Introducing High Modulus Asphalt (HiMA)

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Outline of presentation

- The need for innovative asphalt technology,
- Background to the HiMA T² project,
- Benefits of HiMA technology,
- Designing for performance,
- Implementation of the technology,
- Way forward,
- Conclusions.
The need for innovation

- Economic growth,
- Higher traffic volumes,
- Higher axle loads,
- Higher tyre pressures,
- Need for sustainable use of resources,
- Design concepts from 1950s still suitable?
Background: What is High Modulus Asphalt?

Origin: France early 90s
“Enrobés à Module Elevé” (EME)

Typical characteristics:

- High binder content ≈ 6% by mass of aggregate,
- Hard binder: Pen 10-25,
- Low air voids content,
- High Modulus > 14 GPa at 15°C, 10 Hz,
- High resistance against permanent deformation,
- Good fatigue resistance,
- Impermeable,
- Increased mixing temperature.
Background: The greater scheme of things
Background: Structure of SABITA T² project

Phase I
- Feasibility study

Phase II
- Preliminary mix and structural design guidelines

Phase III
- Implementation: APT, LTPP and lab study

Phase IV
- Final guidelines and specifications
Background: The properties of HiMA

Graph showing the dynamic modulus (MPa) plotted against reduced frequency (Hz) for various mixes:
- Red: BTB Mix
- Blue: Coarse/SBS
- Green: Medium/SBS
- Purple: HiMA

The graph illustrates the modulus behavior across different frequency ranges for each mix type.
Background: The properties of HiMA
Background: The properties of HiMA

Strain-fatigue relationship at test temperatures at 70% initial stiffness reduction

All at 10 Degrees C
The benefits of HiMA: Thickness reduction

Average base layer thickness reduction of 30%
The benefits of HiMA: Long life pavements

Less maintenance = less road user delays, less emissions & less use of non-renewable materials

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Performance related mix design

- First implementation of performance related mix design method in SA,
- Direct link between mix design and pavement performance,
- Requirements set for SA test methods:
  - Workability,
  - Durability,
  - Stiffness,
  - Rut resistance,
  - Fatigue.
Implementation

- Mix designs prepared for Cape Town international airport and OR Tambo

- South coast road Durban
Implementation
Implementation

- Road owned by eThekwini municipality,
- Major access road for DBN harbour,
- Frequent maintenance to pavements required (six months life span not uncommon),
- Road too busy to use concrete,
- Estimated number of standard axels: 8000 per lane per day (60 Million E80s in 20 years),
- CSIR tasked by SABITA to provide implementation advice.
Mix Design:
- Interim design guide used to develop mix,
- Mix includes 20% Reclaimed Asphalt Pavement (RAP),
- 10-20 penetration grade binder,
- Aggregate packing optimized,
- Several iterations to optimise design,
- Relatively low binder content to optimise permanent deformation resistance.
Implementation

Mix Design:
Interim design guide used to develop mix, including 20% Reclaimed Asphalt Pavement (RAP), 10-20 penetration grade binder, and 5.2% binder content selected to optimise permanent deformation resistance.

Load repetitions vs. Permanent strain [%]

- BTB 1 55°C
- Coarse AE2 55°C
- Medium AE2 55°C
- HiMA reference
- Medium 60/70 55°C
- BRASO 55°C
- Design 5.7
- Design 5.2
Innovations in the structural design process:
- CSIR Pavement temperature prediction software used,
- Use of new SAPDM models for rutting prediction,
- Use of new SAPDM approach to determine stiffness of HiMA at combination of loading speed and temperature,
- Preferred option: Two 80 mm HiMA layers, with 30 mm Stone Mastic Asphalt (SMA) surfacing,
- Predicted life of HiMA base layers >100 Million standard axels.
Implementation
Implementation
Implementation

- Paving of HiMA layers South Coast road completed 6 September 2011,
- Many challenges overcome and lessons learned during construction,
- Performance of section over time to be monitored by CSIR.
HiMA mix designs developed for two major asphalt producers,

The use of HiMA being investigated for various road construction projects,

Laboratory trials with warm mixed HiMA underway,

CSIR and Much Asphalt collaborate on innovative labour intensive HiMA application,

The experience gained with performance related mix design will be used in the development of the South African Asphalt Mix Design Manual.
Conclusions

- HiMA technology successfully transferred,
- Performance related mix design guidelines available to industry,
- Benefits of HiMA:
  - Reduction in life cycle costs,
  - Improved durability,
  - Reduction in road user delay costs,
  - Increased sustainability of pavement structure.
- Link between mix design and pavement performance made,
- HiMA set for large scale implementation,
- HiMA is a cost effective, innovative solution to help meet the increased demands placed on the SA road infrastructure.
Acknowledgements