GREEN ROADS: THE SUSTAINABLE ROAD AHEAD

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Outline of Presentation

- Background
- Context of Work
- Sustainable Practices
- Lessons Learned
Context of CPATT Research

● Linking laboratory to field testing
● Evaluate the use of innovative materials, designs and management practices
● Improved life cycle costs, sustainability
● Assimilation of new technologies
● Provide leadership to Canadian transportation community (environment/loading)
● Public-Private-Academic Partnerships
Context for Work

• Investment balances: PRESERVATION & EXPANSION

• Make decisions: TECHNICAL, ECONOMIC & ENVIRONMENTAL EFFECTIVENESS

• Consider: SHORT & LONG TERM GOALS

• Allocate Budgets: CUSTOMER REQUIREMENTS, PERFORMANCE EXPECTATIONS
Context for Work

• Infrastructure deteriorates overtime
• Insufficient resources and funding
• Opportunity to be “Green” and Sustainable
• Combine sustainability with economic benefits
• Need a simple way to quantify sustainability
Integrating Laboratory Testing

● Demonstrating differences between materials
● Using innovative tools to measure noise characteristics
● Calibrating design models using finite element, finite differences, mechanistic empirical methods
● Technical/economic/sustainable designs
● Moving laboratory to field
Field Testing: CPATT Test Track

- Field performance of three premium surface course mix technologies
- Traffic/Environmental Impacts on Pavement Design
- Training and Education of Students
- Testing of Innovative Monitoring Equipment
- Evaluation of WIM
- Assisted in developing satellite test sites (Perpetual Pavement, GTAA, City of Hamilton)
Laboratory Testing

- Examining material characterization properties (recycled products, warm asphalt)
- Using innovative tools to measure noise characteristics
- Full sized freezer to test materials (-40C)
- Working with data loggers to improve in-situ measurements (seasonal load restrictions)
- Relate lab mixes to construction – consider workability
Laboratory – Field Integration

Cored sample for dynamic modulus testing

Dynamic modulus sensor configuration of three linear variable differential transducers (LVDT’s)
Laboratory – Field Integration

Dense Graded Asphalt Cored Sample  Porous Asphalt Cored Sample
Pavement Sustainability Factors

Sustainable pavement is a subset of sustainable transportation

Main focus on Pavement Design and Management; and Material Use and Recycling
Pavement Sustainability Factors

• Usage of Raw Materials
• Alternative Materials
• Usage of Management Systems
• Air Quality
• Water Quality
• Noise
• Energy Usage
Pavement Sustainability Factors

• Calculate these factors for various designs
• Consider short and long term goals and objectives
• Consider sustainability
Sustainability Workshop
It is not more difficult
But, it is different
Availability of Resources

- Critical shortage of quality aggregate
- Many areas using aggregate faster than it is being made available
- More difficult to access aggregate
Reclaimed Asphalt Pavement

Tires
Other Materials?
New Designs?

Shingles

Recycled Concrete Aggregates
Recycling

- Consider sustainable preservation and rehabilitation options that are:
  - Safe
  - Efficient
  - Environmentally Friendly
  - Cost effective
- Optimize recycling
- Best Use of Materials
In-Situ Recycling

● In-situ recycled pavements have performed well, often carrying significantly more traffic over their service life than anticipated
● Designs built in the past have evolved from theory, road tests, and trial and error
● Many lessons have been learned from design problems/flaws, materials, and construction practices that have caused problems
Perpetual Pavement (PP)

Very thick asphalt pavement
Real-time evaluation of performance
HWY 401 Project: Instrumentation Design
• HWY 401 Project: Instrumentation Design
Sound Absorption Coefficient vs. Frequency

Absorption Coefficient

Frequency (Hz)

200 300 400 500 600 700 800 900 1000 1100 1200

- rOFC
- rOGC
- SMA
- HL-3
• Enables for Longer Truck Hauls
• Extends Paving Season

• Joint Solution
• Improved Workability
• Lower Emissions
Innovative Materials and Design

Warm Asphalt (WA) & Porous Asphalt (PA)

- Reduces Emissions, Longer Hauls (WA)
- Innovative Technology (WA)
- Structurally same as conventional (WA)
- Assists with Stormwater Management (PA)
- Excellent Potential for Parking Lots and Low Volume Roadways (PA)
- Structural and Hydrological Design (PA)
- Assist with Climate Change (WA & PA)
Sustainability: Identification Factors

- Emission control
- Material conservation
- Long life infrastructure
- Recycling and reuse
- Innovation
- Research and development

- Air quality
- Noise reduction
- Proactive planning
- Reduce user delay
- Improve safety
- Training and leadership
Goal

● Understand the material performance
● Understand the performance under varying environments and loading conditions
● Examine how using different technologies effect LCC of pavement
● Provide triple bottom line solution
Serviceability

Cost

Environmental Impacts

Conventional Pavement

Porous Pavement

Recycled Pavement/Using By-Products
- Based on many simulations: Option lowest LCC
- Preferred option: highest probability of lowest LCC, but consider importance of risk to agency

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Quantify Costs/Benefits – Short and Long Term

With The Inherent Goal To:

● Understand functional/structural performance of technologies

● Understand the environmental performance between technologies

● Examine how using different technologies effect LCC

● Identify social/political aspect of sustainability
Sustainable Material

- Develop a design procedure?
- Will it work in cold climates?
- Will it work in hot climates?
- Can it improve economics?
- Maintain or improve performance characteristics?
- Will contamination impact performance?
Life Cycle Assessment

- Technical
- Economic
- Sustainable
- Costs/Benefits
Green Initiatives

• To understand green rating systems available
• Distinguish between different rating systems
• Use them as guideline for developing MTO Green Pavement Rating System
# Examples of Sustainability Credits

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Pavement Sustainability

• Why are these technologies sustainable?
• What are the benefits of using the technologies?
• How well are these technologies currently utilized?
• Can we better utilize the technologies?
• Are there barriers to implementation?
• How can we address pavement sustainability in 5, 10, and 50 years?
Pavement Sustainability

• What are the costs to develop sustainable technologies?
• What are the benefits of implementing pavement sustainability?
• How should we achieve a balanced quantification of a sustainable pavement technology?
• Are there other technologies that should be explored?
Lessons Learned

- Development of Transportation Association of Canada Pavement Asset Design and Management Guide
- Structural/Environmental data fundamental
- Two staged process: lab testing/field testing
- Experimental Design Essential!!!
- Public-Private –Academic Partnerships Work
- Adoption of New Materials and Designs
- Think Green!!!