*Category 2: Industry Excellence in Consulting, Research or Education*

# Using Recycled Materials in Stabilised Pavements

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*2024 AustStab Awards of Excellence*

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# Project Outline


**Title:** Using Recycled Materials in Stabilised Pavements (NACOE O24)

**Key Contributing Staff:** Dr Negin Zhalehjoo (NTRO), Meera Creagh (TMR), Dr James Grenfell (NTRO) and Dr Jaspreet Pooni (NTRO)

**Project Timeframe:** July 2021 – June 2025

**Project Objective:**
The main objective of this research project is to investigate the feasibility of the use of different recycled material blends as host materials for foamed bitumen stabilisation and cement stabilisation.

The project aims to evaluate the performance of recycled host material blends treated by foamed bitumen stabilisation and cement stabilisation using a laboratory testing program and field trial.

**Acknowledgements:**
NACOE Project O24: Undertaken by NTRO|ARRB and Department of Transport and Main Roads (TMR) through the National Asset Centre of Excellence (NACOE) Program

TMR Bulwer Island Laboratory undertook the laboratory testing of this project

The contribution of Rino Recycling in Pinkenba, Alex Fraser in Nudgee, and Rowcon Recycling in Caloundra, Queensland who supplied the recycled material blends are acknowledged.

# Stabilisation of Recycled Material Blends

## What

Materials

- Type 2.3
- Different recycled blends as host materials
- Blends including recycled crushed concrete, reclaimed asphalt pavement, recycled crushed glass, and recycled crushed brick

Binders

- Cement stabilisation
- Foamed bitumen stabilisation

## Why

- Stabilisation forms a significant proportion of works on rural and urban networks

- Aiming to reduce the reliance on virgin quarried materials and improve the use of recycled materials

- Aligns with the broader goals of sustainability and improved resilience in road construction



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# Waste 2 Resource Strategy

**This project aligns with TMR's Waste 2 Resource Strategy**

## Objectives

1. Minimise disposal to landfill
2. Achieve resource efficiency through circular economy practices
3. Facilitate market growth
4. Reduce greenhouse gas emissions from waste generation and resource use

Source: TMR.


Source: TMR.

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# Benefits of Foamed Bitumen Stabilisation (FBS) in Pavements

- Creates strong and flexible pavements
- Reduces moisture susceptibility and improves resilience to flooding
- Can be opened early to traffic
- Reduces shrinkage cracking
- Environmentally-friendly & Cost-effective
- Up to 100% of the existing pavements can be used – lower use of finite resources (sustainable solution)

*ABC News: Floodwaters demolished pavements in Rockhampton, QLD*

# Benefits of Lightly-Bound Cemented (LBC) Materials

- Low-cost treatment to improve performance of unbound granular pavements
- Provides granular pavements with rut resistance and resilience to flooding
- Provides excellent performance when used in combination with sprayed seals and thin asphalt surfacings
- LBC bases have shown good performance (no block or crocodile cracking) if appropriately designed and constructed
- LBC exhibits a diffuse cracking mechanism during its life, so is not affected by the expensive to manage block cracking problems like heavily-bound cemented materials

*Austroads AP-R640-20 (2020)*



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# Comprehensive Laboratory Investigation – Phase 1

**Selected Materials**

**8 Materials**
3 Blends Types

- 100% RCC
- Recycled minimum blend: 70% RCC, 10% RAP, 10% CB, and 10% RCG
- Recycled maximum blend: 40% RCC, 20% RAP, 20% CB, and 20% RCG

**Testing Program**

- Indirect Tensile Modulus, mix design – (FBS Materials)
- Indirect Tensile Strength – (FBS Materials)
- Unconfined Compressive Strength UCS – (FBS Materials)
- UCS – (Cement Stabilised Materials)
- Working time – (Cement Stabilised Materials)

Mixing FBS material – Wirtgen apparatus


Indirect tensile modulus testing

UCS testing

- *RCC: recycled crushed concrete*
- *RAP: reclaimed asphalt pavement*
- *CB: crushed brick*
- *RCG: recycled crushed glass*

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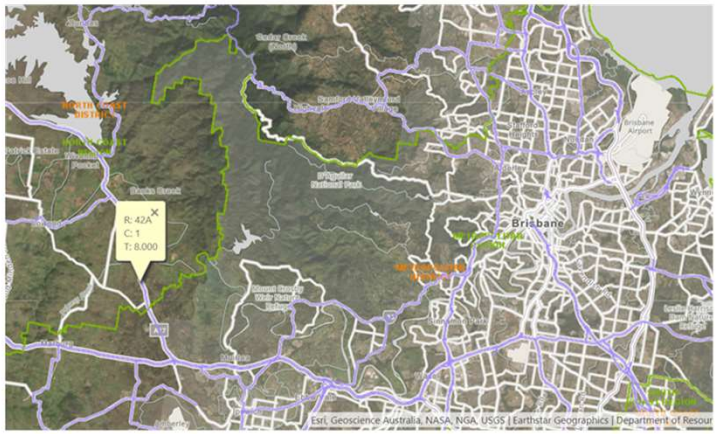
# Final Outcome of First Phase

- Project investigated whether different recycled blends, including RCC, RAP, RCG, and CB, were suitable host materials for both cement and foamed bitumen stabilisation.
- TMR mix design procedures were used for both stabilisation treatments to assess whether recycled materials blends could achieve conformance.
- Conforming mix designs could be achieved with both treatments using recycled host materials.
- This means recycled material blends can be used in plant-mix stabilisation and as top-up material for in-situ stabilisation.
- This will reduce the reliance on virgin quarried materials and aligns with the broader goals of sustainability and improved resilience in road construction.
- There is opportunity to optimise recycled blends through materials engineering expertise to tailor gradings envelopes to the stabilisation method.

# Field Trial Sites – Phase 2

- Ongoing work involves construction and monitoring of field trials to validate findings and provides confidence to practitioners to increase the use of recycled materials within the pavement stabilisation sector.

  - Partnering across TMR – E&T, North Coast District and RoadTek.
  - Brisbane Valley Highway - Between Ipswich and Wivenhoe Dam.
  - Moderately loaded: AADT – 4350 , 15% heavy vehicles.
  - Second field trial (24-25): Plant mixed lightly bound material




TMR

**Scope**

**Aim**
- Construction process
- In-service performance

**Project**
- 1 x 200m long lot on Brisbane Valley Highway

**Material**
- 100% RCC (type 2.1) lightly bound application
  - Commercially produced blend
  - SEQ uses a lot of lightly bound materials
  - Cementitious vs bitumen costs

**Constraints and Benefits**

- Manage risk to TMR
- Minimise cost impacts
- Overall sustainability goals
- Maximise opportunities



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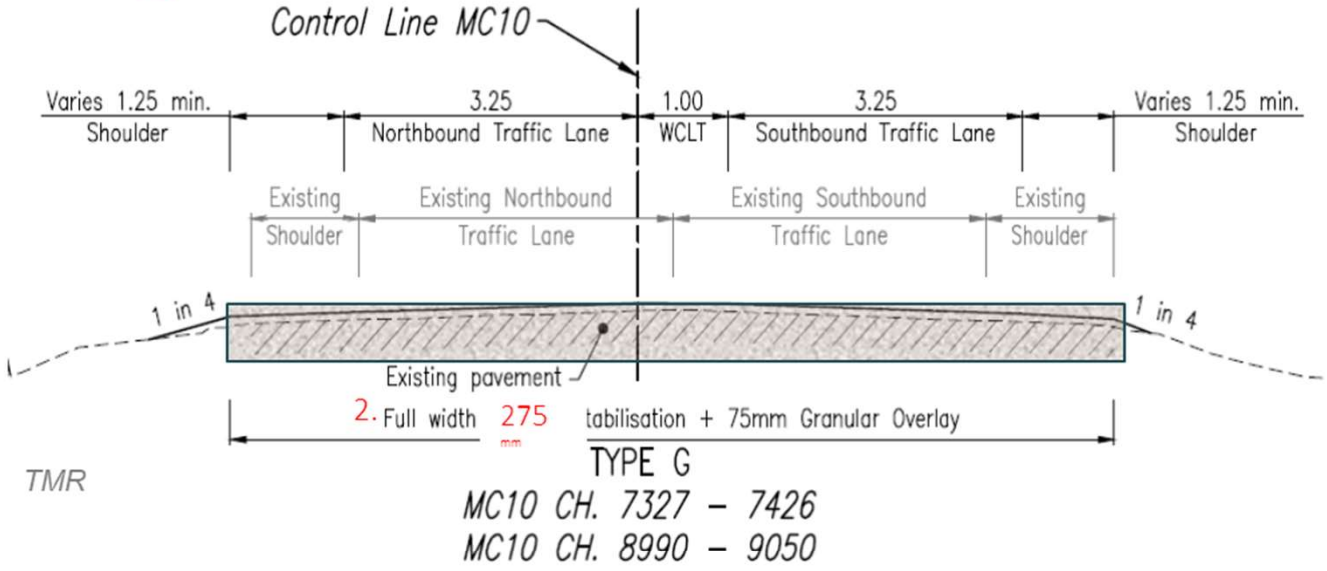
# Design




## Site & Material

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## Ongoing Field Testing

- Subgrade
  - Classification
  - Soaked & unsoaked CBR
  - DCP
- Grading & Atterberg limits
  - Pre & Post compaction
- Field UCSs
- Long term performance monitoring
  - Visual inspection
  - Asset condition data
  - Comparison with adjacent lane
- Future Field Trials
  - Plant mixed
  - Subbase; improved layers

## For wider implementation, some challenges remain

Challenges – flexibility and One TMR Approach is essential

- Sourcing materials from Registered Recyclers close enough to in-situ stabilisation sites
- Suitable support conditions
- Managing risks and constraints of construction around intersections
- Education of crews around constructing with recycled materials – Project Linked Training
- Sustainable procurement requirements