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**Shell Bitumen**

Shell Bitumen Technical Report 2008/126

Durability Assessment on 6mm and 10mm Stone Mastic Asphalt (SMA) Designs with Shell Cariphalte TS binder for Leith (Scotland) Limited.

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Summary

Shell Bitumen has carried out durability testing on two Stone Mastic Asphalt mixtures submitted by Leith (Scotland) Limited, taken from the Newton Grange plant utilising aggregates from Edston quarry and using Shell Cariphalte TS binder.

Test results show that no durability issues are envisaged with the 6mm SMA and 10mm SMA as shown by the good BBA water sensitivity values, and both asphalt mixtures demonstrate excellent resistance to permanent deformation when wheel-tracked at 60°C.

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3.2 BBA Water Sensitivity

Water sensitivity testing was carried out on 6 specimens for each design using the 100mm diameter specimens supplied by Leith Technical services. The water sensitivity testing was carried out in accordance with British Board of Agrément BBA SG3/05/234 Appendix A.2. This method involves vacuum saturating the specimens with water and then cycling the saturated specimens through three hot and cold cycles (each cycle consists of 6 hours @ 60°C followed by 16 hours @ 5°C and a 2 hour conditioning period @ 20°C prior to stiffness testing) and reporting the change in stiffness modulus. The results are detailed for the 6mm and 10mm Stone Mastic Asphalt in Table 2 and Table 3 respectively below along with graphical representation of the results in Figures 1 and 2.

Table 2 – BBA Water Sensitivity – 6mm Stone Mastic Asphalt

Shell Sample Number	Customer Reference	Customer Density (g/ml)	Indirect Tensile Stiffness (ITSM) Ratio		
			After 1 st Cycle (ITSM _{c1})	After 2 nd Cycle (ITSM _{c2})	After 3 rd Cycle (ITSM _{c3})
08-534	W	2.280	0.89	0.81	1.06
08-535	X	2.280	0.88	0.89	0.92
08-536	Y	2.273	1.06	1.04	1.01
08-537	W1	2.281	0.93	0.98	1.13
08-539	X1	2.282	0.87	0.85	0.93
08-539	Y1	2.281	0.91	0.80	0.82
Mean			0.92	0.90	0.98

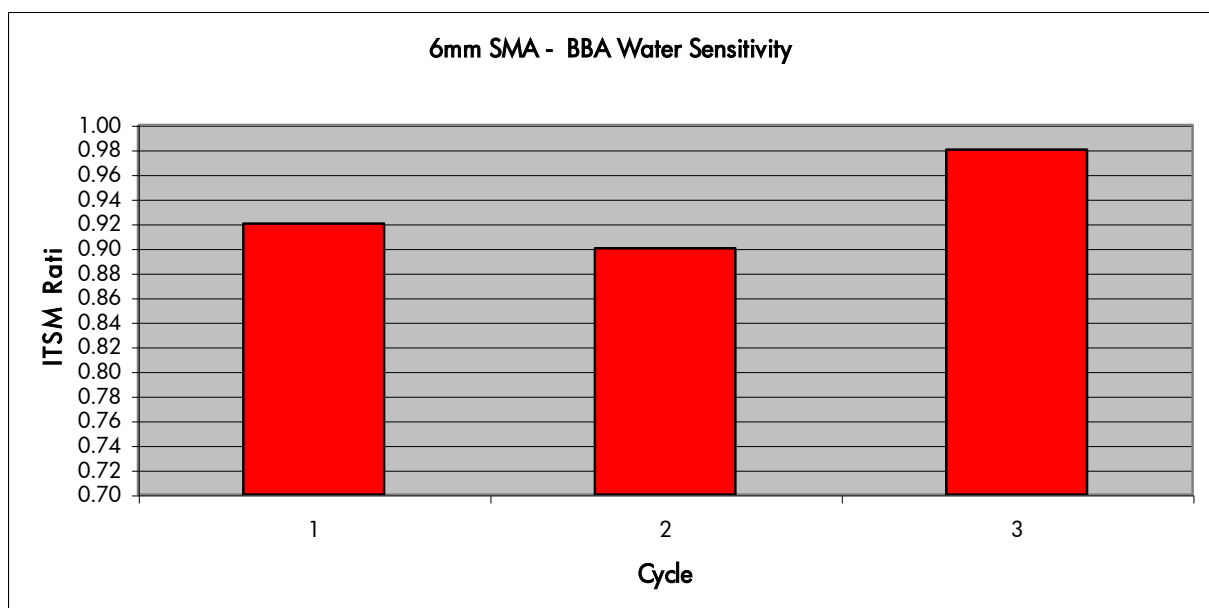


Figure 1 – Graphical Representation of BBA Water Sensitivity - 6mm SMA Design

Table 3 – BBA Water Sensitivity – 10mm Stone Mastic Asphalt

Shell Sample Number	Customer Reference	Customer Density (g/ml)	Indirect Tensile Stiffness (ITSM) Ratio		
			After 1 st Cycle (ITSM _{c1})	After 2 nd Cycle (ITSM _{c2})	After 3 rd Cycle (ITSM _{c3})
08-540	20	2.347	0.92	0.89	0.96
08-541	21	2.348	0.87	0.89	0.98
08-542	22	2.345	0.93	1.11	1.09
08-543	26	2.344	1.18	1.11	0.99
08-544	27	2.345	0.92	1.00	1.01
08-545	28	2.351	1.15	1.03	1.12
Mean			1.00	1.01	1.03

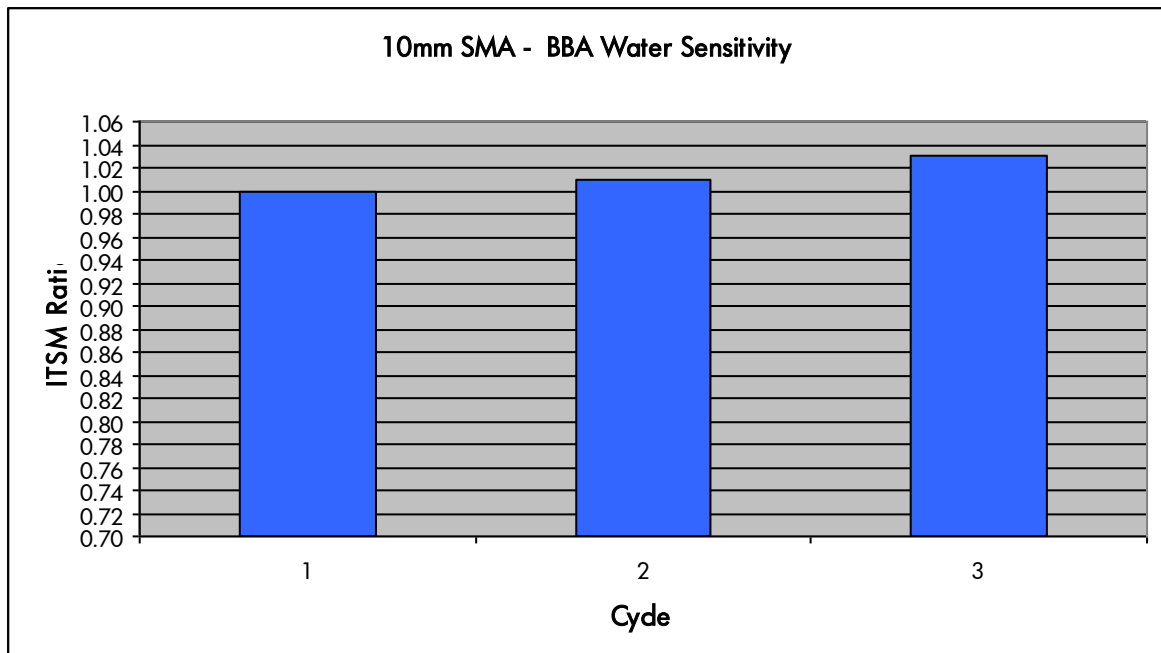


Figure 2 – Graphical Representation of BBA Water Sensitivity - 10mm SMA Design

Water sensitivity as the name implies assesses the resistance of a mixture to deterioration by water damage and is accepted as one indicator of durability. Whilst there are no specifications for performance in this test, typical industry values for acceptable durability are a stiffness ratio greater than 0.70 or 0.80 retained stiffness after cycle 3 of the mean initial stiffness modulus. Both designs actually show an increase in mean stiffness modulus, which suggests the mixtures are unlikely to be affected by water damage, and hence durable.

3.3 Wheel-Tracking

Three 305mm × 305mm slabs were manufactured for the 6mm SMA and 10mm SMA design using pre-blended aggregate samples supplied by Leiths to the particle size distribution detailed in Table 1. Cariphalte TS was used as the binder at a content of 5.5% and 5.8% for the 6mm SMA and 10mm SMA respectively.

Wheel tracking was carried out at 60°C according to British Board of Agrément BBA SG3 /05/234 Appendix A.1 that requires the test to be carried out in accordance with BS598-110:1998. The results are detailed in Table 4 and Table 5 along with graphical representation of the test data in figure 3 and 4.

Table 4 – Wheel-Tracking of 6mm SMA Design Incorporating Cariphalte TS

Wheel-tracking at 60°C to BS598-110:1998		
Specimen Number	Rut Depth (mm)	Rut Rate (mm/hr)
08-1056	1.75	0.32
08-1057	1.68	0.43
08-1058	1.72	0.42
Mean of 3	1.72	0.39
Limiting wheel-tracking requirements at 60°C	5.0	7.0

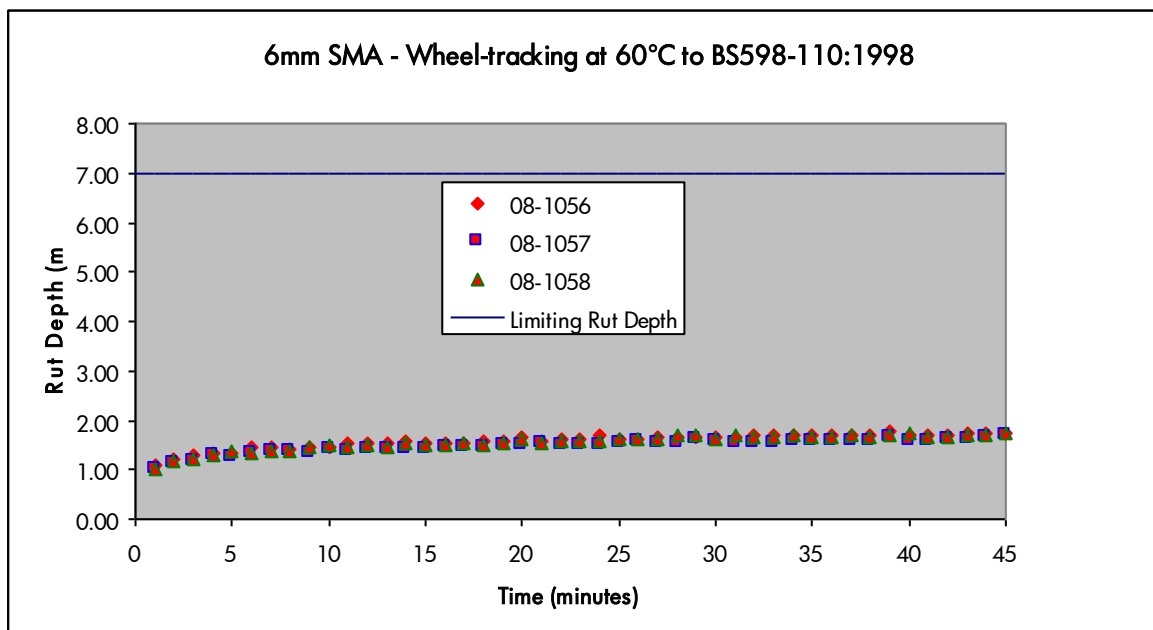


Figure 3 – Graphical Representation of Wheel-Tracking - 6mm SMA Design Incorporating Cariphalte TS

Table 5 – Wheel-Tracking of 10mm SMA Design Incorporating Cariphalte TS

Wheel-tracking at 60°C to BS598-110:1998		
Specimen Number	Rut Depth (mm)	Rut Rate (mm/hr)
08-1059	1.75	0.37
08-1060	1.67	0.38
08-1061	2.19	0.65
Mean of 3	1.87	0.47
Limiting wheel-tracking requirements at 60°C	5.0	7.0

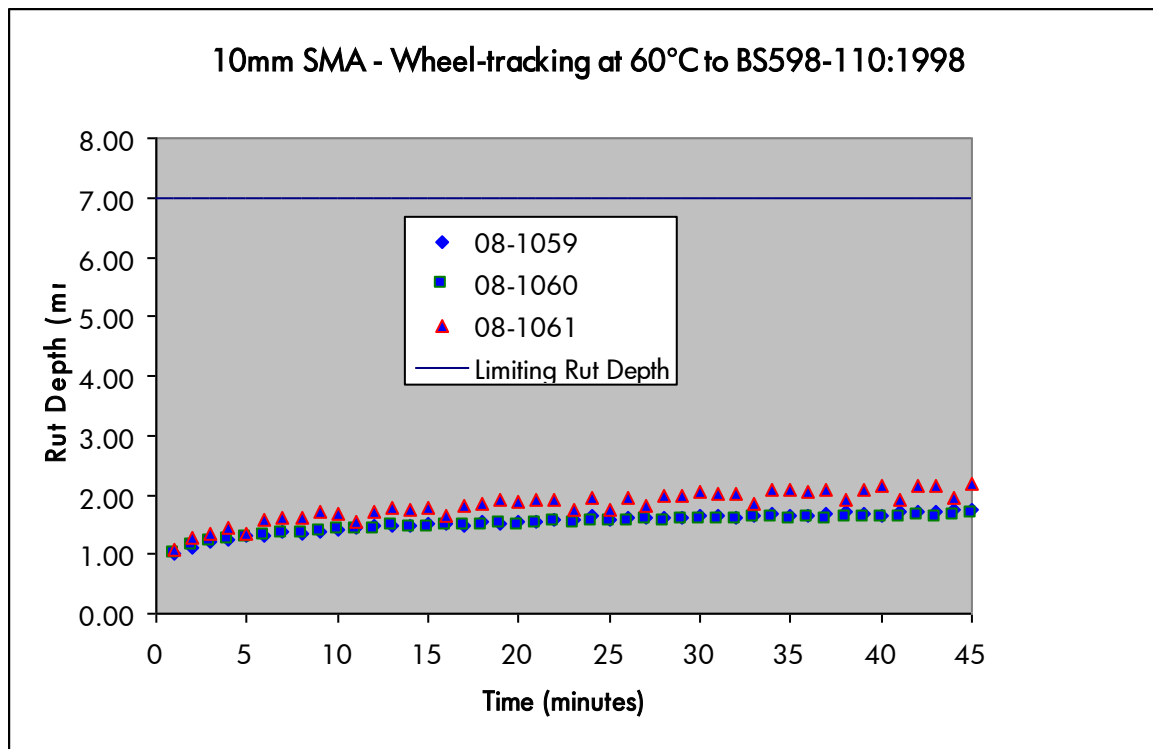


Figure 4 – Graphical Representation of Wheel-Tracking - 10mm SMA Design Incorporating Cariphalte TS

The wheeltracking data for both the 6mm and 10mm designs indicate that the rutting performance is likely to be good. Rut rate and rut depth values for both designs are well below typical limiting values for this type of material at the test temperature.

Conclusions

- 6mm and 10mm Stone Mastic Asphalt (SMA) proprietary thin surfacings from Newton Grange plant have been tested with aggregates ex Edston quarry and Shell Cariphalte TS polymer modified bitumen.
- Wheeltracking of 6mm and 10mm Stone Mastic Asphalt (SMA) designs indicated low rutting values.
- No durability issues are envisaged as evidenced by the good water sensitivity test results

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