Sabita EME Design Standards feedback

May 2014

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Feedback

- Sabita requested and sponsored

- Initial EME study
  - Provisional guidance regarding EME designs
  - Optimum EME layer thickness
- Follow-up EME study
  - Based on outcomes of initial study

Initial EME study
Methodology

- Selected limited typical pavement structures
- Conduct comparative mechanistic analysis
  - various layer thicknesses of EME
  - similar supporting layers
  - climatic conditions in Durban, Gauteng, Cape Town
- Compare data and iterate process
  - optimum EME layer thicknesses
  - adapting EME base layer thickness
- Develop recommendations for initial selection of EME base layer thicknesses based on the analysis

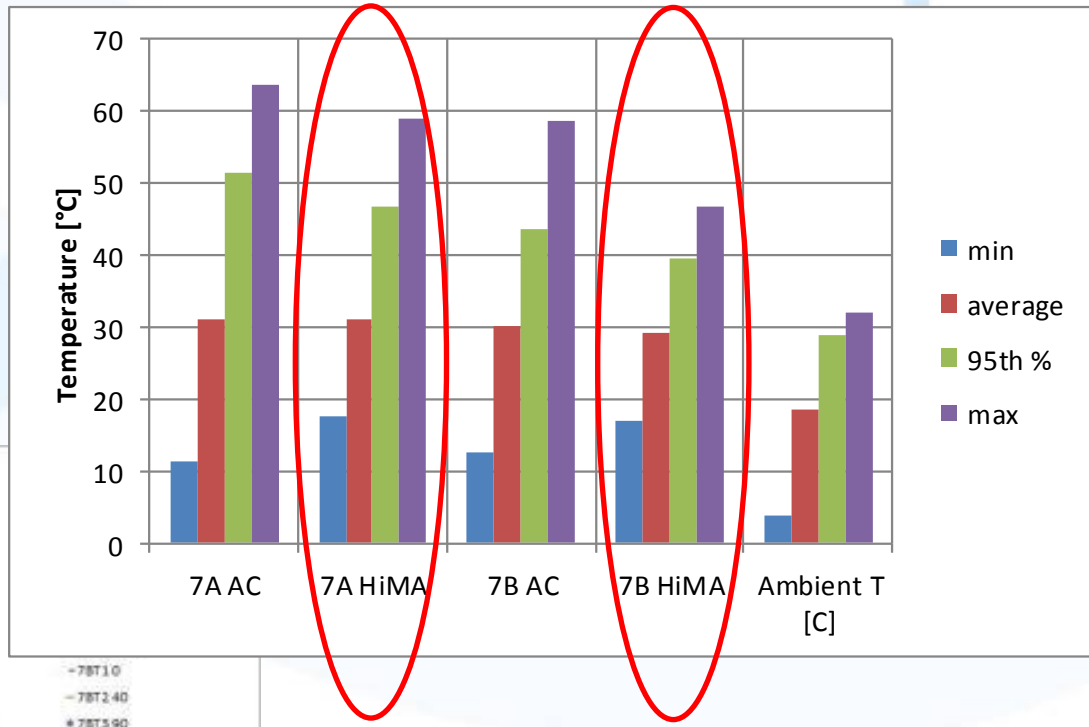
Initial EME study
Climatic conditions

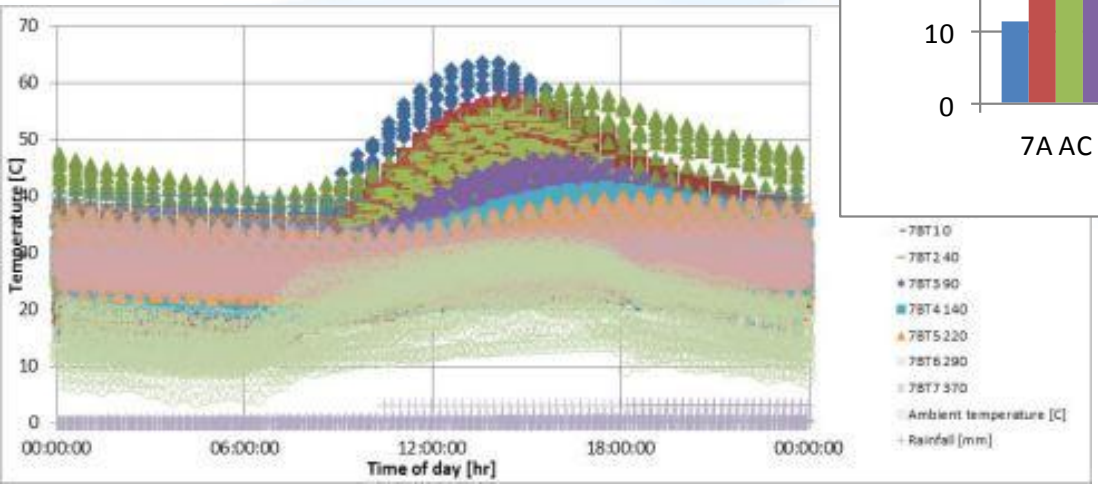
- ThermalPADS data
  - Typically
    - Average annual minimum surface temperature
    - Maximum 7-day average at 20 mm depth
    - Average annual pavement temperature

- R104 temperature measurements
- Is temperature an issue below the surfacing?
  - Upper and lower part of typical EME base
  - Temperature distributions inside base layers – effect on stiffness of EME

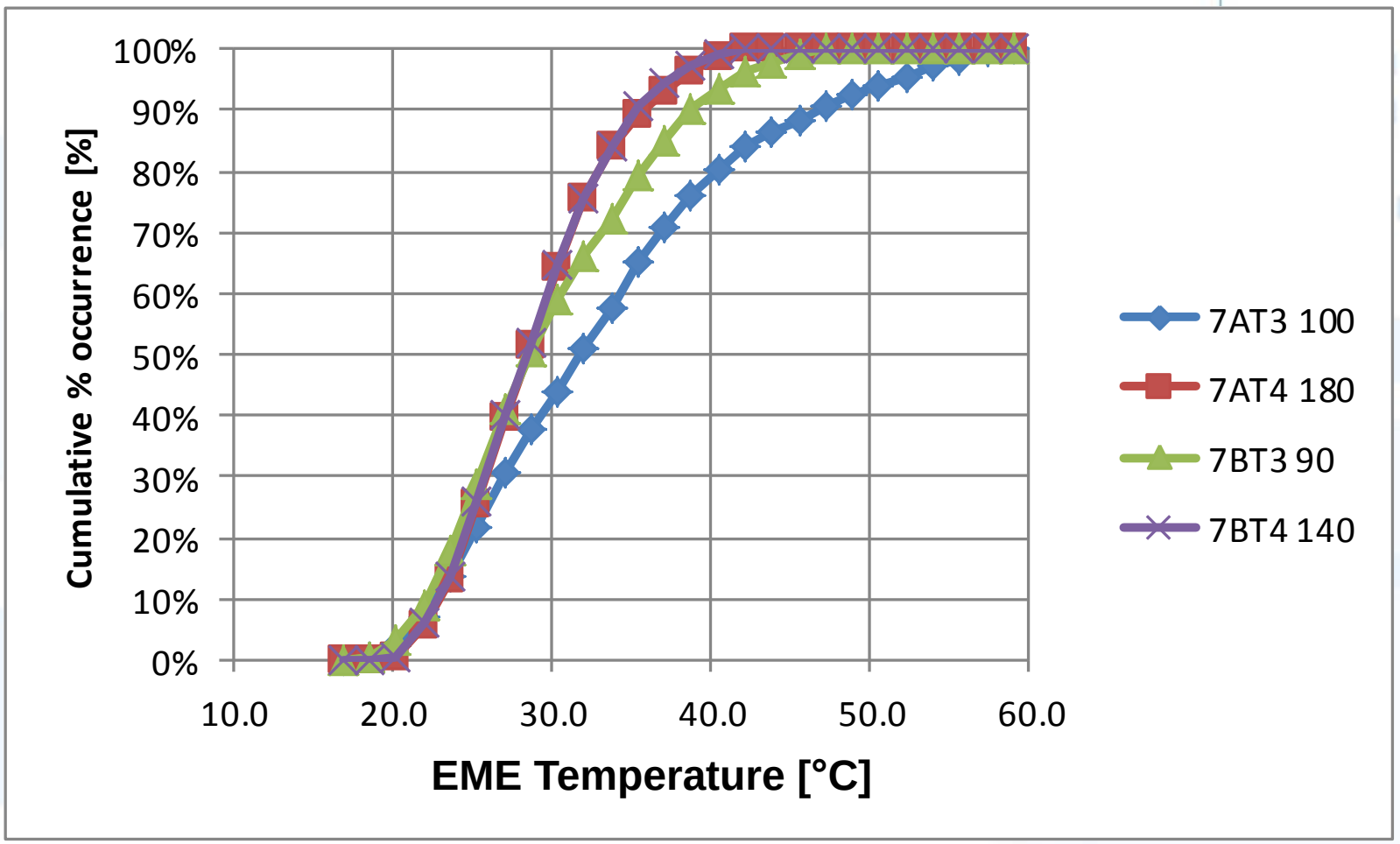
Initial EME study
Climatic conditions – Real EME

- Top and bottom of EME layers
- Also AC and other layers
- Winter / Spring





Initial EME study
EME R104 middle and bottom temperatures



Initial EME study
Pavement structures selected

- Final decision
  - Thickness
    - 40AC, 80/100/200EME, 100/200/300C3 **/** G2, 250G7, G10
  - Stiffness
    - AC – 3 500 MPa
    - EME – 1 000 / 10 000 MPa
    - C3 – 1 500 / 100 MPa
    - G2 – 250 MPa
    - G7 – 120 MPa
    - G10 – 100 MPa

- Load input
  - 1 x 20 kN, 700 kPa (E80)

Initial EME study
Materials issues

- Surfacing layers
  - 40 AC for all analyses
- EME properties
  - Stiffness ranges – laboratory
  - Stiffness ranges – field data
- Supporting layers
  - Stiff support
  - Weak support
  - NB - Compaction issues for EME on weak support

Initial EME study
Analysis methodology

- Current SAMDM process

- Layer thicknesses
  - R104 – 100 and 150 mm
  - Rule of thumb – min 3x max aggregate
  - 40 to 80 mm minimum dependent on aggregate
  - French – 30% decrease **if stiff support**
  - Beware too thin, even if 3x min aggregate

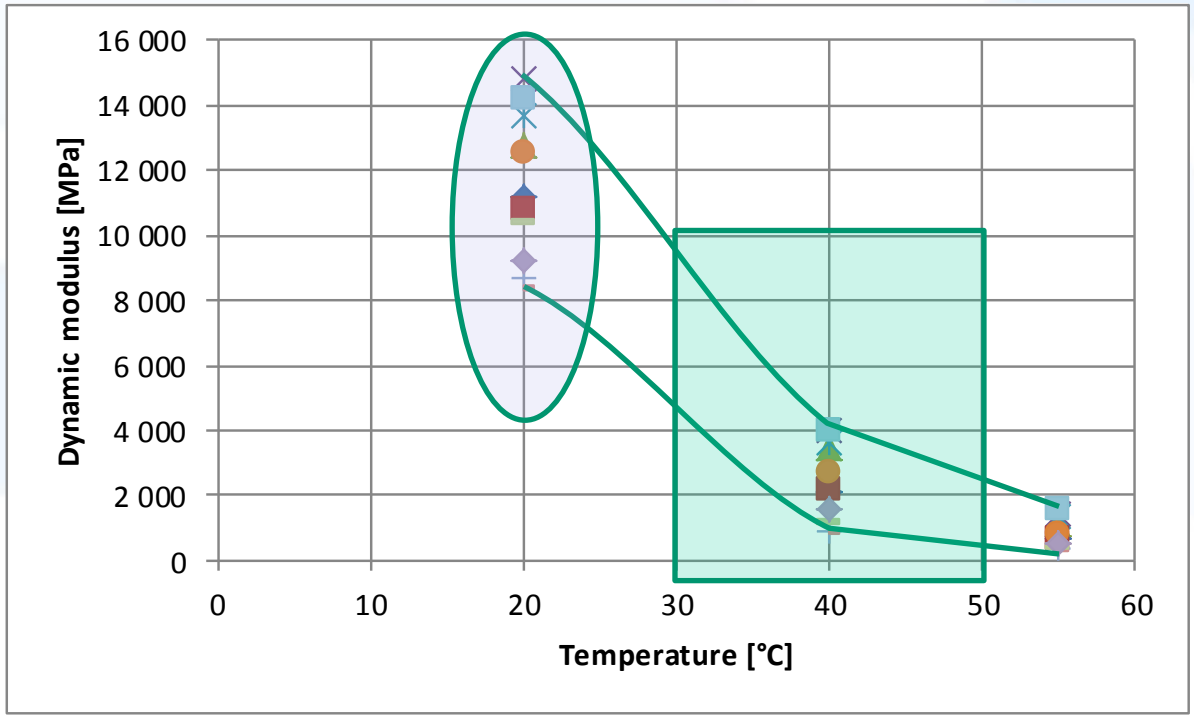
- Pavement balance and depth – probably relatively shallow

Initial EME study
Analysis inputs

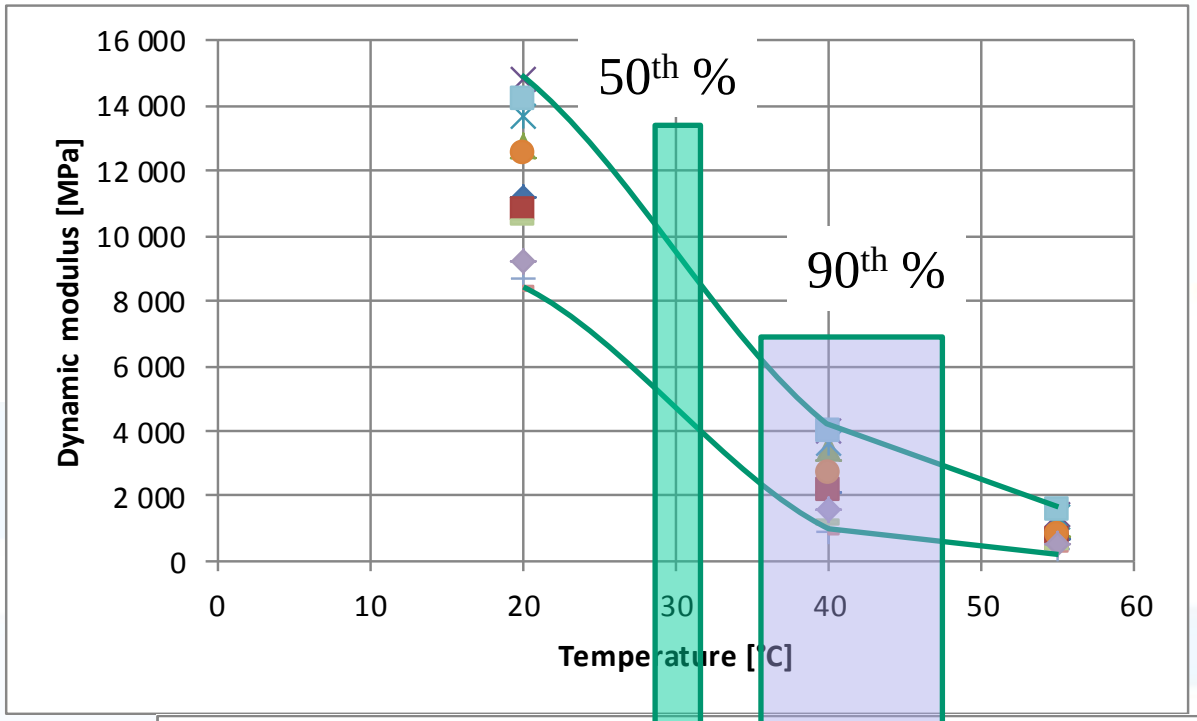
- EME stiffness
  - LTPP Durban
    - 6 000 (fresh) to 20 000 MPa
    - 20 to 30 °C ambient
  - R104
    - Ambient average 20°C
    - EME average 30°C
    - Similar to LTPP
    - Warning
      - in situ went up to 40 to 50 °C (95%)
      - only winter / spring currently

Initial EME study
Analysis inputs

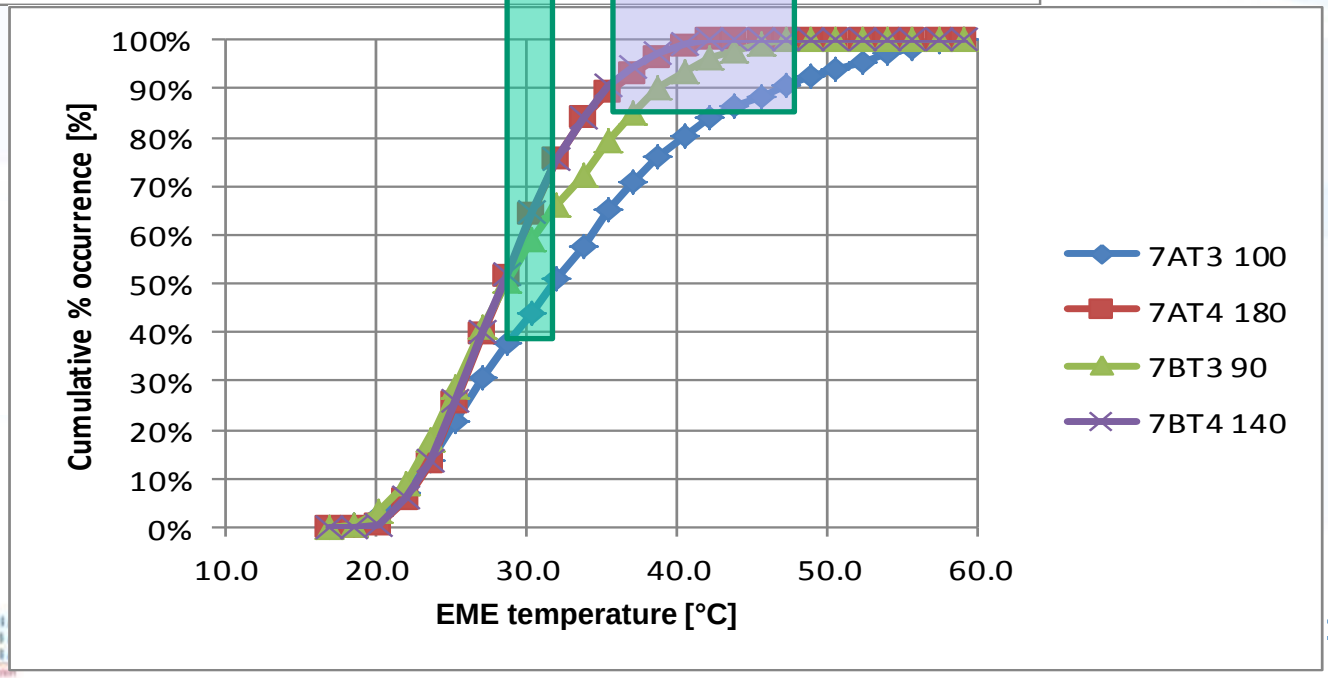
- Range of possible stiffnesses for analysis
- 1 000 to 10 000 MPa
  - depending on temperature (all at 10 Hz)
  - from laboratory evaluation
- FWD mostly done at 20°C



EME R104
Lab stiffness



In situ EME R104
winter / spring
temperatures

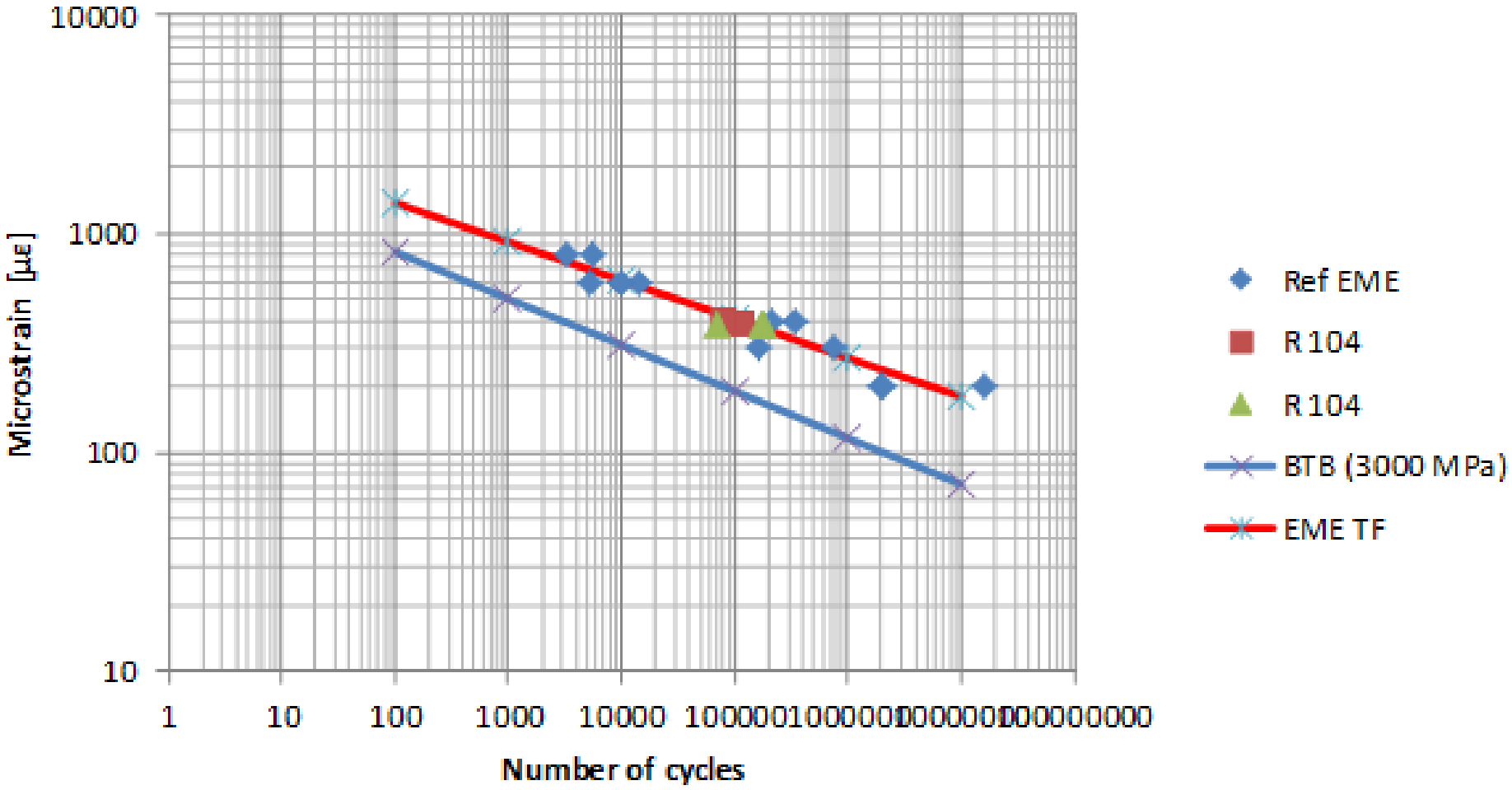


Initial EME study
Analysis outcome

- Typical structure
- Comparison between EME and BTB and other materials
  - Beware of too high stiffness values in analysis
    - R104 temperatures etc.
- Effect of EME stiffness
  - Increase stiffness - Higher fatigue life
- Effect of EME thickness
  - Increase thickness - Higher fatigue life
- Effect of Subbase (C3 / G2) thickness
  - Increase thickness - Higher fatigue life
  - Not as sensitive as EME E and h

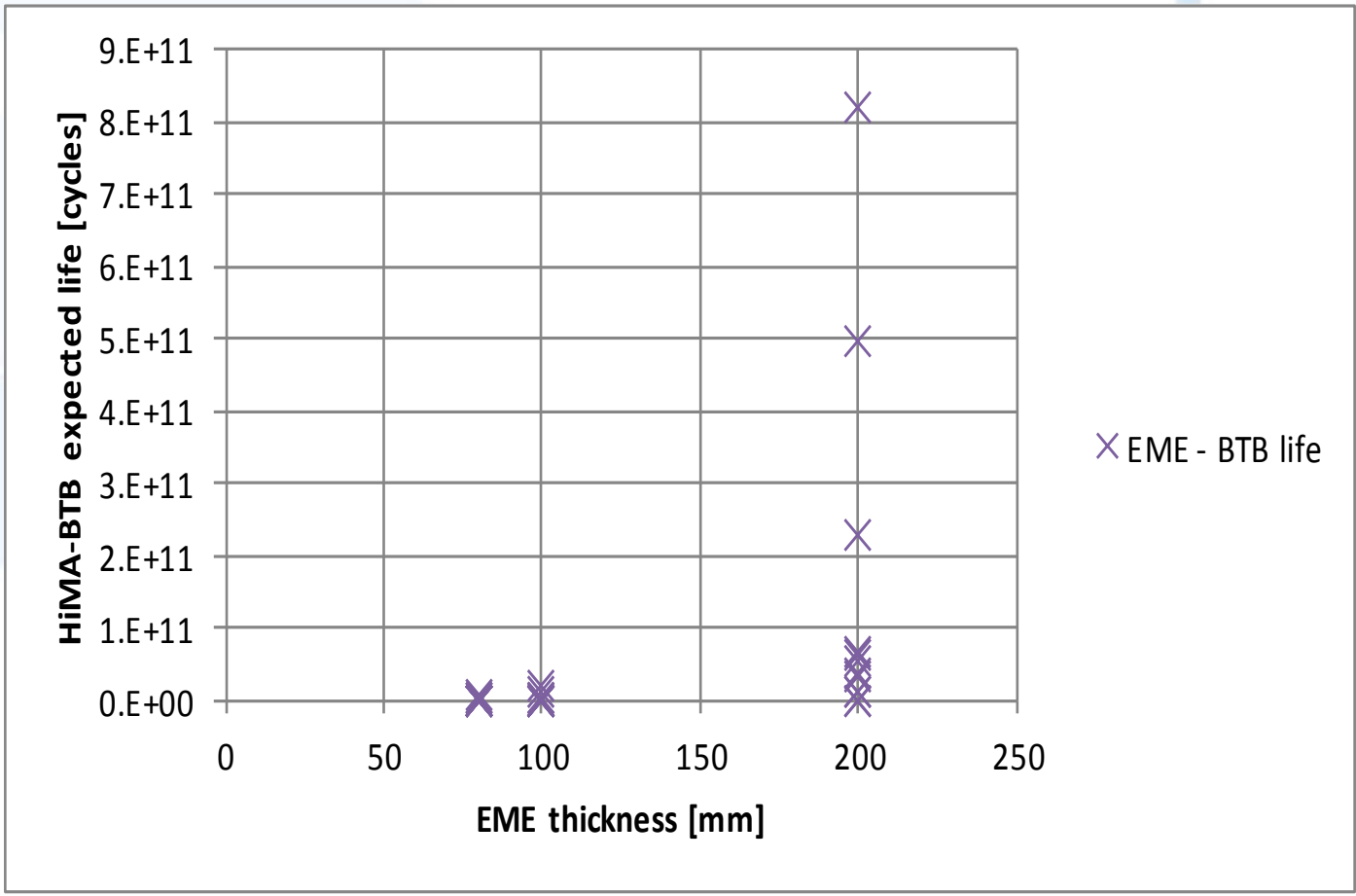
Initial EME study
Version 1 updated transfer function

- Based on data from CSIR and other analyses



Initial EME study
Version 1 updated transfer function

- Comparison between lives of EME and BTB layers for range of layer thicknesses



Initial EME study
Version 1 updated transfer function

- Comparison between EME and BTB thicknesses for standard stiffnesses (EME 8 GPa and BTB 2 GPa)

BTB THICKNESS [mm]	EME THICKNESS [mm]
100	64
200	128

Initial EME study
Cost issues

- Typical range of costs from industry
- Issues around costs and cost sensitivity
  - Imported vs local binders

- EME vs BTB
  - R 1 200/t vs R 840/t (imported 10/20 bitumen)
  - R 1 000/t vs R 840/t (local 10/20 bitumen)
- EME vs A-P1 base
  - EME around R 500/t more expensive (imported 10/20 bitumen)
- Cost is higher (25 to 44%)
- Expected performance improvement?

Initial EME study
Conclusions

- Provisional EME transfer function
- Beware of actual temperature / stiffness values
- Minimum thickness based on practical requirements
- Minimum support stiffness and thickness based on practical requirements (compaction platform)

Follow-up EME study
Objectives

- Develop improved transfer functions based on available actual data from various current and recently completed EME projects, supported by available laboratory data
- Evaluate minimum support conditions for a typical SA EME base
- Evaluate whether or not current permanent deformation transfer function can be improved
- Assist with update of relevant sections of Manual 33 with the new information originating from this project