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PAVEMENT SUSTAINABILITY AND PERFORMANCE IMPROVEMENT: CASE STUDIES

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Introduction

- From Grooved Marshall Asphalt to Ungrooved Airfield Asphalt Concrete (AC)
- Progress to date – case studies
- Friction characteristics
- Sustainable pavement solutions
- Benefits
- Conclusions

Reasons for using improved materials

- Pressure to maximise runway availability
- Low maintenance
- Better whole life cost
- Sustainability
- Requirements to demonstrate best value

UK airfield asphalt materials

- Grooved Marshall Asphalt surfacing
- Marshall Asphalt binder course
- Dense Bitumen Macadam (AC) binder course/base

French airfield asphalts

- Ungrooved Airfield Asphalt Surfacings
  - BBA (Bétons Bitumineux pour chausées Aeronautiques) surface/binder course

- High Modulus Asphalts
  - BBME (Bétons Bitumineux à Module Elévé) surface course,
  - EME (Enrobé à Module Elévé) binder course/base

BBA classification

- Four types

Type	Average Thickness (mm)	Minimum thickness at any point (mm)
Continuously graded – 0/10 (AC 10-BBA C)	60 - 70	40
Continuously graded – 0/14 (AC 14-BBA C)	70 – 90	50
Gap-graded 0/10 (AC 10-BBA D)	40 – 50	30
Gap-graded 0/14 (AC 14-BBA D)	50 - 70	40

- Three classes: 1, 2 and 3 depending upon the Performance Levels

Fre

- BBA su
- French National Standards
- Track records > 25 years
- n

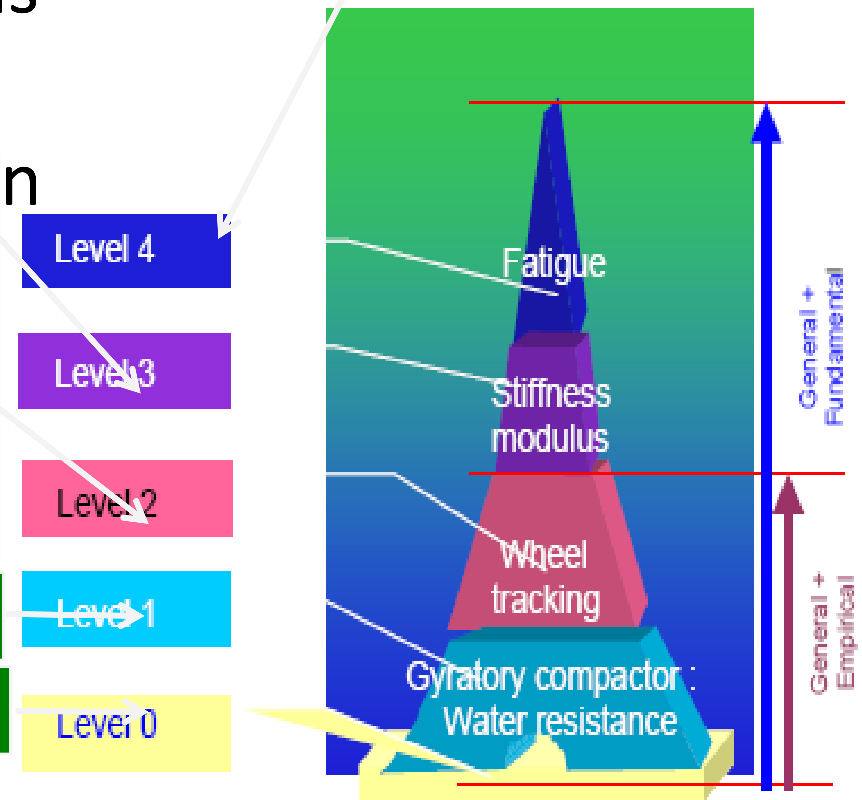
applies to base, binder and surface course mixes when the determination of the stiffness of the mix is required for pavement design purposes

carried out for heavily trafficked pavements, for mixes used in base layers of new pavements or of overlays in relation to pavement design

for surface and binder or base courses that will be subjected to high traffic of heavy aircraft and includes a verification of the resistance to rutting with the wheel-tracking rut tester

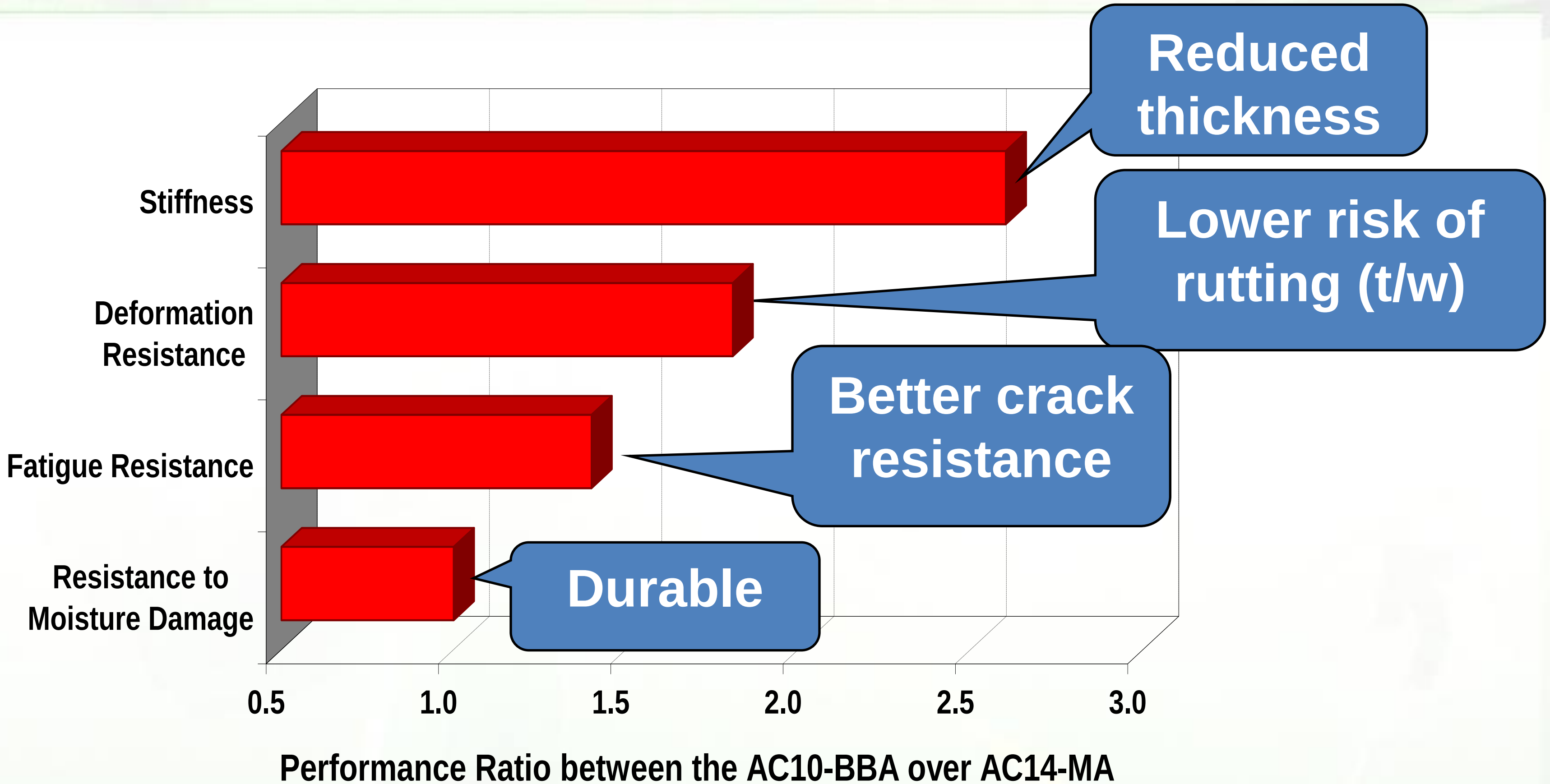
mandatory in every case

recipe mix for non-traffic area only



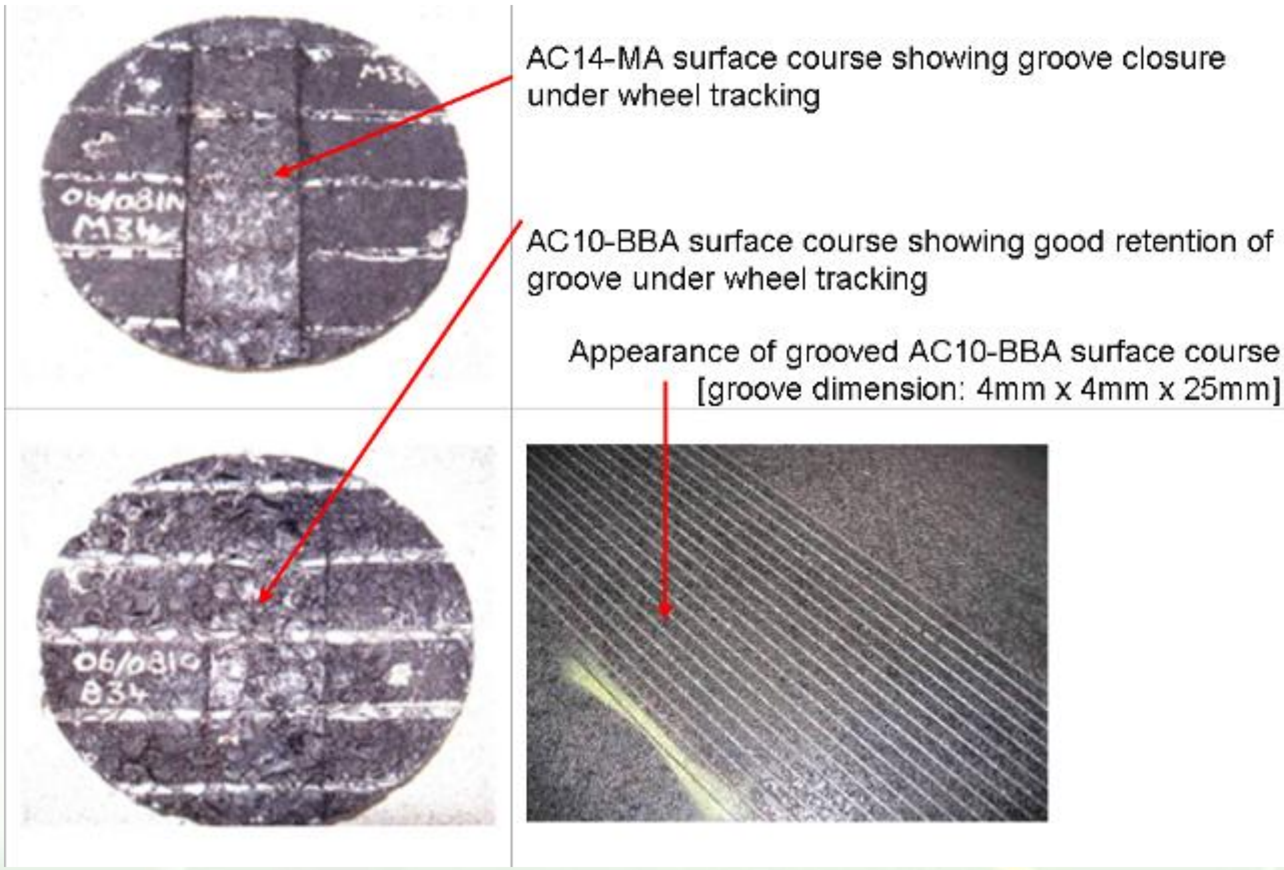
Source: LPC Bituminous Mixtures Design Guide

BBA vs MA Surfacing

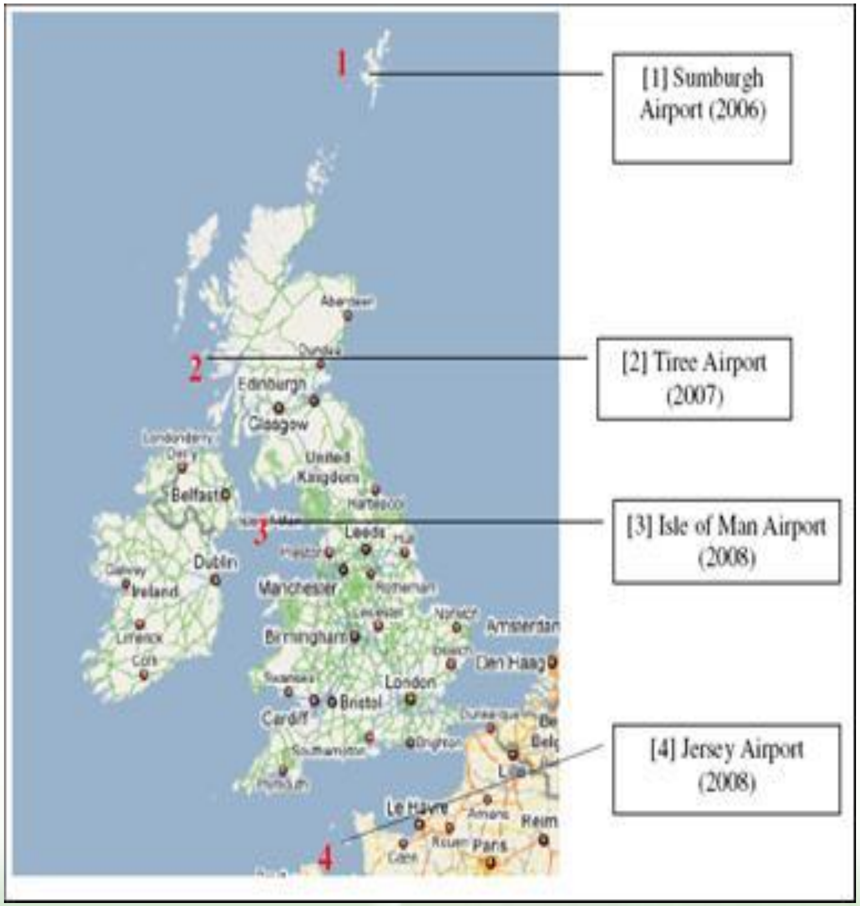


BBA has better stiffness, fatigue, deformation, durability and stability to receive grooving than MA

Groove Retention

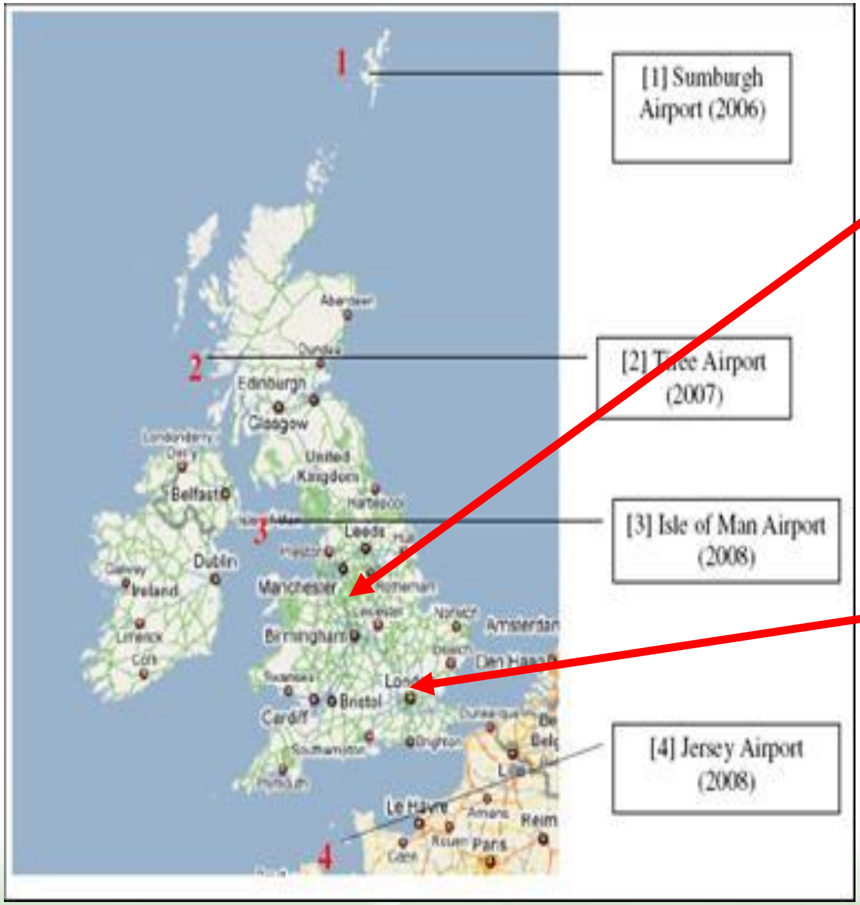


Grooved "BBA"



- All surfaced with grooved 0/10mm BBA (*AC 10-BBA*)
- The use of 0/14mm BBA (*AC 10-BBA*) as enhanced binder course
- Use of local and RAP materials

Ungrooved BBA



- July/August 2011: ungrooved 0/14mm BBA (AC 14-BBA D) surface course at Manchester International Airport
- March 2011: ungrooved 0/14mm BBA (AC 14-BBA D) surface course and binder course at London Southend Airport

Surface Characteristics

- Texture depth
  - Minimum average texture depth of 1mm (ICAO and CAP168 of CAA)
  - Minimum texture depth of 0.6mm on runways for 90% of the zones tested (AFNOR, 1999)
- Wet friction characteristics
  - Using Continuous Friction Measurement Equipment (CFME), such as Mu-Meter, Grip Tester and IMAG.

Continuous Friction Measuring Equipment	Minimum Design Objective Level (DOL)		Maintenance Planning Level (MPL)		Minimum Friction Level (MFL)	
	CAA	ICAO	CAA	ICAO	CAA	ICAO
Mu-meter	0.72	0.72	0.57	0.52	0.50	0.42
Grip Tester	0.80	0.74	0.63	0.53	0.55	0.43

Note: CAA specifies water depth of 0.5mm and 0.25mm for the wet friction assessment using Mu-meter and Grip Tester respectively, whilst ICAO specifies water depth of 1mm for these tests.

European Friction Measurement

- Skid resistance – ICAO Annex 14, Vol1, Supplement A, Chapter7

Measuring apparatus	Speed of test in km/h	Nominal level for new runway surfaces
Skidometre BV 11	65	0.82
	95	0.74
IMAG	65	0.53
	95	0.44
ADHERA	65	0.45
	95	0.34

Classification

- According to JAR OPS 1, ***paved runways which have been specially prepared with grooves or porous pavement may be considered as having "effectively dry" braking action even when moisture is present, but provided that it is not contaminated*** (i.e. no WATER PATCHES or FLOODED).

But:

- **How Many Grooves?**
- **What Size?**
- **What Spacing?**

TTURL [CAP 781]

3.1.5 Temporary Total Ungrooved Runway Length (TTURL)

Once renewal of the surface course has started a three-part method of shift working may be employed:

1 Planing-off

2 Laying

3 Grooving (if required)

Decisions that can affect aircraft safety will have been made during planning and it is important that the accountable manager ensures no deviation from plan and those nightly targets are met in full.

Laying new material follows removal of the surface course, which is usually done by planing-off. If Marshall Asphalt is specified this is delivered hot and rolled into place. Because of the time taken to cure, grooving cannot generally start for at least 72 hours thereafter.

A decision about temporary total ungrooved runway length (TTURL) has therefore to be made. An arbitrary figure based on asphalt batch production and laying speed may not meet the operational requirement if the runway is to be returned to service after each night shift. 100m of TTURL on a 3km long runway will have less significance than on one 1100m long so there should be a balance against declared distances available. It should also be borne in mind that more than one area can be ungrooved over the full runway length.

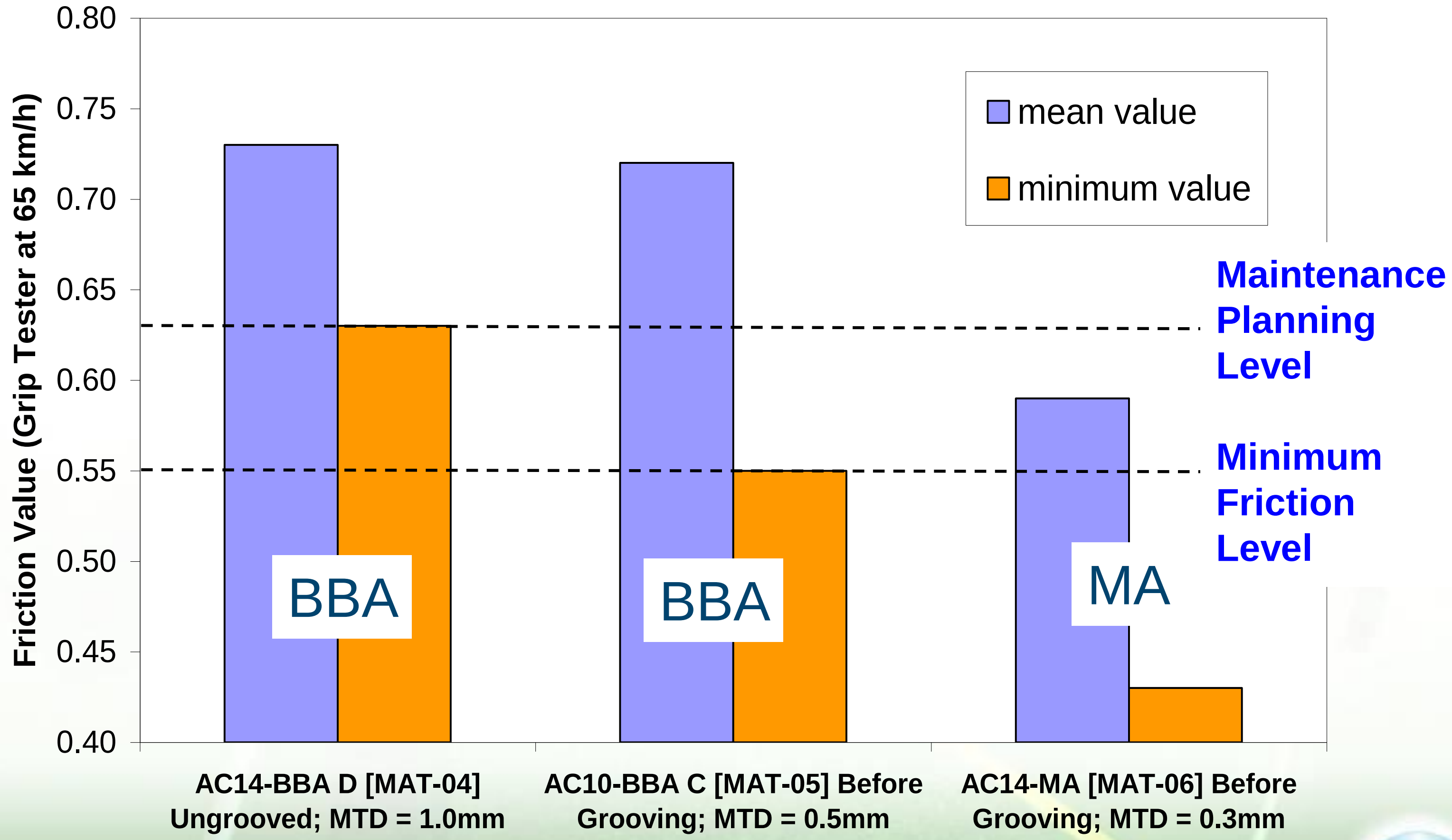
Class and type of BBA materials

Material ID	MAT-01	MAT-02	MAT-03	MAT-04	MAT-05
Mix	AC10-BBA D	AC10-BBA D	AC10-BBA C	AC14-BBA D	AC10-BBA C
Nominal Aggregate Size	0/10mm	0/10mm	0/10mm	0/14mm	0/10mm
Type of Grading	Discontinuous	Discontinuous	Continuous	Discontinuous	Continuous
Layer	Surface Course	Surface Course	Surface Course	Binder Course	Surface Course
Binder	Pen 40/60$^+$	Pen 40/60$^+$	Colflex N	Pen 35/50$^+$	Colflex N
Class	3	3	3	2	2
Design Level	3	2	3	3	3
Coarse Aggregate PSV	66	58	55 – 60	48	60
Fine Aggregate PSV (parent rock)	66	65	55 – 60	53	48

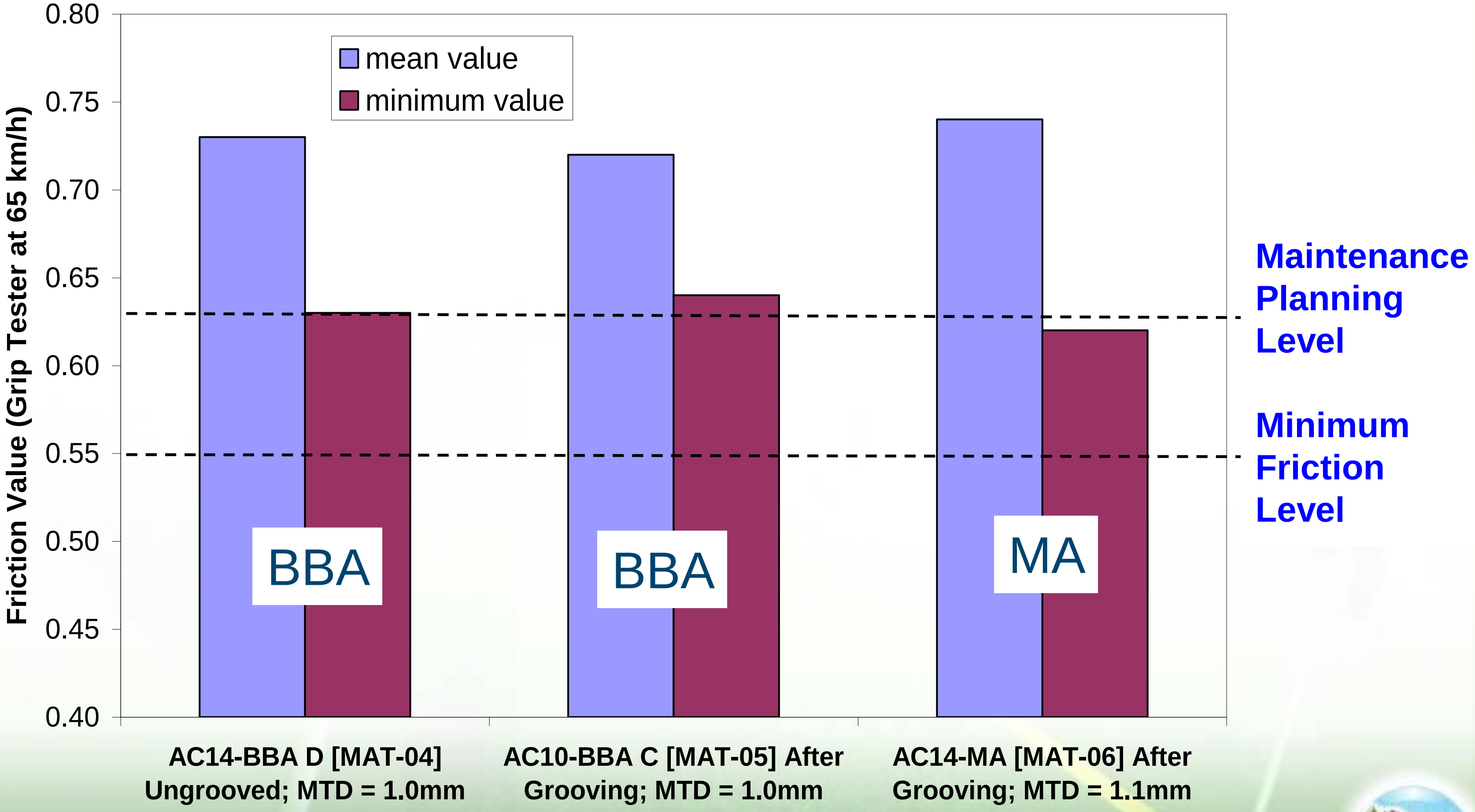
Early Life Surface characteristics

Material ID	MAT-01	MAT-02	MAT-03	MAT-04	MAT-05
Mix	AC10-BBA D	AC10-BBA D	AC10-BBA C	AC14-BBA D	AC10-BBA C
Layer	Surface Course	Surface Course	Surface Course	Binder Course	Surface Course
Mean Texture Depth as Laid	0.8mm	0.6mm	0.5mm	1.0mm	0.5mm
Mean Texture depth after grooving	1.0mm	1.0mm	0.9mm	*see Note	1.0mm
Groove Dimension (mm x mm x mm)	4x4x25	4x4x25	3x3x25	*see Note	4x4x25
Continuous Friction Measurement Equipment	Mu-meter at 0.5mm water depth		Grip Tester at 0.25mm water depth		
Average friction results prior to grooving	Not available	0.63	0.68	0.73	0.72
Average friction results after grooving	0.63	0.66	0.69	*see Note	0.72
CAA CAP 683 Requirements	MFL = 0.50, MPL = 0.57, DOL > 0.72		MFL = 0.55, MPL = 0.63, DOL > 0.80		

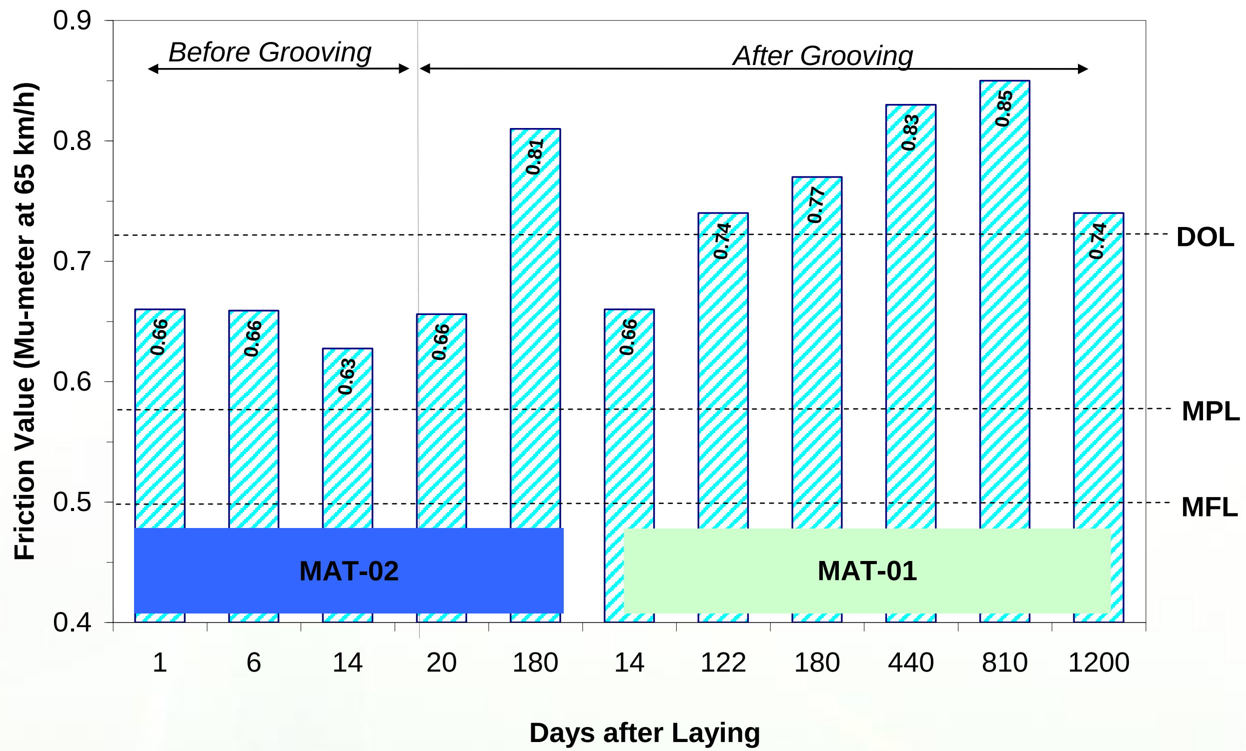
Ungrooved Asphalt Early Life



Ungrooved and Grooved Asphalts Early Life

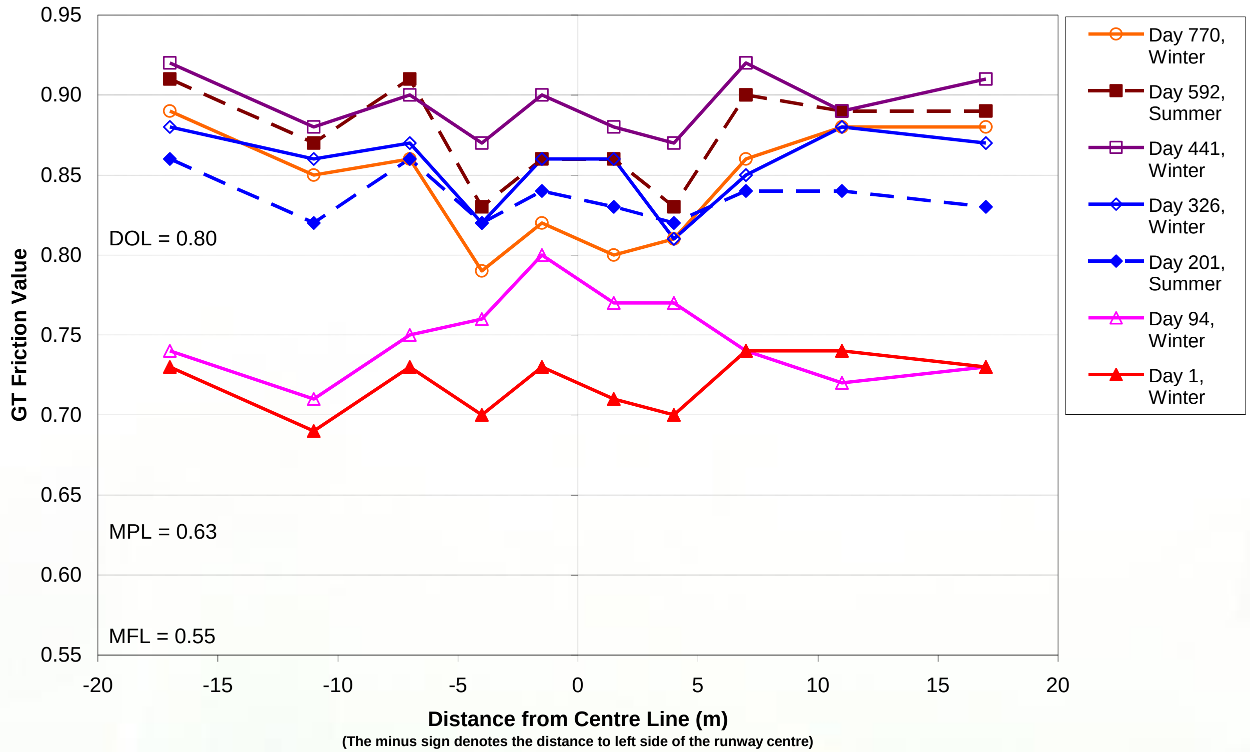


Changes in Friction Value with time



Changes in Friction Value with time, measured by Mu-Meter at water depth of 0.5mm, for MAT-01 and MAT-02 surfacings

Changes in Friction Value with time



Changes in Friction Value with time, measured by Grip Tester, at 0.25mm water depth, MAT-05 surfacing


BE SAFE

Sustainable Pavement Solutions

- Hot Ex Situ Recycling incorporating Reclaimed Asphalt Pavement (RAP)
  - RAP incorporated in BBA binder course and surface course at Jersey Airport
- Repave Hot In Situ Recycling
  - Repave process on taxiways at Isle of Man Airport
- Full Depth Cold In Situ Recycling
  - Deep recycling options adopted at Isle of Man Airport taxiways

Options and Actual Treatments

Taxiway	Conventional Design	Recycling Design	Actual Treatment Performed on Taxiway
Bravo South	No structural treatment required.		Repave 30mm BBA.
Charlie South	Remove 160mm existing pavement materials and replace with 50mm surface course on 110mm HDM binder/base.	Remove 365mm existing pavement materials and replace with 100mm surfacing on 265mm cold recycled H1 HBM material.	Remove 365mm existing pavement materials and replace with 100mm surfacing (comprising 40mm BBA surface course on 60mm HDM binder course) on 265mm cold recycled H1 HBM material.
Delta East			
Delta West			
Echo East	Overlay with 40mm BBA surface course after repairing cracks and defects.	N/A	Repave 30mm BBA.
Echo West			
Foxtrot North	No structural treatment required.		Overlay 45mm BBA.
Foxtrot South	Remove 160mm existing pavement materials and replace with 50mm surface course on 110mm HDM binder/base.	Remove 350mm existing pavement materials and replace with 100mm surfacing on 250mm cold recycled H1 HBM material.	Remove 365mm existing pavement materials and replace with 100mm surfacing (comprising 40mm BBA surface course on 60mm HDM binder course) on 265mm cold recycled H1 HBM material.

Benefits from Sustainable Pavement

- Substantial saving in cost (40%);
- Energy consumption (44%), and;
- Carbon dioxide emissions (32%).

Hakim, B. and Fergusson, C. Sustainable Pavement Construction at the Isle of Man Airport. Asphalt Professional No. 46, November 2010

Conclusions (1)

- Use of BBA for binder course when runways are in temporary condition is advantageous;
- Greater length of Temporary Total Ungrooved Runway Length (TTURL) can be considered when BBA is used;
- Rapid achievement of Design Objective Level (DOL) friction;

Conclusions (2)

- BBA groove stability is not an issue;
- A good comparison can be made between the ungrooved AC 14-BBA D, grooved AC 10-BBA, and grooved AC 14-MA in terms of friction;
- AC 14-BBA D (ungrooved) have now been used in surface course at UK Manchester International and London Southend airports;
- Sustainable pavement solutions can be incorporated and were regarded cost effective.

Thank You !

Experts have warned Brits to prepare for another big freeze this year