Accelerated Testing and Instrumentation: A Canadian Case Study

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Outline of Presentation

• Introduction
• Research Methodology
• Experimental Analysis
• Analysis of Results
• Findings and Impact
• Closing Thoughts
Introduction

- 1,000,000+ km ; $200 Billion Investment
- Roads and Airfield Pavements
- Massive Investment: Requires Repair
- Dramatic Gap in Funding and Needs
- Vital to Economy, Quality of Life
- Many Factors Impact Performance
- Flexible, Rigid, Composite, Surface Treatments, Gravel

[TAC 2013]
Introduction

• Climate Change Impacts on Infrastructure
• Sustainability Incorporated into Design, Construction, Maintenance, Management
• Multi Criteria Decision Making: Technical, Economic, Environmental, Social, Political
• Negative impacts to the population
• Balance Needs

https://www.youtube.com/channel/UCLbomPwqCgvwr3hPm4oeyfwIntro
Research Methodology

• Experimental Design
• Demonstrating differences between materials
• Using innovative tools to measure Key Performance Indicators
• Calibrating design models
• Technical/economic/sustainable designs
• Moving laboratory to field
Research Methodology

• Several Partnerships Across Canada
• Factor Analysis:
  ▪ Pavement Thickness
  ▪ Traffic
  ▪ Climatic Zone
  ▪ Materials*
  ▪ Maintenance and Management Techniques

* Emphasis on sustainable materials
# Research Methodology

<table>
<thead>
<tr>
<th>Planning and Programming</th>
<th>Design</th>
<th>Construction</th>
<th>Maintenance, Preservation and Rehabilitation</th>
<th>In-Service Evaluation</th>
<th>End of Service Life</th>
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</thead>
<tbody>
<tr>
<td>Traffic and Environmental data information</td>
<td>Information on materials, traffic, costs, environment, etc.</td>
<td>Environment during construction</td>
<td>Standards</td>
<td>Periodic monitoring of structural adequacy, roughness, surface distress, and surface friction</td>
<td>Recycling and reuse of materials for reconstruction</td>
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<tr>
<td>Assess network deficiencies</td>
<td>Design alternatives</td>
<td>Specifications</td>
<td>Treatments</td>
<td>Salvage Value</td>
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<td>Budgets</td>
<td>Analysis</td>
<td>Contracts</td>
<td>Schedules</td>
<td>Records</td>
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<tr>
<td>Establish priorities</td>
<td>Optimization</td>
<td>Schedules</td>
<td>Operations</td>
<td>Records</td>
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</tr>
<tr>
<td>Schedule projects</td>
<td>Sustainability</td>
<td>Construction operations</td>
<td>Budget control</td>
<td>Impact on performance</td>
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</tr>
<tr>
<td>Priorities</td>
<td>User costs</td>
<td>Quality control/quality assurance</td>
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**“Working” Management**

![Diagram](image-url)
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<td>• Recycling and reuse of materials for reconstruction • Salvage Value • Records • Restoration • Zero Waste Management</td>
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</tbody>
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"Working" Management

- Database
- Information

Research Loop

Research Loop
Experimental Analysis

- Asphalt Mix Designs
- Asphalt Pavement Thickness
- Jointed Plain Concrete Pavement
- Pervious Concrete Pavement
- Concrete Overlay
- Structural Dome Pavements
Experimental Analysis

• Technical
• Economic
• Sustainable
• Costs/Benefits
Analysis of Results: Asphalt

- Asphalt Mix Designs
- Asphalt Pavement Thickness
- Warm Mix
- Recycled Asphalt Pavement Performance
- Recycled Crumb Rubber
Analysis of Results: Asphalt Mix Designs, Asphalt Pavement Thickness, Warm Mix, Recycled Asphalt Pavement Performance, Recycled Crumb Rubber

Engineering Analysis:
- Quality Control
- Geogrid Design
- Structural Analyses
- Laboratory Tests
- Field Tests
- Quality Assurance
Analysis of Results: Asphalt
First truly controlled study
Integrated CPX and PBM

Leung et al
Analysis of Results: Asphalt

- Cost-Effective Usage of Innovative Materials
- Recycled Asphalt Shingles, Recycled Asphalt Pavement, Recycled Crumb Rubber
- Pavement Thickness
- Strategic Design
Analysis of Results: Concrete

- Jointed Plain Concrete Pavement
- Pervious Concrete Pavement
- Fast Track Concrete Repairs
- Concrete Overlay
- Structural Dome Pavements
Analysis of Results: Concrete
Analysis of Results : Concrete
Analysis of Results: Concrete

- Cost-Effective Usage of Innovative Materials
- Fast Track Repairs
- Concrete Overlays
- Structural Dome Designs
- Pervious Concrete
Analysis of Results: Performance

- Impact of Maintenance Treatments
- Noise Measurements
- Evaluation of Distress
- Safety Analysis
- Development of New Measures
Analysis of Results: Performance
Analysis of Results: Performance
Analysis of Results: Performance

- Climate
  - Dry
  - Mediterranean
  - Humid

- Hierarchy

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Functional Classification</th>
<th>Traffic</th>
<th>Structure</th>
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<tbody>
<tr>
<td>1</td>
<td>Express</td>
<td></td>
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<tr>
<td>2</td>
<td>Troncal</td>
<td>Different traffic volume and equivalent axles ranges defined</td>
<td>Different structural strengths (MPa) to be defined (Structure and subgrade)</td>
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<tr>
<td>3</td>
<td>Colector</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Local</td>
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Available data and field evaluation
Analysis of Results : Performance
Findings and Impact

• Use Lab or Software Tools to examine mix designs and pavement designs
• Tools for Long Term Management
• Provide a design and management guides, specifications
• Technology Transfer
Findings and Impact

- Making information available in a variety of formats
- Working with stakeholders
- Promoting Best Practices
Closing Thoughts

• Strategic Partnering
• Opportunity to Highlight Canadian Expertise
• Provides National and International Business Opportunities
• Impact on Research and Education of Future Leaders
Acknowledgements

- Norman McLeod Chair
- CPATT Partners, Faculty, Students, Staff
- Transportation Association of Canada: Pavement Asset Design and Management Guide
- Queensland Pavement Centre
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