Category 2: Industry Excellence in Consulting, Research or Education

National Design Procedures for Lightly Bound Cemented Materials in Flexible Pavements

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Project Outline

Project Title:
National Design Procedures for Lightly Bound Cemented Materials in Flexible Pavements

Key Contributing Staff:
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Danielle Garton, Jun Yan Lu, Dr Michael Moffatt

Project Timeframe:
August 2015 – December 2020

Project Objective:
The purpose of project was to improve understanding of the mechanisms of crack formation associated with Lightly Bound Cemented (LBC) materials and develop Austroads guidance in terms of the pavement design.

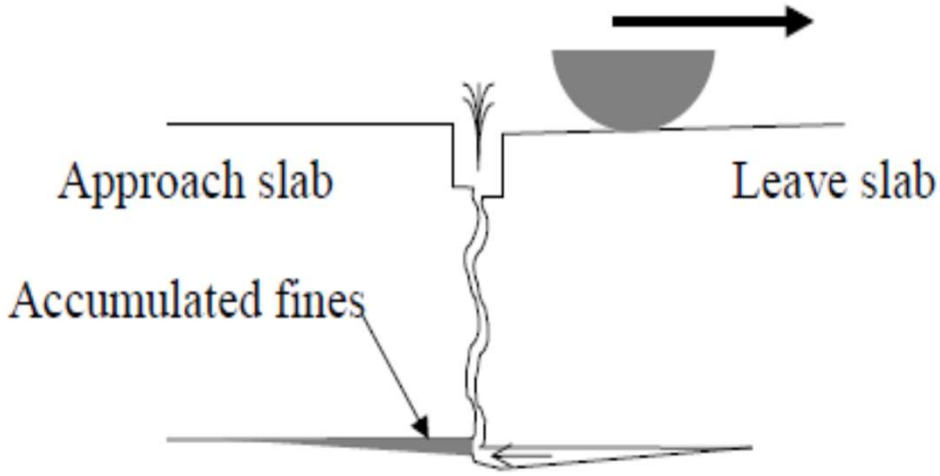
Acknowledgements:
Austroads funded project (Transport Infrastructure Program)

Lightly-Bound Cemented Materials

- Lightly-Bound Cemented (LBC) materials are granular materials with moderate amounts of stabilising binder to improve modulus
- It is common practice to categorise LBC materials with a 28-day UCS of 1.0 to 2.0 MPa
- Road agencies have identified the potential to increase the use of granular bases treated with 1–2% cementitious binders
- Improves rut resistance and stiffness when used with thin bituminous surfacings
- LBC bases have shown good performance (no block or crocodile cracking) if appropriately designed and constructed

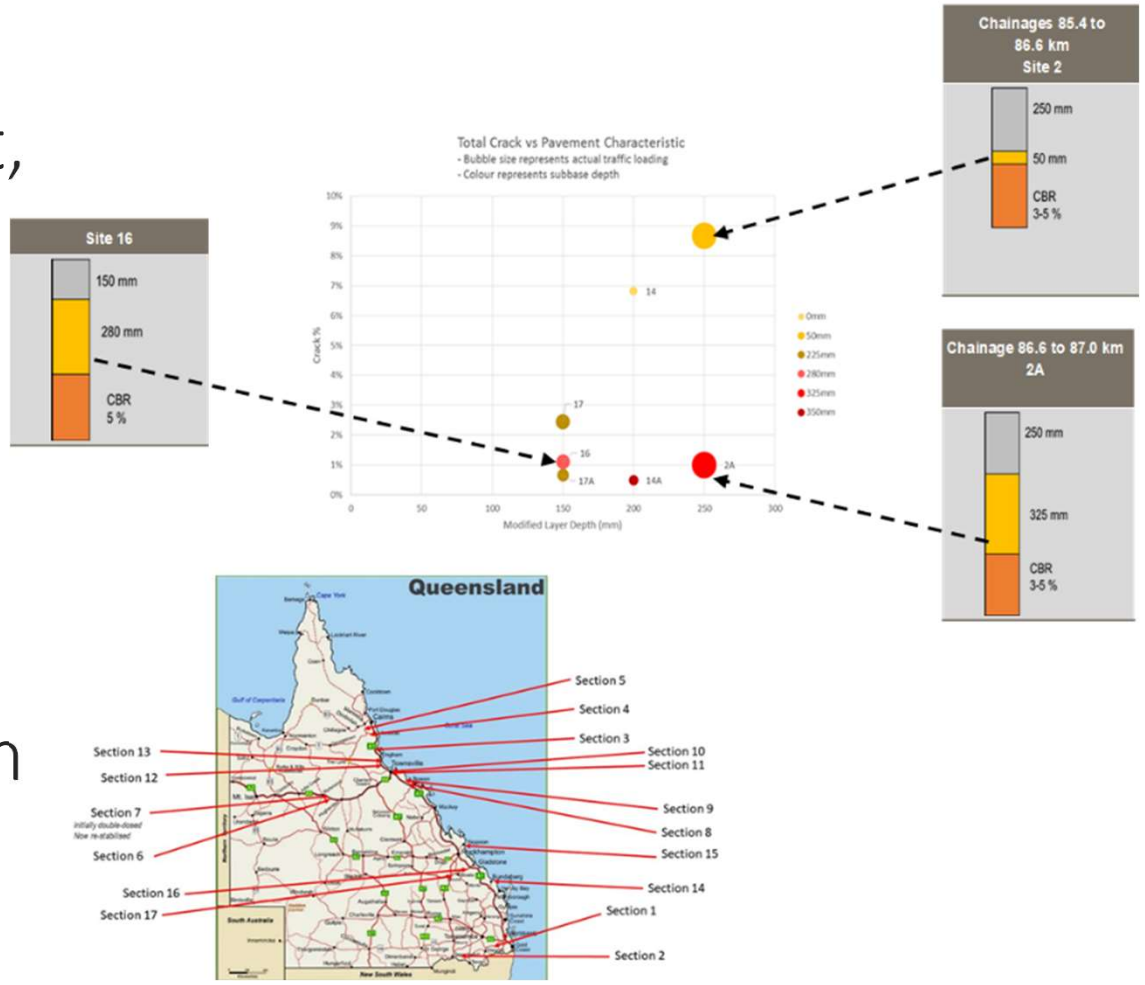
Properties and design requirements

- LBC are susceptible to shrinkage and fatigue cracking, but different cracking from heavily bound materials
- LBC have low strength not economic to design to inhibit fatigue cracking – no need for an LBC fatigue relationship
- Need a method to determine LBC design moduli
- LBC bases need to be designed to inhibit the development of macro-cracking from fatigue-induced micro-cracking
- LBC subbases may not need to be designed to inhibit the development of macro-cracking



Effect of subbase support

- Understanding in-service performance is important, in particular the propensity of LBC bases to crack
- Understand total crack length versus LBC base thickness
- Underlying subbase depth affects performance



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Mimicking field behaviour in the lab

- The Extra-large wheel tracking (XL-WT) device was used to replicate field behaviour
- The XL-WT was used to apply heavy wheel loading to LBC slabs to induce cracking
- After trafficking, slabs were investigated to determine cracking characteristics

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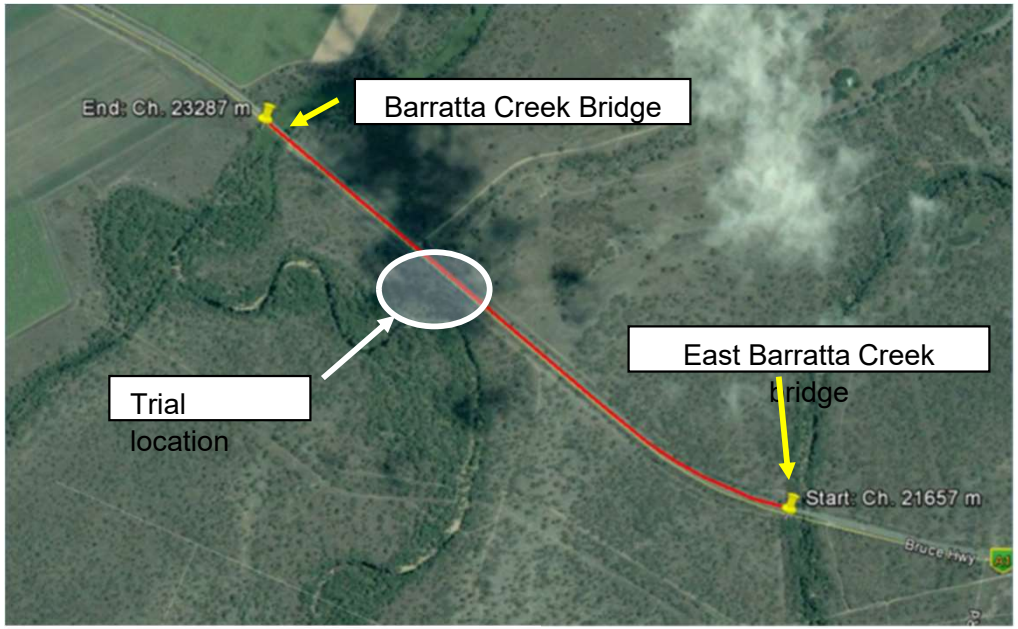
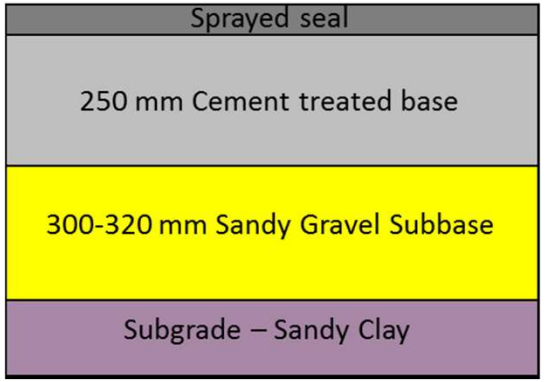
Field trial sites

Barratta Creek - 100 m section of Bruce Highway between Ayr and Townsville

- 250 mm of in-situ cement stabilisation with 2% type GB cement content
- Pavement constructed in March 2017 and surface deflections were monitored over first year of opening to traffic





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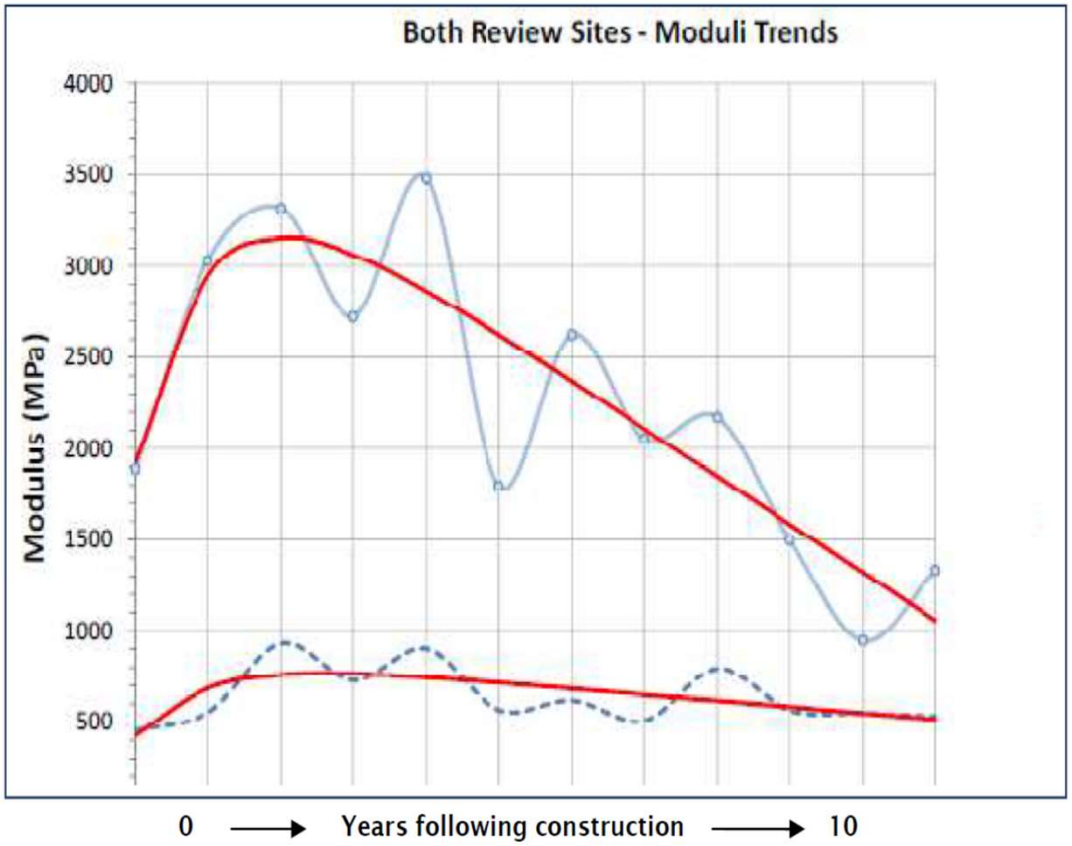
Maximum cracked LBC modulus

- Host materials base or upper subbase quality (e.g. CBR ≥ 30%)
- Proposed maximum vertical modulus of 600 MPa, horizontal 300 MPa based Australian and NZ back-calculated moduli
- No sublayering



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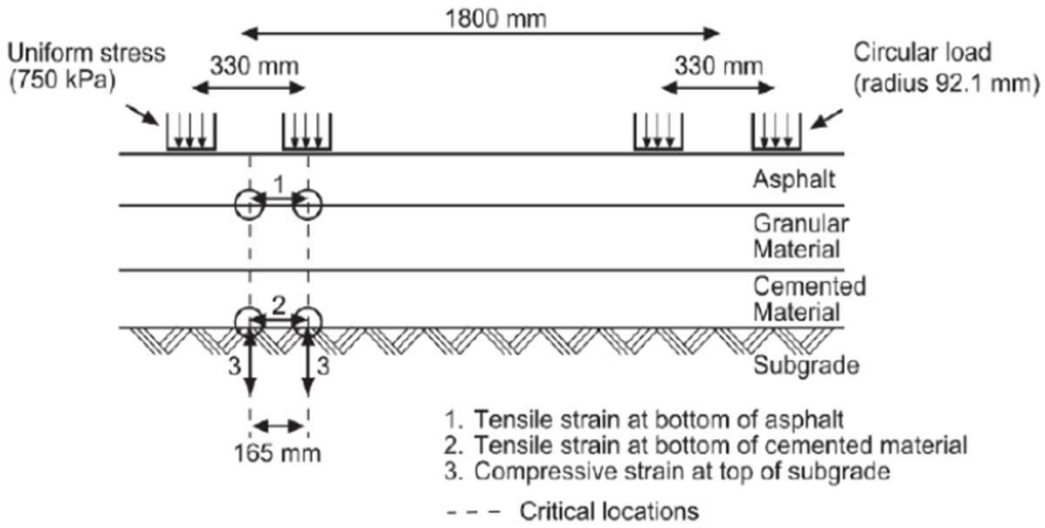
ME design method for LBC materials

- When designed to inhibit macro-cracking:
  - Consider minimum layer thickness
  - Consider minimum support to the LBC layer
- Select a trial pavement composition
- Determine LBC moduli in cracked state



- Follow Austroads ME method to determine:
  - Allowable traffic loading in terms of permanent deformation
  - Allowable traffic loading in terms of asphalt fatigue cracking

Final outcome

- Improvement in design method, leading to potential thickness reductions
- Queensland Department of Transport and Main Roads (TMR) is considering the outcomes of the project for new and rehabilitated pavements
- TMR is planning to publish an update of its Pavement Design Supplement – that incorporates the new design method recommended by this project