



U.S. Department of Transportation
Federal Highway Administration

FHWA'S MOVEMENT TOWARD SUSTAINABLE PAVEMENTS

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US DOT Committed to Sustainability

"Sustainability must be a principle reflected in all our infrastructure investments, from highways and transit to aviation and ports."

Former Secretary Ray LaHood, March 2009

US DOT Sustainability Policy Statement

DOT will incorporate sustainability principles into our policies, operations, investments and research through innovative initiatives and actions such as:

- Infrastructure investments and other grant programs,
- Innovative financial tools and credit programs,
- Rule- and policy- making,
- Research, technology development and application,
- Public information, and
- Enforcement and monitoring

Signed Secretary Anthony R. Foxx, June 2014

Sustainable Transportation

Sustainable Transportation means providing exceptional mobility and access in a manner that meets development needs without compromising the quality of life for future generation

- Safe
- Healthy
- Affordable
- Renewable
- Operates fairly
- Limits emissions and the use of non-renewable resources



Sustainable Highways

- Consideration of the highway system:
 - From conception to completion
 - Through maintenance and operation
 - Satisfies life-cycle functional requirements
 - While improving the natural, built, and social environment



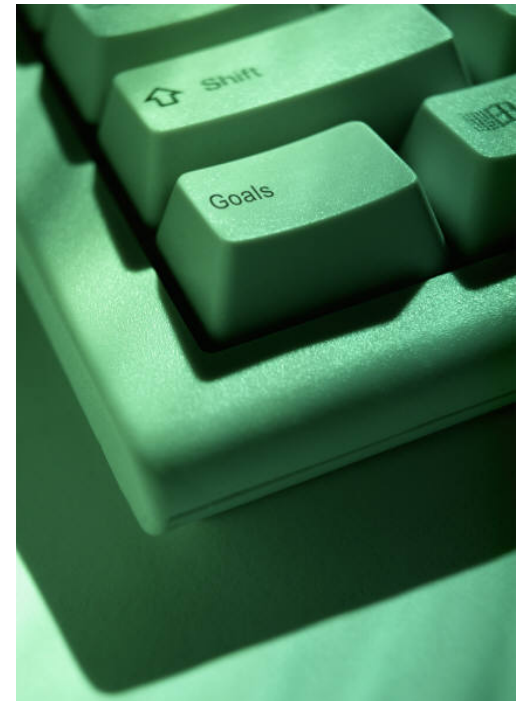
FHWA Sustainable Pavements Program

Goals

- Support the US DOT goals for liveability and sustainable transportation
- Increase the body of knowledge regarding sustainability of asphalt and concrete materials in pavement design, construction, preservation, and maintenance
- Increase the use of sustainable technologies and practices in pavement design deign, construction, preservation, and maintenance

FHWA Sustainable Pavement Program

- Technical Input from Stakeholders
- Technical Guidance on Pavement and Materials Sustainability
- Advancing Sustainability Tools
- Technology Transfer



Technical Input from Stakeholders

Sustainable Pavements Technical Working Group

- The SP TWG is composed of stakeholders in State DOT's, academia, industry, and other government agencies
 - 20 members and 200+ friends
- Goal is for FHWA to gather feedback from stakeholders on the technical aspects of the Sustainable Program



Technical Guidance of Pavement and Materials Sustainability

- Develop guidelines for the design, construction, preservation, and maintenance of sustainable pavements utilizing asphalt and concrete materials.
 - Educate practitioners on what sustainability means for pavements and materials.
 - Encourage practitioners to adopt sustainable practices.



“Towards Sustainable Pavement Systems: A Reference Document”

1. Introduction
2. Concepts of Pavement Sustainability
3. Sustainable Materials for Paving
4. Design of Sustainable Pavements
5. Construction of Sustainable Pavements
6. Use Phase Considerations
7. Maintenance / Preservation / Rehabilitation Practices
8. End of Life for Sustainable Pavements
9. Sustainable Pavements in Livable Communities
10. Assessing Pavement Sustainability

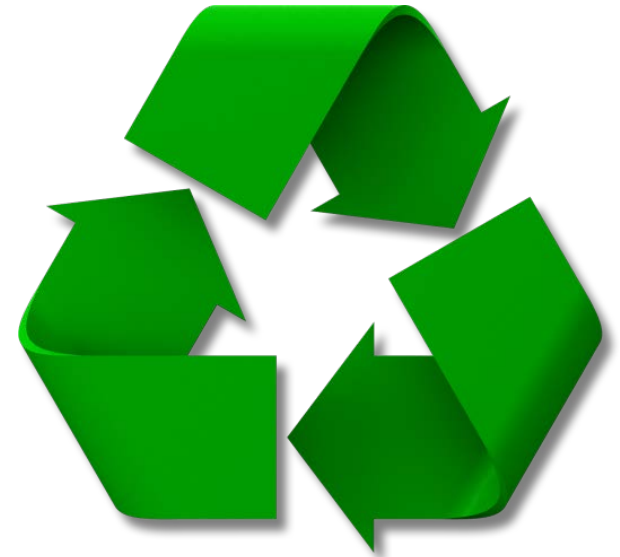
1. Introduction



- Target Audience
 - State Department of Transportation practitioners
 - Designers
 - Maintenance Engineers
 - Materials Engineers
 - Construction Engineers
 - Inspectors
 - Planners
 - Others who will benefit: local roadway agencies, industry, academia, public interest groups

2. Concepts of Pavement Sustainability

- The Pavement Life Cycle
 - Materials production
 - Pavement design
 - Construction
 - Use
 - Maintenance and preservation
 - End-of-life



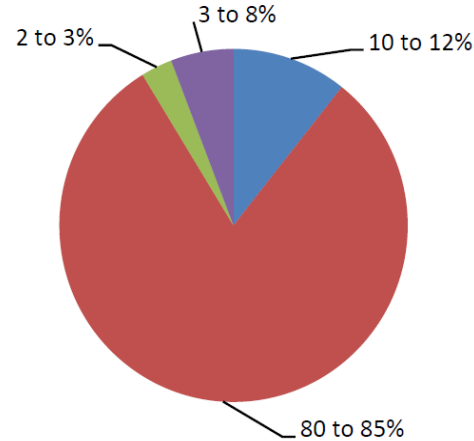
3. Materials Considerations to Improve Pavement Sustainability

Aggregates

- Strategies

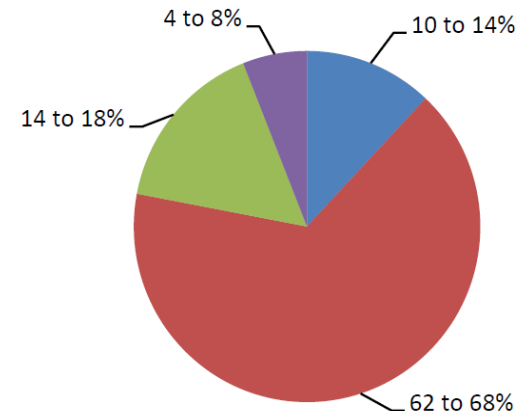
Percentage of Volume of Typical Asphalt Concrete

■ Asphalt Binder ■ Aggregate ■ Filler ■ Air



Percentage of Volume of Typical Concrete

■ Cementitious ■ Aggregate ■ Water ■ Air



- Reduce amount of virgin aggregate used
- Reduce impact of virgin aggregate acquisition and processing
- Reduce impact of aggregate transportation

3. Materials Considerations, cont.

Asphalt Materials

- Strategies
 - Reduce virgin binder content
 - Reduce energy consumed and emissions generated during production
 - Extend service life (compaction, polymers, improved designs)
 - Locally available materials



3. Materials Considerations, cont.

Concrete Materials

- Strategies
 - Reduce energy consumption and emissions during cement manufacturing (biofuels, minimize clinker, etc.)
 - Reduce energy consumption and emissions during concrete production (blended cements, SCMs, etc.)
 - Increase RCWM (Recycled Co-Product or Waste Material)
 - Improve concrete durability

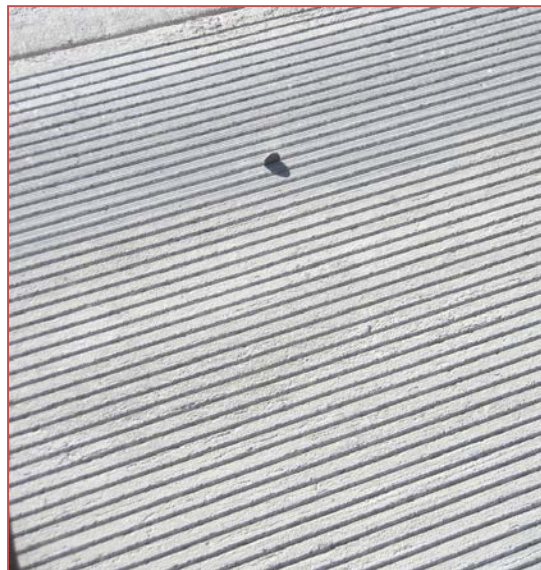


Two-lift concrete construction

4. Pavement and Rehabilitation Design to Improve Sustainability

- Strategies
 - ME Design for optimization
 - Enhanced pavement smoothness
 - Noise reducing surfaces
 - Minimize impacts of utility construction
 - Permeable pavements

Next Generation
Diamond Grinding



Stone Matrix Asphalt Surface

5. Construction Considerations to Improve Pavement Sustainability

Asphalt Construction

- Strategies

- Achieve target density
- Prevent segregation
- Proper construction of longitudinal joints
- Achieve smoothness requirements



5. Construction Considerations to Improve Pavement Sustainability, Cont.

Concrete Construction Strategies



- Protect water resources
- Improve initial ride quality
- Increase pavement service life
- Balance surface friction and tire-pavement noise

6. Use Phase Considerations

- Major Issues
 - Roughness and macrotexture
 - Tire-pavement noise
 - Stormwater runoff
 - Pavement thermal performance (urban heat island)
 - Safety



7. Maintenance and Preservation Treatments

- Lower life cycle cost are often highly correlated with lower environmental burden. Depends on:
 - Treatment selection, materials selection, and timing of treatment
- On higher traffic routes, high economic cost of more frequent treatments may be offset by large reductions in environmental impacts
- Treatment, materials, and construction quality play a major role



8. End of Life

Asphalt Pavement Recycling

- Strategies
 - Increase central plant recycling rate
 - Improve plant technology
 - Increase initial quality of pavement materials and construction
 - Maintain and manage RAP stockpiles
 - Increase in-place recycling rate
 - Use proper type and amount of additives/stabilizers
 - Use of structural asphalt overlays
 - Standards for mix design and QA

Stockpile of recycled aggregate



8. End of life, cont.

Concrete Pavement Recycling

- Strategies
 - Increase use of recycled materials
 - Reduce CO₂ emissions over life cycle through sequestration
 - Reduce virgin materials

Class C fly ash, Metakaolin, Silica Fume,
Class F fly ash, Slag, Calcined Shale; photo
from Portland Cement Association



9. Pavement Sustainability Within the Larger System

- Enhance roadway aesthetics
- Minimize impaction of utility cuts
- Improve worker and community health: reduce odors, soot, and particulate
- Balanced approach to allowable hours of construction

Zion Park Blvd. in Utah (SR 9);
photo from Dr. Steve Mueuch



10. Assessing Pavement Sustainability

- Life Cycle Cost Analysis (LCCA)
 - Evaluation of the total economic worth of a usable project segment
 - FHWA RealCost
- Sustainability Rating Systems
 - List of sustainability best practices with an associated common metric
 - FHWA INVEST, Greenroads, Envision, GreenLITES, LEED
- Life Cycle Assessment (LCA)
 - Quantifies environmental impact over the full life cycle of a product or system

Advance Sustainability Tools

Pavement Life Cycle Assessment (LCA) Framework

- Structural evaluation methodology that quantifies environmental impacts
- Comprehensive approach to evaluating the total environmental burden of a product
- Examine all inputs and outputs over the life cycle
- Consideration from materials production to end-of-life



Technology Transfer

Moving from Paper to Practice

- Update FHWA Pavements website with useful sustainable pavements and materials information and references
 - Technical Articles
 - Reference Center



The screenshot shows the FHWA Sustainability website. The main navigation bar includes "Home", "Sustainability", "Business", "Safety", "State", "Construction", "Social", "FHWA", and social media icons. The "Sustainability" section is highlighted. Below the navigation bar, there is a banner image of a road with a yellow center line. The main content area is titled "Sustainable Pavements Program" and features a large image of a construction site with a yellow truck. Below the image, there is a caption: "Two (2) Concrete Treatment Contractors" and a set of navigation buttons: "Home", "Pavement", "New".

The FHWA launched the Sustainable Pavements Program in 2012 to advance the knowledge and practice of sustainability related to pavements. The overall objective is to establish a program that considers material, economic, genetic, and other aspects in pavement systems including new and emerging materials. A critical outcome of the program is to increase the awareness, visibility, and the body of knowledge of sustainability considerations by all the life cycle phases of pavement systems.

The website provides access to the sustainability documents, reference documents and other useful web sites from the document that cover key topics and core issues.

[Technical Articles](#)

[Reference Center](#)

[Technology Transfer](#)

[Technical Working Group](#)

Technology Transfer, Cont.

- Tech Briefs under development:
 - “Pavement Sustainability”
 - “Life Cycle Assessment of Pavements”
 - “Climate Change and Pavements”
 - “Asphalt Pavement Sustainability”
 - “Concrete Pavement Sustainability”



Prepare for the Future

Legislation?



Public Opinion?



THANK YOU

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<http://www.fhwa.dot.gov/pavement/sustainability/>