

# Road Trials of Low Noise High Performance Asphalt Surfacing

Iswandaru Widyatmoko

*Technical Director, Pavement Engineering,*

*Centre of Excellence for Asset Consultancy, AECOM, Nottingham, UK*

Presented at the 1st International Conference on SMA, 5-7 November 2018, Atlanta

## Co-authors and research team

- C. Ojum (AECOM)
- R. Hudson-Griffiths & A. Khojinian (Highways England)
- D. Giles, M, Lancaster, G. Schofield & C. Southwell (Eurobitume UK)
- D. Markham, M. Simms & T. Smith (Mineral Products Association)



# Acknowledgements

This work was part of a series of collaborative research projects funded by Highways England, Eurobitume UK and Mineral Products Association under *Highways England Framework for Transport Related Technical and Engineering Advice and delivered by AECOM*.

Our appreciation to all parties who have been providing supports during the course of this project:

- material suppliers; contracting companies;
- area managers; local highway authorities;
- universities;
- AECOM's delivery team: Jessica Tuck, Dr Paul Edwards, Dr Matthew Muirhead, Dr Helena Lacalle, Dr Giacomo D'Angelo.... (the list continues)


**Big thanks to all of you.**

# Collaborative Research Projects



The primary objective of these projects are “to ensure that asphalt surfacings continue to **deliver value for money** on the strategic road network (SRN) and to **maximise the benefit from innovation**”

## Project themes

- |   |  |
|---|--|
| 1 | Next generation low noise surfacing materials – Road Trial, Installation and Assessment.  |
| 2 | Automated <b>QA</b> test methods.  |
| 3 | Low Temperature Asphalt/Warm Mix Asphalt ( <b>WMA</b> ) Evaluation.  |
| 4 | Specification of Construction Joints.  |
| 5 | Review of Asphalt Recycling Practices.   |
| 6 | Evaluation of existing demonstration sites with Radio Frequency Identification ( <b>RFID</b> ) Tags.   |
| 7 | Noise Evaluation.  |

# Roads today



“Our roads connect the country together and our network helps four million **journeys** to be made **safely** and **reliably** each day. We want the people who use them to be safe and a big part of that is ensuring we have **a good quality road surface too.**

Some people may not be aware of the incredible engineering that has taken place beneath their wheels to make them happen. **But just like a cake, it really is a refined recipe.**”

(Nicola Debnam, Highways England Director of Asset Development, Safety, Engineering and Standards, October 2018)

### Highways England's Layer Cake

**Ingredients**

- Surface layer - like good quality, smooth icing
- Binder layer - like a sponge full of fine ingredients
- Bond coat - like sticky jam
- Base - a rich, nutty fruit cake layer of coarse ingredients
- Sub-base - like crushed biscuit base

Are you aware of the engineering beneath your wheels when you're driving on our roads?

**Surface layer -** The icing on the cake

**Binder layer -** A supporting layer full of substance

**Bond coat -** Sticky jam between the layers

**Base -** A coarse layer providing load distribution and drainage

**Sub-base -** A layer of crushed biscuits rolled together preventing a soggy bottom!

highways england #bakeoff #roads #YoE

Caption: Highways England's Layer Cake

# Next Generation of Asphalt Surfacing

Have been carried out under 3 consecutive collaborative projects:

Aim To review the surfacing materials worldwide with a view to developing the next generation of asphalt materials which has significantly enhanced **durability, optimised noise** and **skid resistance characteristics**.

Task 409 (2015/2016) – literature review, workshop, mix design and demonstration trial

Task 1-111 (2016/2017) – mix design optimisation and field trial on SRN

Task 1-444 (2017/2018) – further trials on SRN, inspection panel and launch event

Literature  
Review

Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# Technology/Innovation Readiness Level (Paul Sanders, Highways England, October 2016)

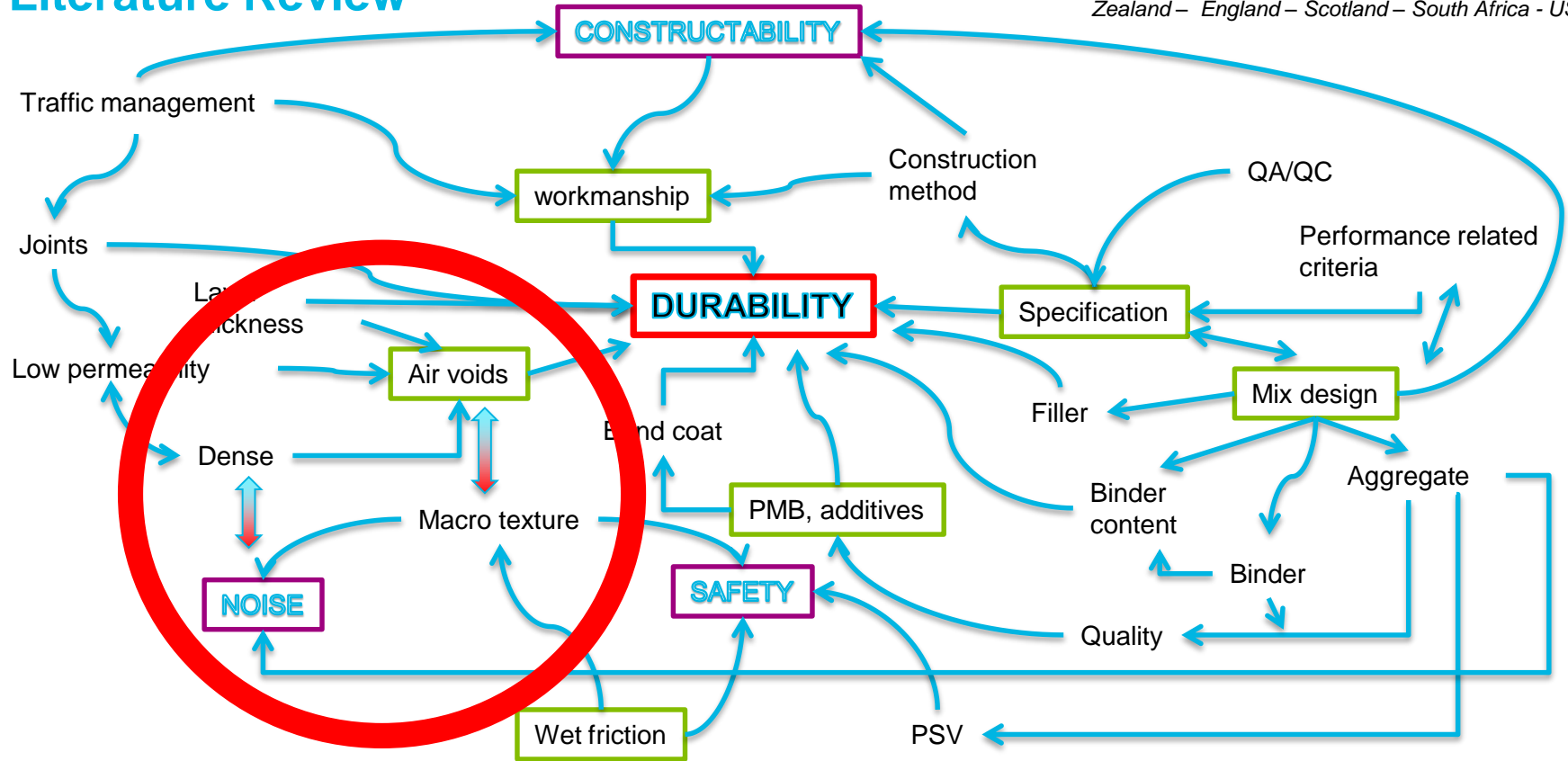
Readiness Level	Description	Assessment Implication & Further work recommendation	Responsibility
1	Basic principles observed and reported	(Further) Laboratory investigation and validation	Innovator
2	Technology concept and/or application formulated		
3	Analytical and experimental critical function and/or characteristic proof-of-concept		
4	Technology validation in a laboratory environment	Demonstration / validation of concept trial (off HE network)	Innovator
5	Technology basic validation in a relevant environment	Trafficked demonstration / validation of concept trial (off HE network)	Innovator (+ HE or other sponsor)
6	Technology model or prototype demonstration in a relevant environment	Demonstration / validation of concept trial (on HE network)	Innovator / HE sponsor
7	Technology prototype demonstration in an operational environment	If acceptable, authorise for DfS on project basis	HE
8	Actual technology completed and qualified through test and demonstration	Develop standard/specification	HE
9	Actual technology qualified through successful mission operations	Authorise duplicate/ related technologies for Generic Network Approval. Publish new standard/specification in DMRB/MCHW	HE





# Literature Review

Case Studies & Feedbacks from:  
 Australia – France – Germany – Netherland - New  
 Zealand – England – Scotland – South Africa - USA



# International Workshop

The workshop took place on 2nd June 2015, from 9am to 2pm, at Lea Marston Hotel in Warwickshire



What are your ideas for the next generation of asphalt surfacing for use on Highways England's Network, that will increase durability without compromising the current performance of Specification for Highway Works (SHW) Clause 942?

Literature  
Review

Workshop

Laboratory  
Design

Demonstration Trial

Field Trial

# International Workshop



Literature  
Review

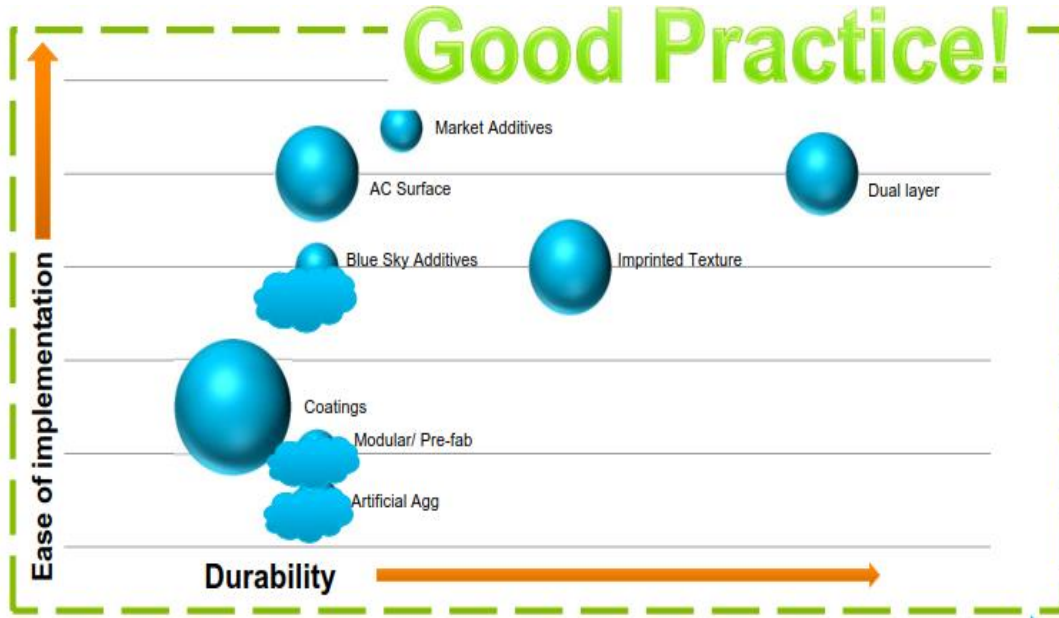
Workshop

Laboratory  
Design

Demonstration Trial

Field Trial

# “Dual function layer” with Good Practice



- Better understanding of **aggregate packing**
- Improvements **to mix design process**
- **Improving workmanship** / operational upskilling / training
- **Procurement and ‘risk sharing’**
- Better feedback loop on **performance**
- **Substrate** condition
- **Bond between layers**
- **Access** / traffic management / full road closure
- Relationship with **supply chain**
- **Temperature control** (shuttle buggies)

Literature Review

Workshop

Laboratory  
Design

Demonstration Trial

Field Trial

## Agreed Options to Investigate

- **Polymer Modified Hot Rolled Asphalt with smaller size of chipping:** The use of 6/10 mm pre-coated chippings at various application rates. The aim was to minimise noise through embedment of smaller size chippings. The Hot Rolled Asphalt (HRA) used in the project conformed to SHW Clause 943 (Performance Related Design Mixture) designated as HRA 35/14F surf PMB Class 2
- **Premium Asphalt Surfacing Systems (PASS):** PASS layer was the top idea amongst a range of other options. The PASS concept is based on a durable, low voided, dense body of material with improved surface characteristics (low noise, good macrotexture). The adopted nominal aggregate size was 0/10mm.
- **Benchmark = Thin Surface Course Stone Mastic Asphalt:** Produced in compliance with EN 13108-5 and SHW Clause 942. Thin Surface course control (0/10 mm TSC) to act as a benchmark mixture.

Literature  
Review

Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# Premium Asphalt Surfacing Systems (PASS)

The Initial Works



# Laboratory Design and Assessment

## Tests

Mixture volumetrics (density and air voids)

Workability Assessment

Visual assessment of samples

Determination of surface texture to EN 13036-1

Determination of skid Pendulum Test Value (EN 13036-4)

Resistance to deformation measured by using wheel track testing (small device in air) at 60°C to EN 12697-22

Resistance to moisture damage measured by Indirect Tensile Strength (ITS) to EN 12697-12

Determination of noise by acoustic impedance tube method (EN ISO13472-2)

Literature  
Review

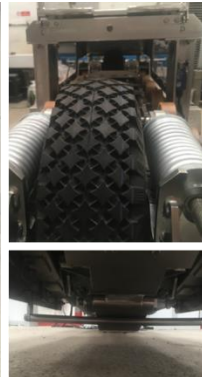
Workshop

Laboratory  
Design

Demonstration Trial

Field Trial

# Laboratory trials and design validations



*Photos taken at AECOM Specialist Laboratories in Nottingham*



# Demonstration Trial



**Pilot Scale Trial  
Tarmac - Alrewas  
Quarry Access Road –  
June 2016**

Literature  
Review

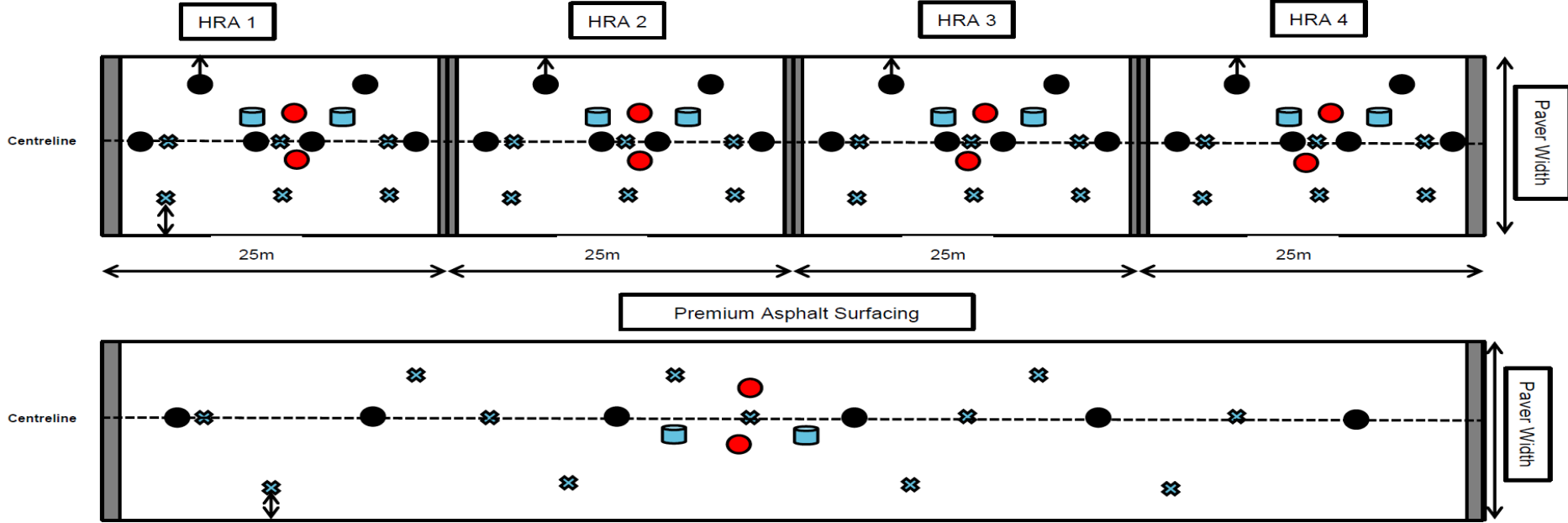
Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# Test Layout for Demonstration Trial



# 0/10mm PASS PMB 45/80-60, 5.4% Binder Content



Literature  
Review

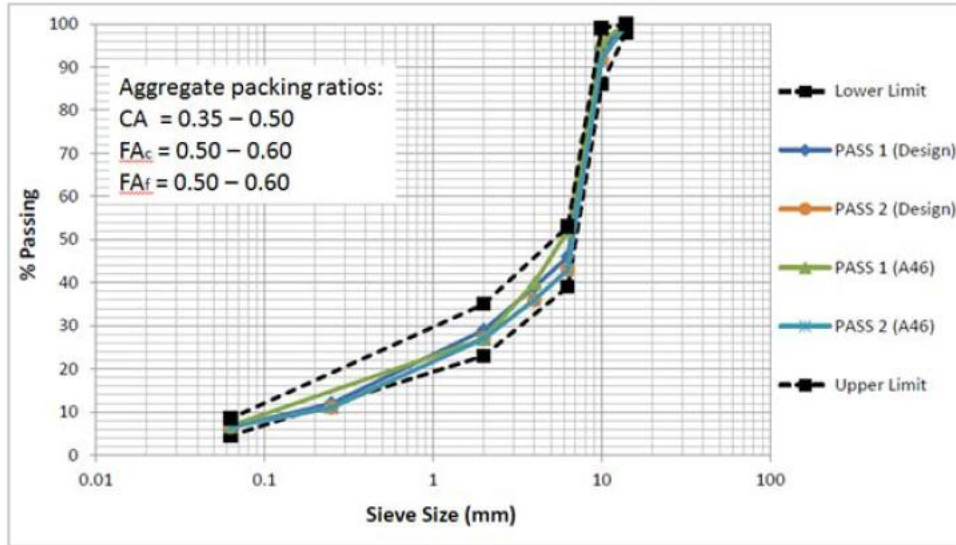
Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# The materials



Top View



Side View

PMB class 45/80-60, 5.4% Binder Content

## Key Findings and Considerations

Properties	Lab	Trial	Comments
<b>Workability</b>	☑	☑	<b>Excellent.</b> Both materials were reported as relatively easy to produce and install. No foreseeable workability related issue.
<b>Volumetrics – Air Voids</b>	☑	☑	<b>Excellent.</b> Between 3 and 6% air voids (Lab 1 & Lab 2). Quality control measures for the production and installation of the materials to facilitate compliance with specifications.
<b>Surface Macrotexture</b>	☑	☒	Lab (1.2mm) – <b>acceptable</b> and Trial (0.8mm) – <b>low</b> . Must optimise the gradation in order to increase the mean texture depth in future trials.
<b>Skid Resistance</b>	☑	☑	Both showed <b>excellent</b> Pendulum Test Values $\geq 70$ .
<b>Noise Assessments</b>	☑	☑	<b>Inconclusive</b> acoustic impedance tube test results – SPB for the main trials.
<b>Moisture Susceptibility</b>	☑	☑	Showed <b>good</b> moisture susceptibility properties. ITR: $>90\%$ (Lab 1 & Lab 2) and $>70\%$ (Trial 1).
<b>Wheel Tracking</b>	☑	☑	<b>Excellent</b> (Lab 1 & Lab 2). At 10000 cycles (in air at 60°C): wheel track slope $< 0.07\text{mm}/1000\text{cycles}$ , proportional rut depth $< 5\%$ and rut depths $< 2.5\text{ mm}$

Literature  
Review

Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# After 19 months (February 2018)

## Technical Note

AECOM

Project: Task 1-444: Collaborative Research into the Next Generation of Asphalt Surfacing Job No/Ref: 60559099  
 Subject: Alrewas Quarry Access Road Trial Visual Condition Survey of PASS and Low Noise Hot Rolled Asphalt  
 Prepared by: Chibuzor Ojum Date: 28<sup>th</sup> February 2018  
 Checked by: Paul Edwards Date: 7<sup>th</sup> March 2018  
 Approved by: Iswandaru Widyatmoko Date: 9<sup>th</sup> March 2018

### 1 Introduction

The objective of the Alrewas Quarry Access Road Trial installed on 27th June 2016 was to validate the optimised laboratory mix designs and demonstrate constructability of the Premium Asphalt Surfacing Systems (PASS) and the low noise polymer modified Hot Rolled Asphalt (HRA).

This technical note presents the findings following a site inspection, visual condition survey and surface macrotexture depth measurements after this installation at the Alrewas Quarry Access Road to ascertain if there any pavement defects including cracking, fretting, loss of chippings and rutting on the installed asphalt surfacings. This site inspection and visual condition survey were carried out on 6<sup>th</sup> February 2018.

The installation layout and core location plan for the PASS and the low noise polymer modified HRA are shown below in Figure 1.

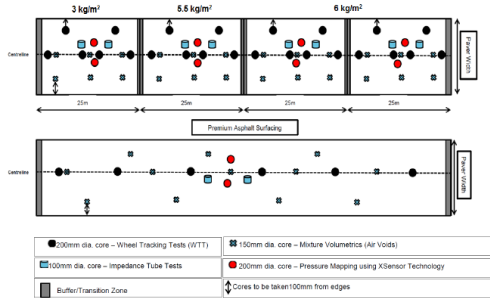
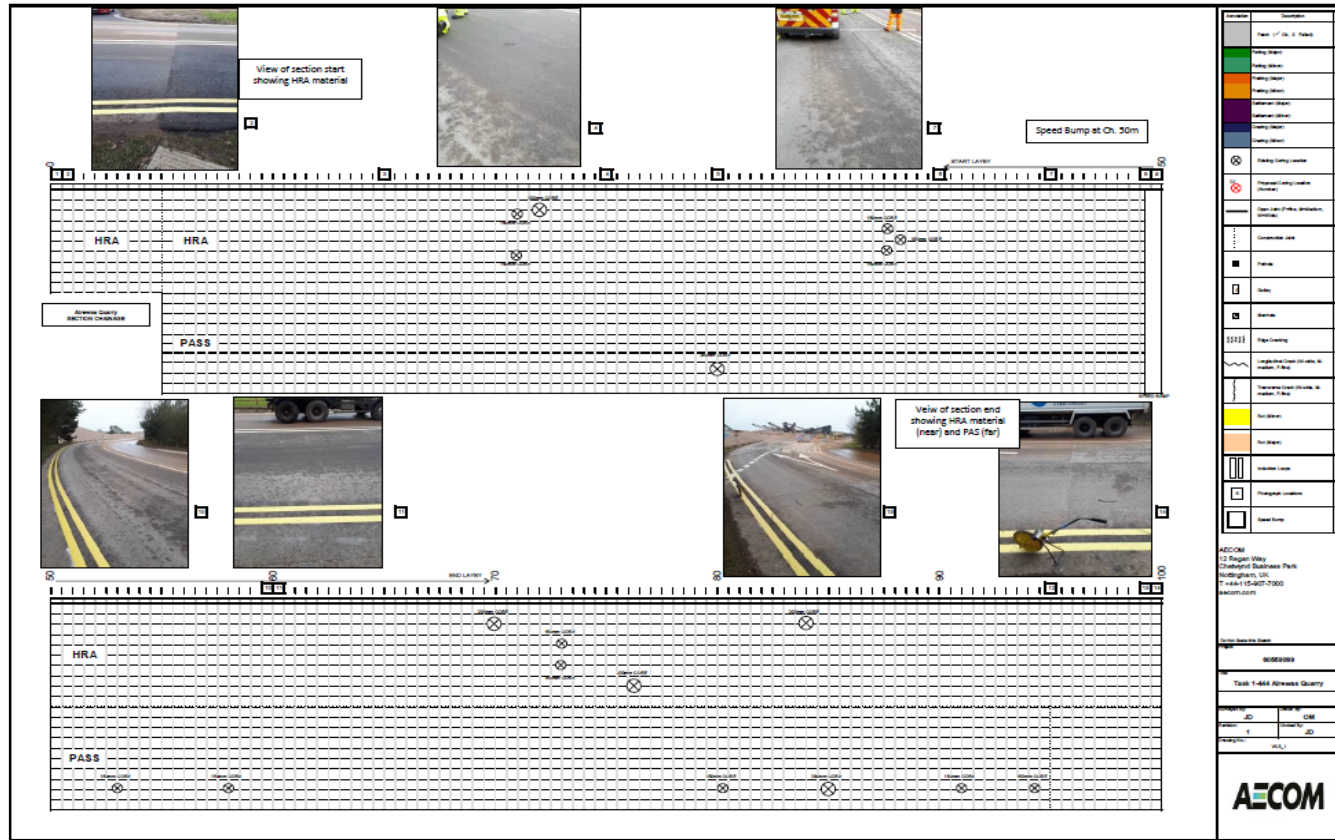


Figure 1: Test Layout for Alrewas Quarry Access Road



**“Excellent.** Observations showed no material loss, cracking, or fretting”

Literature Review

Workshop

Laboratory Design

Demonstration Trial

Field Trial

# Premium Asphalt Surfacing Systems (PASS)

The Road Trials



# Field trial

The trial was completed on 9<sup>th</sup> August (Night Time Works)/10th August. The site location for the PASS trial is the A46 Hykeham to Carholme (Southbound)



Literature  
Review

Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial



# A46 Hykeham to Carholme







Laying (off paver)



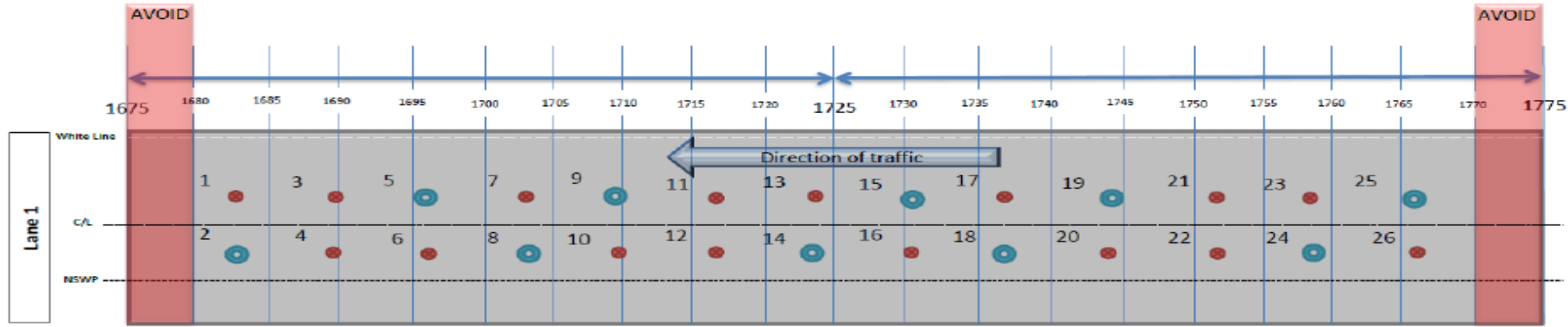
Compaction



Volumetric patch test



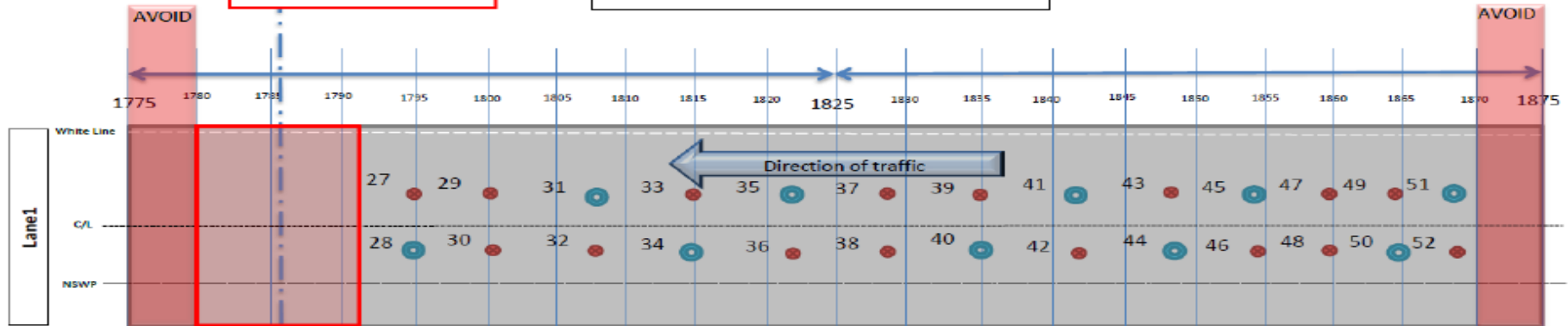
Apparent surface finish



PASS 1

Water pipe present at Ch. 1786m (Anglian Water).

● = 150mm core   ● = 200mm core  
Diagram is not to scale.



PASS 2

# Noise Measurements of PASS

Two measurements, 100m apart, at the trial site

SPB method but microphone at 4.5m rather than 7.5m

Correction factor of -2.5 dB(A) applied from comparison measurements (on another surface)

**Road Surface Influence (RSI) values: -5.5 and -5.7 dB(A)**

**Good result – meets MCHW ‘very quiet surfacing material’ (Level 3)**



**TABLE NG 9/30: (08/08) Road/Tyre Noise Levels**

Level	Equivalence to Traditional Surfacing Materials	Road Surface Influence RSI
3	Very quiet surfacing material	- 3.5 dB(A)
2	Quieter than HRA surfacing materials	- 2.5 dB(A)
1	Equivalent to HRA surfacing materials	- 0.5 dB(A)
0	No requirement	No requirement

# Key Findings and Considerations from the Road Trials

Properties	PASS1	PASS2	Comments
<b>Workability</b>	☑	☑	<b>Excellent.</b> Both materials were reported as relatively easy to produce and install. No foreseeable workability related issue.
<b>Volumetrics – Air Voids</b>	☒	☒	<b>Concern.</b> Between 7 and 9% air voids. Quality control measures for the production and installation of asphalt materials to obtain dense body with open surface texture.
<b>Surface Macrotexture</b>	☑	☑	<b>Excellent.</b> Average of 1.2mm and 1.3mm for both PASS mixtures.
<b>Skid Resistance</b>	☑	☑	<b>Excellent.</b> Pendulum Test Values $\geq 70$ .
<b>Noise Assessments</b>	☑	☑	<b>Good</b> result – meets MCHW ‘very quiet surfacing material’. Road Surface Influence -5.5 and -5.7 dB(A)
<b>Moisture Susceptibility</b>	☑	☑	<b>Good</b> resistance to moisture (BS EN 12697-12); comparable to those obtained from the demonstration trial (Alrewas Quarry)
<b>Wheel Tracking</b>	☑	☑	<b>Good</b> results comparable to those obtained from the demonstration trial (Alrewas Quarry)

Literature  
Review

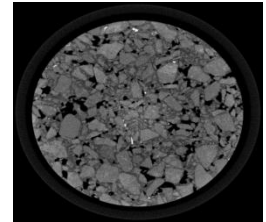
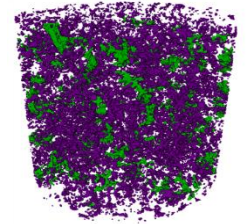
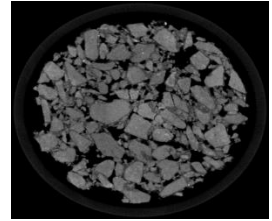
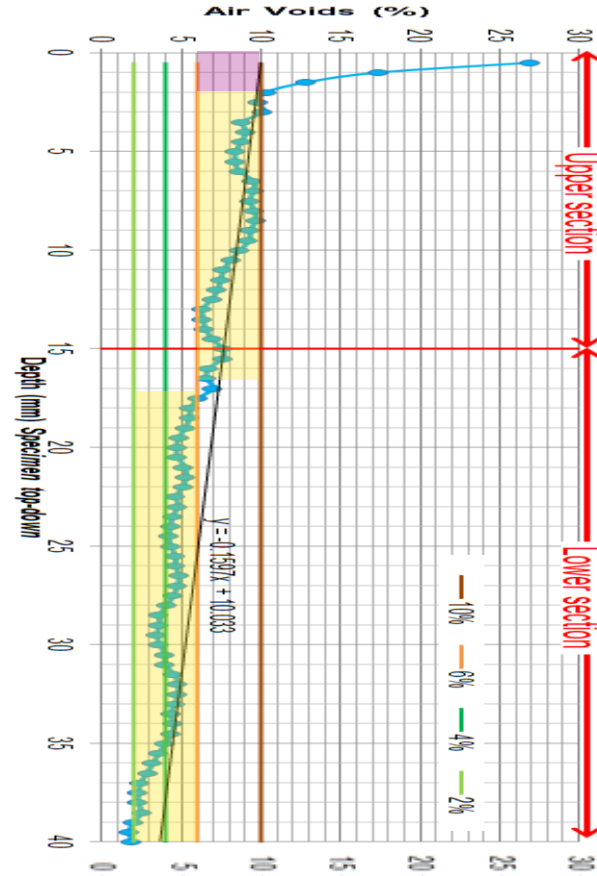
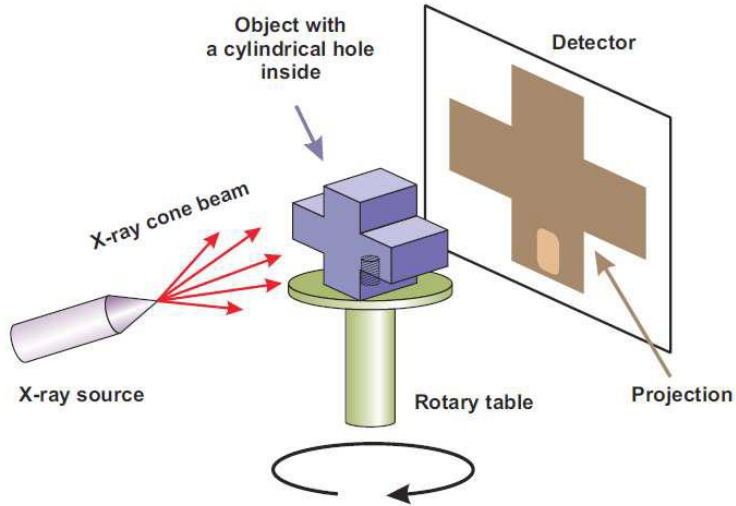
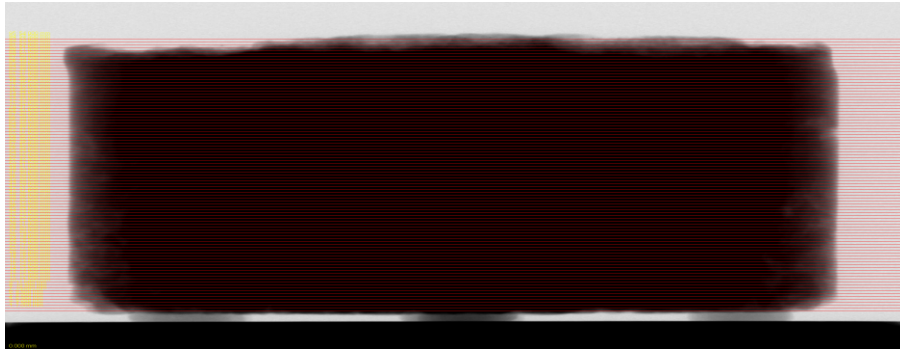
Workshop

Laboratory  
Design

Demonstration  
Trial

Field Trial

# Imaging Analysis: X-Ray Computed Tomography (CT scan)



Note: bulk air voids was 7.5%

# After 6 months (February 2018)

## Technical Note



Project:	<b>Task 1-444: Collaborative Research into the Next Generation of Asphalt Surfacing</b>	Job No/Ref: 60559099
Subject:	<b>A46 Road Trial Visual Condition Survey of the Premium Asphalt Surfacing System (PASS)</b>	
Prepared by:	<b>Chibuzor Ojum</b>	Date: <b>28<sup>th</sup> February 2018</b>
Checked by:	<b>Paul Edwards</b>	Date: <b>7<sup>th</sup> March 2018</b>
Approved by:	<b>Iswandaru Widyatmoko</b>	Date: <b>9<sup>th</sup> March 2018</b>

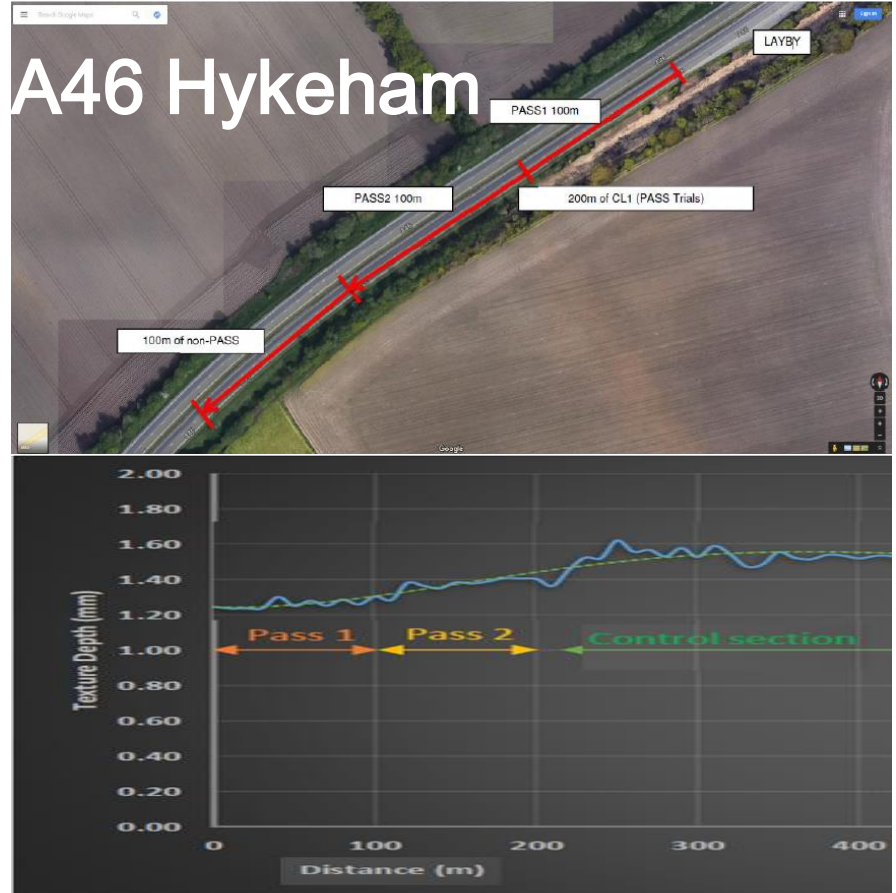
## 1 Introduction

AECOM as part of the collaborative research project led the project delivery team that completed the successful network trial and installation of the PASS on the A46 Hykeham to Carholme (Southbound) which is part of the Area 7 scheme. The trial was conducted on 9th/10th August 2017 (night time installation).

This technical note details the findings following a site inspection and visual condition survey using video imaging techniques on the A46 Hykeham to Carholme (Southbound) – Chainage 1675 to 1817.

Table 1: Pavement Surface Macrotexture Depth Measurements

Material	August 2017 (BS EN 13036-1)	February 2018 (Laser Technique)
PASS 1	1.2	1.3
PASS 2	1.3	1.4



Literature Review

Workshop

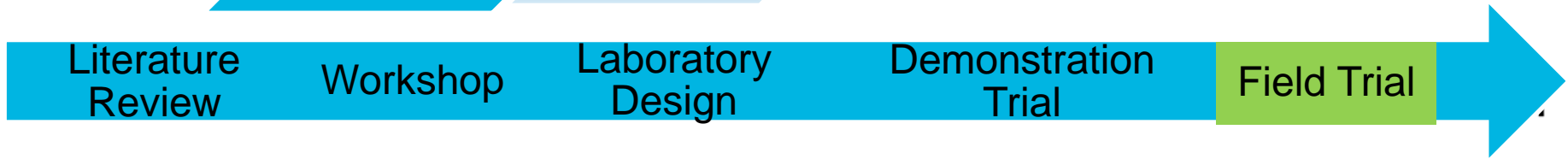
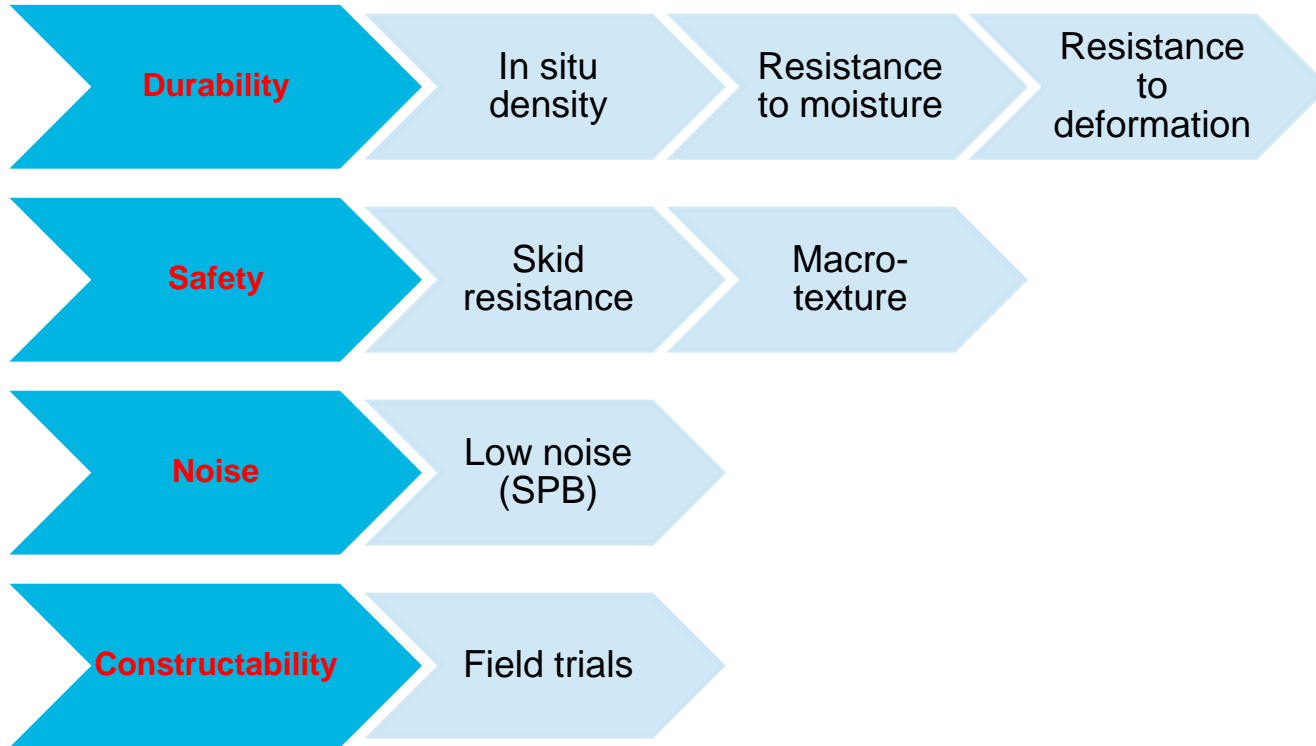
Laboratory Design

Demonstration Trial

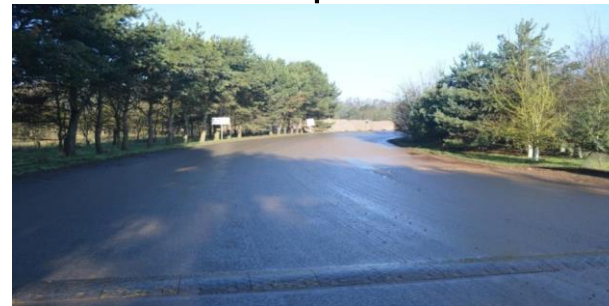
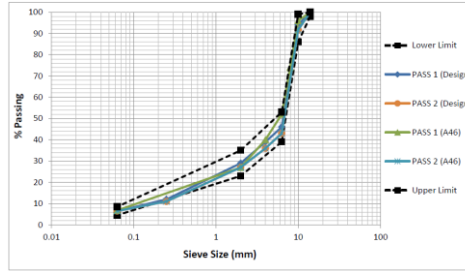
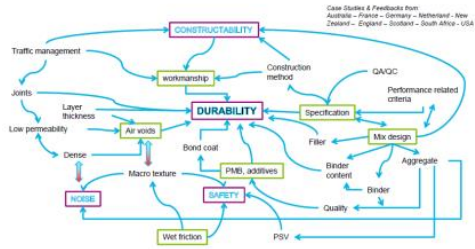
Field Trial



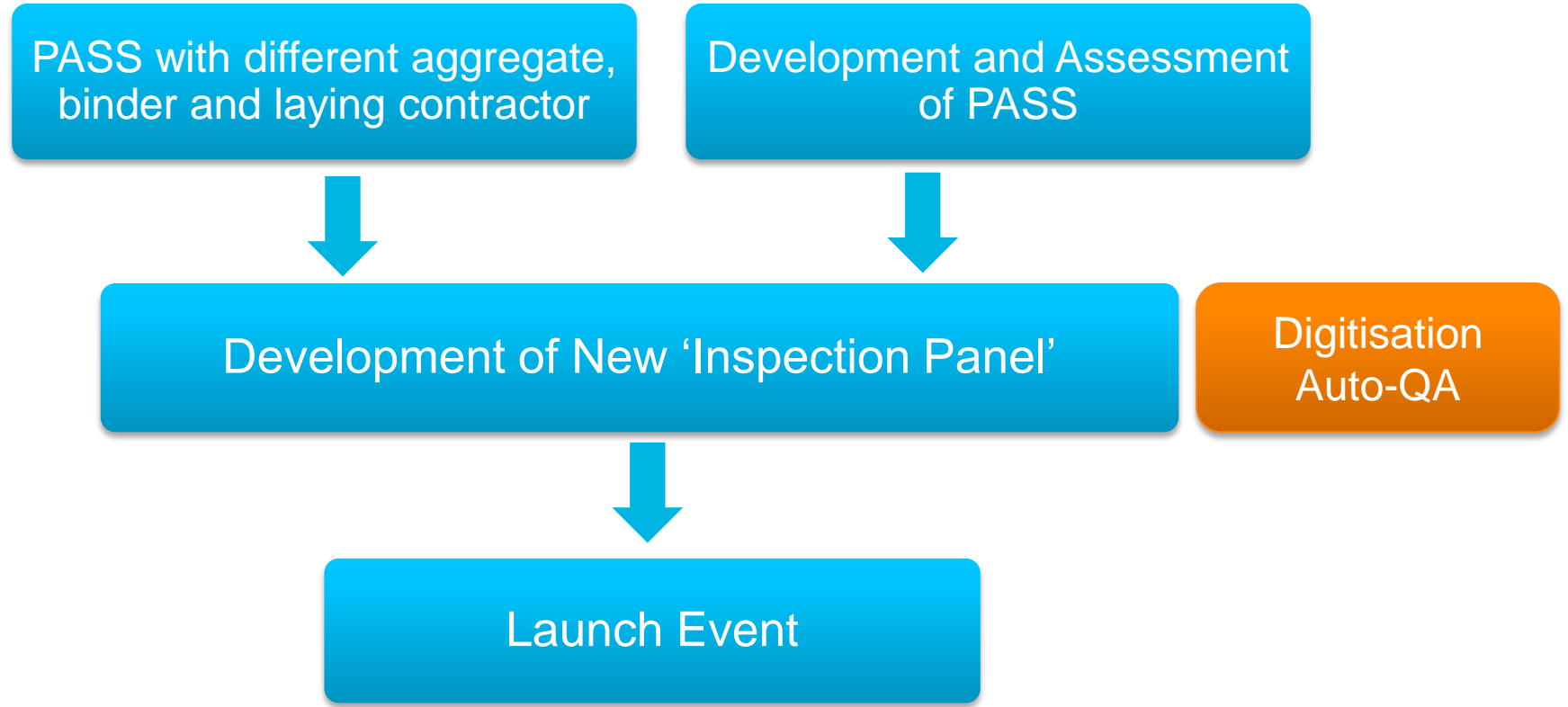
# Summary



# The Journey



## What next?



# Project reports

Findings and reports from these projects can be found at Highways England's Knowledge Compendium (<http://www.highways.gov.uk/knowledge/>), as well as AECOM microsite (<http://www.aecom.com/uk/pavement-design-publications/>)



- Traffic information
- Road projects
- Web Chats
- Highways England

You are here: HA home > Knowledge Compendium

- Knowledge Compendium
- News
- Topics
- Innovation programme
- Innovation, technology and research
- Collaboration Initiatives
- How We Commission Work
- Publication and Assessment Scheme
- Request Information

Knowledge Compendium Knowledge Compendium Search GO

For pre-2009 projects, please see our index of archived project pages.

## Welcome to the Knowledge Compendium

Highways England's Knowledge Compendium is designed to help you easily navigate through projects, link research to outcomes, and to provide details on our Innovation, Technology and Research Strategy and Innovation Programme.

The Innovation, Technology and Research Strategy identifies the company's operational and business needs. The Innovation Programme comprises a number of portfolios, each with stated outputs and outcomes that contain projects designed to fulfil the particular needs of the Company.

As well as details of the current programme you can find past research projects carried out by Highways England and formerly Highways Agency since 2002, and information on previous strategies.

Search for past and present research, browsing by portfolio in the current and previous programmes, using the list on the topics page or by using the search box at the top of the page. Generic searches can be done by using keyword(s) or for a specific project, use the project title or reference number where known.

**AECOM** ABOUT MARKETS SERVICES PROJECTS INSIGHTS INVESTORS CAREERS

## Pavement Design and Asset Management publications

Reports and publications commissioned by clients that help them think without limits to design, build, finance and operate a better world.

**Collaborative Research into the Next Generation of Asphalt Surfacing**  
February 2017  
PDF, 10.1MB

**Improving Durability of Thin Surfacing Course Systems - Measuring Asphalt Density using In-Situ Test Methods**  
November 2016  
PDF, 0.2MB

highways england mpa eurobitume

# Thank You

[Daru.Widyatmoko@Aecom.com](mailto:Daru.Widyatmoko@Aecom.com)

AECOM, Pavement Engineering, Centre of Excellence for Asset Consultancy

12 Regan Way, Chetwynd Business Park, Chilwell. Nottingham NG9 6RZ

<http://www.aecom.com/>

The landmark air control tower at New Istanbul Airport. A design partnership between AECOM and Pininfarina.