Future Challenges & Sustainability of Road Pavements

Foamed Bitumen at Tauranga Eastern Link

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Future Challenges: Sustainability

Roadshow Theme: Future Challenges

The 3x E’s:

- Economy
- Energy & Resources
- Environment / Ecology
Future Challenges: Sustainability

We will cover:

- Foamed Bitumen – benefits vs recent challenges
- Tauranga Eastern Link project (TEL)

In Brief: The Big Picture:

- FB Advantages: Oil / Bitumen Resources
- Addressing future challenges there
Foamed Bitumen Stabilisation (FBS)

Benefits:
- FBS compared to Structural Asphalt
  - Uses ~50 to 60% of the bitumen
  - ~60% of the SAC layer cost for same loading / traffic.

Recent Challenges:
- SH1 AKL. Bombay Hills: **block cracking**: shrinkage related cracking related to excessive stiffness (& other factors)

Findings: Reduced cement advised
Project: Tauranga Eastern Link (TEL)

- State Highway 2: 20 km length – East of Tauranga
  - Traffic Loading: 29 to 34 Million Standard Axles (ESAs) - High
- Foamed Bitumen: 40% of the project, completed 2015

- Constructed by – Fulton Hogan / HEB Alliance
- Designed by – Aecom / Opus / Bartley Consultants / Gaia
Foamed Bitumen at TEL Project

The Pavement (FBS Basecourse)

25mm OGPA10 PMB

PRIME COAT 0.5 l/m² RESIDUAL +
2-COAT SEAL 1.7 l/m² RESIDUAL

230mm FBS FBA40

250mm MODIFIED TEL AP65

600mm SAND SIL: CBR_{SG} ≥ 1
(OR 500mm SIL: CBR_{SG} ≥ 3.5)

SG CBR ≥ 3.5 OR CBR ≥ 1
MINIMUM.
TEL Project – Construction / Testing

My Role

- Designer’s Representative
- Construction Monitoring
- Review Quality Assurance Data
  - Test Results

Foamed Bitumen QA:

- ITS Testing

Deflection Testing (FWD / B. Beam)
TEL: Foamed Bitumen – Shrinkage Risk

Bitumen Content: initially 3%, 2.5% after further trials
Cement content: 1.3% adopted after initial trials

- Indirect Tensile Strength (ITS)
  - Target value: 150 kPa (soaked)
  - set by a new Specification NZTA T/19
  - relatively short track record.
TEL Project: Foamed Bitumen Testing

Indirect Tensile Strength (ITS) – **Results were variable…**

(Similar variability on other projects)

Results:

<table>
<thead>
<tr>
<th>ITS (soaked) parameter</th>
<th>Results (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90(^{th}) Percentile</td>
<td>280.5</td>
</tr>
<tr>
<td>75(^{th}) Percentile</td>
<td>197.0</td>
</tr>
<tr>
<td><strong>Average / Mean</strong></td>
<td><strong>172.8</strong></td>
</tr>
<tr>
<td>Median</td>
<td>140.0</td>
</tr>
<tr>
<td>25(^{th}) Percentile</td>
<td>101.3</td>
</tr>
<tr>
<td>10(^{th}) Percentile</td>
<td>66.2</td>
</tr>
</tbody>
</table>
Good strength: ITS vs FWD stiffness shows that ITS testing was variable.

A correlation between Curvature and ITS (compacted samples) would be expected if strength issues were present.

Very few FWD results indicate a rigid pavement layer (low cracking risk).
Overview of the results: FWD and ITS along the project

- Retested FWD (good). Results kept in for correlation identification purposes.

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**FWD Curvatures:**
Shows good basecourse stiffness in final results

**ITS and FWD Curvature:**
Shows viable ITS results; these do not suggest a rigid or crack-prone layer.
Curvature values are not extremely low and do not correlate with high ITS.
Our Trial Section showed further improvement with trafficking:

Results have shown significant improvement: especially in curvature.
In Summary:

- Results: Good performance, despite low / variable ITS results
  - Similar results on other projects
    - Variable ITS also: SH16 Project, Auckland
- Good QA results: density verification, FWD confirmation
- Lower cement: not problematic
- Results demonstrate that cracking risk is low
- FBS layer: neither weak nor overly rigid
- Good outcome confirmed by FWD results
Foamed Bitumen Pavements

- Economical; high levels of traffic
- Ideal for road maintenance (rehabilitation)

- Alternatives using cement important in long run
  - but some are difficult to build, deeper foundations
  - cracking risk: high-cement bound pavement layers
  - Many kms of urban roads difficult to rebuild / maintain that way.

Future: we think “expensive Oil…”

- Efficiency and alternatives become essential…
The Future Outlook Going Forward

- Efficiency and Sustainability goals align ($ Savings)

- The Present:
  
  Good to streamline what we currently do while preparing for change…
  
  Make the most of now?

  A possibly unpopular opinion…

  Rystad Energy: Global Oil reserves total 2.1T barrels = ~70 years of consumption

  But we're well aware of long term trends in supply & price…

  The Future Outlook Going Forward
A Quick Look at the Future

Cost of Oil Production (Long Term)

- Oil: price low, below production costs of many sources.
- Long Term: Up...

Back to Roads...

- Efficient solutions for heavily trafficked roads will be important.
- Cement stabilisation alternatives: important developments
- Foamed Bitumen strategic benefits (recycling / rehabilitation)
  - Robust and cost-efficient solution on arterial roads (& rehabs)
  - Provides good performance despite recent concerns.
  - Efficient to construct.
  - Shrinkage cracking concerns are largely put to rest with mitigation / QA checks.
Sustainability & Future Challenges

The need to seek efficiency / lower cost aligns with sustainability.

This is all the more important in the future…

- Efficient solutions: Moving towards all 3x E’s:

  Economy: Cost Efficiency
  Energy & Resources
  Environment
(The End)

Questions...