Technical Note TN190

Construction and Trafficking of High Modulus Asphalt (EME2)

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Queensland Government

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1 Introduction

High modulus asphalt (EME2) was introduced into Queensland in 2014. EME2 is a structural (base course) material primarily intended to reduce the overall thickness of asphalt pavements whilst still providing sound pavement performance through a combination of:

- high modulus
- superior fatigue resistance
- superior deformation resistance
- superior moisture resistance, and
- increased workability.

In 2017, the first large-scale use of EME2 in Australia occurred in Queensland. In the time since, the use of EME2 has increased significantly.

This Technical Note is intended to assist personnel involved in Transport and Main Roads projects to understand more about the construction and trafficking of EME2.

The guidance has been prepared on the basis that the EME2 conforms with the requirements of MRTS32 *High Modulus Asphalt (EME2)*.

2 Construction advantages

EME2 offers a number of key construction advantages over conventional dense graded asphalt bases, including that the:

- mixes are highly workable
- pavements are thinner and the mixes can be placed in thicker layers – this has been reported to result in construction program savings of up to 30%
- quantity of materials needed can be significantly reduced, and
- emissions generated from production, delivery and construction can be significantly reduced (it has been reported to reduce the number of truck movements needed by up to 25%, while also significantly reducing the need to use non-renewable raw materials.)

3 Construction

3.1 Workability and stability

EME2 is more workable and easier to compact than conventional dense graded asphalt, due to its higher binder content and the fact that the mix itself has been designed to be workable.

This increased workability may make the mix 'livelier' during initial compaction when compared to conventional dense graded asphalt mixes. Without appropriate process controls, the increased workability may result in:

- the surface shape being out of tolerance
- ride quality issues
- 'edge drop' (where the unsupported edge of a mat settles more than the middle of the mat – refer Figure 3.1), and/or
- difficulty placing multiple layers in conforming thickness during a single work shift.

Figure 3.1 – Edge drop

On projects completed to date, these issues have been successfully managed with appropriate process controls (which may be different to those used for 'conventional' dense graded asphalt mixes); for example:

- surface shape and ride quality have been managed by closely monitoring and adjusting the compaction process
- edge drop has been managed by keeping rollers away from the unsupported edges of the mat until the centre of the mat is fully compacted and the mix has cooled and stiffened slightly
- stability has been improved by reducing the paving temperature (for example, by batching the mix slightly cooler), and
- paving multiple layers consecutively has been achieved by properly understanding the cooling properties of the mix and considering these properties as part of compaction and placement processes.

3.2 Cooling

3.2.1 General

In general, EME2 has been found to cool at a similar rate to the same thickness of conventional dense graded asphalt. The actual cooling rate of asphalt is typically sensitive to environmental conditions (for example, pavement and air temperatures), layer thickness and site layout (for example, proximity of concrete traffic islands or vegetation / shade to the pavement).

Cooling rates of EME2 have been monitored on a number of projects and compared with the predictions from proprietary computer simulation applications (for example, MultiCool™, PaveCool™). This comparison has shown that these applications provide a reasonable approximation of the cooling rate of EME2. For assistance with modelling, contact the department's Pavements, Research and Innovation Unit of Engineering & Technology Branch.

3.2.2 Workability as the mix cools

Prior to the implementation of EME2 in Queensland, there were some concerns that the mix may abruptly 'lock up' due to the binder stiffness increasing rapidly as the mix cooled. This has not been observed to date and the mixes have remained workable for longer than conventional dense graded mixes.

3.2.3 Opening to traffic

Like any asphalt, EME2 must be given sufficient time to cool prior to being opened to traffic.

Transport and Main Roads asphalt specifications do not currently specify a minimum temperature for asphalt to be opened to traffic. Rather, it is the Contractor's responsibility to ensure the asphalt has cooled sufficiently to prevent deformation of the asphalt when trafficked.

Experience to date has indicated that EME2 layers can be opened to traffic at a slightly higher temperature than conventional dense graded asphalt, however, some variability has been observed between mixes in this regard.

On projects where early trafficking is proposed, it is recommended that trafficking of the warm asphalt be assessed by the Contractor as part of the placement trial or be verified with historical evidence from previous projects where the same mix design was used.

3.2.4 Multiple layers

Constructing multiple layers of pavement in a single work shift is often seen on brownfield / rehabilitation projects. EME2 has been successfully paved in multiple layers (for example, two 75 mm layers) in a single work shift. The stability of EME2 layers needs to be considered when planning to pave multiple layers in a single work shift; however, as noted in Section 3.1, this can be successfully managed with appropriate process controls.

As noted in Section 3.2.1, proprietary software has been found to provide a reasonable approximation of the cooling rate of EME2 and may be used as a guide, along with field calibration, when planning to place multiple layers of asphalt in a single work shift.

Regardless of asphalt type, placing fewer thicker layers will take longer to cool than more thinner layers. Although MRTS32 permits EME2 to be placed in layers up to 130 mm thick, the cooling rate of thicker layers should be compared to thinner layers when trying to determine the optimum paving program.

3.3 Compaction

To date, few issues have been observed achieving the maximum insitu air voids requirement.

For some mixes, the use of pneumatic-tyred rollers may need to be limited during the compaction process to avoid the surfacing becoming excessively binder rich.

3.4 Productivity

EME2 can be placed in thick layers which reduces the number of layers needed and, hence, enhances the construction productivity. As noted in Section 2, it has been reported to reduce the number of truck movements needed by up to 25%.

4 Trafficking EME2

EME2 is not intended to be used as a surfacing course or to be temporarily trafficked for extended periods of time. As with conventional AC20 dense graded asphalt bases, for construction and traffic management purposes, EME2 may need to be trafficked by general (public) traffic for a limited period of time until the overlying course is laid.

4.1 Timeframe to cover

Restrictions are sometimes placed on the period for which conventional AC20 dense graded asphalt bases can be trafficked. These restrictions are generally based on the risk that moisture may penetrate the asphalt and lead to ravelling and loss of strength. This risk significantly reduces as the insitu air voids decrease; however, a residual risk can remain for conventional AC20 dense graded asphalt. For EME2, this risk of moisture penetration is considered low, due to the higher binder content, lower insitu air voids, dense grading and workable nature of the mix.

There are currently no specified timeframes to cover EME2; however, the overlying layer should be placed as soon as practical as it should be for AC20 dense graded asphalt.

4.2 Surface texture

In general, the surface texture of newly-laid EME2 has been found to be within the same range as conventional AC14 dense graded asphalt (approximately 0.4–0.8 mm). On projects completed to date, it has been observed that EME2 is more likely to have surface texture depths towards the lower end of this range. This is likely the result of EME2 mixes being:

- highly workable
- potentially having a finer grading than conventional AC14 dense graded asphalt mixes, and
- typically compacted to lower insitu air voids.

Where temporary trafficking of EME2 is proposed, designers should consider the potential for lower surface texture to ensure that any aquaplaning risks are adequately addressed.

In the situation where the risk of aquaplaning has been identified and trafficking of the EME2 layer is planned, the designer (or the Contractor if it is the Contractor's proposal to traffic the EME2) may be required to nominate a minimum surface texture depth to be achieved for the EME2 asphalt (based on the aquaplaning risks), and surface texture be tested during construction.

4.3 Skid resistance

Experience to date on Transport and Main Roads projects has indicated that EME2 is capable of providing sufficient skid resistance for temporary trafficking in applications where conventional dense graded asphalt would otherwise be used.

It has been found that EME2 has similar or better early life skid resistance compared to AC14 dense graded asphalt and generally exceeds the skid resistance investigatory levels for the highest demand sites (for example, high traffic signalised intersections, roundabouts).

Where skid resistance is a particular concern (for example, high skid demand sites with a history of wet skid crashes), skid resistance testing should be considered to be undertaken as part of the placement trial to validate the trafficked surface will exceed the relevant skid resistance investigatory levels and to inform on whether further testing throughout the project is necessary.

If the EME2 surface becomes flushed during construction and there is concern about skid resistance for trafficking of the EME2, temporarily reducing speed limits should be considered and the overlying layer placed as soon as possible. Skid resistance testing may also be considered in these circumstances.

Where considered necessary, the skid resistance of the asphalt surface (including EME2) to be temporarily trafficked can be tested using a Sideways-force Coefficient Routine Investigation Machine (SCRIM®), Intelligent Safe Surface Assessment Vehicle (iSSAVe), Grip Tester, ViaFriction Skid Tester or British Pendulum Tester (BPT). The various skid resistance demand categories and investigatory levels typically adopted by Transport and Main Roads can be found in the following documents:

- SCRIM®, iSSAVe, or Grip Tester: *Skid Resistance Management Plan*, Transport and Main Roads, May 2016.
- ViaFriction: *Skid Resistance Management Plan*, Transport and Main Roads, June 2006.
- BPT: *Skid Resistance and the Impact of the New International Friction Index Parameters*, E. Baran, Technology Transfer Forum, 1996.

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