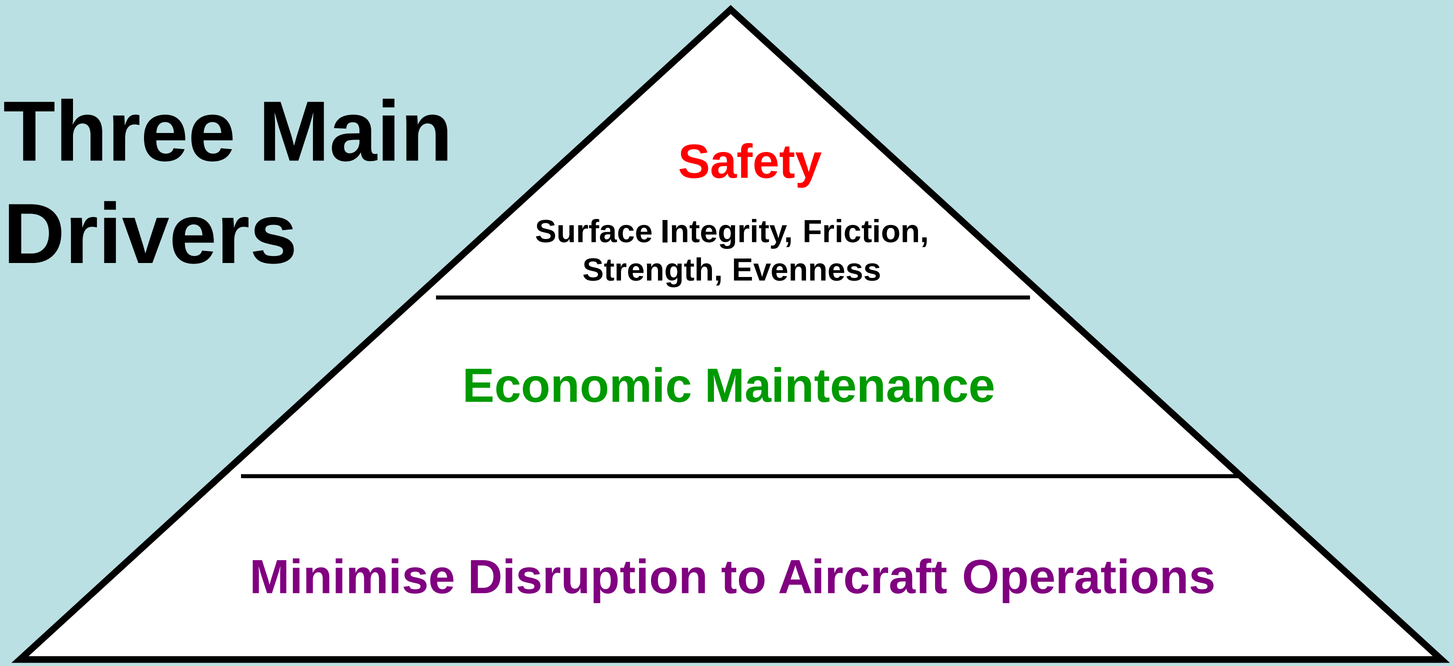
Airfield Pavements

JOHN COOK – Defence Infrastructure Organisation

Airfield Pavement Management

Three Main Drivers



Surface Integrity

Runway Friction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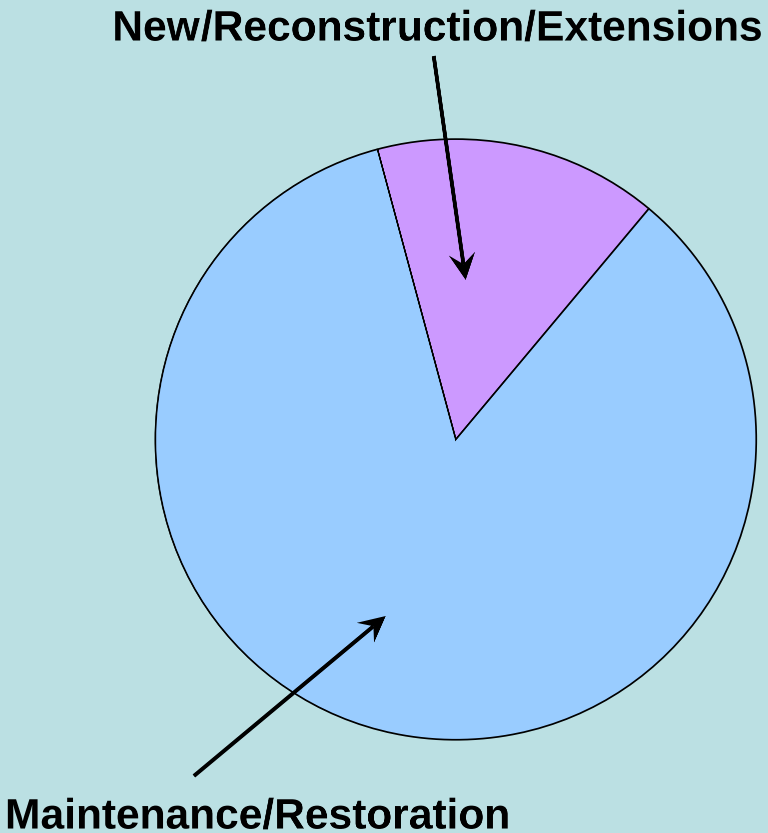
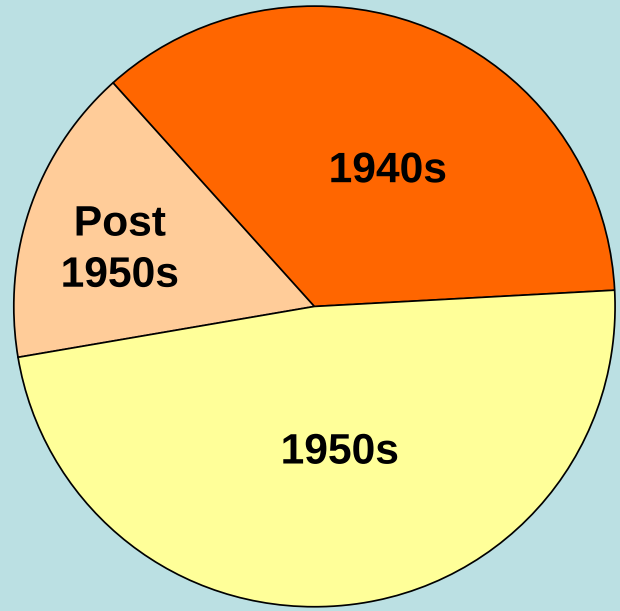
Delivering Estate Solutions to Defence Needs



Cost Split - Maintenance/Restoration and New Works 1990-2000



Age of Airfield Pavement Sub Structures

CHALLENGES

- Balancing Maintenance and Funding
- Increased Trafficking
- Higher Rates of Wear and Fatigue
- Limited Access for Technical Surveys/Tests and Maintenance

Some Key Initiatives In respect of Use of Asphalt on MOD Airfields Aimed at Addressing These Challenges

- Use of PMBs in asphalt surfaces to improve performance – VFM - Standard Specification plus additional ‘end performance’ test methods
- Use of proprietary spray treatments to extend lives of asphalt surface runways
- For major restoration – recycle existing pavement

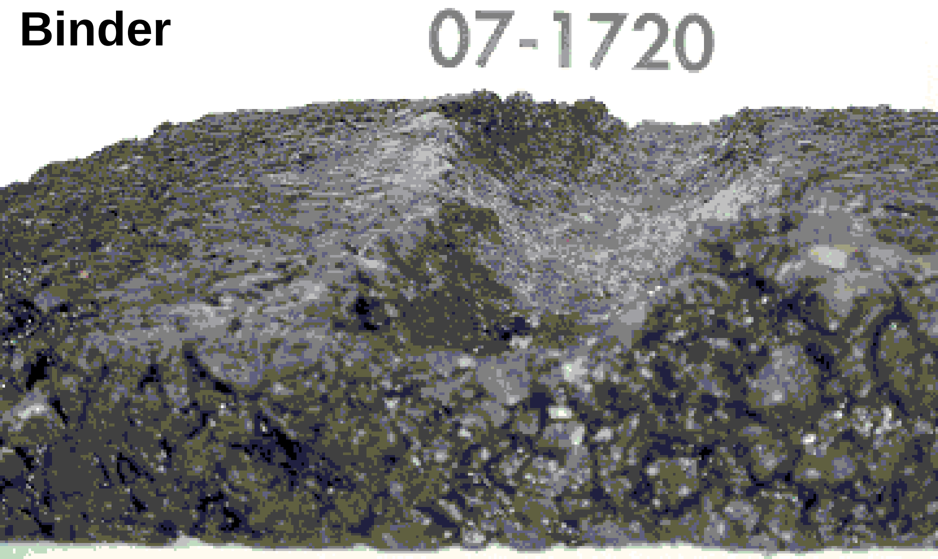
Use Of PMBs In Asphalt Mixes

- Our Specifications for asphalt mix design don’t effectively discriminate between use of standard grade binders and PMBs – new Tests Methods needed:-

- Resistance to cold temperature cracking

- Resistance to surface shear/scuffing at medium/high temperatures

Porous Friction Course – Unmodified Binder

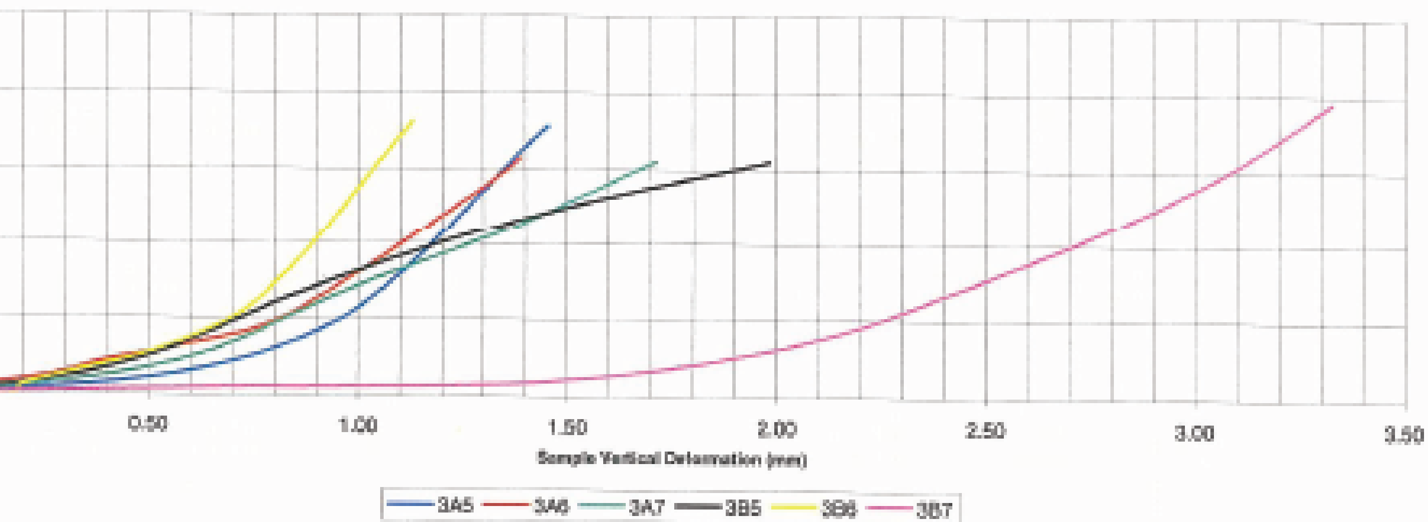


Porous Friction Course – Modified binder

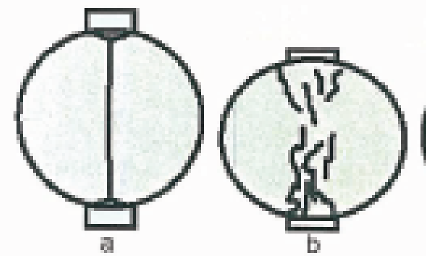
: DOOM141
: CR9/016D+H
: Laboratory manufactured

Date : 19-Feb-10
Tested by : GW
Laboratory : Scott Wilson, Nottingha

Sample ID	Test Temperature (°C)	Bulk Density (kg/m³)	Thickness (mm)	Diameter (mm)	Peak Load (kN)	ITST (GPa)	Failure Mode	Broken Aggregate
Mix A (160/220) AGED								
3A5	-18.0	2067	64.7	99.8	17.9	1.76E-03	a	Yes
3A6	-18.0	2074	64.7	99.8	15.8	1.55E-03	a	Yes
3A7	-18.0	2068	64.8	99.8	15.5	1.53E-03	a	Yes
Mix B (PMB) without HL AGED								
3B5	-18.0	2066	64.8	99.8	15.6	1.53E-03	a	Yes
3B6	-18.0	2072	64.8	99.9	18.1	1.78E-03	a	Yes
3B7	-18.0	2068	64.8	99.9	19.6	1.93E-03	a	Yes



* Failure Types
a:- clear tensile break
b:- deformation
c:- combination



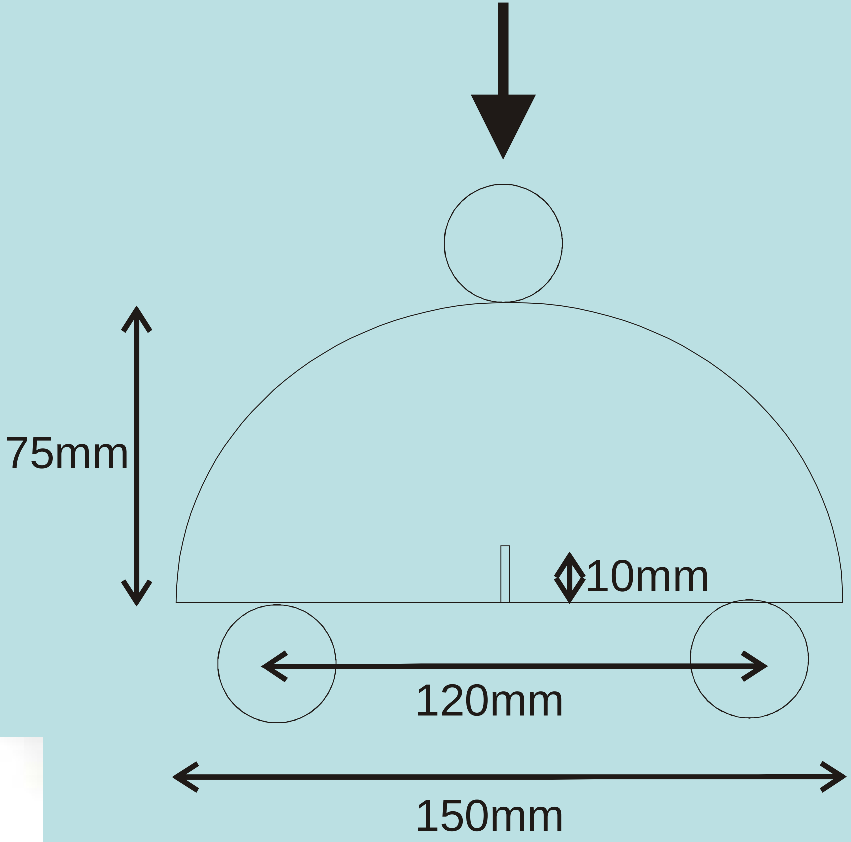
$$ITST = \frac{2P}{\pi DH}$$

ITS = Indirect Tensile Strength (GPa)
P = Peak Load (kN)
D = Specimen Diameter (mm)
H = Specimen Thickness (mm)

a: - "clear tensile break" - Specimen clearly broken along a diametrical line, except perhaps for small triangular sections close to the loading strips -
b: - "deformation" - Specimen without a clearly visible tensile break line -
c: - "combination" - Specimen with a limited tensile break line and larger deformed areas close to the loading strips -

Aged samples (ageing was carried out in accordance with Appendix A.12 of BBA HAPAS Doc SG3/08/256).

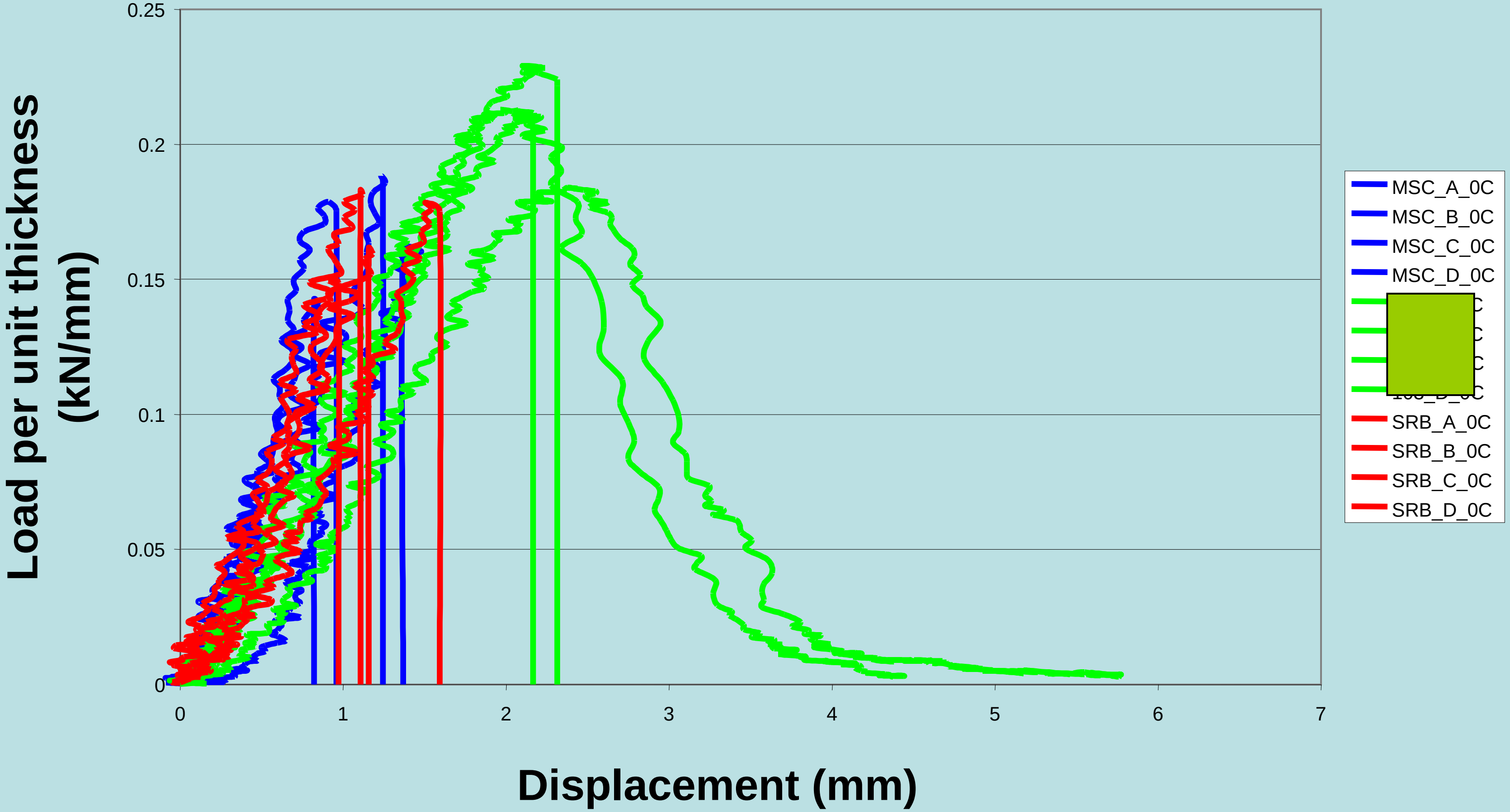
Date Checked :



Semi Circular Bending Test

EN 12697-44 (Crack Propagation)

prEN12697-44 : Crack propagation by semi-circular bending test (test performed at 0C)



Tentative Conclusions – Use of PMBs in Asphalt for Airfield Pavements

- **Porous Friction Course with PMB – 2 runways resurfaced – 2007 and 2010**

  Scuffing Test (TRL Report 176) highlights a substantial improvement in integrity and robustness that can be provided by a suitable PMB.

  To retain ductility and durability - Use of EN 12697-23 (ITST) to determine Deformation at Break - ITVD (Indirect Tensile Vertical Deformation) after ageing -test at –18^{0}C Tentative Criteria > 1.3mm

  Torque/Shear/Bond Test ? Possible future criteria.

- **Stone Mastic Asphalt with PMB – 3 taxiways; 1 current runway project.**

  The Torque/Shear/Bond Test has provided a range of values for both straight grade binders and PMBs – probably reflecting the variation in integrity caused by several factors – the binder, the adhesion between binder and aggregates and the surface texture and voids in the mix. Criteria (aged/un-aged) > ? Kpa

  To retain/enhance ductility and durability - Either Displacement at Break (based on EN12687-44) 0r Deformation at Break ITVD (Indirect Tensile Vertical Deformation) after ageing at –18^{0}C > mm ?

- **Marshall Asphalt – limited trials only.**

  Very robust and durable with straight grade binders.

  We could benefit from improved resistance to reflection cracking

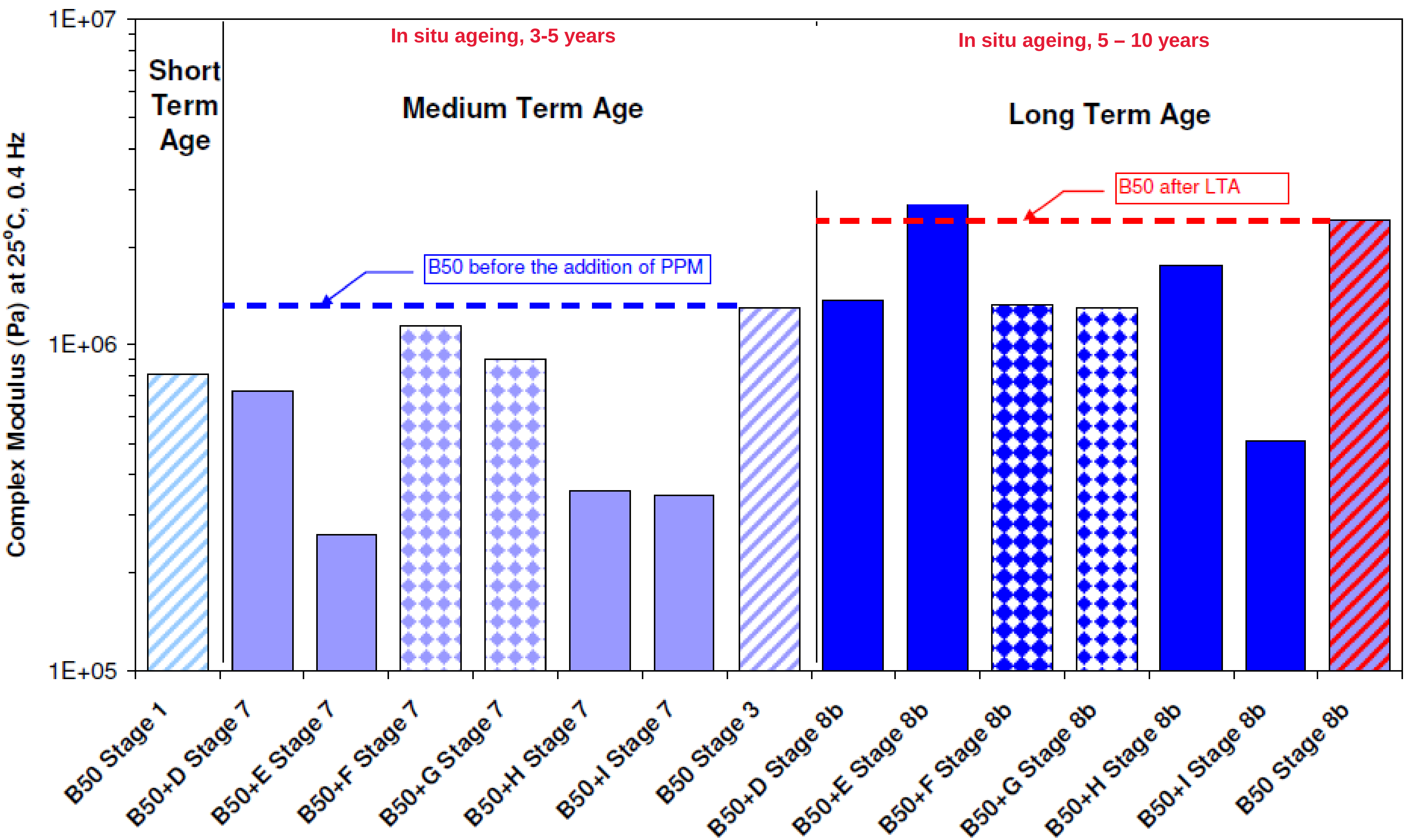
Asphalt Preservatives/Rejuvenators

- Low cost treatment to extend life of asphalt surfaces
- Speed and ease of application of treatment to minimise disruption
- Evaluation – field experience and laboratory testing

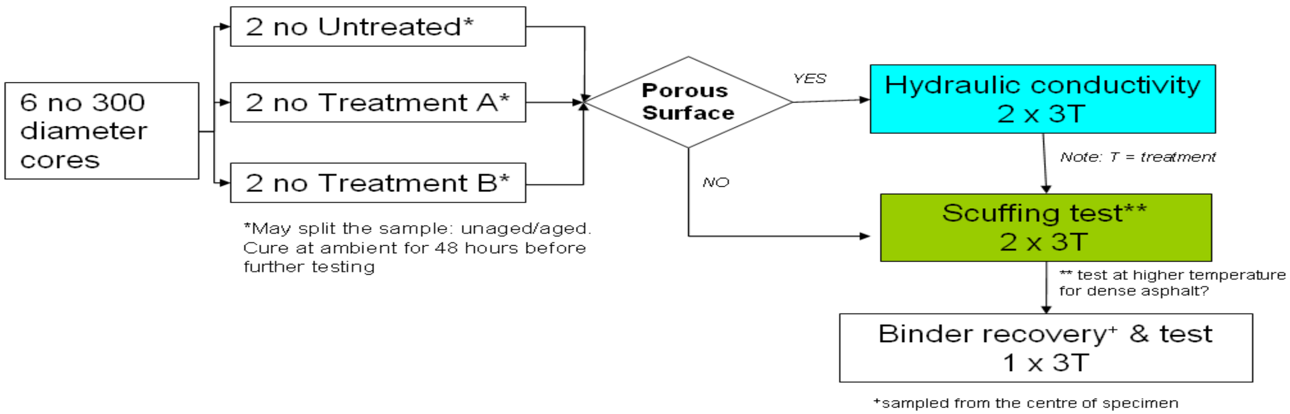
Rejuvenator Spray – Marshall Asphalt

- Application of bitumen emulsion spray
- 1 to 4 hour curing time
- Application of fine dust (<1.5mm)
- Removal of excess dust

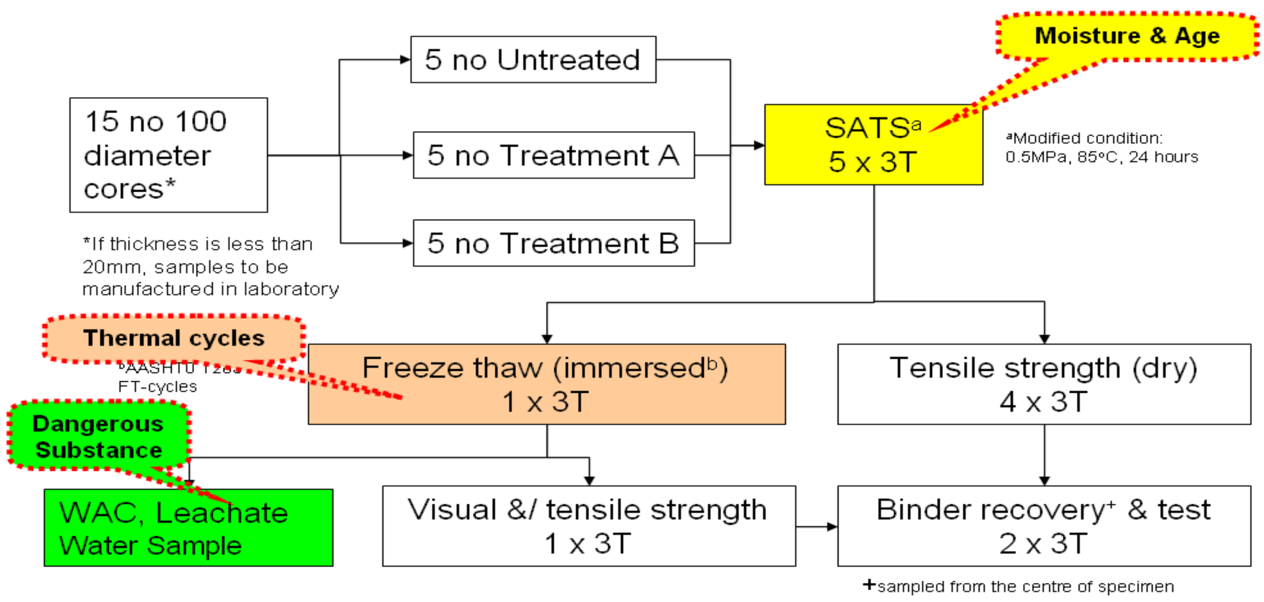

Effectiveness of Asphalt Preservatives/Rejuvenators - Stiffness



Laboratory Testing - Large cores



Laboratory Testing - Small cores



Experience and Tentative Conclusions – Use of Asphalt Preservatives/Rejuvenators

- Successfully used two types of treatments on runways:

  a. One classed as a rejuvenator

  b. One classed as a penetrative preserver
- Treatments have been applied to both Grooved Marshall Asphalt (GMA) and Porous Friction Course (PFC).
- First runway treated over 4 years ago (PFC). Since that time 1 further PFC runway and 4 GMA surfaced runways have been treated.
- Initial results from laboratory testing programme corroborate ‘field experience’.
- More runways earmarked for treatment. Likely in future to become standard practice – reduce whole life cost and disruption.


RAF BENSON
RUNWAY Ch 530
OFFSET 3.8


TOP OF CORE
0.1m
0.2m
0.3m
0.4m
0.5m
0.6m


TOP OF CORE
0.1m
0.2m
0.3m
0.4m
0.5m
0.6m
0.7m

Recycling Existing Pavements - Advantages

- Minimise use of virgin materials
- Reduction of offsite haulage of materials
- Reduction of waist and landfill
- Reduction of carbon dioxide emissions
- Reduction of cost and improved VFM

Sustainability can be defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs

Need to be Aware of Risks

- Design – long term performance
- Mix Design - Quality/Properties of Secondary/recycled aggregates/component materials and mix design - behaviour/performance of the mixed material – structural, susceptibility to fatigue/reflection cracking and durability
- Construction
- Measured approach to development/application of new practices

Foamed Bitumen

- Inject cold water and air into hot bitumen at high pressure
- Foaming bitumen increases volume and reduces viscosity for a short period
- This enables a degree of coating of cold damp aggregate

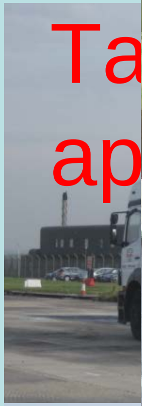
RAF Marham – S Taxiway
Foamix - plant mix details

- Bitumen 3.5%
- Cement 1.8%
- PFA 7.0%
- Water 3.0%

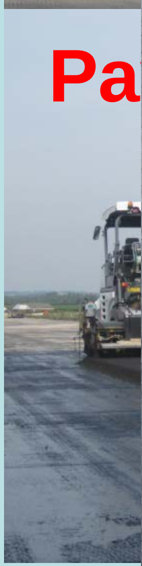
- 0-10mm aggregate 51.0%
- 10-20mm aggregate 34.0%

Foamix site laying

- Ta
  ap

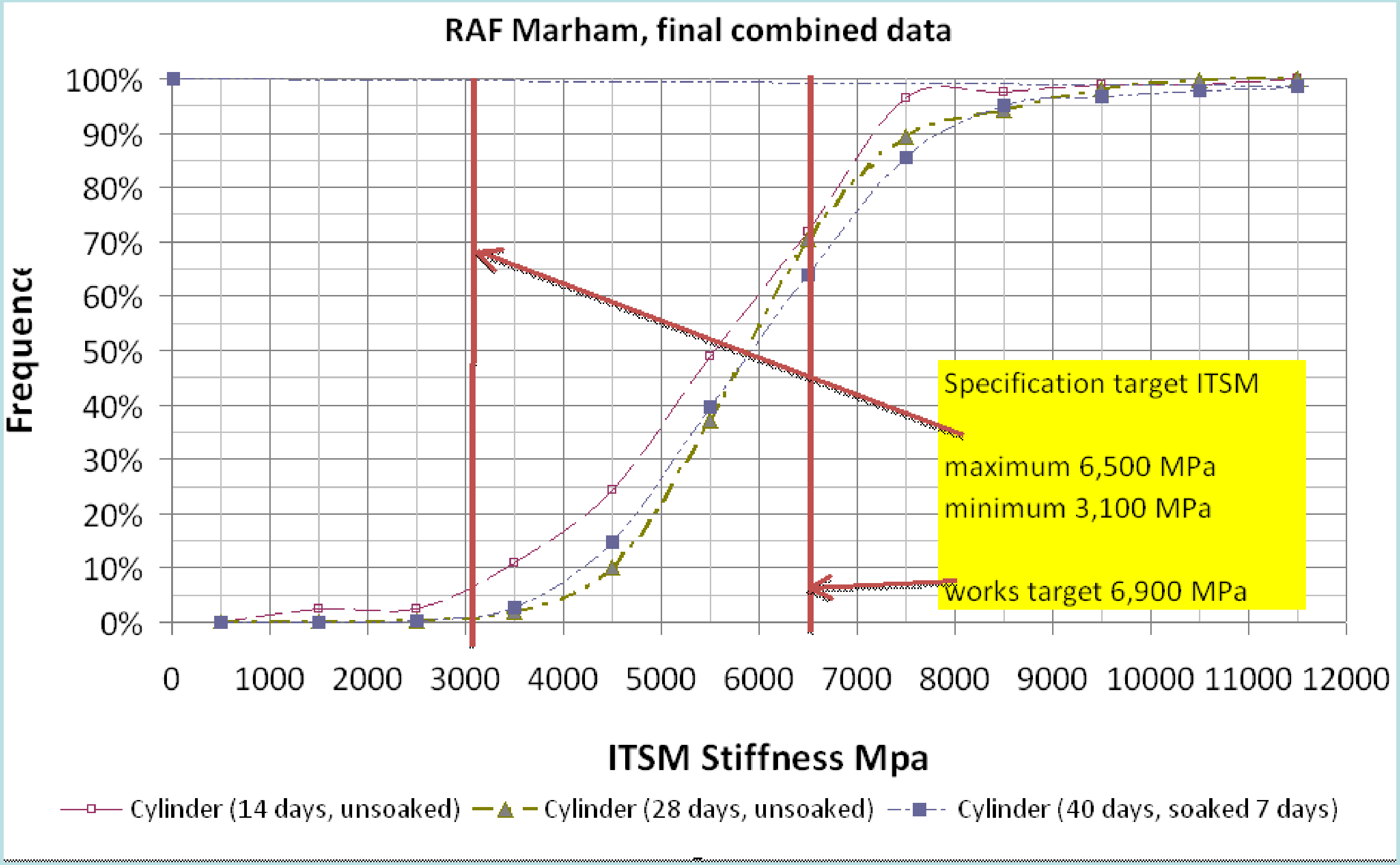


- **Pa**

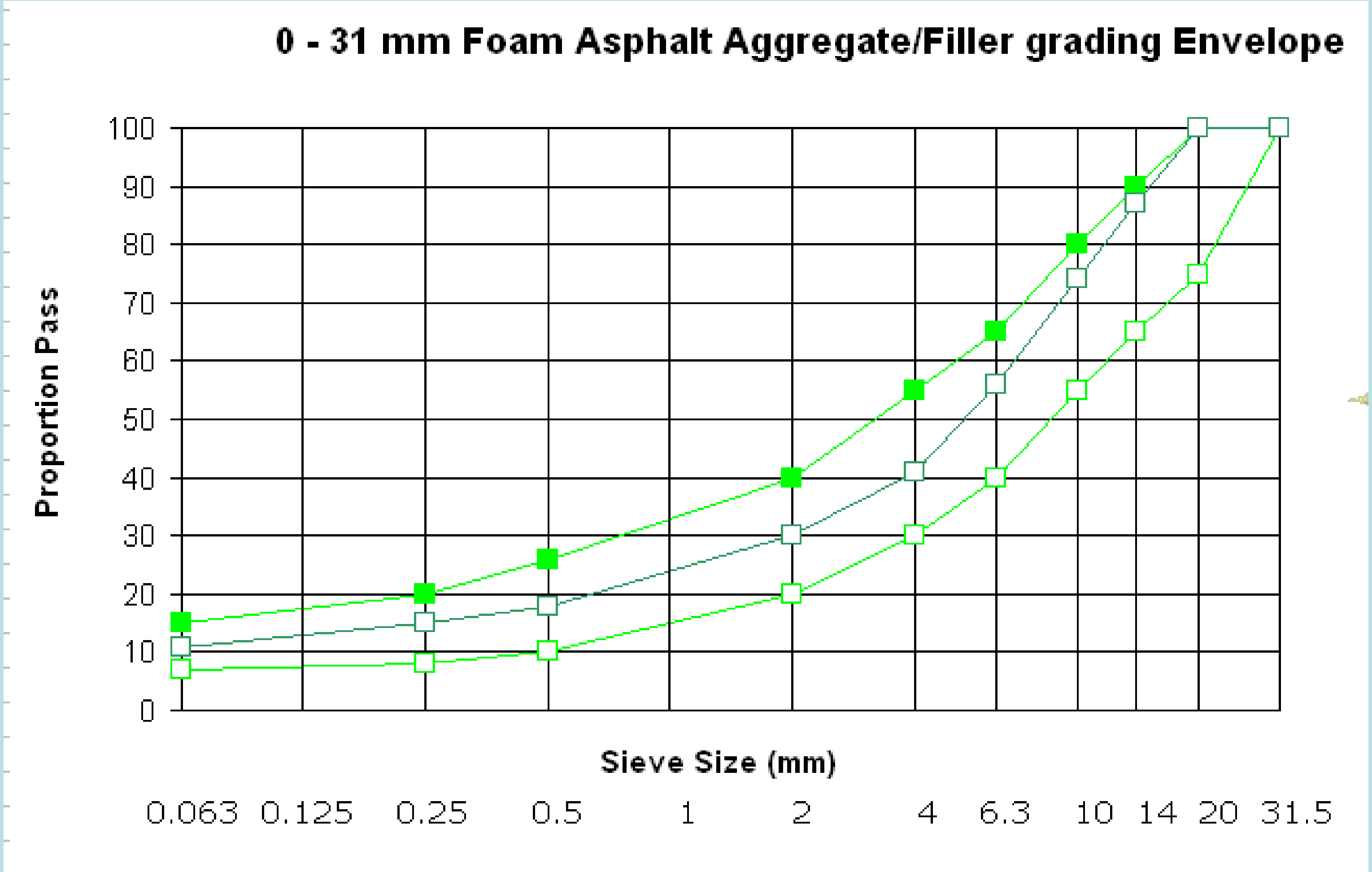


- **The completed, tack coated mat**

Summary of site ITSM testing



Revised Grading Envelope



Findings and Conclusions

- **Inconsistencies with site cored specimens – ie much lower stiffness than cylinder mould samples**
- **At planning stage of a project - core existing pavements for laboratory testing of foam mixes – range of densities.**
- **Construction Trial Area – Densities. Comparison with laboratory results. At least for early projects, dry coring at 14 days plus accelerated curing – ITSM stiffness – soaked/un-soaked - comparison with test data on moulded samples.**
- **Stricter requirements on mix control – limited scope**
- **Long term performance – monitor – future tests**
- **Anticipate future use with recycled tar asphalt planings**
- **Can lay large volumes quickly/continuously**
- **In Project Case Study a considerable cost saving made over conventional asphalt base courses.**
- **In Project Case Study saving in CO2 emissions over conventional asphalt base courses was 60% ie 5000 tons. Also reducing waste, traffic movements and use of new materials/aggregates.**
- **Confident in using on a firm foundation**
- **Low resistance to reflection cracking**
- **Confident in using to within 100mm of surface I.e. min overlay 100mm dense asphalt.**


Thank You
DU Z