An Introduction to Pavement Sustainability

SEAUPG’s Annual Meeting
Baton Rouge, LA

Khadija Ngozi-Bullock, P.E.
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Vision and Mission

- To advance the knowledge and practice of designing, constructing, and maintaining more sustainable pavement through:
  - Stakeholder engagement
  - Education
  - Development of guidance and tools

Key Takeaways

- Definition and characteristics of pavement sustainability
- Benefits of moving toward sustainable pavement systems
- Current sustainability practices
- Emerging trends and technologies
- Tools to measure and quantify sustainability

https://www.fhwa.dot.gov/pavement/sustainability/ref_doc.cfm

Sustainable Pavements and the Pavement Life Cycle

Definition: Sustainable Pavements

1. Achieve the engineering goals.
2. Preserve and (ideally) restore surrounding ecosystems.
3. Use financial, human, and environmental resources wisely.
4. Meet basic human needs such as health, safety, equity, employment, comfort, and happiness.

Opportunities for Improving Sustainability Exist Throughout the Pavement Life Cycle
Why Should We Care About Pavement Sustainability?

Benefits of Being More Sustainable

- Reduced pavement life-cycle costs
- Reduced energy
- Reduced noise
- Improved air quality
- Improved safety
- Improved ride
- Conservation of resources

How Do We Consider Sustainability in design?

Sustainability = Good Engineering Practice

Example Sustainability Priorities/Values

Sustainability...
- Considers all life cycle stages
- Looks for continuous and ongoing improvements
- Prioritizes and operationalizes values through a conscious effort
- IS NOT an add-on value to a system

Trade-Off Considerations
- Improving one outcome may compromise another
- Consideration of Opportunity Costs
- Priorities/values of the organization/project
  - Which sustainability components are particularly valued?
  - How do we prioritize these values?
  - How do we operationalize these values?
- Risk
  - What risks do we face?
  - How much risk is acceptable?

Sustainability is Context Sensitive

I-90 near Snoqualmie Pass, Washington

Photo credit: S. Muench

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Sustainability Is Context Sensitive

I-5 Seattle, Washington
11 lanes
280,000 AADT
5% trucks
38 inches annual precipitation

Photo credit: S. Muench

RAP vs. Local Aggregate:
Is one more sustainable?

RAP benefits:
- Reduced raw materials use
- Reduced air emissions
- Reduced solid waste

Local materials benefits:
- Reduced fossil fuel use
- Reduced air emissions
- Improves local economies
- Reduces costs

It Depends! Context Sensitive!
Priorities, location of project site relative to material sources
- Example: nearest source of RAP is 100 miles away vs. acceptable local material only 5 miles away.
  - Consider economic, environmental, and societal impacts of material hauling.

How Do We Measure Pavement Sustainability?

Balance of the Triple Bottom Line

Life-Cycle Assessment (LCA)
Performance Testing
Life-Cycle Cost Analysis (LCCA)
Sustainability Rating Systems (e.g., INVEST)
Performance Testing

Life-Cycle Cost Analysis

Title: Life-Cycle Cost Analysis in Pavement Design – Interim Technical Bulletin
Authors: Walls and Smith (for FHWA)
Published: 1998
Description: Recommends procedures for conducting LCCA of pavements. Sets standard for inclusion of user costs (WZ only) and probabilistic analysis.
Where: USDOT and various other websites

Life-Cycle Assessment

Title: Performance Life Cycle Assessment Framework
Authors: Shao et al.
Published: 2019
Description: Framework for performing LCA of pavements. Includes life-cycle inventory, impact assessment, and interpretation.
Where: Available online
  - https://www.fhwa.dot.gov/pavement/pub_details.cfm?id=935
  - https://www.fhwa.dot.gov/pavement/pub_details.cfm?id=998

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Reasons to Measure Sustainability

- Achieving sustainability and performance goals
- Satisfying accounting mandates
- Providing decision support
- Improving agency processes
- Improving public image

Sustainability Initiatives from Transportation Agencies

- Arizona DOT
  - Sustainable Transportation Program
  - Sustainable Pavement Program
  - Resilience Program
- Hawaii DOT
  - Sustainable Transportation Forum
  - Minnesota DOT Sustainability Program
  - Vision: Maximize health of people, environment, and economy

Available Resources

- Guide Documents:
  - Towards Sustainable Pavement Systems
  - Pavement Life Cycle Assessment Framework
- Tech Briefs on following topics:
  - Pavement Sustainability
  - Life Cycle Assessment
  - Improving Resiliency of Pavement Systems
  - Strategies for Improving Sustainability of Asphalt/Concrete Pavements
- Webinar series on pavement sustainability

Key Takeaways

- “Sustainable” in the context of pavements refers to system characteristics that encompass a pavement’s ability to:
  - Achieve engineering goals
  - Preserve ecosystems
  - Use resources judiciously
  - Meet basic human needs
  - Sustainability is a continuum
  - Sustainability requires innovation
  - Sustainability involves trade-offs
- The FHWA’s Sustainable Pavements Program provides many resources to help agencies

To Learn More:

Summary

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For More Information

- FHWA Sustainable Pavements Website
  - www.fhwa.dot.gov/pavement/sustainability

- FHWA Contacts:
  - Heather Dylla (Heather.Dylla@dot.gov)
  - Khadija Ngozi-Bullock
    (Khadija.NgoziBullock@dot.gov)