International Transport Forum

Joint Transport Research Centre

OECD

Long Life Surfacings for Busy Roads

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Epoxy Asphalt: Concept and Properties

by

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HIGHWAYS AGENCY

Epoxy Asphalt Surfacing

- Premium surfacing material for steel bridge decks.
- First application (San Francisco,1967) is still performing after 40 years of service.
  - Widely used in a number of other countries
  - Extensive recent use for bridge deck surfacing in China.
- High stiffness, suitable for use in thin surface layers.
- Greatly improved performance compared to conventional mixtures.

Epoxy Asphalt Surfacing

Two components of epoxy asphalt

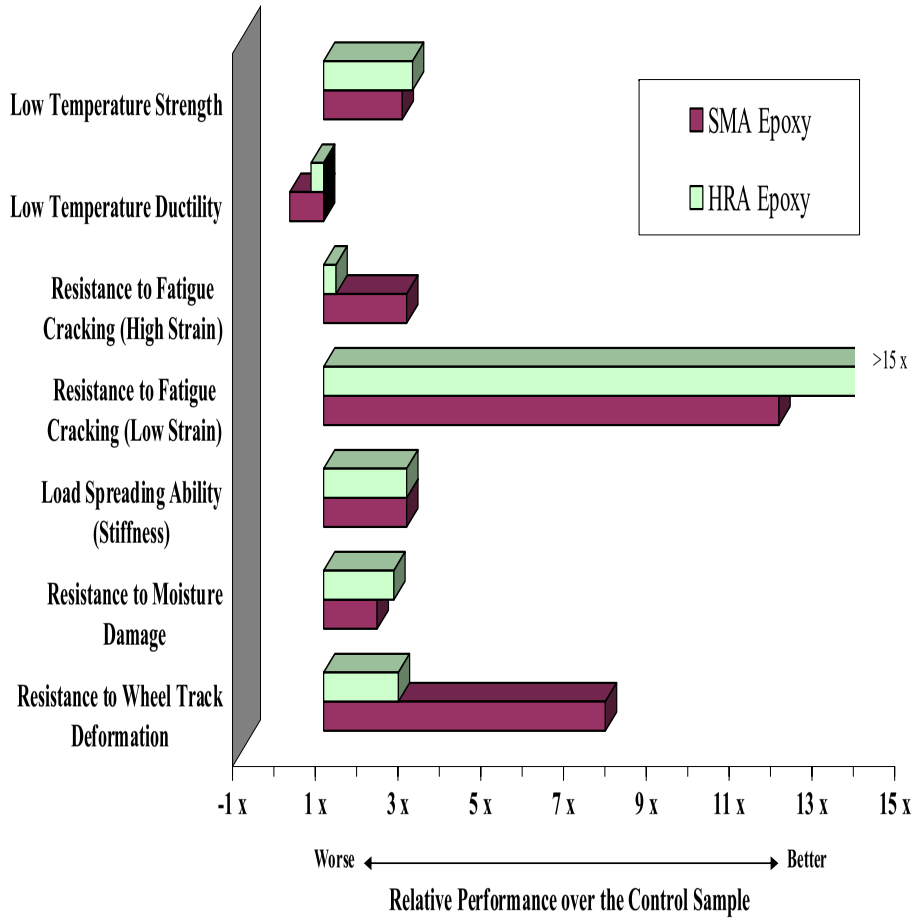
Part A Part B

Handling characteristics

Epoxy Asphalt in the Laboratory

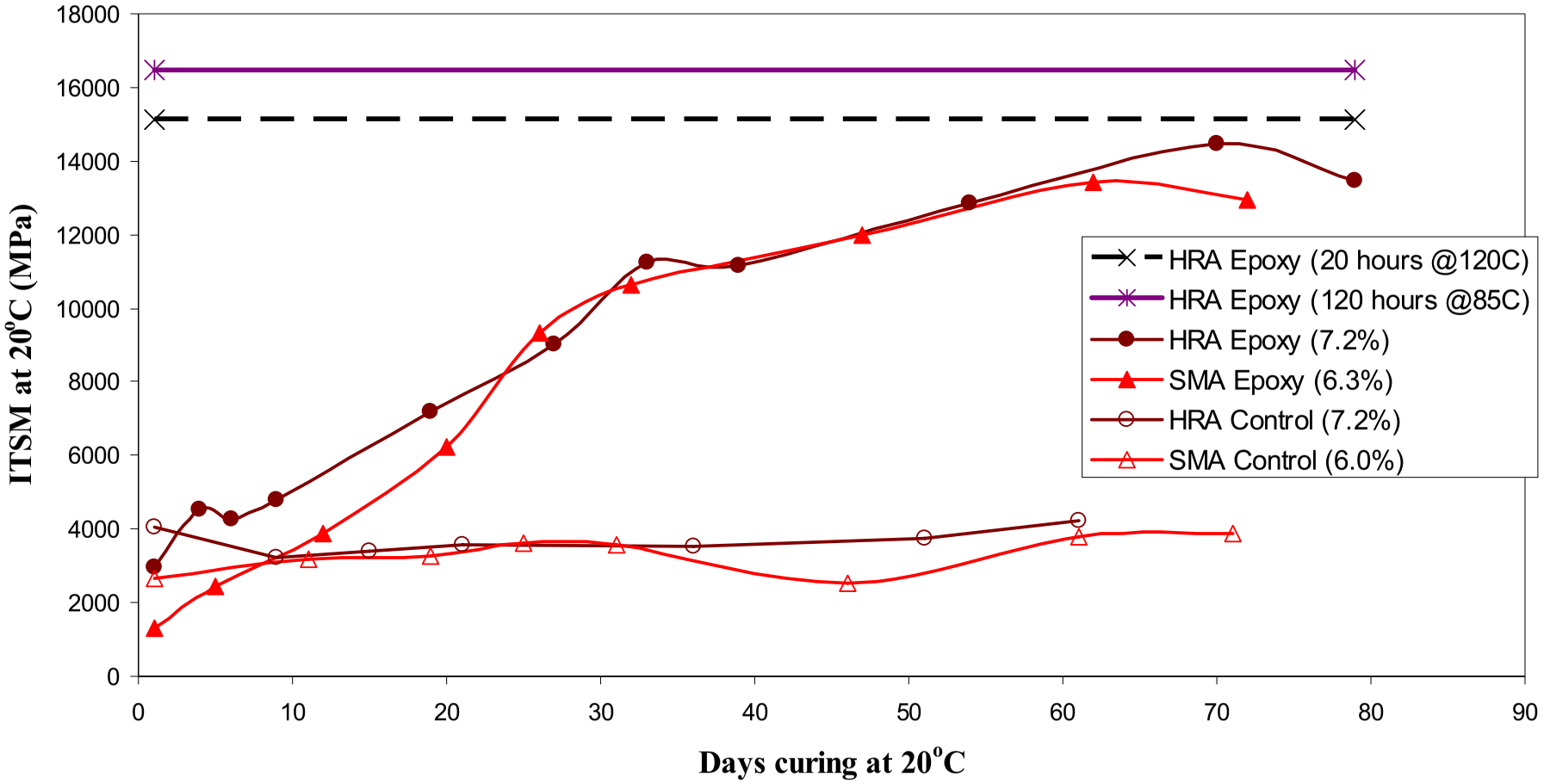
- Two asphalt mixtures investigated
  - Hot rolled asphalt (HRA) and stone mastic asphalt (SMA)
  - Acid based epoxy (test) and 40/60 pen binders (control)
  - High quality igneous aggregate source (PSV 60)
- Standardised protocol for manufacture
  - 14.5% component A/85.5% component B
  - Relatively low temperature (maximum 135°C)
  - Incorporates 30 minute ‘holding’ period at mix temperature (130°C) to allow reaction to take place

Epoxy Asphalt in the Laboratory



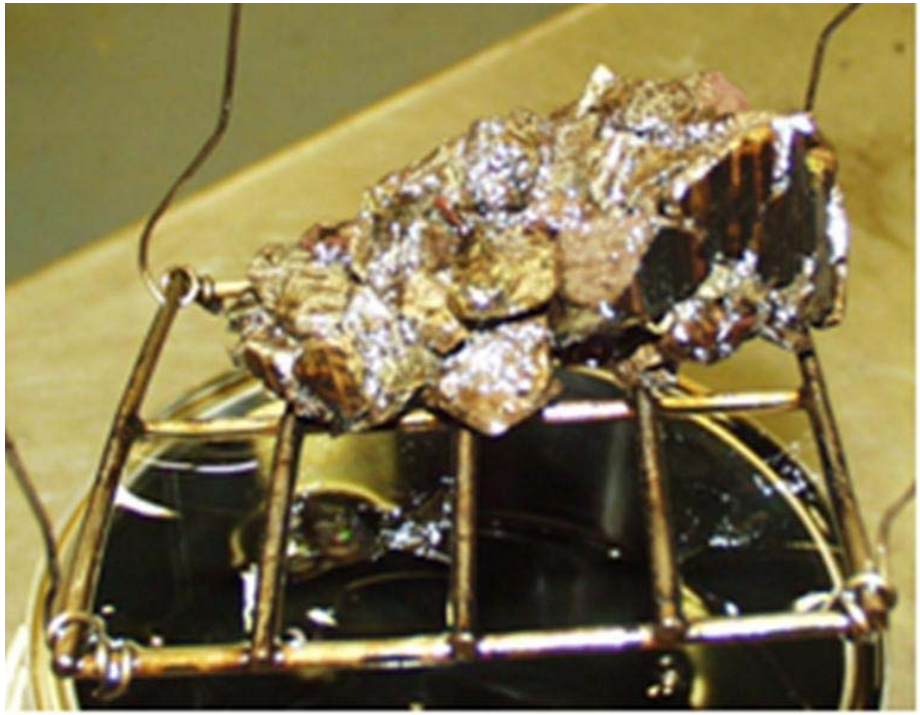
- More resistant to low temperature cracking
- More resistant to fatigue cracking
- Stiffer (higher modulus) at service temperatures, with greater load spreading ability
- Less susceptible to water induced damage
- More resistant to rutting
- More resistant to ageing
- More resistant to surface abrasion from tyre action

Stiffness Transition

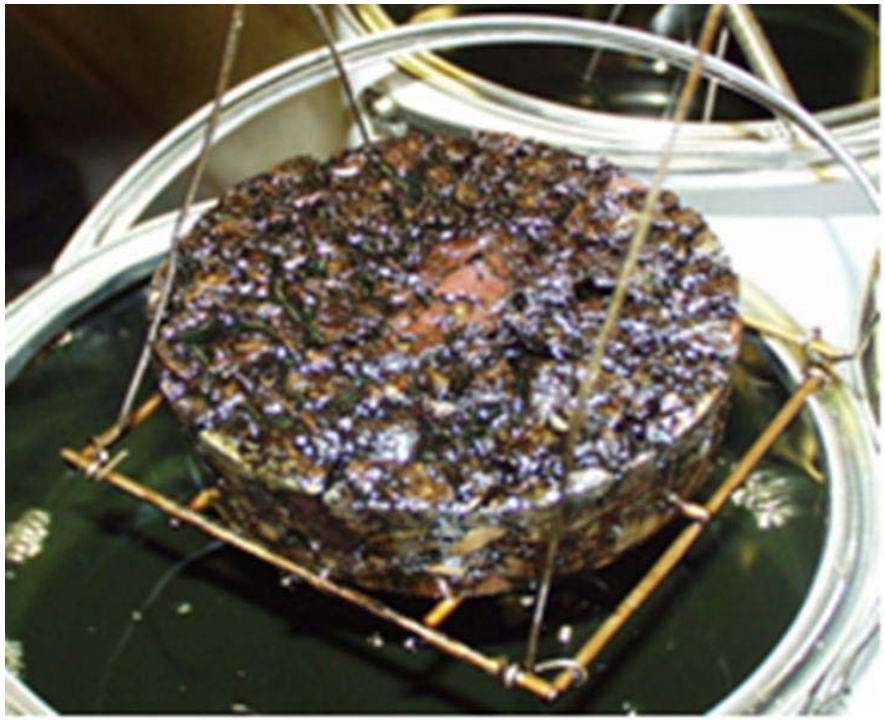


Effect of Diesel Immersion

Control↓

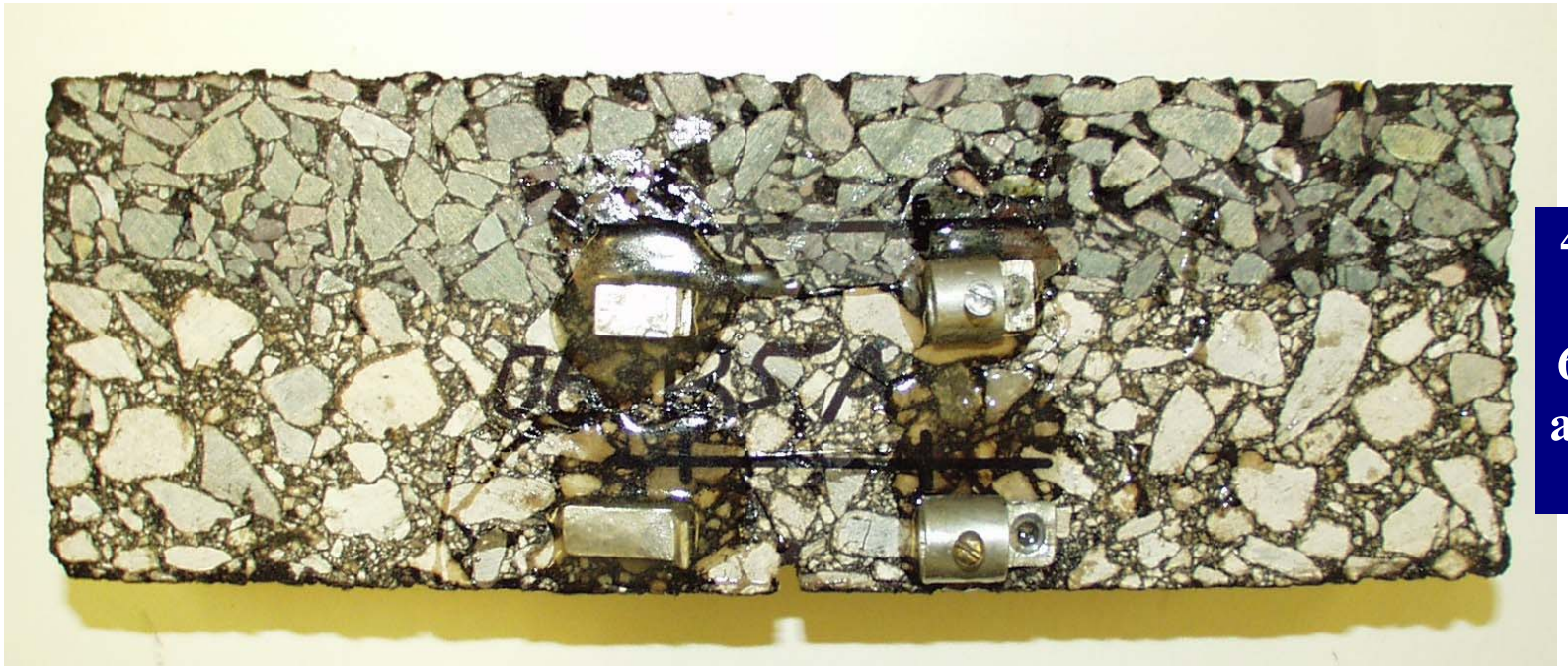


Epoxy→



40mm SMA Control on 60mm DBM after 55,000 cycles.

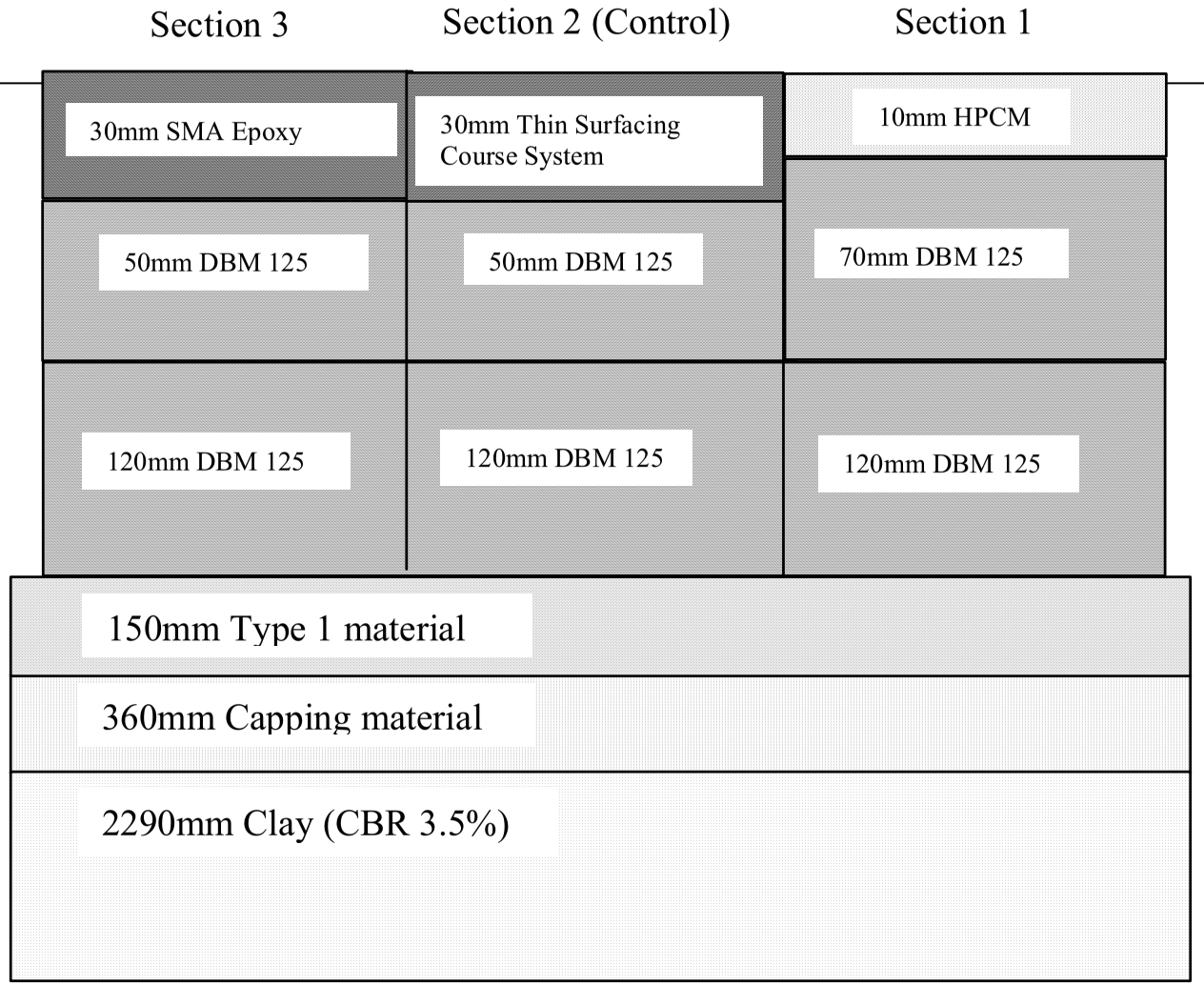
Two-layer Repeated Load Test



40mm SMA Epoxy on 60mm DBM after 100,000 cycles.

Epoxy Asphalt in Pilot Scale

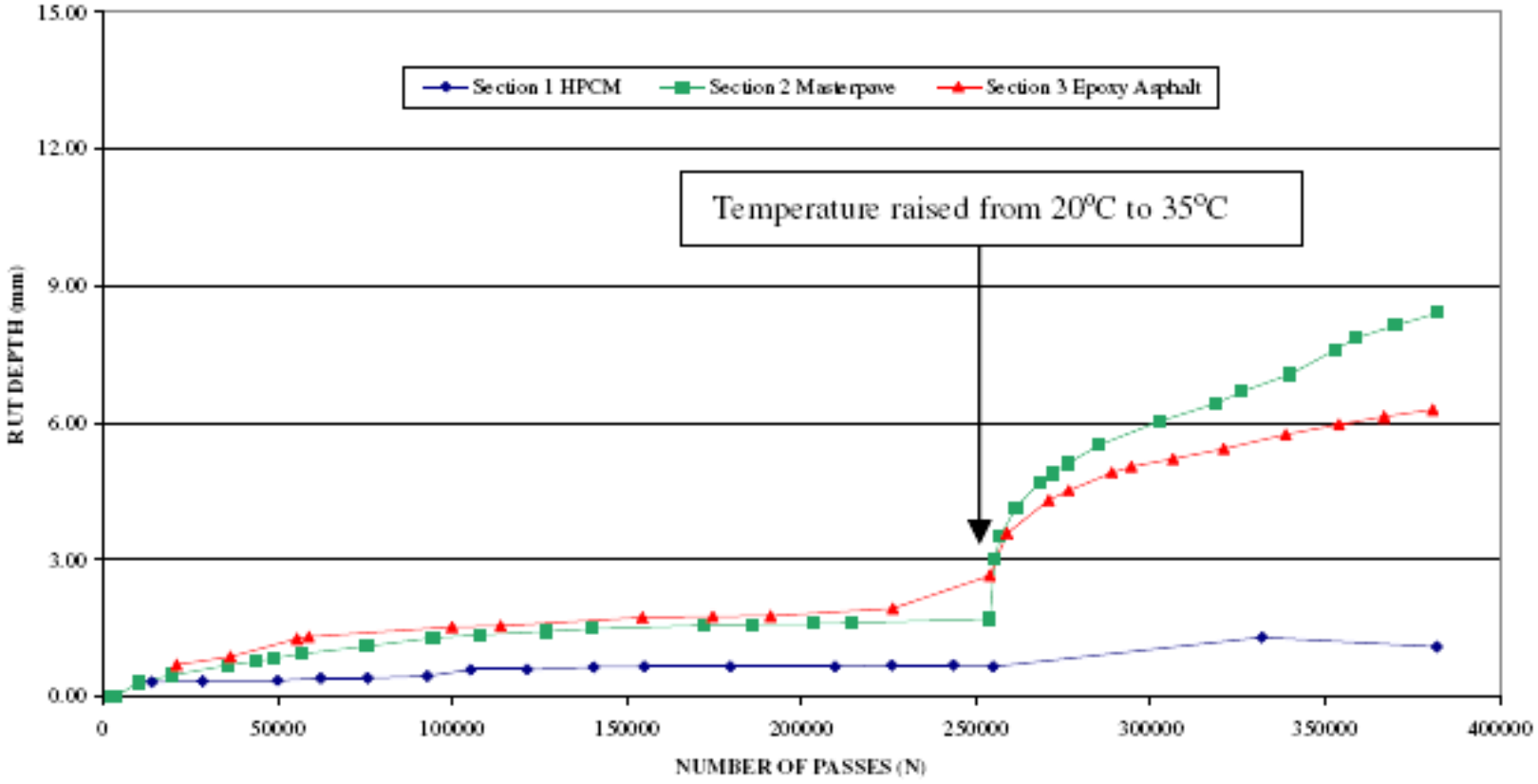
Epoxy Asphalt in Pilot Scale



Epoxy Asphalt in Pilot Scale

- Nominal 2.5 x 10m strips of material
- Design to HD 26/01 for a traffic loading of 1msa
- 56.3kN load applied through dual wheel assembly
- 1 msa at 20°C followed by 0.5 msa at 35°C
- Epoxy asphalt trial strip showed
  - Improved rut resistance at 35°C compared with the control
  - Good bond with substrate
  - Similar skid resistance to the control (same aggregate)

Rut Depths in Pilot Scale Tests



Epoxy Asphalt: Words of Caution

- Type of epoxy materials needs to be chosen carefully
  - When uncured, certain epoxy materials are strong allergy provoking compounds. These were not used for the Epoxy Asphalts in this project.
- Great care needed in choice of aggregates for best performance
- Epoxy asphalt needs close supervision at time of production and laying to ensure full mixing
- Time and temperature need to be carefully monitored to achieve the best performance outcomes

Epoxy Asphalt Research Issues

- *Curing and construction time*
  - optimise the curing profile/desired rate of reaction for the local conditions (time for curing, distance of transport and laying)
- *Curing period*
  - when is the reaction complete?
- *Curing temperature*
  - potential for lower temperature curing – and energy and cost savings during production – with amine based systems

Epoxy Asphalt: Construction Issues

- Experience to date almost exclusively with a batch plant that gives good control of mixing time
- The risk of construction failures and damage to plant is greater than with conventional bitumen
- Curing of the epoxy asphalt requires careful management during manufacture, transport and laying, and an awareness of ambient conditions
- Fatty acid based epoxy asphalts do not entail any additional environmental risk over usual good practice, and the cured products is safe and suitable for reuse
  - Other systems could require special equipment and safety precautions

Epoxy Asphalt Performance Assessment

- Compared with conventional surface course asphalt, acid based epoxy asphalts display:
  - Similar workability and 'user friendliness'
  - Superior mechanical properties and durability
  - Equivalent (good) adhesion to an asphalt substrate
- Overall, the testing indicated that Epoxy Asphalt has the potential to provide **a durable surfacing**, even in the most heavily trafficked road situations with a much extended, **practically maintenance-free life of 30 years or more**

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For further information, see :

http://www.cemt.org/JTRC/WorkingGroups/Pavements/index.htm