

# Category 3: Excellence in Sustainability

Towards marginal gravels for sustainable foamed bitumen stabilisation

Roberto Espinosa *(submitted by Dr Greg White)*

Fulton Hogan and University of the Sunshine Coast



## 2021 AustStab Awards of Excellence

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# Background and Motivation

Prior to and during his research, Roberto worked as a laboratory technician and manager at Fulton Hogan. Roberto was passionate about sustainable pavement rehabilitation and recognised the benefits of foamed bitumen stabilisation. Roberto also recognised the cost associated with the importation of standard gravels to remote locations, where locally available marginal gravels are not allowed to be included in foamed bitumen stabilisation.

- Roberto identified the potential for marginal gravels to make good foamed bitumen base (FBB) in order to preserve new standard materials
- Agreement was sought from Fulton Hogan to research this issue
- The project was initiated under the supervision of Dr Greg White at the University of the Sunshine Coast
- Roberto was motivated and enthused to do a good job of the research in order to improve the industry
- The aim of the project was to demonstrate marginal material suitability to FBB and the relative performance in order to improve sustainability in remote areas

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# The Project

Roberto designed an ambitious research project to compare the performance of marginal gravel materials to standard (compliant) gravels for foamed bitumen stabilisation. The marginal materials were also corrected by mechanical stabilisation and the improved materials were similarly compared. Three representative gravels that were marginal, either due to their grading, their material properties, or both, were selected. A compliant reference gravel was also selected.

Roberto completed a Master of Science (Engineering) at the University of the Sunshine Coast by:

- Selecting three different marginal gravels and one standard gravel
- Making FBB with all four gravels and testing their performance using cured and soaked modulus after 3 to 14 days of curing
- Blending some marginal gravels together or with the standard gravel to improve the marginal gravels and producing/testing improved FBB
- Comparing the results to determine the relative FBB performance.

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# The Outcomes

Roberto's research made three significant contributions to foamed bitumen stabilisation in regional areas. The first was to demonstrate that some marginal gravels performed, once stabilised with foamed bitumen, better than foamed bitumen stabilised standard gravels. The second was to demonstrate that simple gradation improvement, sometimes achieved by blending two marginal materials together, significantly improved the foamed bitumen stabilised material properties. The third was to highlight the importance of mixing moisture content for marginal gravels, where the traditional '70% of the gravel optimum' produced dry stabilised materials, with 85% of the gravel optimum producing much better samples with significantly improved properties. In summary, the project:

- Demonstrated that some marginal gravels can perform as well as a standard gravel, when both are used to produce FBB
- Demonstrated that two marginal gravels can be blended together and the resulting FBB can outperform both marginal gravels and the standard gravel
- Found associated effects including the higher mixing moisture contents required for marginal gravels and a previously unknown relationship between FBB relative density and modulus

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# Success Indicators

- Roberto's research was warmly welcomed by TMR
- The research has informed the development of an outcome-focussed FBB specification for airport pavements
- The thesis was highly praised by international leaders of the stabilisation industry, with a 'minor changes' award
- Roberto has resolved practical project issues on at least two Fulton Hogan FBB construction projects as a result of his new knowledge and experience
- Roberto's research has led to three peer reviewed conference/journal papers

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# Publications

The quality of Roberto's research is reflected in the publication of his main findings in international journals. The research outcomes will also inform the development of a foamed bitumen stabilisation specification for airports.

- Espinosa, R 2020, *Laboratory Evaluation of Marginal Materials for Foamed Bitumen Stabilisation*, a thesis submitted to the School of Science and Engineering, for the award of Master of Science (Engineering), University of the Sunshine Coast, December
- White, G & Espinosa, R 2020, *Laboratory Evaluation of Gradation Improvement of Marginal Materials for Foamed Bitumen Stabilization*, Applied Sciences, vol. 10, no. 4224, pp. 1-13
- Weir, T Espinosa, R & White, G 2021, *Review of the Design and Production of Foamed Bitumen Stabilised Base Courses for Pavement Construction*, Australian Journal of Civil Engineering, article-in-progress
- Espinosa, R & White, G 2021, *Making the Case for Considering Marginal Materials for Foamed Bitumen Stabilisation*, International Flexible Pavements Symposium, article-in-progress

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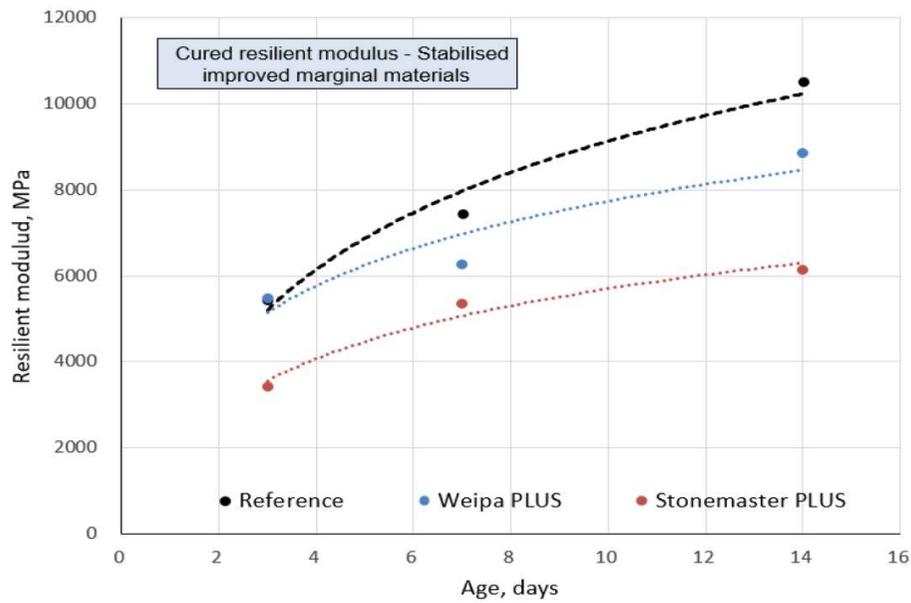
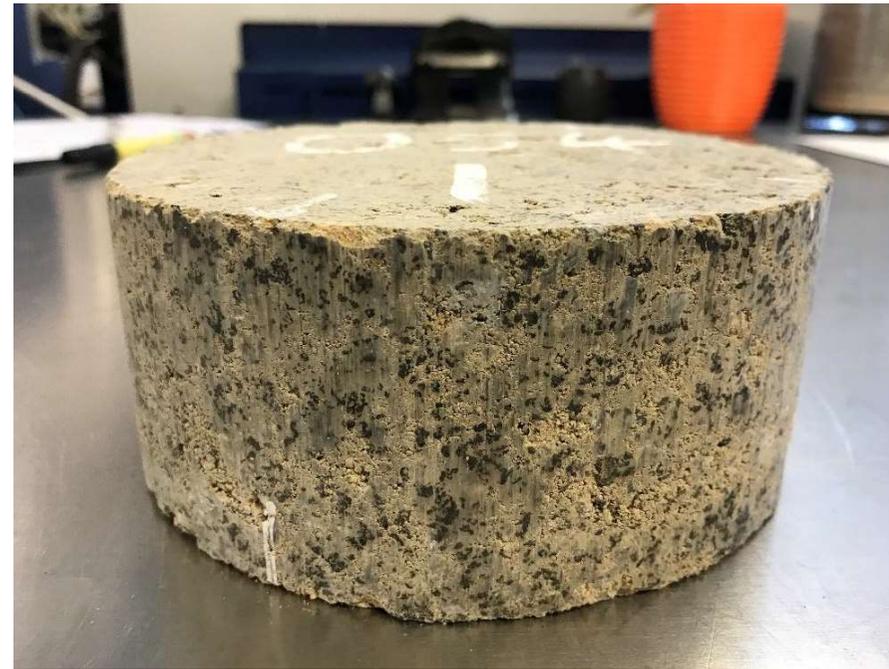
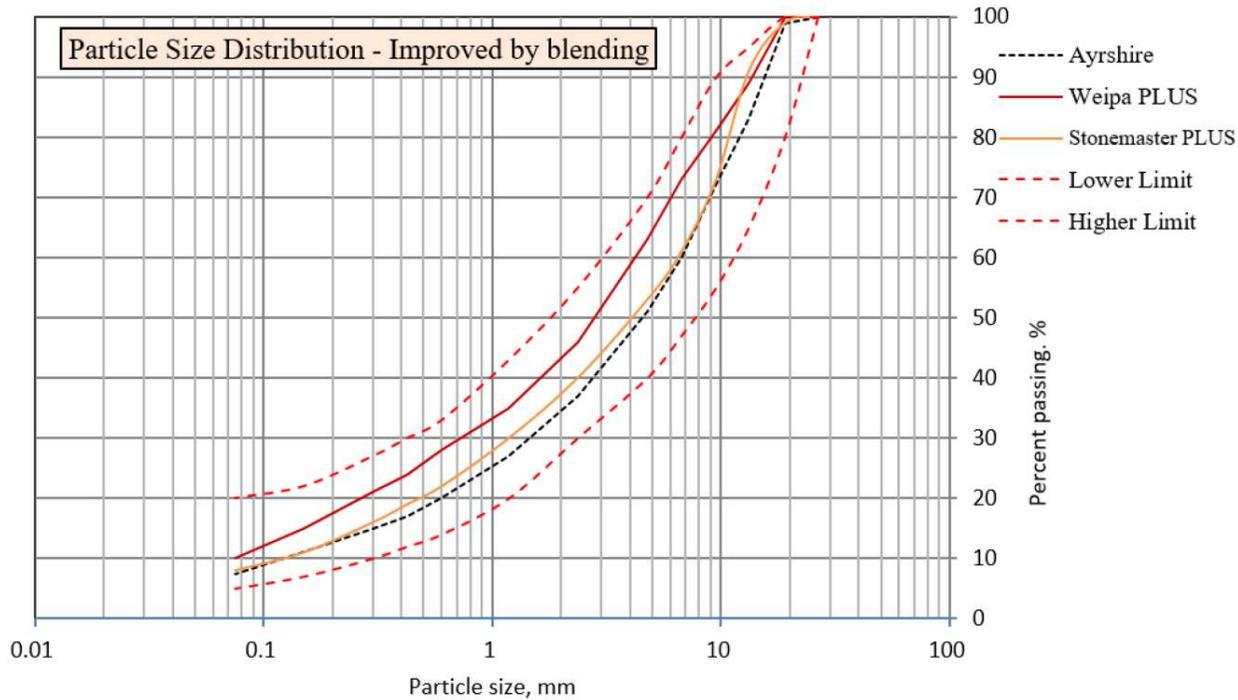
# Excellence

- As Roberto's university research supervisor, I confirm that Roberto went above and beyond (Dr. Greg White, USC, Research Director)
- This reflects Roberto's desire to improve the industry, not just to get a degree
- This reflects Roberto's passion for the topic and his work ethic
- The outcomes are reflected in the publications, which are good for a masters by research project
- The outcomes are reflected in the award of his degree 'with minor changes'
- Roberto was a pleasant and positive student at all times, even when it was tough and the feedback was necessarily critical

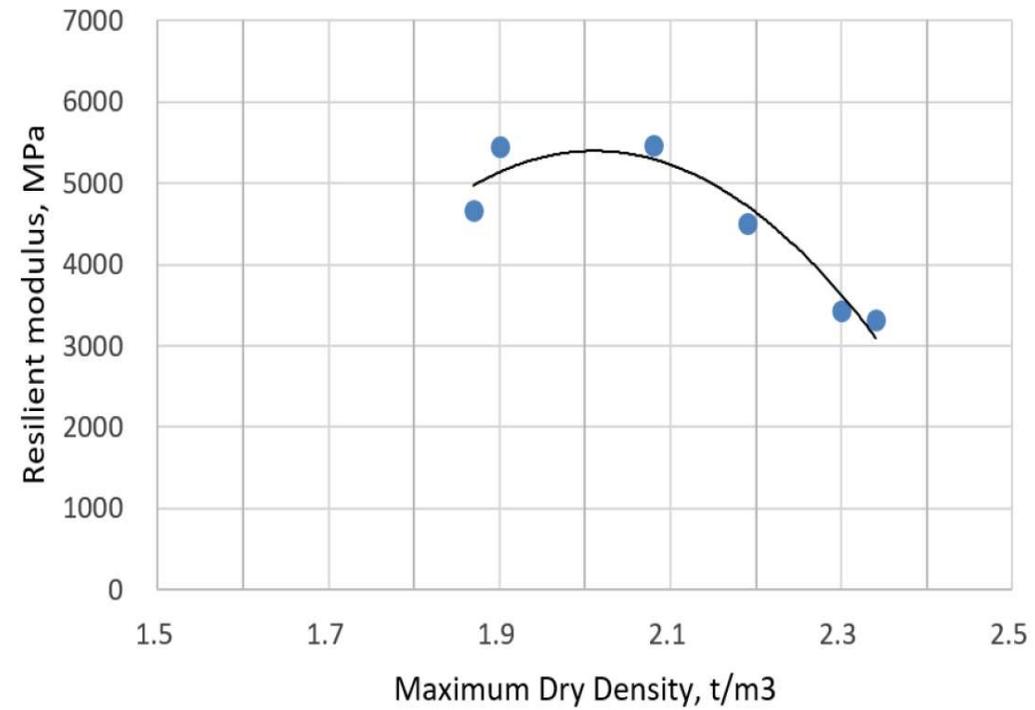
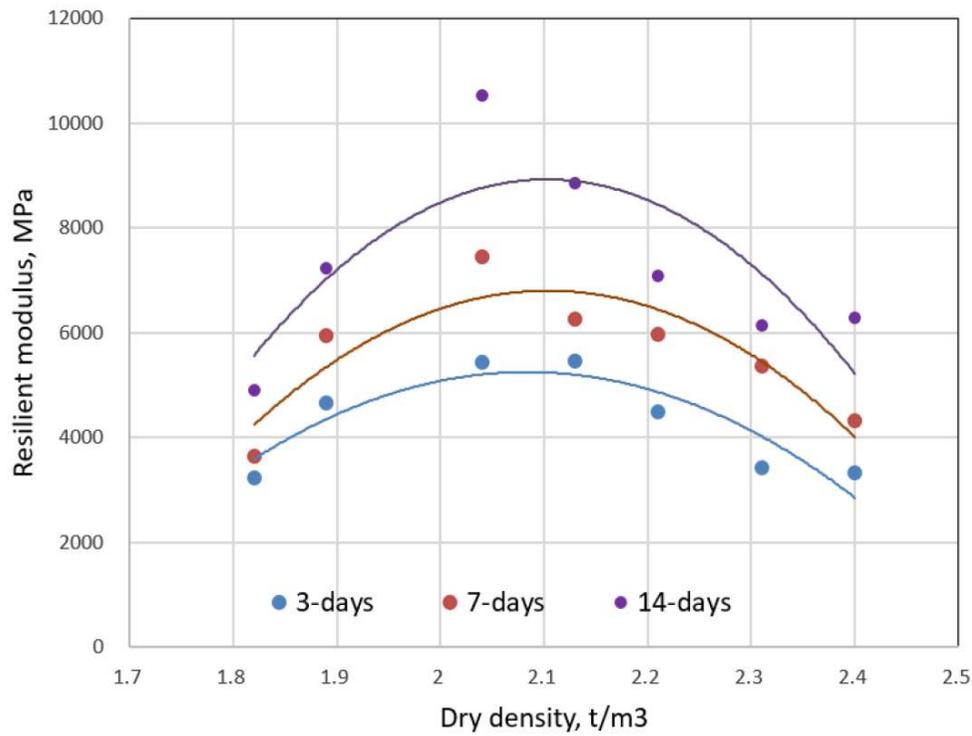
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 **University of Sunshine Coast**  
AUSTRALIA

LABORATORY EVALUATION OF  
MARGINAL MATERIALS FOR  
FOAMED BITUMEN STABILISATION

By Roberto Bayla Espinosa  
Master of Science in Civil Engineering

Submitted for the Examination of Master of Engineering

December 2020

School of Engineering and Science

A copy of Roberto's Masters thesis is available at:

<https://research.usc.edu.au/esploro/outputs/graduate/Laboratory-Evaluation-of-Marginal-Materials-for-Foamed-Bitumen-Stabilisation/99508408302621>

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