PUSHING THE LIMITS FOR HIGH PERFORMANCE THIN ASPHALT SURFACINGS

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ABSTRACT

A durable, modified-binder asphalt has been designed for use as a thin pavement surfacing, with a focus on meeting performance rather than prescriptive specification requirements. Following three years of laboratory research, including in-service trialling of the mix, the outcome is the development of a high performance alternative rehabilitation treatment. Potential also exists for the mix to be used for surfacing on new pavement.

The paper describes both the lab and field attributes of this high performance surfacing which includes an extremely high fatigue life and exceptional deformation resistance while still delivering the functional attributes wanted in an asphalt wearing course.

It is also intended that this mix will allow the thickness of the surfacing to be reduced and initial trials in Queensland where both permeability and texture were targeted, were reported at the last AAPA Conference. Other trials around Australia since then have provided new data to both confirm and widen the scope of this high performance asphalt surfacing.

BACKGROUND

Road authorities and municipalities are constantly on the search for a surfacing that delivers high functional and structural performance so that rehabilitation cost is minimised and treatments can be delivered with the least disturbance to the road surface from alteration of levels or camber.

Similar requirements have been targeted for concrete roads in NSW where slab joints and cracking have reduced driver comfort. In 2010, a trial performance specification was introduced to challenge industry to duplicate work in NSW by delivery a mix with extremely high fatigue and deformation resistance performance without compromising other attributes expected of a surfacing. The results of this work were reported at the AAPA Conference 2011 and since then more trials have been undertaken in Victoria and Western Australia.

This report presents findings from the Victorian trials where even higher levels of fatigue performance were achieved and on-going monitoring has been carried out. A refresher of the specification for the new mix is also presented and a value proposition is discussed to identify the commercial viability of such an innovation.

PURPOSE OF A THIN HIGH PERFORMANCE SURFACING

Laboratory trials were conducted to find a thin, durable, textured asphalt surfacing which was designed specifically to provide a long service life and enhance the skid resistance of an existing pavement.

A high performance polymer modified binder and quality aggregates were combined in an attempt to create a mix with elasticity and strong stone-on-stone interlock to facilitate high fatigue life and rut resistance. The binder used was, first and foremost, formulated so that the asphalt mix could achieve a high fatigue life and the mix was further reinforced with fibres to increase the binder-mastic viscosity.

The nominal maximum aggregate size (NMAS) of the asphalt could not exceed 10 mm and a nominal NMAS was adopted so that the mix could be paved in layer thickness of 20 mm to 30 mm. Layer thickness of this order minimise the change in level of an existing pavement when rehabilitated.

ORIGINS OF A SPECIFICATION

Performance properties of the high performance thin asphalt surfacing were based on the RMS (Roads & Maritime Services, NSW, Australia) TMR (Transport & Main Roads, QLD, Australia) performance contract specifications given below in Table 1. It is noted that the specifications themselves were regarded as project specific and for trial purposes by the respective departments at the time contract works were delivered.

Property	Test Method	Unit	Limit	Value
RMS-NSW, AUSTRALIA**				
Rut resistance by wheel tracking test (mm rut depth)	AG:PT/T231	mm	Maximum	≤ 2
Cracking resistance by beam fatigue test (cycles to failure condition at standard reference test conditions)	AG:PT/T233	Cycles to failure	Minimum	≥ 8,000,000
Permeability of laboratory compacted plant sample (µm/s)	RTA T655	µm/s	Maximum	≤ 10
DEPARTMENT OF MAIN ROADS, QUEENSLAND, AUSTRALIA*				
Asphalt Fatigue Life at 600µξ	AG:PT/T233	Cycles to failure	Minimum	≥ 1,000,000
Deformation of Asphalt (Final Rut Depth)	Q 320	mm	Maximum	2.0
Asphalt Permeability	Q 304	µm/s	Minimum Maximum	100 N/A
Surface Texture At Completion Of Installation	NA	mm	Minimum	0.7

Table 1 – Aspects of RMS (NSW) & TMR (QLD) performance specifications where Durapave was used

TRIALS IN VICTORIA

Trials were organised in Victoria to see if a mix could be developed to meet or exceed those in other states. In co-operation with VicRoads, the state road authority of Victoria, two sites from their 2012 rehabilitation program were chosen, one of which would also have a control section to allow comparison with a standard treatment.

The control mix placed at trial site 2 (Kororoit Creek Road) was a standard stone mastic asphalt laid a nominal 30mm thick. The mix is classified as an SMAN where 'N' designates the use of an A20E binder the characteristics of which are described in the Austroads polymer modified binder guidelines. The high performance surfacing was placed contiguously to this control at a nominal 25mm depth.

An agreed testing regime comprised of fatigue and wheel tracking tests on production - as opposed to laboratory - mix to enable clearer association with field performance.

Texture testing by sand patch method, compaction testing by coring and nuclear gauge, as well as standard quality assurance tests for grading and binder content were reported.

While a fatigue life in excess of 8 million cycles had been achieved in NSW and QLD, it was possible that the physical attributes of local aggregates including geology might have a substantial impact on performance. Marked variation in performance could also occur due to the different bitumen and binder sources between jurisdictions. Cognizant of these issues, it was decided to leave the target fatigue life the same.

An on-going testing regime was planned and would include texture and nuclear gauge density testing at yearly intervals for at least two years from the anniversary of the initial field tests.

Fatigue Life Test Results

Asphalt beams from production mix of the high performance asphalt used at both sites reached 12 million cycles before tests were terminated. Testing was carried out at 400 μξ and standard Austroads method conditions given in AG:PT/T233-2006.

Of special significance was that termination flexural modulus was only approximately 25% lower than the initial flexural modulus and laboratory staff noted that the graph had 'flat-lined' suggesting that further reduction did not appear likely. To promote failure for the sake of experimentation, the strain level was increased to 600 μξ in subsequent tests; however, results remained below the threshold or termination flexural modulus when tests were terminated at 10 million cycles at this strain level. Results are summarized in Table 2.

The control, 10SMA(A20E) mix test was also terminated at 12 million cycles @ 400 μξ without having reached failure; however, it had incurred a greater loss in flexural modulus. When the remaining two control mix beams were tested at 600 μξ they failed to perform as well as 'high performance asphalt', achieving less than 20% of the fatigue life cycles of the latter.

Calculations for strain, stress and flexural modulus as applied in the fatigue test are summarized in Figure 1