"Sustainable Highway Construction" is Not an Oxymoron

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H.W. Lochner, Inc., Chicago

TRB
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Today’s Topics

• Why Sustainability?
• Is “Sustainable Highway” an Oxymoron?
• Can we afford to be Green?
• Do we need a Sustainability Rating System?
• What can TRB Committees do to help?
Why Sustainability?

Sustainability is not:

• The latest management technique
• Thinking harder and working smarter
• Saving a few more trees or a few more fish
Why Sustainability?

- What is it?

The Brundtland Definition (1987)

Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Why Sustainability?

- Why do we need it?
Why Sustainability?

• Why do we need it?
  1. Finite amounts of virgin non-renewable resources.
     In 2008, the world economy consumed:

     - 2.4 billion tons of iron ore
     - 2.9 billion tons of cement
     - 1.2 billion tons of aggregates (USA only)
     - 1.3 trillion gallons of crude oil

Source: USGS
Why Sustainability?

• Why do we need it?

1. Finite amounts of virgin non-renewable resources.
2. Increasing population

![Daily Population Change Graph](source: GeoHive)
Why Sustainability?

- Is it a passing fad?
  1. Population
  2. Demands for higher standards of living
  3. Virgin raw material supply
Is “Sustainable Highway” an Oxymoron?

Highway improvements lead to added sprawl, thus increasing energy use and GHG emissions. How is that part of being sustainable?

Regardless of how we might travel in the future, highways will be necessary for a long time. Implementing sustainability for today’s highways is as much about how we build them as why we build them.
Highway Construction as Part of the Sustainability Solution

How do we do this?

• Maximizing
  o Reuse existing materials
  o Recycling of existing materials

• Minimizing
  o Use of virgin natural resources
  o Construction and demolition waste
What Options are Available?

• Designing for lowest life-cycle impacts
• Minimizing construction & demolition waste
• Recycling asphalt paving materials
• Rehabilitating concrete roadways
• Rubblizing existing concrete pavements in place as base
• Recycling concrete as aggregate
• Modifying Diamond Interchanges to Double Crossover Diamonds
• Specifying sustainable coatings for structures
• Constructing bridges using recycled thermoplastic components
• Maximizing infiltration
• Specifying sustainable landscaping
• Using roundabouts instead of signals
• Using LED signals
• Using LED pedestrian and street lighting
• Generating clean energy on highway rights-of-way
• Performing environmental cleanup
• Reducing greenhouse gas generation
Double Crossover Diamond Interchange

Source: MoDOT Photos
LED Street Lighting

LED Lighting  88 Watts

High Pressure Sodium 196 Watts

Halifax, Nova Scotia
Recycled Plastic Bridge Components

Source: US Army
Photo Credit: Dawn Elizabeth Pandoliano
Renewable Energy Generation on Unused Rights-of-Way

Source: ODOT
A Current Example

Mid-Currituck Crossing
Owner: North Carolina Turnpike Authority
Finance / Construction: ACS / Dragados
Design: Lochner-MMM
Estimated Cost: $650 Million
Anticipated ROD: Fall 2010
A Current Example

Undergoing serious consideration at Mid-Currituck

- Zero C & D Waste to the Landfill
- Porous Pavement for Stormwater Infiltration
- Precast Concrete
- Roundabouts
- LED Signals and Streetlights
- Renewable Energy
- Low-Maintenance Landscaping
- In-situ Contamination Removal
Can We Afford To Be Green?

“When virgin resources become really scarce maybe future generations will make reuse/recycle decisions for economic reasons, but in today’s economy that would just be too expensive.”

- The skeptic
Can We Afford To Recycle?

- Recycled Asphalt Pavement (RAP)
  - Is cost-competitive for overlays
- Foamed In-Place Recycled Asphalt (CFIPR)
  - Is a structurally superior method for rebuilding failed roadway base
  - Saves materials, saves hauling, saves energy
  - Lowers costs by 40%
Can We Afford Sustainable Stormwater?

King County, WA Public Works:

- Military Road S at 272nd Street Intersection – LID Porous Pavements and Rain Gardens
  - Chosen for the technology of being green
  - Saved $44,000
- NE Woodinville-Duvall Road at Mink Road NE:
  - Constructed Wetland Estimate: $160,000
  - Rain Garden Estimate: $80,000
Can We Afford Zero Waste?

- A demolition and disposal project: Nashville Thermal Transfer Corporation
  - Demolish an existing Waste-To-Energy plant
  - Leave the site ready for redevelopment
  - Minimize costs by recycling/reusing as much of the existing material as possible
Can We Afford Zero Waste?

Thermal Demo Summary
Materials Movement & Reuse/Recycle Rate

<table>
<thead>
<tr>
<th>Activity / Item</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auction (Recycled/Reused)</td>
<td>1,093</td>
</tr>
<tr>
<td>Demo Steel, Including Rebars &amp; Structural</td>
<td>4,394</td>
</tr>
<tr>
<td>Crushed Concrete Aggregate Produced</td>
<td>50,007</td>
</tr>
<tr>
<td>Demolition Debris to Landfill</td>
<td>983</td>
</tr>
<tr>
<td>Asbestos (Removed/Disposed at Landfill)</td>
<td>21</td>
</tr>
<tr>
<td>Scrapped Metal from Auction &amp; UST's</td>
<td>118</td>
</tr>
<tr>
<td>Railroad Ties</td>
<td>7</td>
</tr>
<tr>
<td>Crushed Asphalt Produced</td>
<td>9,747</td>
</tr>
<tr>
<td>Total Weight, All Materials</td>
<td>66,370</td>
</tr>
</tbody>
</table>

Total Weight, Recycled/Reused Materials 65,366

% Recycled/Reused (total tons) 98.5%
Can We Afford Zero Waste?

### Overall Dismantlement Project Costs
**Nashville Thermal WTE Plant**

- **Original Year 2000 Demo Estimate** $2,400,000
- **Final Project Costs:**
  - UST $128,000
  - Asbestos Removal $86,000
  - Fencing $13,000
  - Demolition $775,000
  - Cover Dirt & Seeding $96,000
  - Subtotal Cost $1,098,000
  - Internet Auction Income $(983,000)

**Actual Net Total Dismantlement Cost** $115,000
Can We Afford To Be Green?

For reasons having to do with:
• greater environmental benefits,
• resource conservation,
• lower life-cycle cost, and
• in many cases lower current cost,

Can we afford not to?
Why We Need a Sustainability Rating System

We don’t know yet how to be 100% sustainable and we’re not going to be able to change that overnight.
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We don’t know yet how to be 100% sustainable and we’re not going to be able to change that overnight.

“A Lot Less Bad”

“Less Bad”

Non-Sustainable

Now

Sustainable

The Future

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Why We Need a Sustainability Rating System

We don’t know yet how to be 100% sustainable and we’re not going to be able to change that overnight.
Do Sustainability Rating Systems Miss the Point?
STEED (Sustainable Transportation Engineering & Environmental Design)
STEED
• H.W. Lochner, Inc.
• 2008, revised 2010
• Voluntary
• 35 pages (Outcome Oriented)
  • Organized by “Sustainability Categories”
Selected Scoring Elements

In order to have clear, measurable rating elements, Lochner further subdivides each of these criteria. Dozens of elements are considered, with the following 21 elements identified as representing the most significant issues to consider.

<table>
<thead>
<tr>
<th>Environmental Quality</th>
<th>Social Quality</th>
<th>Economic Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>Aesthetics &amp; Livability</td>
<td>Life-Cycle Considerations</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Cultural &amp; Historic Preservation</td>
<td>Construction Duration</td>
</tr>
<tr>
<td>Energy</td>
<td>Equity</td>
<td>Freight Mobility</td>
</tr>
<tr>
<td>Environmental Cleanup</td>
<td>Land &amp; Geology</td>
<td>Innovative Use of Technology &amp; Design</td>
</tr>
<tr>
<td>Light &amp; Noise</td>
<td>Land Use/Transportation Integration</td>
<td>Multiple Modes &amp; Modal Connectivity</td>
</tr>
<tr>
<td>Material Sources &amp; Reuse</td>
<td>Public Involvement</td>
<td>Operations &amp; Maintenance</td>
</tr>
<tr>
<td>Water Resources</td>
<td>Safety &amp; Security</td>
<td>User Economic Impacts</td>
</tr>
</tbody>
</table>

Descriptions of each of these elements are found throughout this booklet.

Users may find that the goals of some scoring elements appear to be in conflict with others. Such conflicts are inevitable in virtually every human endeavor, and the scoring system within STEED recognizes that the goals of any given element will not always align with those of another. This is a fundamental reason why sustainability measure systems seek to balance decision-making criteria.
STEED

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  - Combination Explanation & Checklist
Environmental Quality Rating Sheet

Material Sources & Reuse

Transportation projects often use significant amounts of materials. Some of the materials used are recyclable—some of the materials are renewable, and some are not. Consideration must be given to the avoidance of hazardous materials, use of recycled and longer-lasting materials and an overall reduction in construction waste.

The goals are to minimize use of non-renewable materials and maximize the reuse or recycling of existing materials.

Project Element Description
Provide a description of the elements of your project in which Materials Sources & Reuse is important and supporting information on how the selected elements are addressed. Points are awarded for measures selected below only when the selection is accompanied by a description of how that measure is being achieved on this specific project.

Rating—Each selected measure adds 1 point.

PED A
□ □ □ □ Wherever possible the design avoids the use of materials that may cause harm to people, plants, or animals if released into the environment.
Rating—Each selected measure adds 1 point.

**P = Planning**

☐ ☐ ☐ ☐ Wherever possible the design avoids the use of materials that may cause harm to people, plants, or animals or released into the environment.

☐ ☐ ☐ ☐ Specific provisions to encourage the use of locally-sourced (extracted or manufactured) materials are included, thereby supporting the local economy and reducing haul impacts.

☐ ☐ ☐ ☐ Existing paving materials, such as concrete or asphalt are reused or recycled within this project's construction.

☐ ☐ ☐ ☐ More than 90% of the existing paving materials such as concrete or asphalt are reused or recycled within this project's construction. (A point is awarded for both the statement above and this statement when more than 96% of existing paving materials are reused.)

☐ ☐ ☐ ☐ Other existing materials and/or fixtures are reused within this project's construction or are preserved at a location and in a condition that will enable their reuse by others.

☐ ☐ ☐ ☐ Methods for minimizing construction and demolition waste that would otherwise be taken to a landfill or incinerator are used.

☐ ☐ ☐ ☐ Less than 20% by weight of the construction and materials from demolished structures are disposed of via landfilling or incineration. (A point is awarded for both the statement above and this statement when less than 20% of existing materials are landfilled or destroyed.

☐ ☐ ☐ ☐ The design prioritizes the use of renewable and minimizes the use of non-renewable resources.

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STEED (Sustainable Transportation Engineering & Environmental Design rating system)

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STEEED

• 2008, revised 2010
• H.W. Lochner, Inc.
• Voluntary
• 35 pages (Outcome Oriented)
  • Organized by “Sustainability Categories”
  • Combination Explanation & Checklist
• No Arbitrary “Award Levels” (Silver, Gold, etc.) that:
  • Change the Goal
  • Offer a False Sense of Achievement
  • Limit the Imagination
  • Encourage Inappropriate Value Engineering
STEED

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• No Arbitrary “Award Levels” (Silver, Gold, etc.) that:
  • Change the Goal
  • Offer a False Sense of Achievement
  • Limit the Imagination
  • Encourage Inappropriate Value Engineering
• Four-stage process (parallels the typical Project Delivery process)
  • Planning phase
  • Environmental phase
  • Design phase
  • Construction phase
Rating: Each selected measure adds 1 point.

P E D A

☐ ☐ ☐ ☐ Wherever possible the design avoids the use of materials that may cause harm to people, plants, or animals released into the environment.

☐ ☐ ☐ ☐ Specific provisions to encourage the use of locally-sourced (extracted/manufactured) materials are included, thereby supporting the local economy and reducing haul impacts.

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☐ ☐ ☐ ☐ The design prioritizes the use of renewable and minimizes the use of non-renewable resources.
Why a Four-Stage Evaluation is Critical

- **Goal:** Sustainability
- **Tool:** Continuous Improvement – PDCA Cycle
  - End of Project evaluation only
    - This is what we got.
  - Two-stage evaluation
    - This is what we intended, this is what we got.
  - Four-stage evaluation (Planning, Environmental, Design, As-Built)
    - This is what we intended, this is what we got, and here’s where in the process the goal changed and how it changed.
    - Useful information for making future projects more sustainable.
Food for Thought

- The need to act sustainably isn’t going to go away.
- Sustainability in highway construction is the right thing to pursue.
- We can and should save virgin materials for their highest and best uses.
- We can and should recycle/reuse existing materials to their highest and best uses.
- We can afford to do many of the things I’ve identified today within our existing budgets.
- “Sustainable Highway Construction” is NOT an Oxymoron...it’s a NECESSITY.
What Can TRB Committees Do to Help Construction Become More Sustainable?

- Conglomerate a national sustainability rating system focused on Continuous Improvement.
- Research more-sustainable methods and materials.
- Develop widely-adoptable Materials Specifications that emphasize reuse & recycling.
Thank you!

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