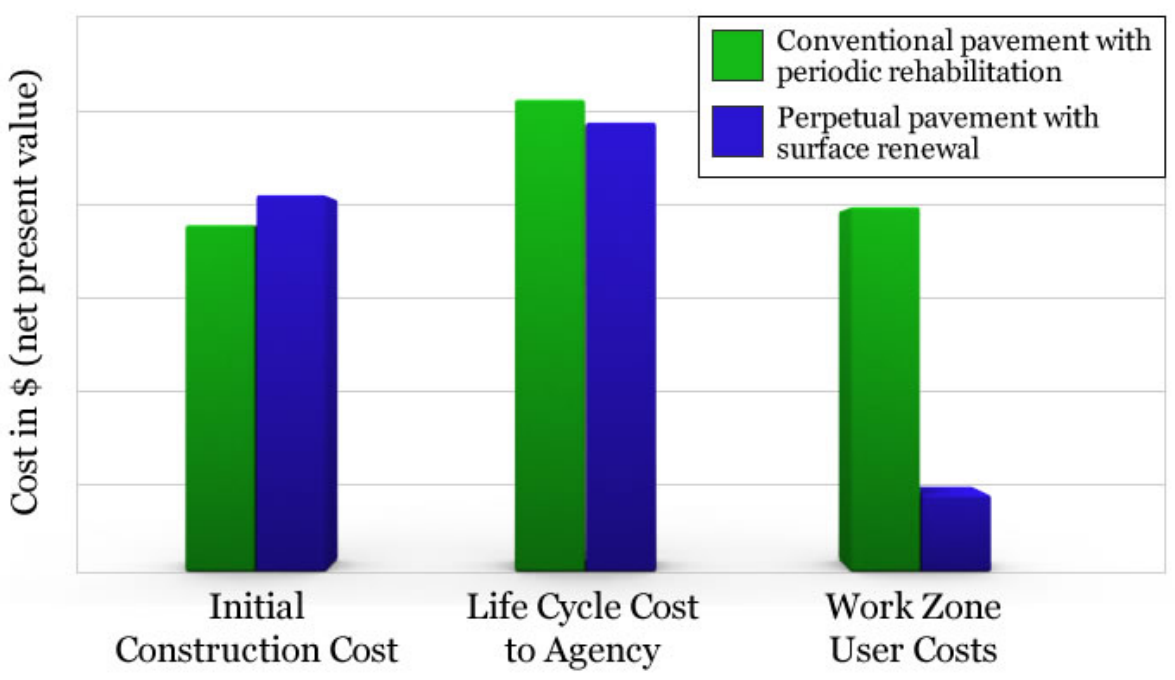
Life Cycle Considerations

Perpetual Pavements

- Designed to never experience structural rutting or cracking
- PennDOT has earned 8 perpetual pavement awards





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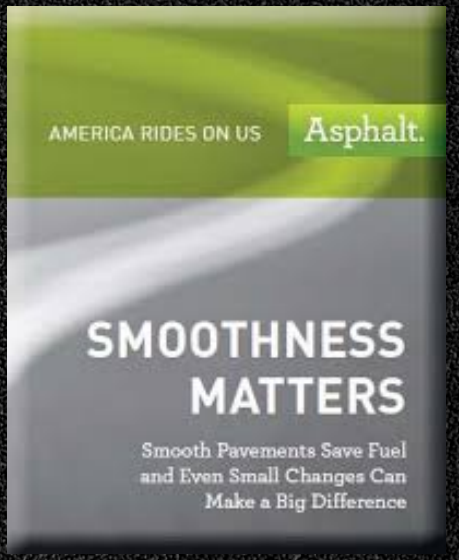
Life Cycle Considerations

Pavement Smoothness

- Vehicle wear and tear
- Pavement wear and tear
- Fuel efficiency
- Noise
- Safety



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Resiliency and Asphalt Pavements

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What is Resilience?

- No common definition
  - AASHTO cited 8 definitions related to transportation infrastructure
- Many faces of resilience
  - But none, by itself, represents the whole

https://environment.transportation.org/pdf/infrastructure_resilience/understandingtransresil_jan2017.pdf

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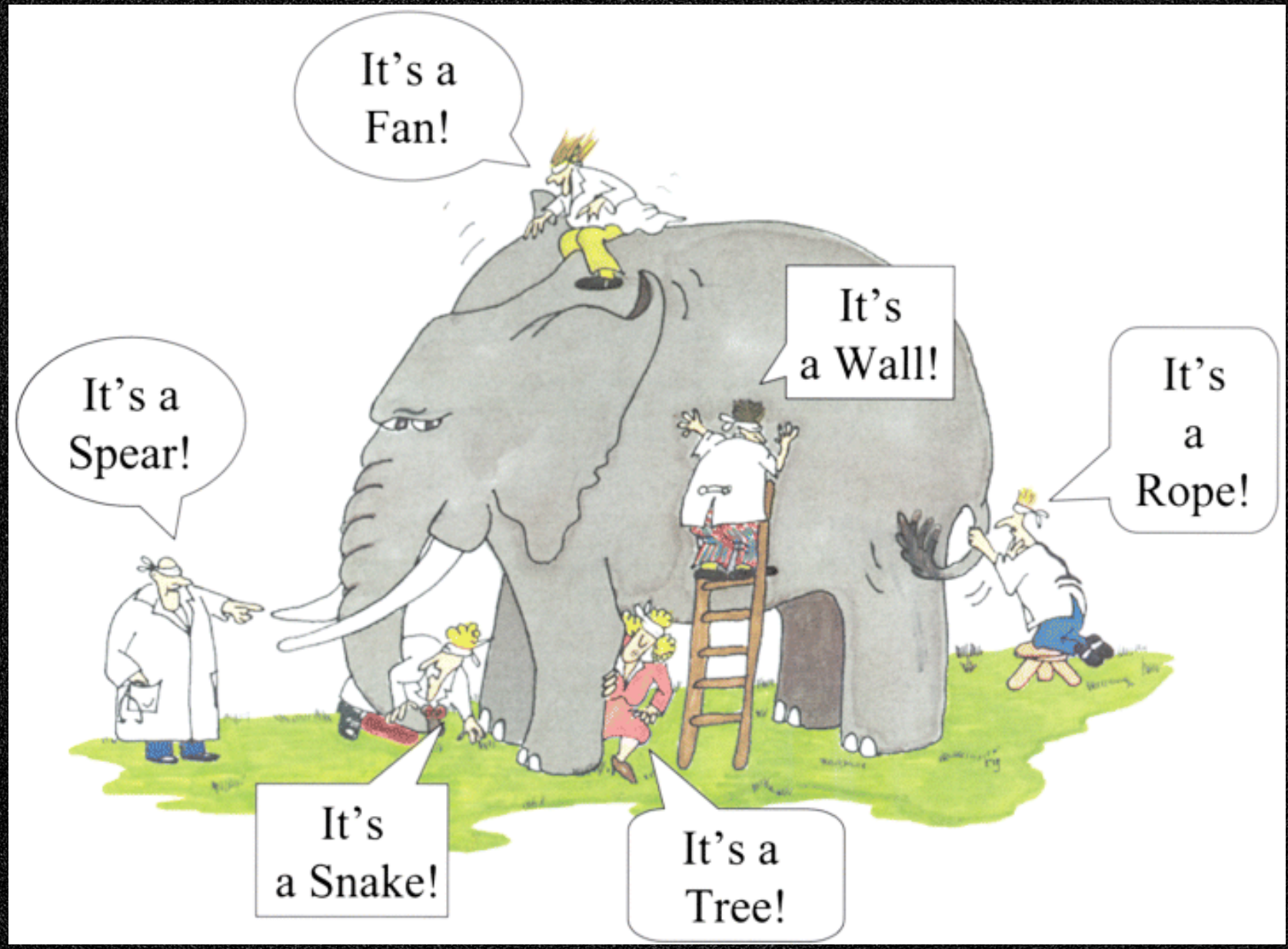
Resilience – The elephant and the 6 blind men



https://www.myeducator.com/reader/web/1293a/chapter01/j596n/

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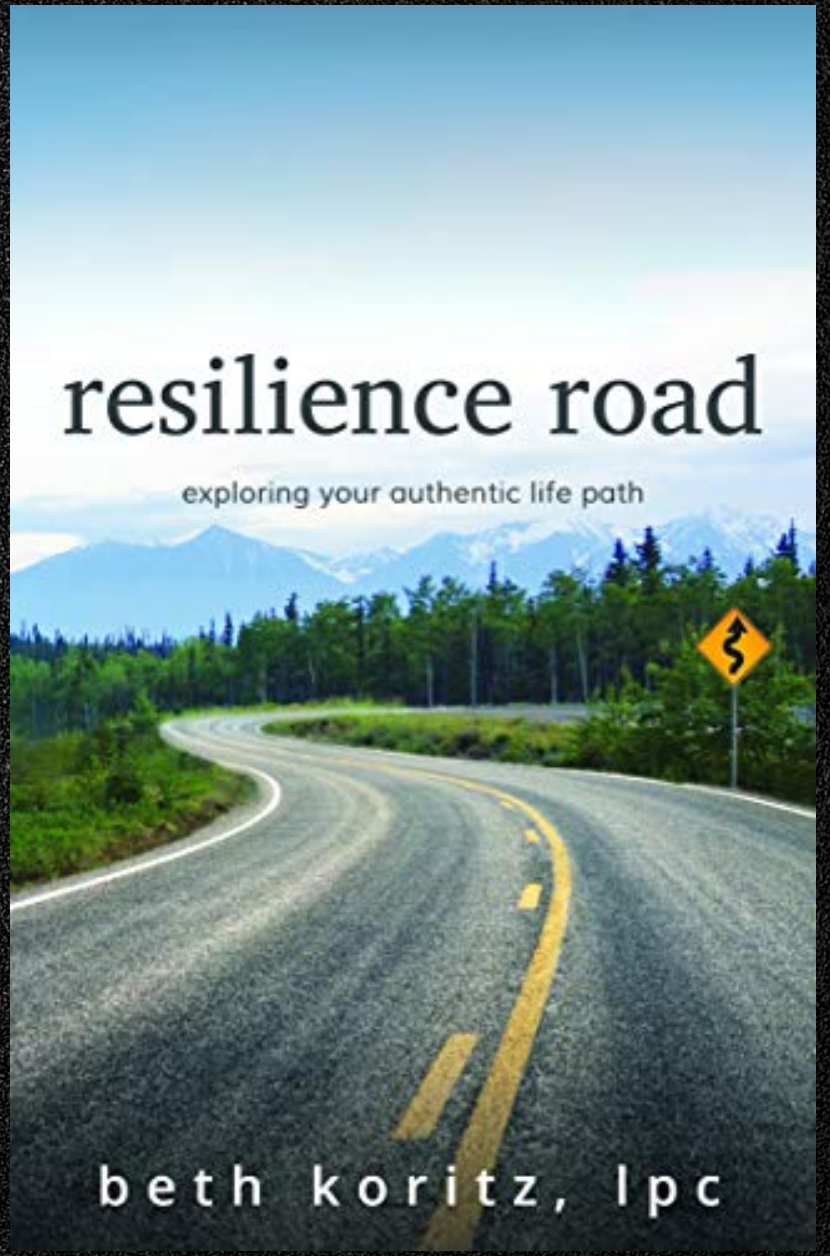
Resilience and Asphalt Pavements

Natural disasters

- Hurricanes, floods, earthquakes, landslides, tornadoes
- Damaged roads affect **mobility**
  - Emergency services
  - Access to medical care
  - Food supplies
  - Commerce
- With unexpected events, the key is to **quickly restore service**



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Resilience – Earthquake Response

- 8 major transportation corridors severely damaged
- All 8 major roads repaired within 5 days

- Anchorage, AK
- December 1, 2019

https://www.theverge.com/2018/12/8/18128983/alaska-earthquake-roads-fixed-anchorage-damage

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Resilience – Earthquake Response

- Ridgecrest, CA –
  - July 4 & 5, 2019
- Back-to-back earthquakes damage Highway 178
- Temporary repairs completed within hours
- Permanent repairs completed less than 10 days later, within a single shift

https://www.sbsun.com/2019/07/04/6-6-magnitude-earthquake-southwest-of-searles-valley-in-san-bernardino-county-is-felt-throughout-the-southland/

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Resilience – Hurricanes

- Orange, Texas after Hurricane Harvey
- August 2017

https://www.nytimes.com/2018/09/19/climate/humans-hurricanes-causes-effects.html

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Resilience – Speed of Hurricanes

- Hurricane Michael severely damaged U.S. 98 in Franklin County, Florida (October 2018)
- 40-mile stretch of highway affected, 15 miles badly damaged
- Lanes were reopened to traffic after every shift

https://www.tallahassee.com/story/news/2018/10/11/u-s-98-closed-east-lanark-village/1601275002/

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Resilience – Warm Mix to the Rescue

- What happens when local plants can't operate?
- Use of warm mix studied after Hurricane Katrina
- Haul distances up to **8-10 hours** can be used with warm mix technology
- Fine graded mixes are more easily compacted

SERRI Southeast Region Research Initiative

SERRI Report 70015-011

Full Scale Testing of Hot-Mixed Warm-Compacted Asphalt for Emergency Paving

http://driveasphalt.org/resource-library/full-scale-testing-of-hot-mixed-warm-compacted-asphalt-for-emergency-paving

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Resilience – Warm Mix to the Rescue
U.S. 34, Colorado, 2013

- 3-hr. haul distances
- Late season paving at high elevation
- Steep canyons with little sun and high winds
- Warm mix was key to getting the job done

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https://www.roadsbridges.com/asphalt-paving-able-reconnect

https://www.cpr.org/2016/09/29/brace-yourself-northern-colorado-us-34-big-thompson-canyon-closure-is-almost-here/

Resilience and Asphalt Pavements

Climate change

- Coastal flooding, groundwater rise, hotter temperatures
- The key is to **plan for expected changes**

http://seagrant.soest.hawaii.edu/coastal-and-climate-science-and-resilience/ccs-projects/building-resilience-to-coastal-hazards-and-climate-change-in-hawaii/

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Resilience – Sea Level Rise

- Highway 80, Tybee Island Access Road
- Caused by king tides and shifting currents
- 3,000+ residents
- October 27, 2015

https://www.ajc.com/blog/politics/supermoon-rising-sea-levels-put-tybee-island-access-under-water/kE3PD96bMn0XJDPSHt0JtO/

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Resilience – Hotter Temps

- Use climate forecasts rather than historical data for pavement design
- Integrate design changes into routine maintenance overlays
- Can be cost effective if planned appropriately

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https://www.bostonglobe.com/metro/2019/07/11/climate-change-means-roads-should-built-differently-unh-researchers-say/iU35VmsG3L02gbFsY0F10J/story.html

Climate change means roads should be built differently, UNH researchers say

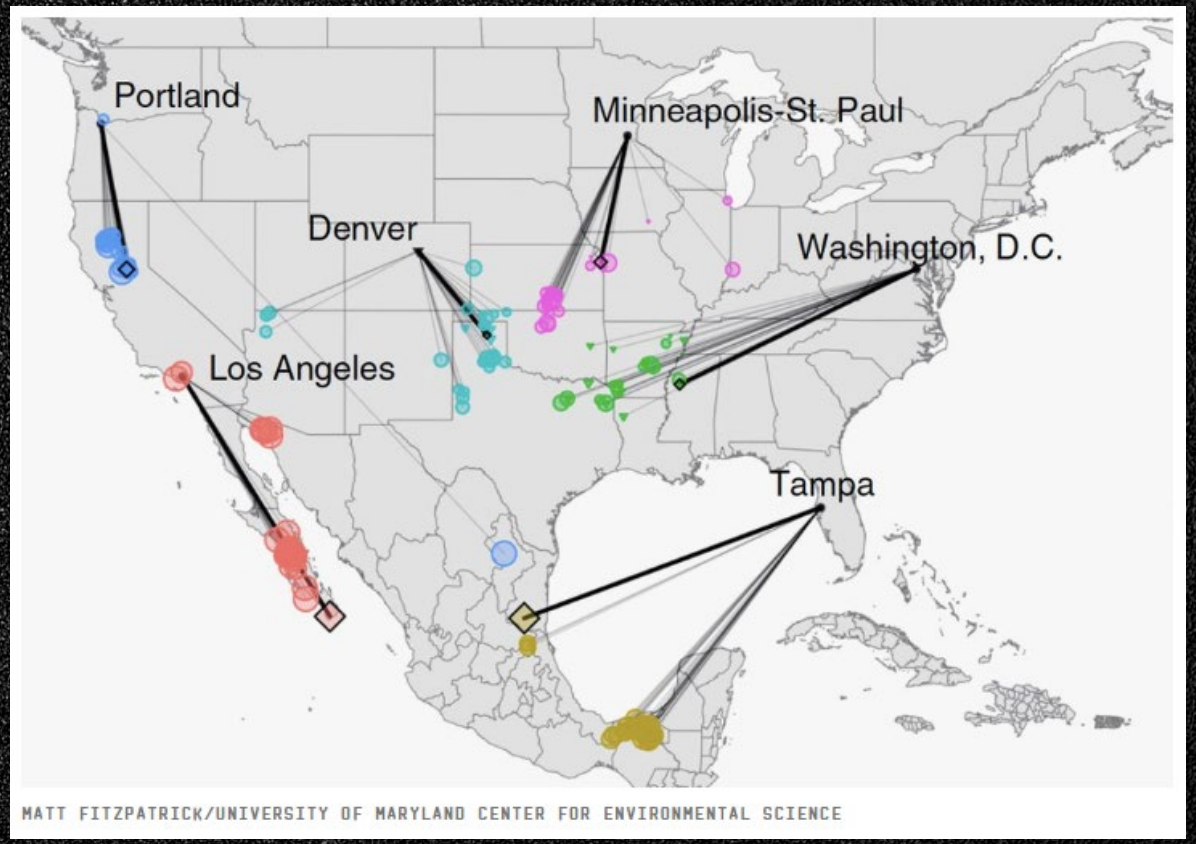
By **Alyssa Lukpat** Globe Correspondent, July 11, 2019, 1:42 p.m.

Harrison Avenue in the South End is in poor shape. It is cracked, crevassed, and noticeably uneven. (FILE 2009)

Researchers at the University of New Hampshire say governments should start building roads with different and thicker asphalt now so they will be ready to withstand the effects of climate change in the future.

Resilience – Will Roads Melt as the Temperatures Heat Up?

- Climate models provide long-term expected temperature changes
- Adjust **binder grades** to accommodate predicted conditions
- Time scale of changes is **decades**
- Can be a part of **routine maintenance** overlays



https://www.wired.com/story/this-scary-map-shows-how-climate-change-will-transform-your-city/?verso=true

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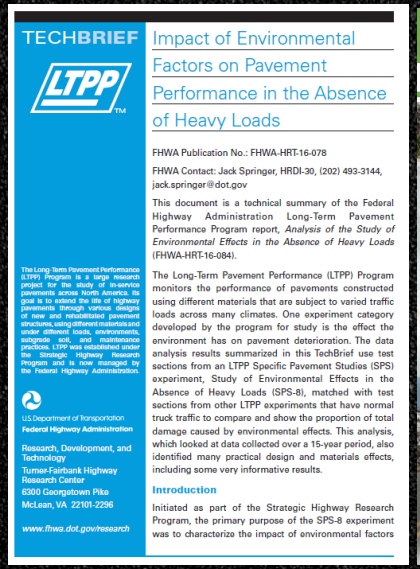
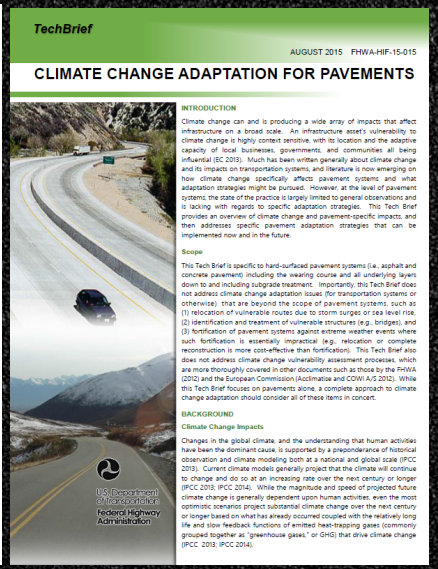
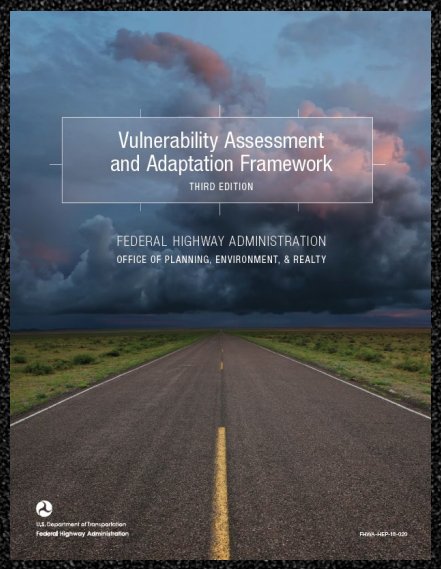
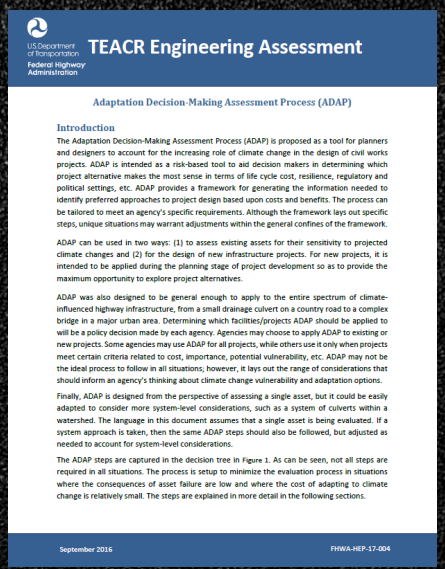
FHWA references for pavement resilience

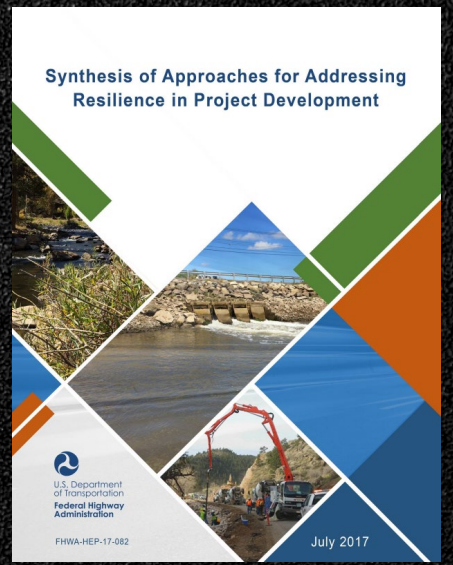
Impact of Environmental Factors on Pavement Performance in the Absence of Heavy Loads (FHWA-HRT-16-078)
www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpp/16078/16078.pdf
Climate Change Adaptation for Pavements (FHWA-HIF-15-015)
www.fhwa.dot.gov/pavement/sustainability/hif15015.pdf
Vulnerability Assessment and Adaptation Framework, Third Edition (FHWA-HEP-18-020)
www.fhwa.dot.gov/environment/sustainability/resilience/adaptation_framework
Adaptation Decision-Making Assessment Process (ADAP) (FHWA-HEP-17-004)
www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/teacr/adap
Synthesis of Approaches for Addressing Resilience in Project Development (FHWA-HEP-17-082)
www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/teacr/synthesis











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PAVING FOR PERFORMANCE:

Built to Perform

www.AsphaltPavement.org/P4P

DECEMBER 3&4, 2019 / AUSTIN, TEXAS

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Questions?

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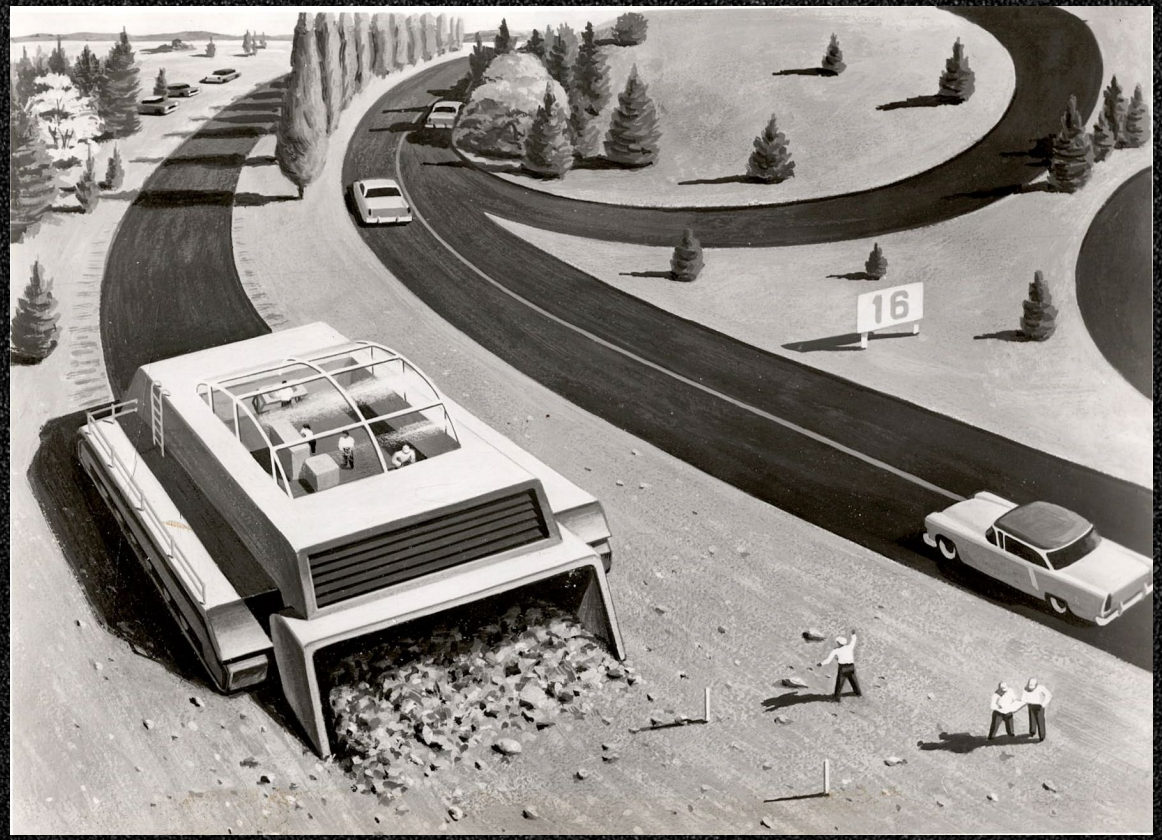

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