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FAYAT GROUP

Successful trials on Warm Mix Asphalt in Durban (S.A.).

Tandem rollers with ”ASPHALT MANAGER“ pave the way

JOB REPORT

Efficient compaction and quality control with BOMAG ASPHALT MANAGER

This job report describes the successful introduction of WMA in South Africa accompanied by the latest state-of-the-art compaction technology, the BOMAG ASPHALT MANAGER (AM).

The ASPHALT MANAGER works using directed vibrations, which can be varied either by stages or infinitely within the AUTO-mode between horizontal and vertical. As a consequence, the compaction force will be intensified in a certain direction but also limited to a certain depth effect in dependance of the material stiffness. Thus, the vibration will be initially vertical directed with bigger depth effect and more directed towards horizontal when compaction is finished i.e. lowest depth effect (Fig.1)

Bomag tandem rollers with AM work well on all typical kind of asphalt materials as well as all typical tasks on frost blanket layers, unbound wear courses and road sub-bases.

This modern technology is able to indicate an increase in compaction on an uniform sub base stability and under consideration of a practical asphalt temperature range.

But the system can also be used for a documentation of the compaction progress if the EVIB value is correlated to the Marshall density. That has been a major asset of the compaction trials described hereafter.

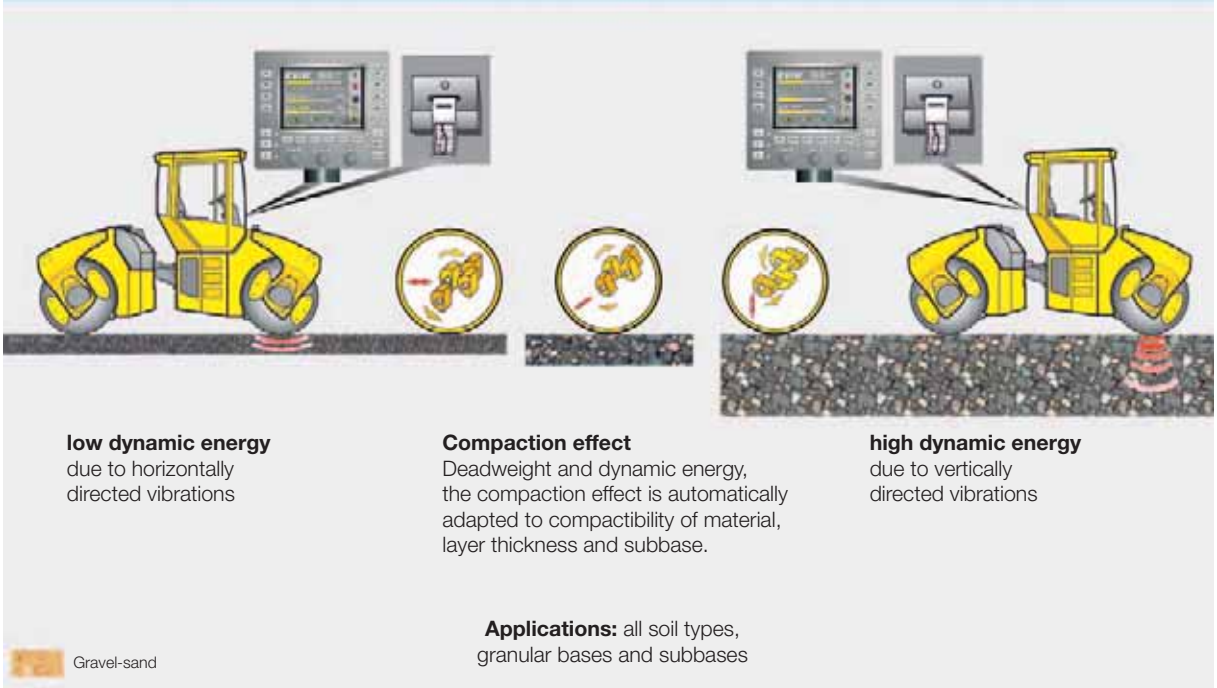


Fig. 1: Automatic optimisation of compaction: one solution for all applications.

Fig. 2: BW 151 AD-AM; 9 t operating weight together with 1.680 mm working width.

Fig. 3: Bomag ASPHALT MANAGER provides target values for compaction.

The BOMAG roller (Fig. 2) was equipped with the ASPHALT MANAGER (AM) system, which automatically optimises compaction performance. It is based on acceleration meters in the front drum together with a control system that quickly responds to changing asphalt stability. The system being introduced to the world market 10 years ago, has been further developed in terms of accuracy and response time so that it is widely used as a compaction and quality control system, today.

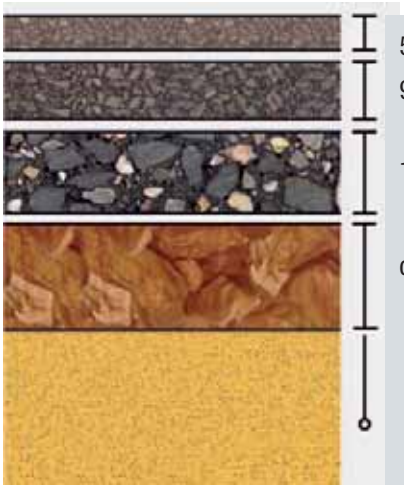
The front drum includes a powerful directed exciter (automatic or manually controlled) with nearly 1 mm of directed amplitude. The rear drum offers a standard rotary exciter with two (fixed) amplitude settings which can be combined with the front drum vibration if required.

As a special feature, the AM-System automatically re-directs the compaction forces in accordance with travel direction – especially advantageous in case of tender mixes as it minimises the typical shoving effect during vibration.

However, this section of dual carriageway of Leicester Road in Mobeni offered a total area of appr. 16.000 m² for the trials with the asphalt itself supposed to be hard-to-compact and stable. Also the overall road structure offered a solid base comprising a 50 cm layer of bigger stones followed by two layers of asphalt up to appr. 30 cm on which the wearing course finally was compacted (Fig. 4).

The E_{VIB} vibration modulus, a physical reference value for compaction progress

The AM, fitted with a display (Fig. 3), provided the driver important job-site key information e.g. asphalt temperature, effective amplitude setting, roller speed as well as a vibration modulus E_{VIB} which reflects the dynamic stiffness value of the material to be compacted. The values were continuously displayed in MN/m² and were taken as a reference for the compaction progress. It allows the driver to set target values for the end of compaction and to avoid overcompaction and/ or unnecessary roller passes. The continuous E_{VIB} indication has been a valuable tool during the trials especially after the operator was set under time pressure due to rapid asphalt temperature losses at site.



5 cm	Control Mix 0/13, B 40/50
9 cm	Base course, 0/20
10-20 cm	Previous asphalt layer
ca. 50 cm	Bigger stones
	Sand

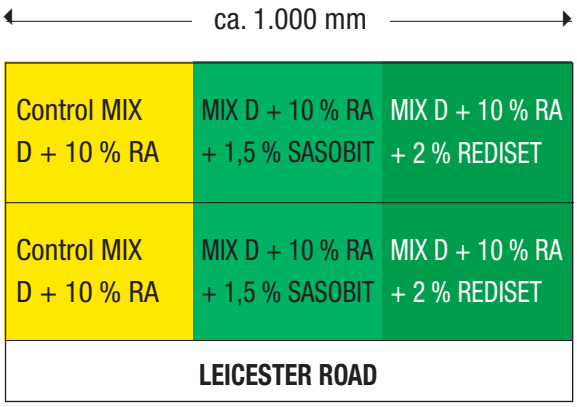


Fig. 5: Overview of the trials at Leicester Road.

Fig. 6: In the „hot zone“: BW 151 AD-AM in operation.

The project:
The chart (Fig. 5) shows the structure of the trials on Leicester Road's dual carriageway which comprised 3 sections per each travel direction.

First a conventional hot asphalt mix (Control Mix) – a continuous graded surfacing mix normally used by eThekwini Municipality – was followed by the two WMA sections (1,5 % SASOBIT® added; 2 % REDISET®).

All mix designs were laid to a compacted thickness of 50 mm, using 10 % of reclaimed asphalt (RA) and a 40 / 50 pen bitumen. The asphalt was produced near the job-site at temperatures of 150-160 °C and minimum temperature loss occurred during transport. But the asphalt mix layer of 5 cm was loosing temperature rapidly at site due to the strong wind. The information was displayed to the driver and he kept the roller closer to the finisher in the hot zone where vibration could be used more efficiently.

Increased quality assurance with AM
But there were also difficulties with the control mix, as the density increase per each pass was too low. In parallel, the EVIB-values were not increasing significantly, as well. The resistance of the control mix was high although the mix temperature (110-120 °C) would still allow for more compaction. The AM-system has reduced the amplitude to avoid aggregate crushing or other quality issues on the mat. It was decided to also use the conventional rear exciter with low amplitude. Then, the target densities were finally achieved after 1-2 extra passes (Fig. 6).

A key issue of this project has been the correlation between Marshall densitiy and the EVIB vibration modulus which was ca. 180-200 MN/m² and it corresponded to 92 % MTHD. Of course, all density measurements were accompanied by intensive temperature controls of the different asphalt layers (Fig. 7).

Subsequent investigation revealed that the mix was outside the specification for filler and bitumen content (slightly too low). This information, together with the rapid temperature loss, explained the high compaction resistance.

Fig. 7: Continuous temperature control at site.

Warm Mix Asphalt allows for compaction at lower temperatures.

The WMA Interest group set tight limits of between 120°C and 140°C which were strictly adhered to throughout the trials.

Warm Mix Asphalt: Easier compaction at lower temperatures

Warm Mix Asphalt is produced and laid at a lower temperature than other asphalt mixes. The production temperatures were between 120 to 140 °C. Paving and compaction was carried out by National Asphalt where initial compaction started between 115 – 120 °C rather than 140-150 °C. A special feature was that compaction could continue to 85 °C at the lowest (Fig. 8)!

WMA additives like SASOBIT® and REDISET® (by Akzo Nobel) reduced the viscosity of the bitumen and worked well in the lower temperature window between 90 – 80 °C. Thus, the compactability of the mix was clearly improved.

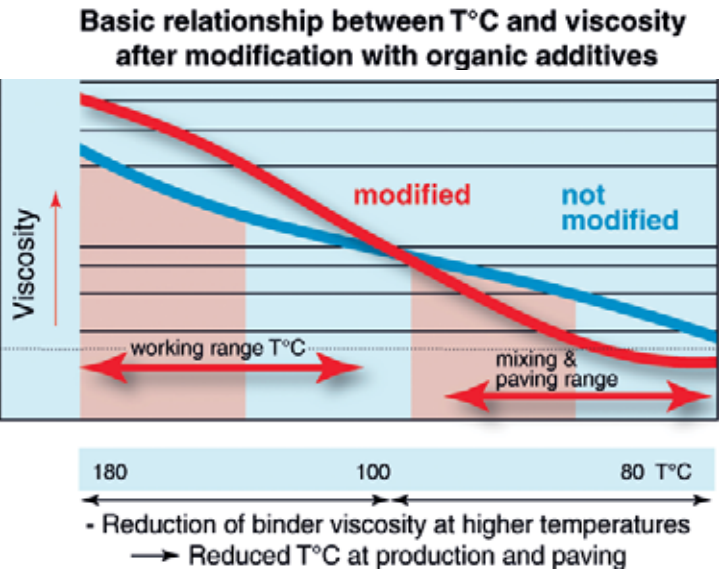


Fig. 8: How WMA additives influence the compactability (Source: German asphalt association).

Fig. 9: Proof rolling at site: Print-out of EVIB and T°C.

How did the BOMAG ASPHALT MANAGER monitor this?

The compaction resistance of the asphalt mix is measured with acceleration meters on the front drum during vibration. The interaction between the material to be compacted and the vibrating drum was evaluated and the display showed the E_{VIB} – value (MN/m²) of the asphalt. This worked well within a practical temperature range and also due to the fact that the asphalt was laid on a solid base.

Bomag printer: Quick documentation of results at site

To document compaction results over a limited length of the road, the roller was equipped with a printer (Fig. 9). The E_{VIB} data recorded as MN/m² by the AM is stored and has been printed out at the end of the measuring pass in an easy read format. Also the following information was available: amplitude, length of pass, travel speed and surface temperature.

Comparison of results with ASPHALT MANAGER.

The E_{VIB}-values (MN/m²) showed on the AM-display gave a continuous picture of the load bearing capacity whilst compaction was in progress.

The operator made spot tests at specific points with print-outs of the E_{VIB} values. These were correlated with measurements by nuclear gauge, thus the roller worked as a proof roller. The dotted line on the print-out indicated that the temperature of the Control Mix was below 100 °C after 4 passes (Fig.10).

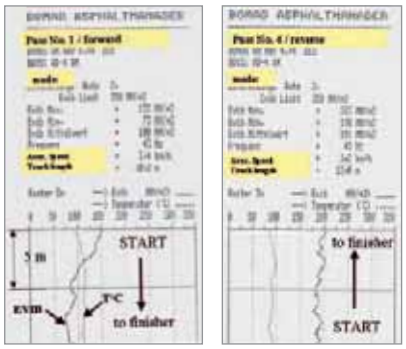


Fig.10: Print-out of EVIB values and T°C of the "Control Mix"

When comparing the E_{VIB} values of the conventional mix (Control Mix) with both of the WMA additives (SASOBIT® and REDISET®), it was evident that the Control Mix was at a lower level (< 200 MN/m²), even after 5 passes. Results with WMA additives were between 220 and 250 MN/m² (Fig.11).

However these values correlated at up to 3 % higher densities and were achieved with fewer passes: Also, the ultimate target of WMA for improved compactability below 90 °C was clearly achieved (see print-out).

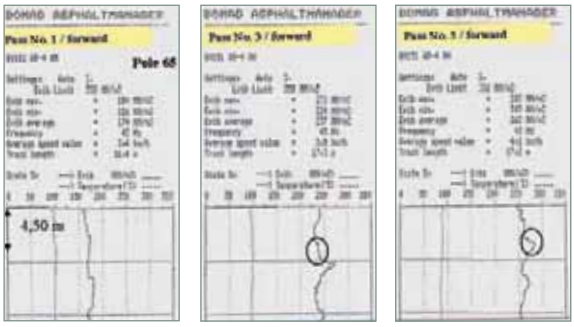


Fig.11: Print-out of EVIB values measured with WMA additive "SASOBIT"

Another print-out measured with the WMA "REDISET® " additive shows almost a straight line for the E_{VIB} value (Fig. 12).

The result highlights the excellent compactability and surfactant effect of the additive which has been proven by comprehensive density checks (Fig. 13).

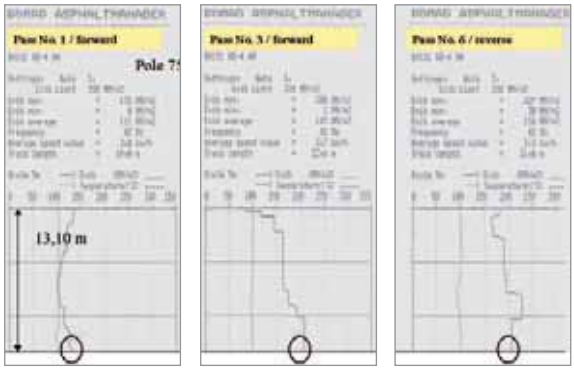


Fig.12: Print-out of E_{VIB} values measured with WMA additive "REDISET"

Fig.13: Calibration to density with a nuclear gauge.

Optimum compaction and quality results achieved with ASPHALT MANAGER

The WMA Interest Group of South Africa have successfully completed their second trials on the Leicester Road in Durban

Fig.14: Quality aspect: Smooth longitudinal joints after horizontal directed compaction.

Quality aspects:
Another special AM feature was seen when compacting joints between layers. The AM system was set to horizontal vibration (similar to the oscillation system), and produced near-perfect compaction of the longitudinal joints with a tight surface closing effect (Fig. 14). Another example of how to handle modern contract requirements with quality and efficiency.

Fig.15: Compaction and quality achieved: BW 151 AD AM.

Targets achieved: The WMA Interest Group of South Africa have successfully completed their second trials on the Leicester Road in Durban. All targets were achieved as the warm mix asphalt was produced and laid at temperatures about 20 °C below HMA. The WMA Interest Group set tight specifications for temperature and thus for the efficiency of compaction. The BOMAG ASPHALT MANAGER compaction technology paved the way – more efficient and environmentally friendly than conventional methods (Fig.15).

Summary by Tony Lewis (independent consultant; Durban S.A.)
"There is no doubt that the participation of compaction equipment suppliers, such as BOMAG, with their sophisticated AM system, as well as the specialised hands-on expertise that they provided, contributed to the success of South Africa's second WMA trials in Durban".

Final Comments of Krishna Naidoo, Manager: Road Rehabilitation
(Pr. Tech Eng.) eThekwini Municipality; Durban S.A.
"The compaction phase of an asphalt layer is critical to its long term performance. BOMAG's AM system is a tool that certainly helps improve consistency and better quality which is sure to contribute to better long-term performance of the asphalt layer. South Africa's WMA Interest Group would have been poorer without BOMAG's specialised expertise."

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