DATA MINING RAMM AND HSD TO INVESTIGATE FOAMED BITUMEN STABILISATION PEFORMANCE

Author: Chris Pacey

Company: Fulton Hogan Ltd

Phone: +64 3-357-1400

Email: Chris.Pacey@fultonhogan.com

In 2013 a small number of Foamed Bitumen Stabilising (FBS) sites developed transverse shrinkage cracks, which triggered an investigation into the performance of FBS on the New Zealand State Highways (SH). Data regarding FBS sites on the SH network was sourced from the RAMM (Road Assessment and Maintenance Management) database. Only actual performance data from the sites was mined; back-calculated or inferred values such as moduli were not included in the scope of this paper.

RAMM is an SQL-based database that stores information about roads, including their location, construction and performance. Roads are split by Reference Stations (RS), with each section being assigned its own unique identifier (Road ID); this and the distance along the Route from the last RS to the Position of any object (RP) allows a variety of information to be stored in a geospatially aware context. It is possible to query the database for any site, and return a history of its recorded performance.

The author accessed the RAMM database for the State Highways, plus four separately created spreadsheets of FBS sites in New Zealand, and a report by Fröbel & Hallet (2008). The entire Pavement Layer and Pavement Structure databases from 1/1/2000 until 12/05/2014 were downloaded (via the RAMM SQL interface) and data regarding the topmost layer searched via spreadsheets for any reference to the following keywords:

- Foam
- FBS
- Cement

This generated a list of Road IDs that was combined with those sourced from the aforementioned spreadsheets to create a master list of possible sites. This list was then reviewed to remove duplicates, split layers, split sites and false positives (such as cement-only stabilised sites). Attached to this list was enough information to align both construction history and performance history, through High Speed Data (HSD) surveys, from RAMM.

A combination of a Microsoft Access database, Excel spreadsheet and the master list was then used to generate statistics regarding performance of the FBS sites in the following areas:

- Roughness
- Rutting
- Deflections
- Surface Cracking

An analytical procedure based on that reported in Hallett (2012) was used to generate performance history graphs, where performance is plotted relative to the years since construction.

When roughness history was plotted the distinct jump across the 6 years since construction mark was immediately noticeable. All datasets were then split to contain either sites constructed before 01/01/2008 or those constructed afterwards. Two distinctly different trends emerged and are displayed in Figure 1 below.

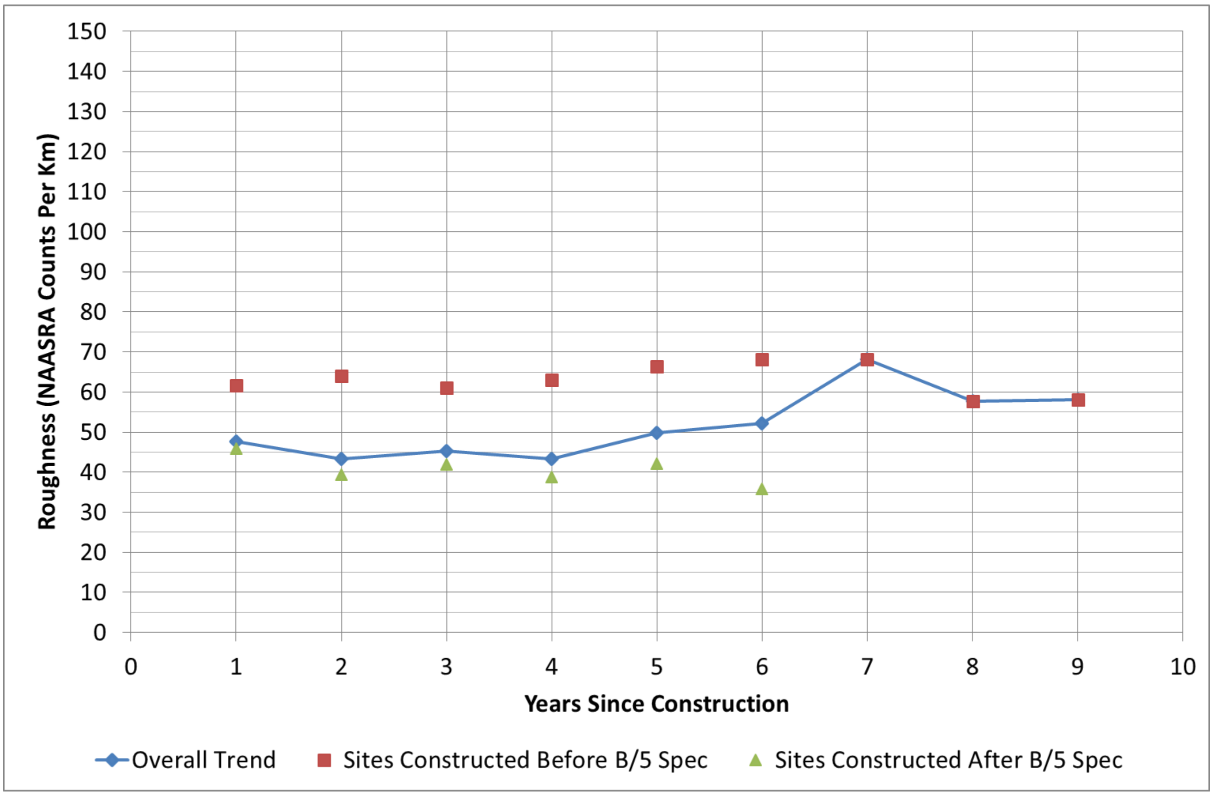

FIGURE 1: MEAN ROUGHNESS BY YEARS SINCE CONSTRUCTION

The improvement in performance observed in FBS pavements constructed after 2007 is attributed to the introduction of the NZTA B/5 Specification for In-Situ Stabilisation of Modified Pavement Layers in 2008. The results also showed that both trends remained superior to the national average as they plateau after initial densification, rather than grow. While the rutting and deflection graphs also showed the same trend, there wasn't enough information within the RAMM database to reliably analyse surface cracking; due to the way in which cracking information is collected and stored within RAMM.

One of the hypotheses regarding FBS treatments is that they behave like an unbound granular pavement, undergoing an initial period of consolidation where consecutive deflection results display a decreasing trend. After this initial consolidation period, peak strength is reached and maintained before the pavement deteriorates as per normal conditions.

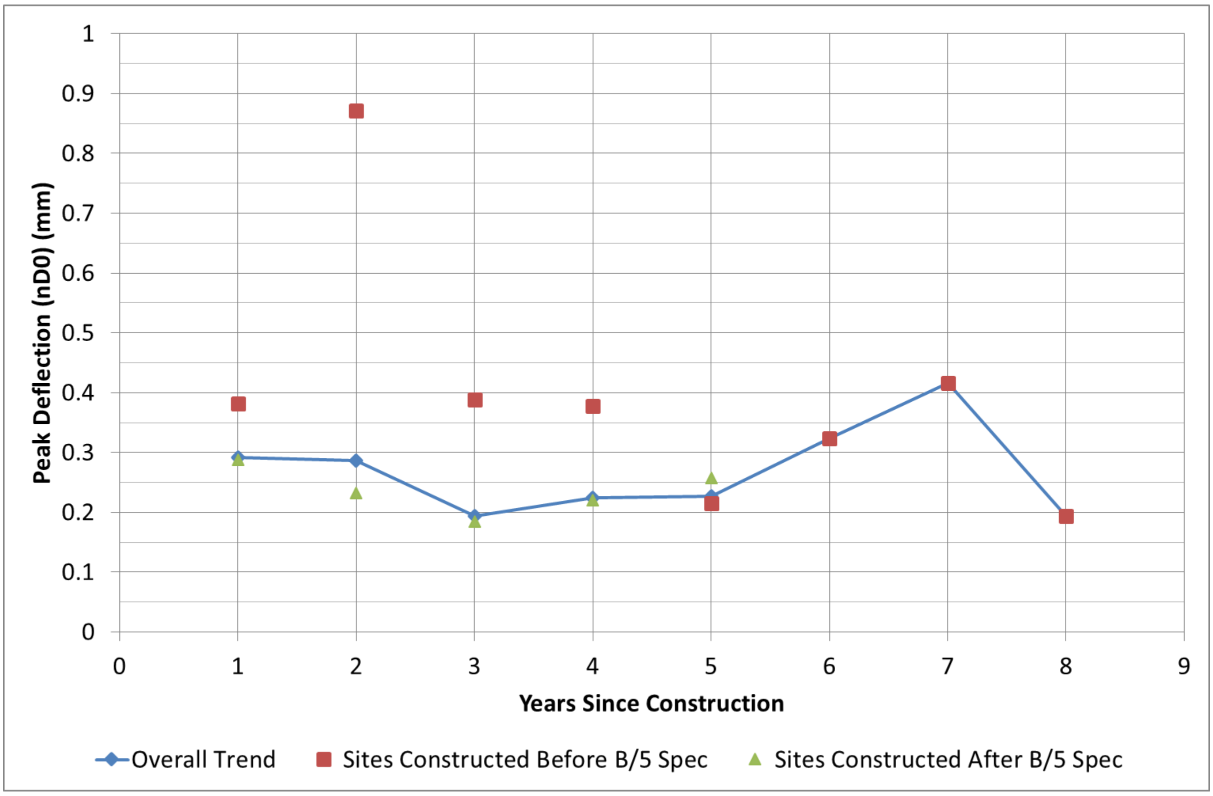

FIGURE 2: MEAN NORMALISED MAXIMUM DEFLECTION BY YEARS SINCE CONSTRUCTION

Figure 2 shows an initial downward trend in nD0 results over the first three years of the pavements' lives, indicating an increase in strength through consolidation. It also shows a period of relatively stable results between years 3 and 5. Therefore the results of this study seem to prove that initial hypothesis. This behaviour was further confirmed by von Pein (2014), who also reported that fatigue cracking is not considered a critical mode of distress for FBS pavements constructed in accordance with New Zealand customary practice.

CONCLUSION

The author created a master list of FBS sites on the SH network and used this to retrieve and plot performance history for roughness, rutting and deflections from the HSD survey data within the RAMM database. Due to the method of surveying used to populate surface cracking information within RAMM, the author was unable to perform the same analysis for this defect type.

This project showed that FBS pavements perform better on average than the national trends for the key measures of performance and that there was a distinct difference in performance for sites constructed before and after 2008. This improvement is attributed to the introduction of the Transport Agency's B/5 Specification for In-Situ Stabilisation of Modified Pavement Layers in 2008.

REFERENCES

Fröbel, T. and Hallet, J., 2008. *Foamed Bitumen Stabilisation in New Zealand – Projects, Do's and Dont's, Performance.* Auckland, New Zealand, Recycling and Stabilisation Conference.

Hallett, J., 2012. *Performance Comparison of Pavement Rehabilitation Treatments.* Nelson, New Zealand, New Zealand Institute of Highway Technology.

New Zealand Transport Agency, 2008. *Specification for the In-Situ Stabilisation of Modified Pavement Layers.* [Online]
Available at: http://www.nzta.govt.nz/resources/insitu-stabilisation-mod-pavement-layers/docs/insitu-stabilisation-mod-pavement-layers.pdf
[Accessed 12 05 2014].

RAMM Software Ltd, 2014. *RAMM.* [Online]
Available at: http://www.ramm.co.nz/
[Accessed 12 05 2014].

von Pein, J. D., 2014. *Performance of Foam Bitumen Stabilised (FBS) Pavements in New Zealand*. Auckland, New Zealand: University of Auckland

ACKNOWLEDGEMENTS

The contributions of Dr. Bryan Pidwerbesky, Allen Browne, Les Rohleder, Cameron Mitchell, Adam Leslie, Sean Rainsford and the New Zealand National Technical Pavements Group in preparing this paper are acknowledged.