High Modulus Asphalt (HiMA) Technology Transfer (T^2) May 2010 Progress report

Prepared for presentation at the 19th meeting of the Roads Pavements Forum (RPF), Salt Rock, 5 May 2010

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Presentation structure

- Background on HiMA,
- The sabita HiMA T^2 project,
- Progress,
- Preliminary results,
- Way forward.

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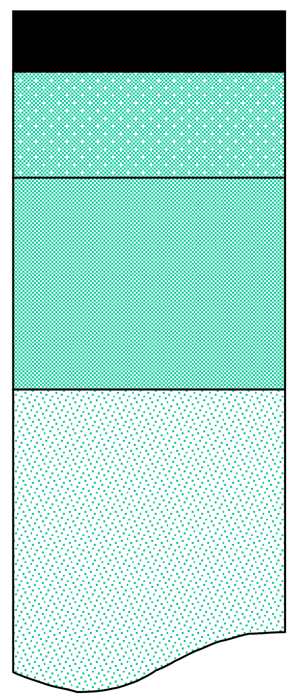
High Modulus Asphalt (HiMA)

- 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 10°C, 25 Hz,
  - High resistance against permanent deformation,
  - Good fatigue resistance,
  - Impermeable,
  - High mixing temperature.

Application examples

Case #1: HMA vs HiMA

70mm HiMA, 9000 MPa



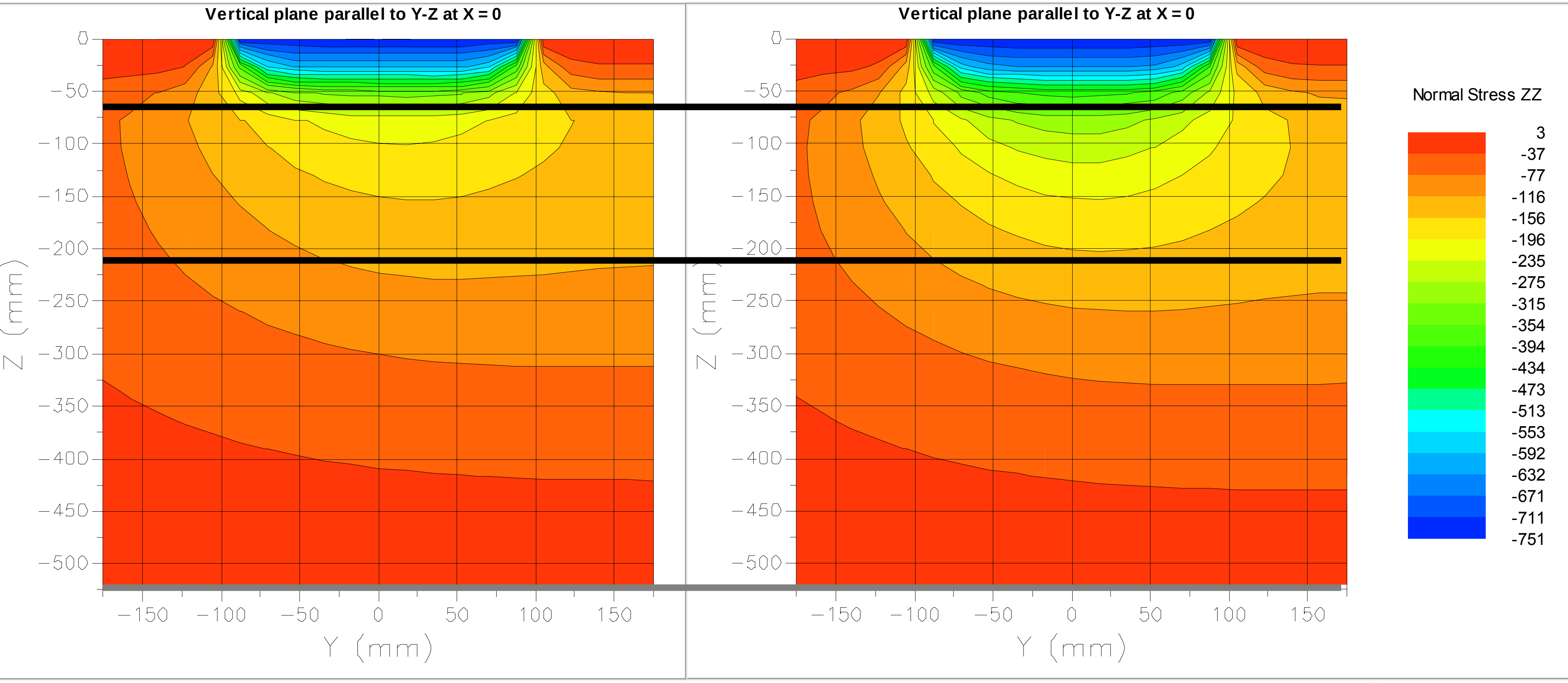
70mm HMA, 3500 MPa

150mm G1, 300 MPa

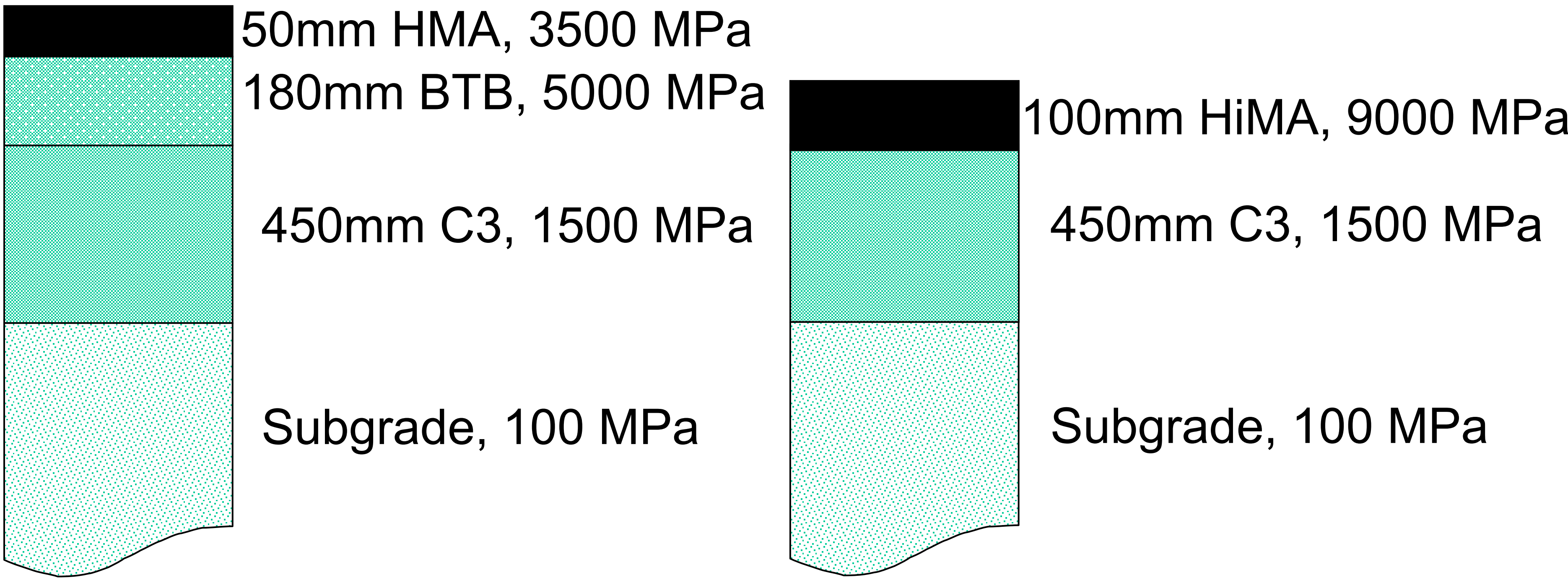
300mm C3, 1500 MPa

Subgrade, 100 MPa

Case #1: HMA vs HiMA

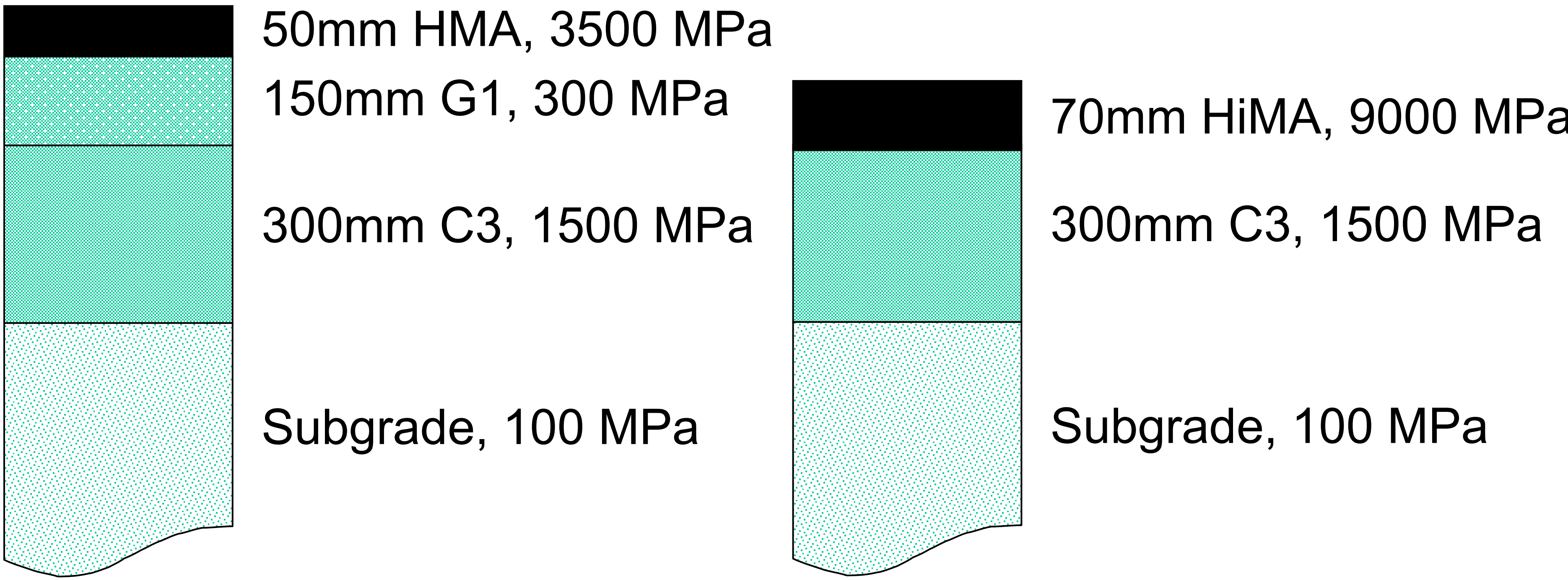


Case #2: BTB+HMA vs HiMA



Reduction of 130mm in thickness

Case #3: G1+HMA vs HiMA



Reduction of 130mm in thickness

sabita HiMA T^2 project

Phase I

Feasibility study

Phase II

Preliminary mix and structural design guidelines

Phase III

Validation through APT,LTPP and lab study

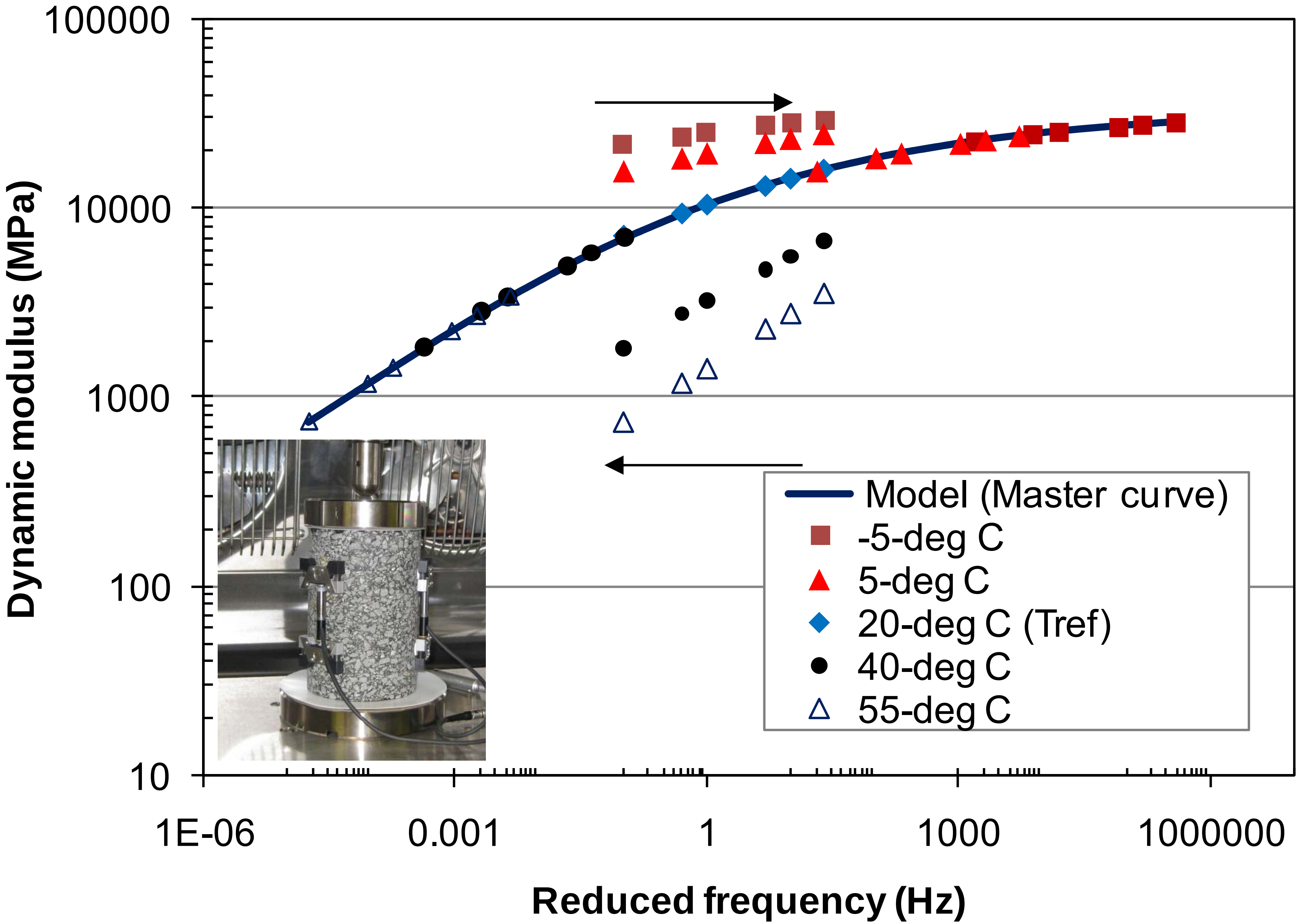
Phase IV

Drafting of guidelines and specs

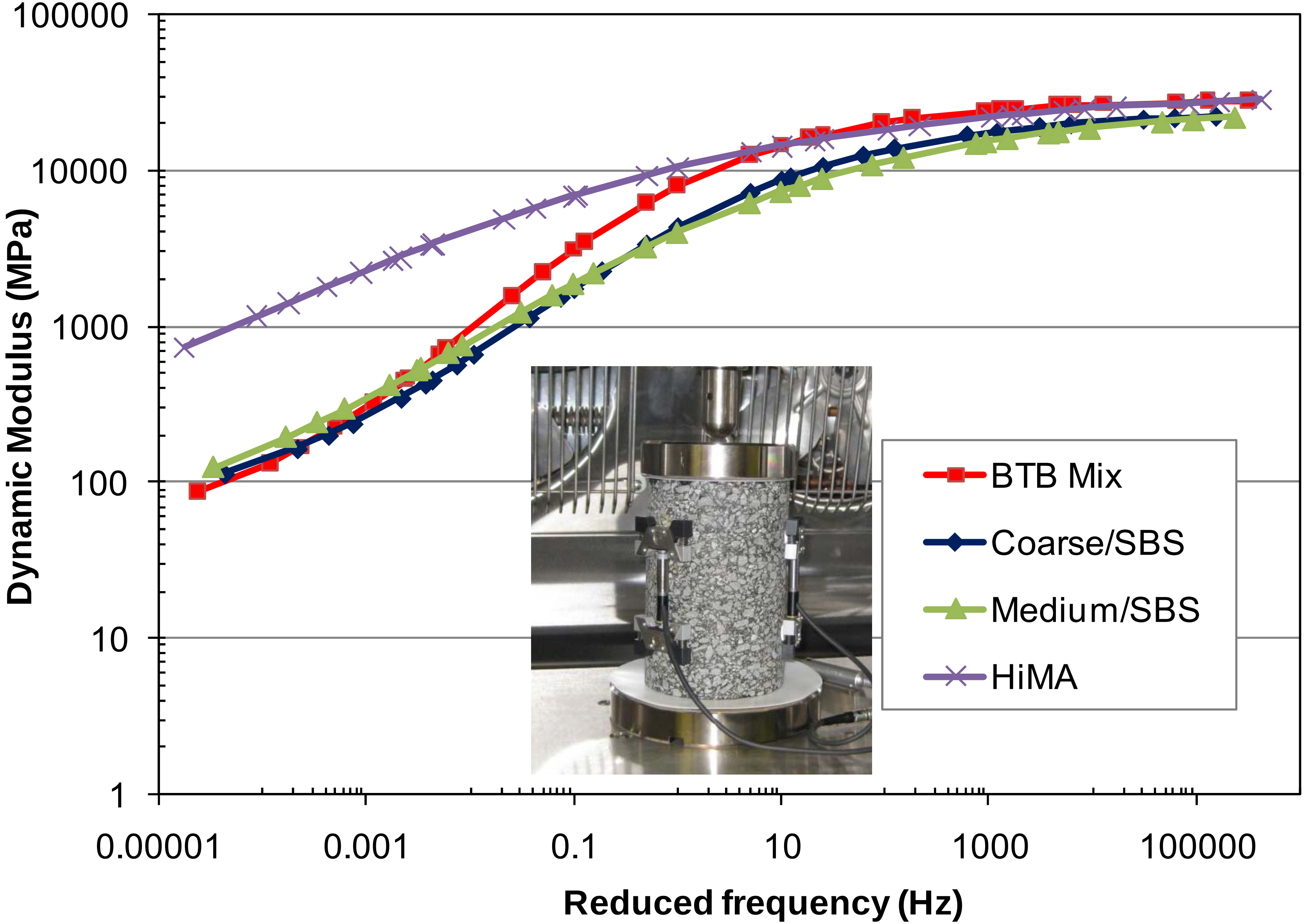
sabita HiMA T^2 progress

- Phase I: Feasibility, completed July 2008
- Phase II: Prelim guidelines mix design and structural design
  - Task 1: Finalisation mix designs and benchmarking, partially completed. Task had to be revised after French mix design failed to make specs.
  - Task 2: Structural design and cost comparisons, ongoing
  - Task 3: Experimental design for phase 3, ongoing
- Tests feed into SANRAL revision of SAPDM project

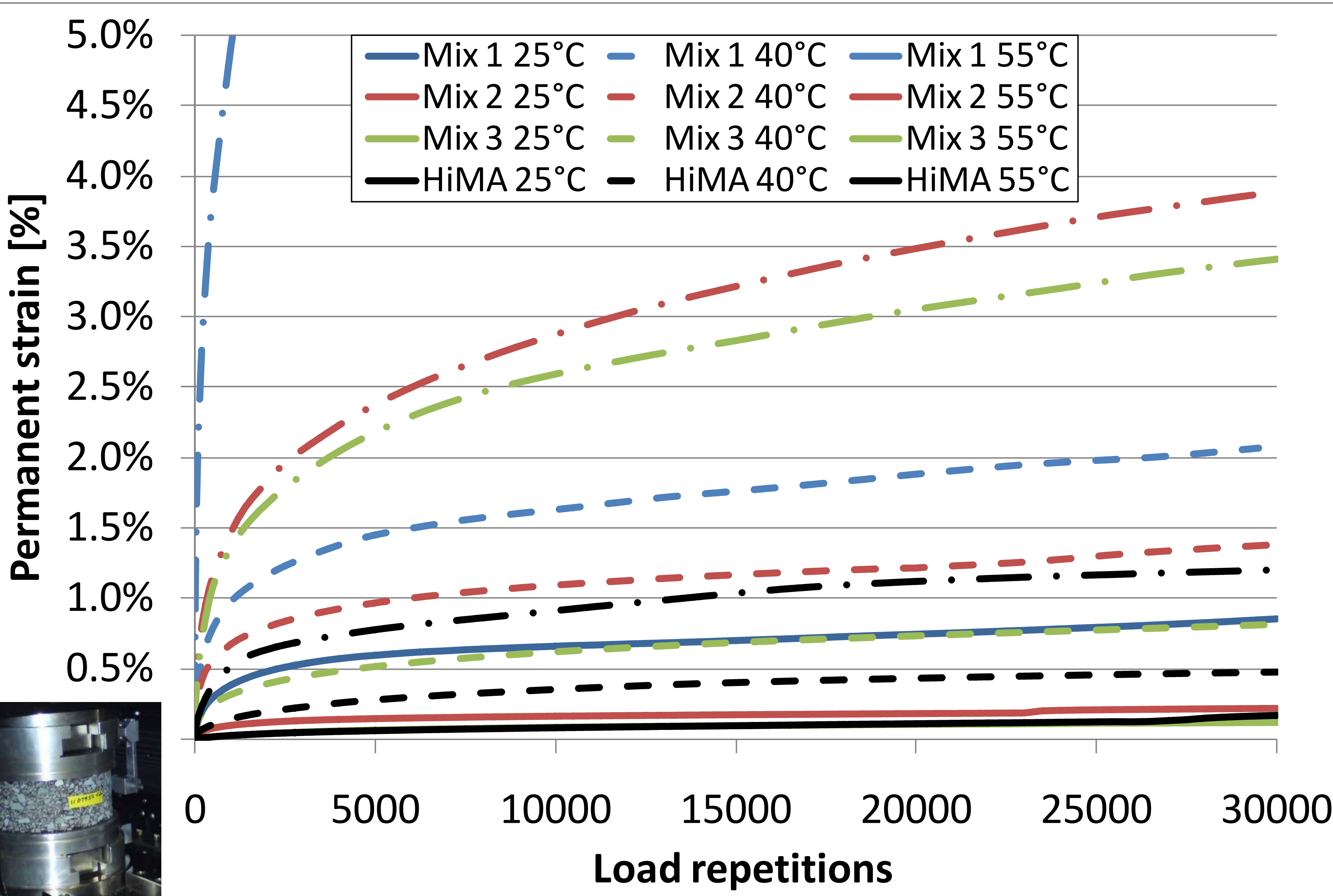
Master curve development



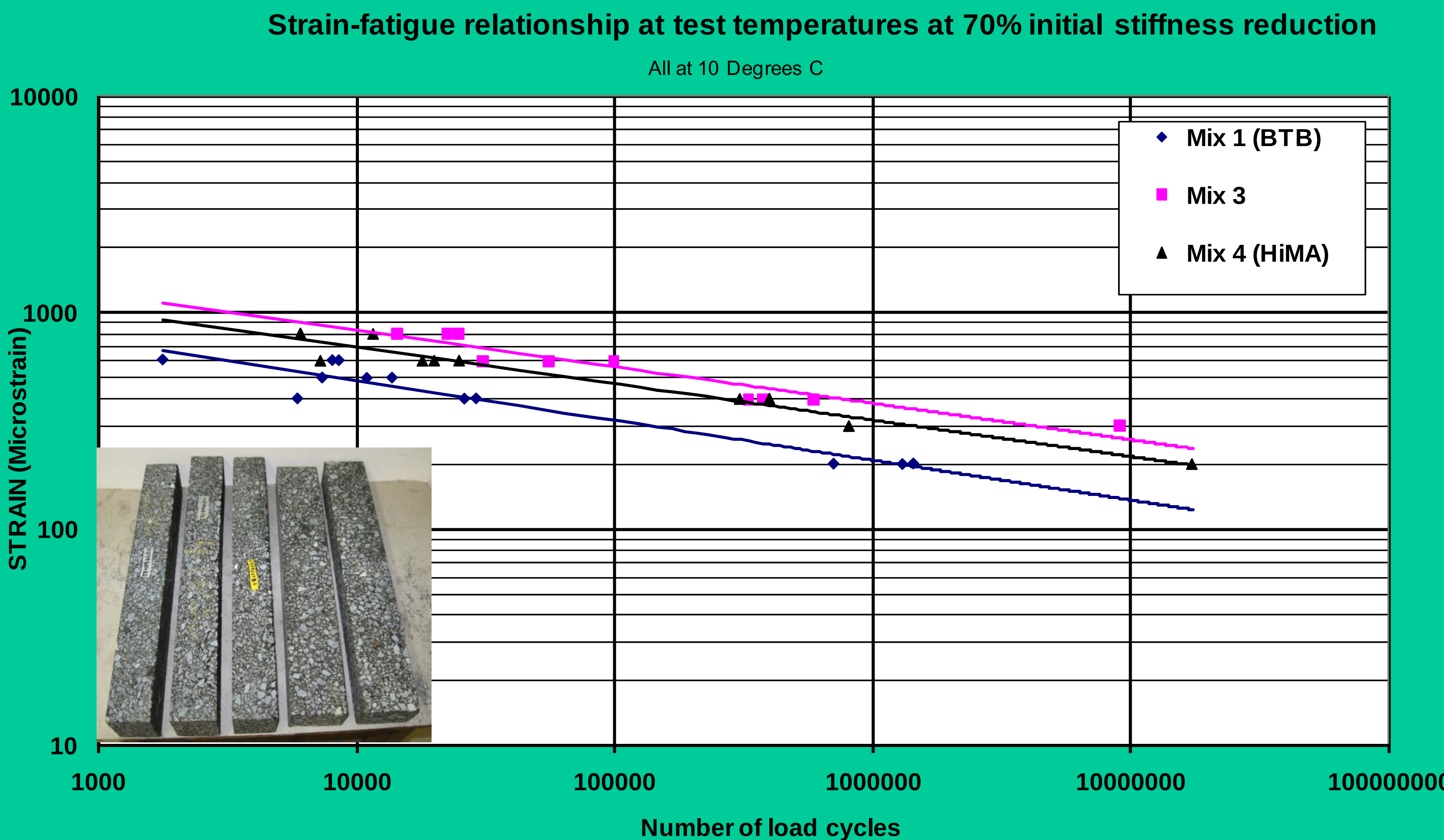
Comparison of mix moduli



Permanent deformation (RSST-CH)



Fatigue results (10 °C 25 Hz)



French mix design effort

Parameter	Requirement	Result	SA equivalent test
Workability (Gyratory compactor)	Max 6% voids after 100 gyrations	5.7 %	Gyratory
Durability (Duriez test)	Retained strength: >0.7	0.9	Modified Lottmann
Rutting (Wheel tracker)	Rut depth after 30 000 cycles <7.5 mm	5.2 mm	RSST-CH, Wheel tracking
Beam dynamic modulus	15 °C-10 Hz: >14 GPa	17 GPa	Beam or cylinder dynamic modulus
Fatigue (Prism)	με for 10^6 fatigue life: >130	90 με	Beam fatigue

Binder specifications

Property	Result	Test method	Specification
Before RTFOT			
Penetration @ 25□, 10^{-1}mm	25 ± 1	ASTM D5	(20-30) (15-25)
Softening point, R&B, °C	62.8	ASTM D36	(55-63) (55-71)
Dynamic Viscosity @ 60°C, Pas	2713.0	ASTM D4402	(≥550)
After RTFOT			
Mass change, % (m/m)	±0.061	ASTM D2872	(±0.5) (≤0.5)
Softening point, R&B, °C Increase	69.2 6.4	ASTM D36	(≥57) (≥ Orig. Min +2)
Penetration @ 25□, 10^{-1}mm % Original	76	ASTM D5	(≥55) (≥55)

Mixing temperature

Binder	Mixing Temperature	TMH1 C2 Recommended viscosity	Temperature at the viscosity	Mixing Temperature Used
HiMA binder	Lower Mixing Temperature	190cSt	172°C	175°C
	Upper Mixing Temperature	150cSt	177°C	

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Mix improvement

- Develop mix that fulfils the requirements for:
  - Workability,
  - Durability,
  - Resistance against permanent deformation,
  - Rutting,
  - Dynamic modulus,
  - Fatigue.
- Use French mix design as benchmark
- Current challenge: Increase VMA to allow more binder and increased fatigue life

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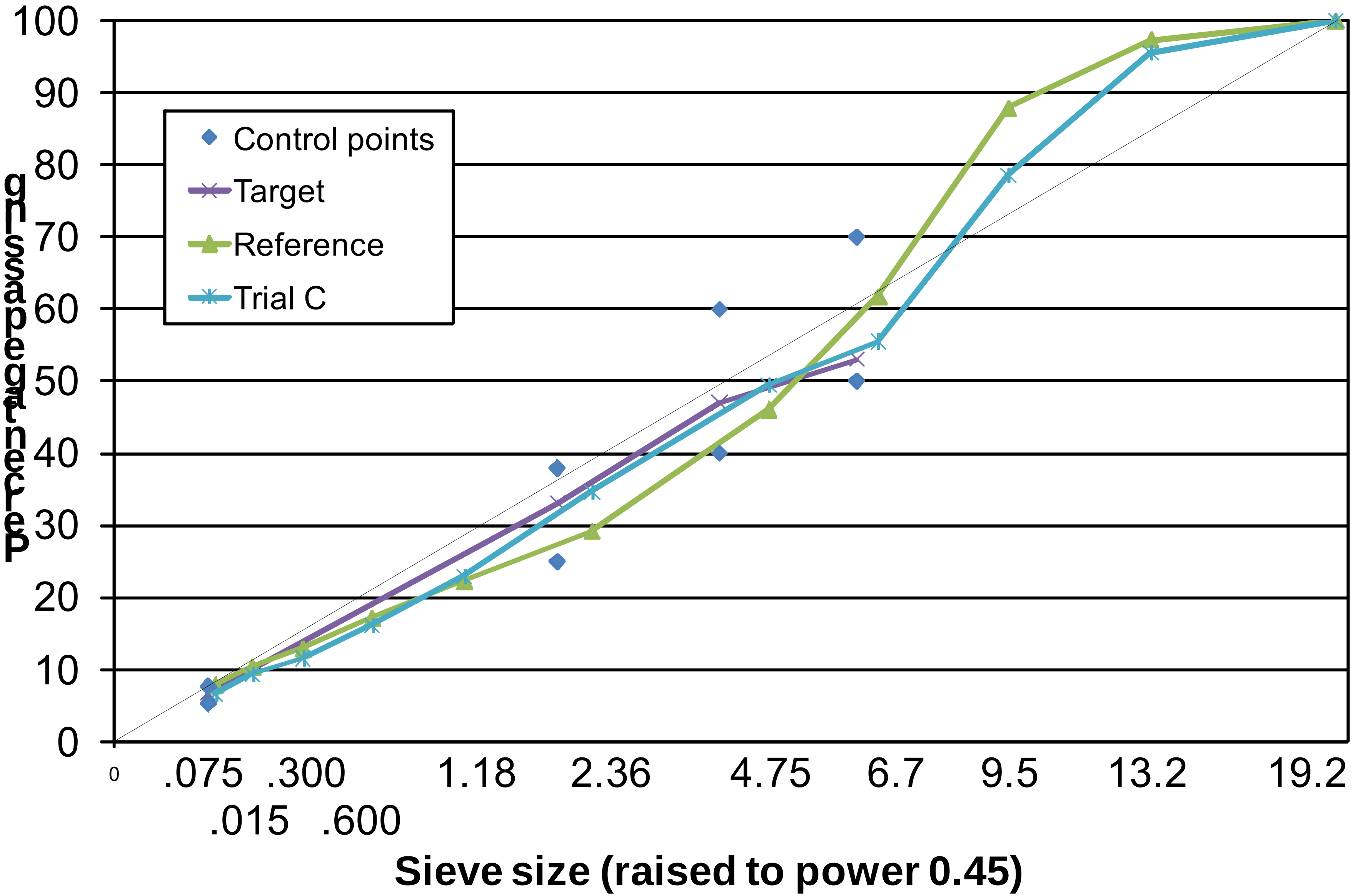
Mix improvement

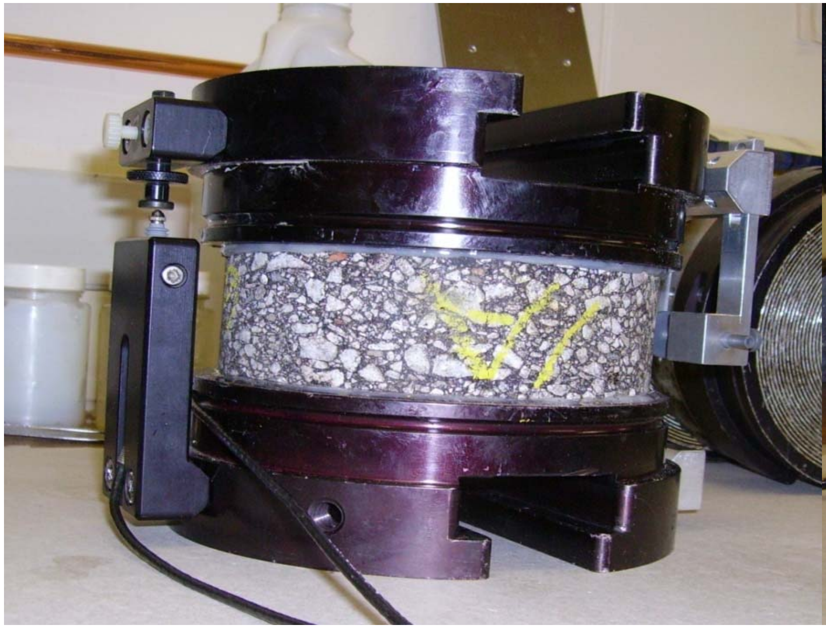


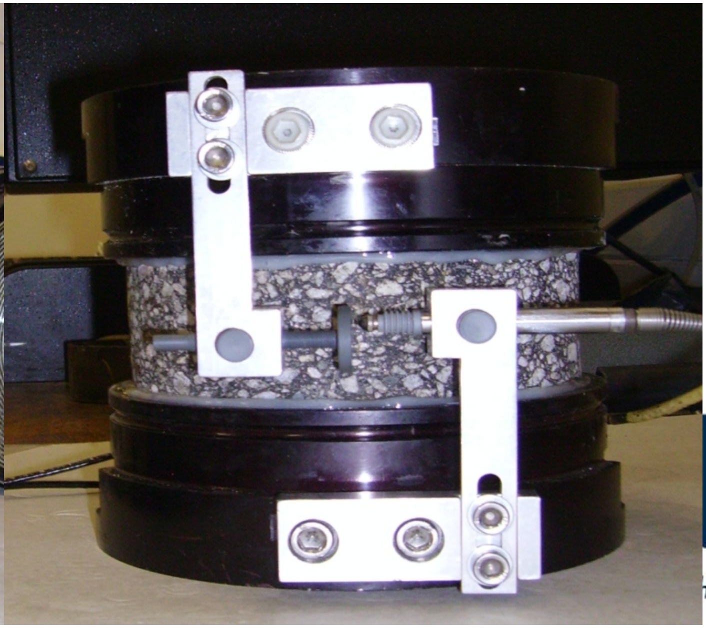
Structural design

- Short term: Use French philosophy i.e. design such that strains in pavement remain below threshold.
- Medium term: Develop shift functions from APT trials.

Way forward:

- Improve mix design
- Complete preliminary mix design and structural design guideline,
- Perform APT and LTPP,
- Finalize mix design and structural design guidelines





Thank you

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