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# EARLY LIFE AND IN SERVICE FRICTION CHARACTERISTICS OF RUNWAY SURFACE

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# Introduction

- From Grooved Marshall Asphalt to Ungrooved Airfield Asphalt Concrete
- Friction characteristics
- Early life and in service friction values
- Conclusions

# Why using improved materials

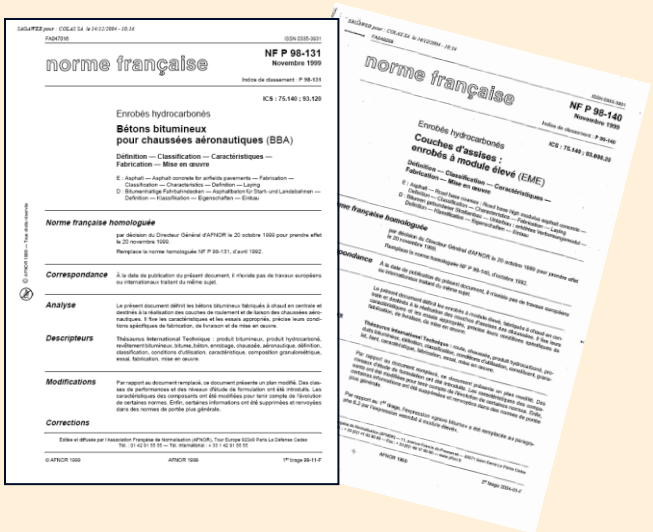
- Pressure to maximise runway availability
- Low maintenance
- Better whole life cost
- Sustainability
- Requirements to demonstrate best value

# UK airfield asphalts

- Grooved Marshall Asphalt surfacing
- Marshall Asphalt binder course
- Dense Macadam binder course/base

# French airfield asphalts

- Bétons Bitumineux pour chausées Aeronautiques (BBA)
- BBA surface and binder course
- Ungrooved
- French National Standards
- Track records > 25 years
- Performance based design


norme française

NF P 98-131
Novembre 1999

Enrobés hydrocarbonés

**Bétons bitumineux pour chaussées aéronautiques** (BBA)

Définition — Classification — Caractéristiques — Fabrication — Mise en œuvre

*Norme française homologuée*

*Correspondance*

*Analyse*

*Descripteurs*

*Modifications*

*Corrections*

norme française

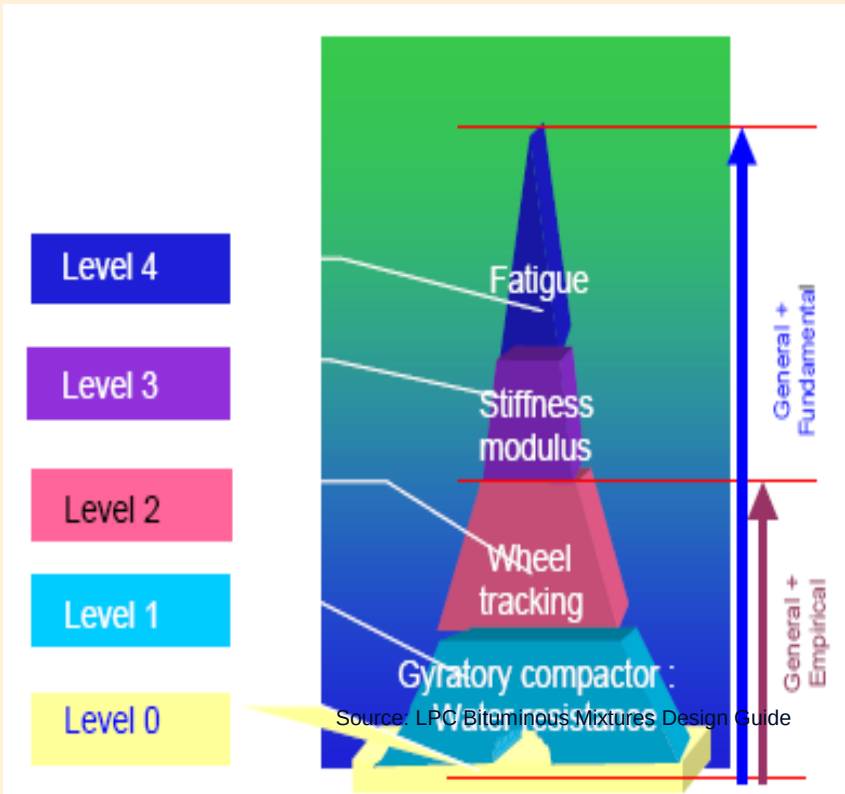
NF P 98-140
Novembre 1999

Enrobés hydrocarbonés

**Couches d'assises : enrobés à module élevé** (EME)

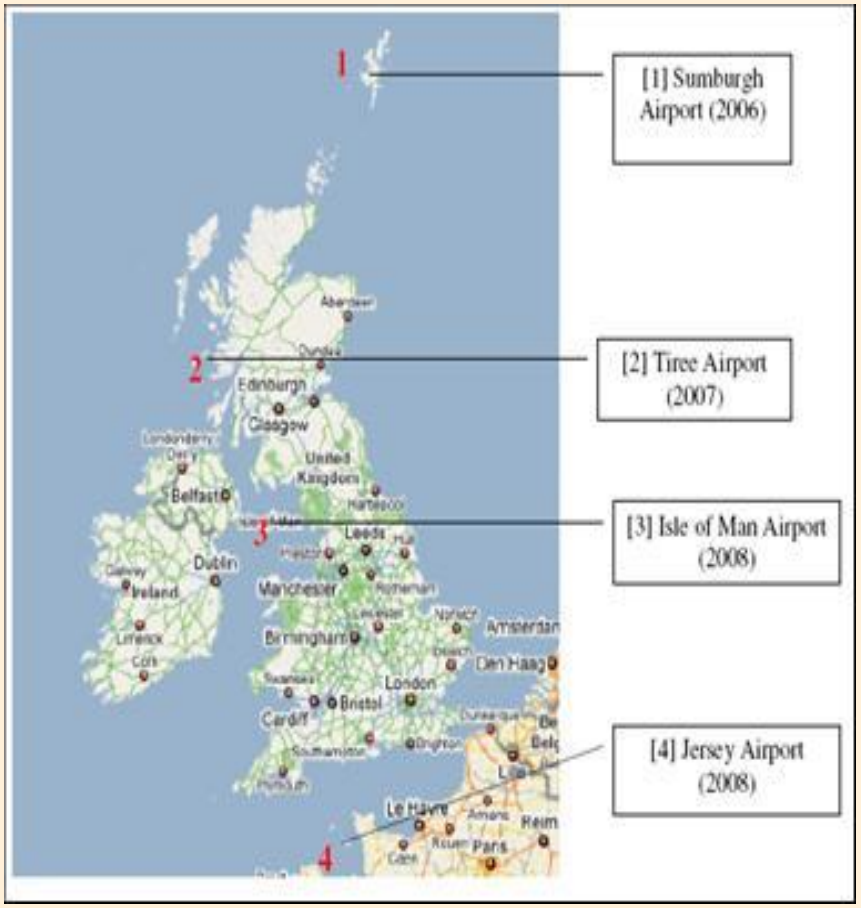
Définition — Classification — Caractéristiques — Fabrication — Mise en œuvre

*Norme française homologuée*




Source: LPC Bituminous Mixtures Design Guide

# 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 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

**……5 years!**

# Class and type of BBAs

| Material ID | MAT-01 | MAT-02 | MAT-03 | MAT-05 | MAT-04 | MAT-07 | MAT-08 | MAT-09 |
|---|---|---|---|---|---|---|---|---|
| Material ID | AC10-BBA D | AC10-BBA D | AC10-BBA C | AC10-BBA C | AC14-BBA D | AC14-BBA D | AC14-BBA D | AC14-BBA D |
| Nominal Aggregate Size | 0/10mm | 0/10mm | 0/10mm | 0/10mm | 0/14mm | 0/14mm | 0/14mm | 0/14mm |
| Type of Grading | D | D | C | C | C | D | D | D |
| Layer | S/C | S/C | S/C | S/C | B/C | S/C | S/C | S/C |
| Binder | Pen 40/60+ | Pen 40/60+ | Colflex N | Colflex N | Pen 35/50+ | Other PMB | Colflex S | Colflex S |
| Class | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| Design Level | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| Coarse Aggregate PSV | 66 | 58 | 55 – 60 | 60 | 48 | 62 | 60 | 62 |
| Fine Aggregate PSV (parent rock) | 66 | 65 | 55 – 60 | 48 | 53 | 62 | 60 | 62 |
| Mean Texture Depth as Laid | 0.8mm | 0.6mm | 0.5mm | 0.5mm | 1.0mm | 1.2mm | 1.3mm | 1.2mm |
| Treatment | Grooved | Grooved | Grooved | Grooved | Not Grooved | Not Grooved | Not Grooved | Not Grooved |
| Mean Texture depth after grooving | 1.0mm | 1.0mm | 0.9mm | 1.0mm | n/a | n/a | n/a | n/a |

# 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.

# TTURL [CAA 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.

# 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).**

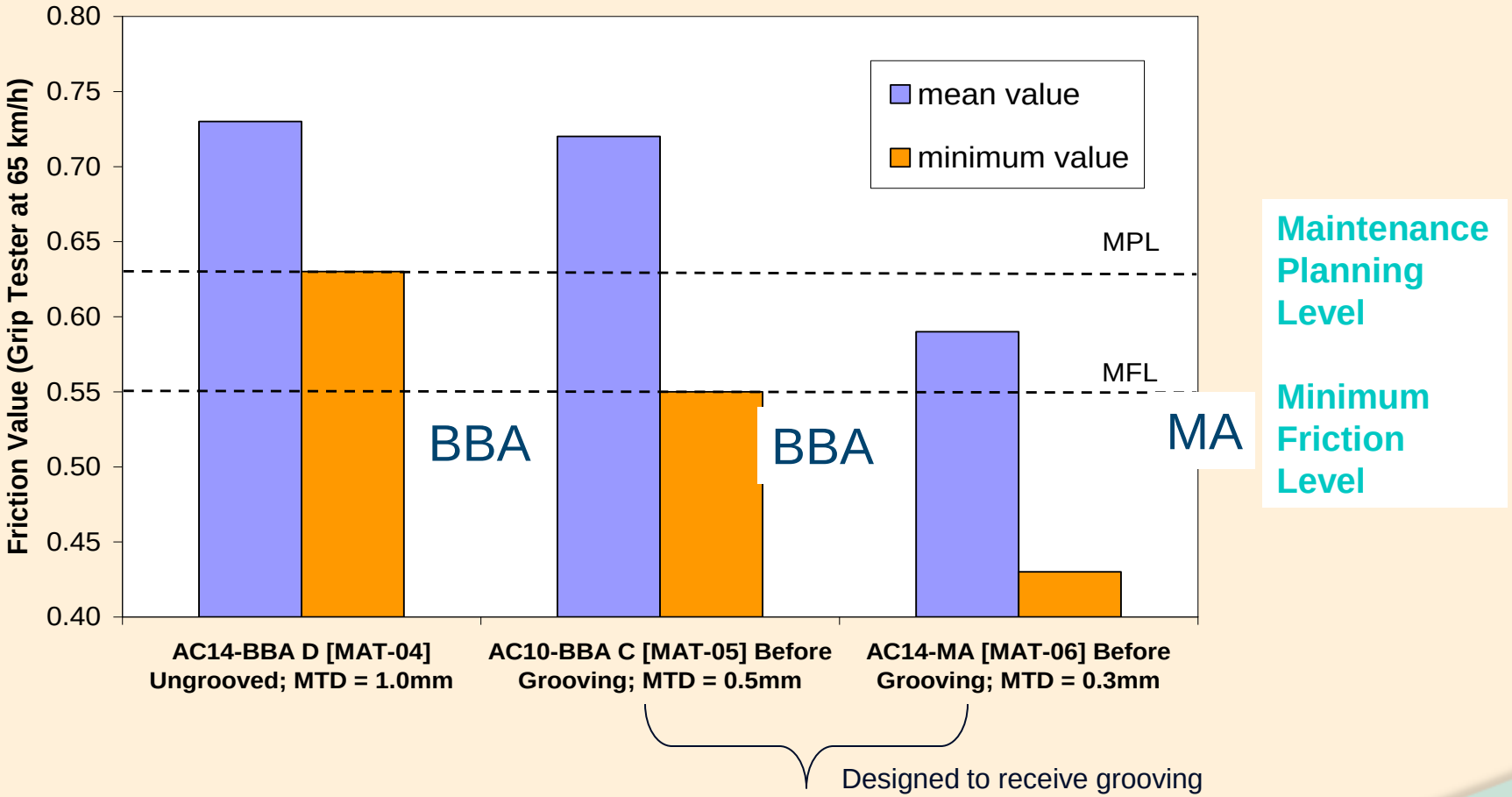
**But:**

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

# Early Life Surface characteristics

| Material ID | MAT-01 | MAT-02 | MAT-03 | MAT-05 | MAT-04 | MAT-07 | MAT-08 | MAT-09 |
|---|---|---|---|---|---|---|---|---|
| **Material ID** | AC10-BBA D | AC10-BBA D | AC10-BBA C | AC10-BBA C | AC14-BBA D | AC14-BBA D | AC14-BBA D | AC14-BBA D |
| Nominal Aggregate Size | 0/10mm | 0/10mm | 0/10mm | 0/10mm | 0/14mm | 0/14mm | 0/14mm | 0/14mm |
| Mean Texture Depth as Laid | 0.8mm | 0.6mm | 0.5mm | 0.5mm | 1.0mm | 1.2mm | 1.3mm | 1.2mm |
| Treatment | Grooved | Grooved | Grooved | Grooved | Not Grooved | Not Grooved | Not Grooved | Not Grooved |
| Mean Texture depth after grooving | 1.0mm | 1.0mm | 0.9mm | 1.0mm | n/a | n/a | n/a | n/a |
| Groove Dimension | 4mm x 4mm | 3mm x 3mm | 3mm x 3mm | 4mm x 4mm | n/a | n/a | n/a | n/a |
| Approximate age at grooving | min 3 days | min 14 days | 4 - 15 days | 20hrs | n/a | n/a | n/a | n/a |
| CFME | Mu Meter | Mu Meter | Grip Tester | Grip Tester | Grip Tester | Grip Tester | Grip Tester | Grip Tester |
| Average friction results immediately after laying | n/a | 0.63 | n/a | 0.76 | 0.73 | 0.75 | 0.70 | 0.76 |
| Average friction results prior to grooving | n/a | 0.62 | 0.68 | n/a | n/a | n/a | n/a | n/a |
| Average friction results after grooving | 0.63 | 0.68 | 0.80 | 0.72 | n/a | n/a | n/a | n/a |
| CAA CAP 683 Requirements | MFL = 0.50, MPL = 0.57, DOL > 0.72 | | MFL = 0.55, MPL = 0.63, DOL > 0.80 | | | | | |

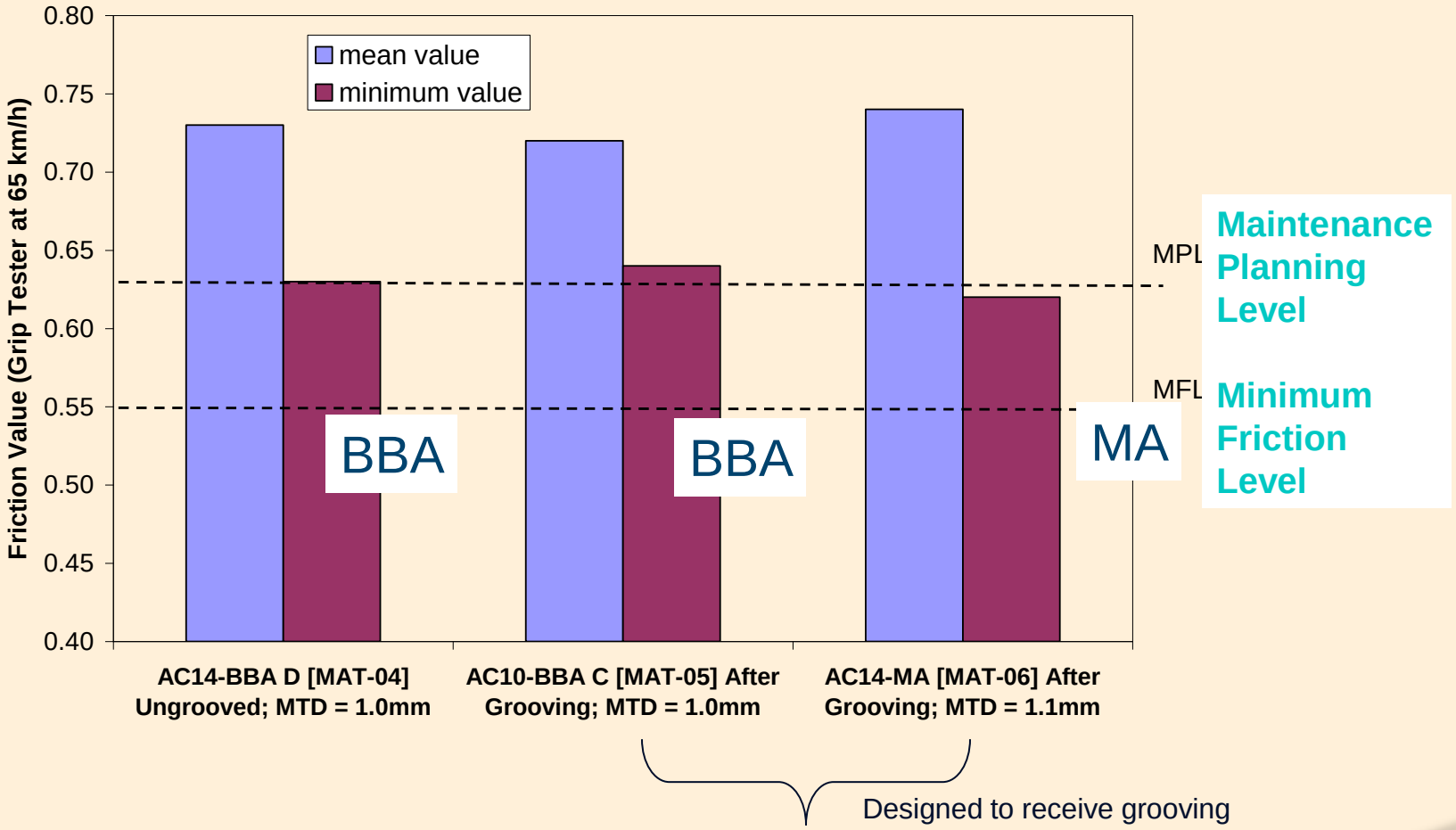
# Ungrooved Asphalt Early Life



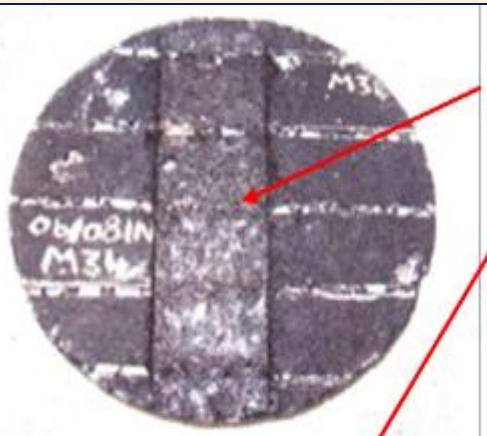

**Maintenance Planning Level**

**Minimum Friction Level**

# Ungrooved and Grooved Asphalts Early Life



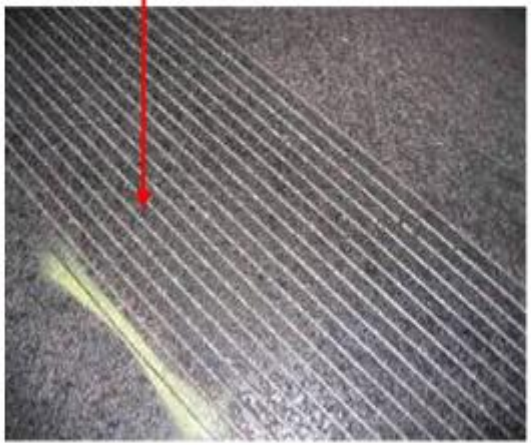
# Groove Retention



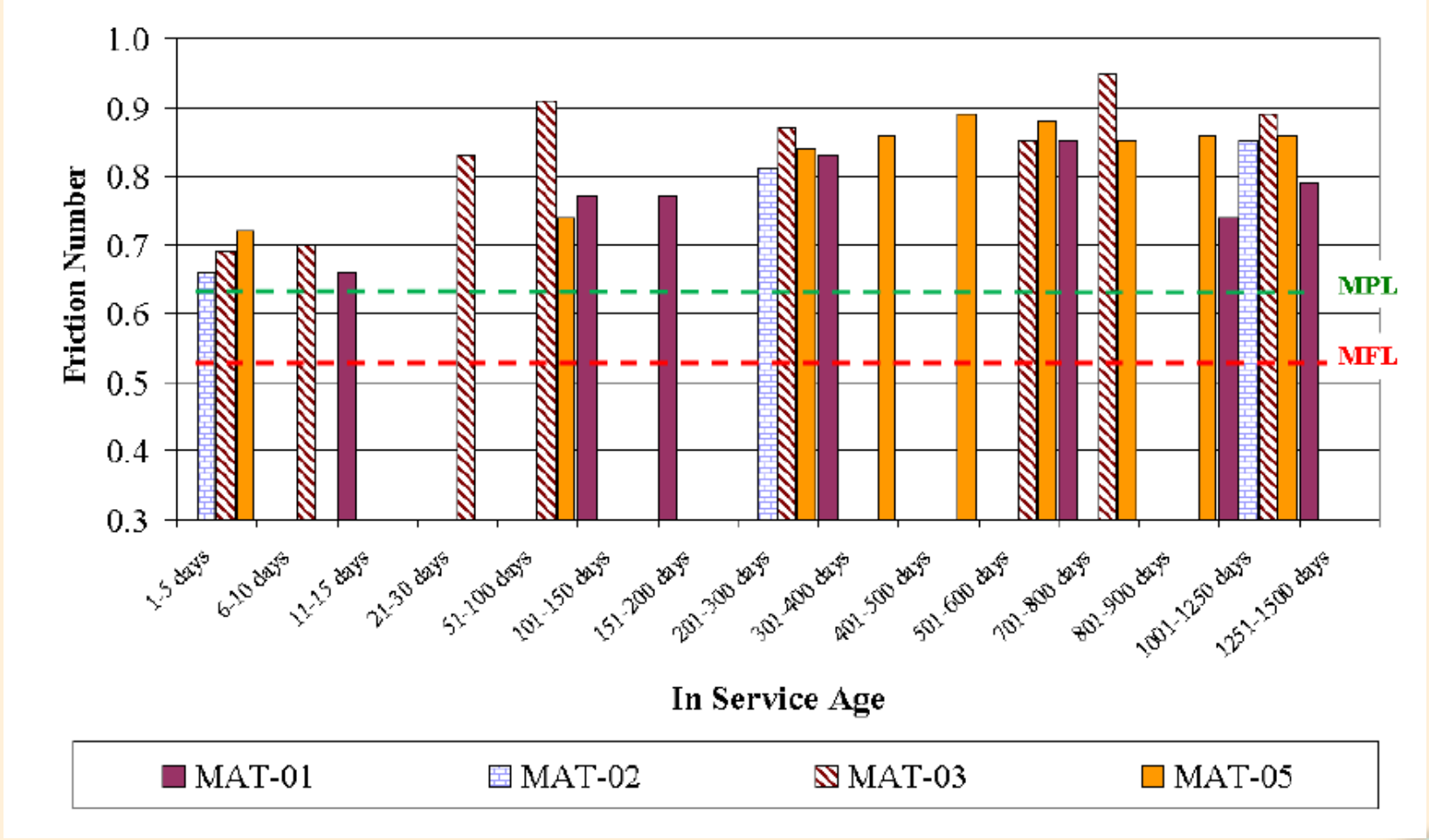
AC14-MA surface course showing groove closure under wheel tracking

AC10-BBA surface course showing good retention of groove under wheel tracking

Appearance of grooved AC10-BBA surface course [groove dimension: 4mm x 4mm x 25mm]



# Friction Value vs time Grooved "BBA"



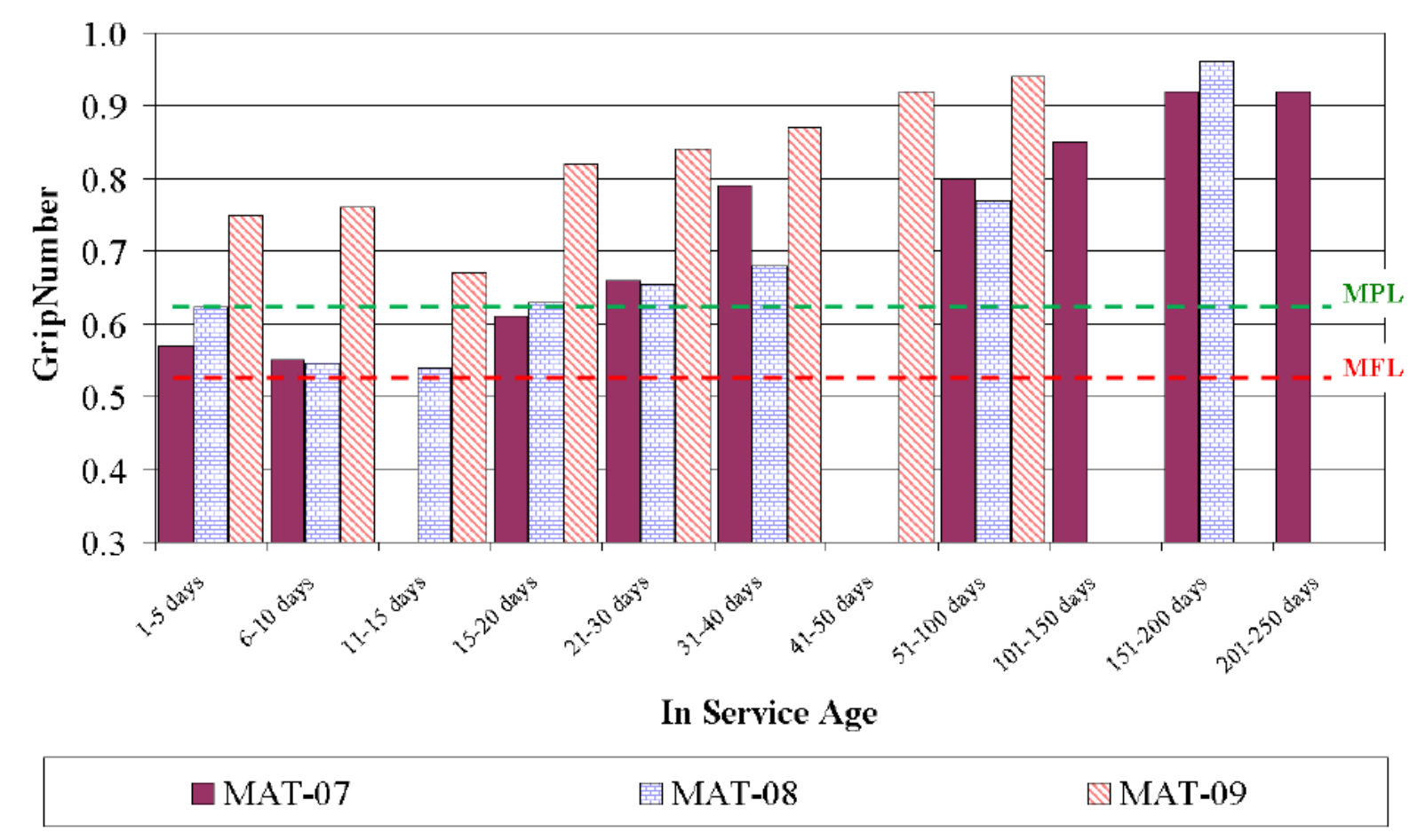
# Still very good after 3 years in service

(a) Surface area generally in good condition

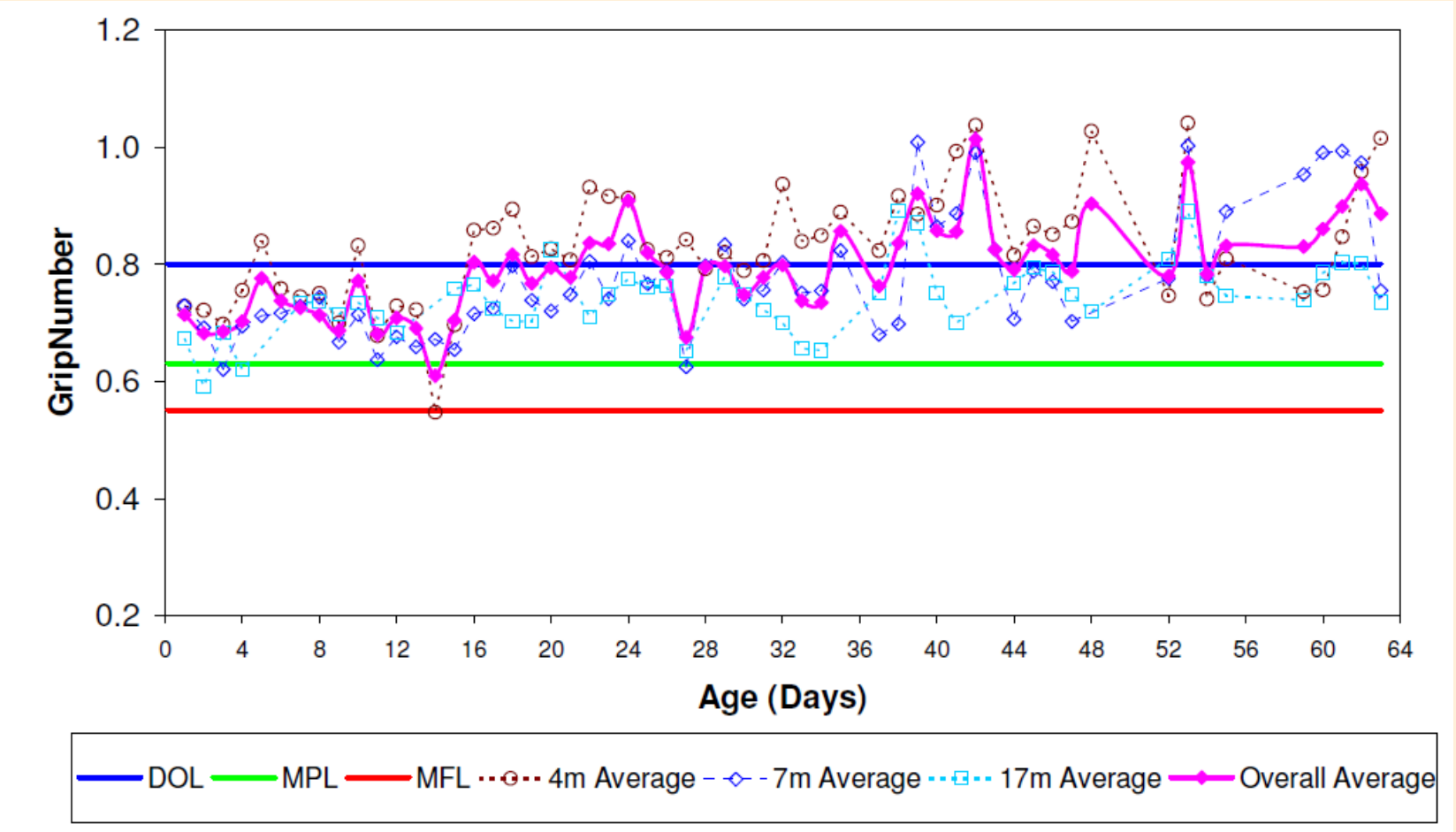
(b) Localised rubber deposits

# Construction Ungrooved BBA

# Friction Value vs time Ungrooved BBA



# Friction Value During Construction



# 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;
- Ungrooved AC 14-BBA D have now been used in surface course in UK airfields;
- It has now been adopted as a permissible option for airfield rehabilitation under CAA CAP 781.