The Institute of Asphalt Technology

APSE – Manchester 15 August 2019

Lyle Andrew FIAT MCIHT
Director of Development

The Institute of Asphalt Technology

Outline

- About the IAT
- Asphalt – Back to basics
- Products
  - Product Development
  - Recycling
  - Testing – See **Automated QA** below
- Innovation
  - Automated QA
  - Low Volume Asphalt
- Competence (Time permitting)
  - Why?
  - Sector Schemes

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About the IAT

- Professional body representing individual members from the asphalt, road and related disciplines
- Over 1100 members in the UK, Ireland and overseas
- Closely linked with industry to develop and encourage education and training at all levels
- Managed by a Council as Directors of the Institute

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Celebrated 50 years in 2016

- Took the opportunity to rebrand

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50+ years of Training

Asphalte courses at the South East London Technical College

It has now been agreed that the courses in asphalt technology at the South East London Technical College shall be as follows:—

Stage	Commence at College	No. of working weeks at College	Holidays from College	Examinations held
FIRST INTAKE 1st YEAR	3rd week Sept. 1968	18	2 weeks at Xmas	1st week Feb. 1969
2nd YEAR	3rd week Sept. 1969	18	2 weeks at Xmas	1st week Feb. 1970
SECOND INTAKE 1st YEAR	2nd week Feb. 1970	18	2 weeks Easter 1 week Whitsun	1st week July 1970
2nd YEAR	2nd week Feb. 1971	18	2 weeks Easter 1 week Whitsun	1st week July 1971

- **Mission -** To promote the use of asphalt through **education, shared knowledge** and **networking**
- First IAT Asphalt Technology Course started September 1968
- Evolved DAPS and now UoD
- Newcastle University course in 46th consecutive year (MPA)

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5 year Corporate Strategy

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Asphalt – The Basics

- What is Asphalt?
- What is in Asphalt?
- Asphalt Production
- Asphalt Mixes
- Pavement Layers

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What is Asphalt?

- "homogenous mixture of coarse and fine aggregates, filler aggregate and bituminous binder which is used in the construction of flexible pavement layers"
- Asphalt = Aggregate + Binder + Filler + Air
- Generic term for range of bituminous bound road materials available in UK
- >95% of UK road construction

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What is in Asphalt?

Coarse Aggregate: (Crushed rock >4mm)
Extends the mortar, making the mix economical and increases the stability of the mix.

Fine Aggregate: *(*Crushed rock fines / sand <4mm)
Forms the major proportion of the mortar and influencing the performance of the material both during application and in service.

Filler: (Limestone filler / reclaimed fines <0.063mm)
Modifies the grading of the fine aggregate and helps in the binding of fine aggregates to form mortar.

Binder: Paving grade bitumen / resin / synthetic binders
Lubricant during compaction and a visco-elastic binder of (high viscosity) in service.

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Additives

- Fibres
  - (Loose, compressed and binder coated)
  - Increase binder content / reduce binder drainage
- Pigments
  - (Commonly derived from metal oxides)
  - Colour
- Polymers
  - (Plastomers/Elastomers)
  - Increase stiffness / reduce permanent deformation / reduce cracking

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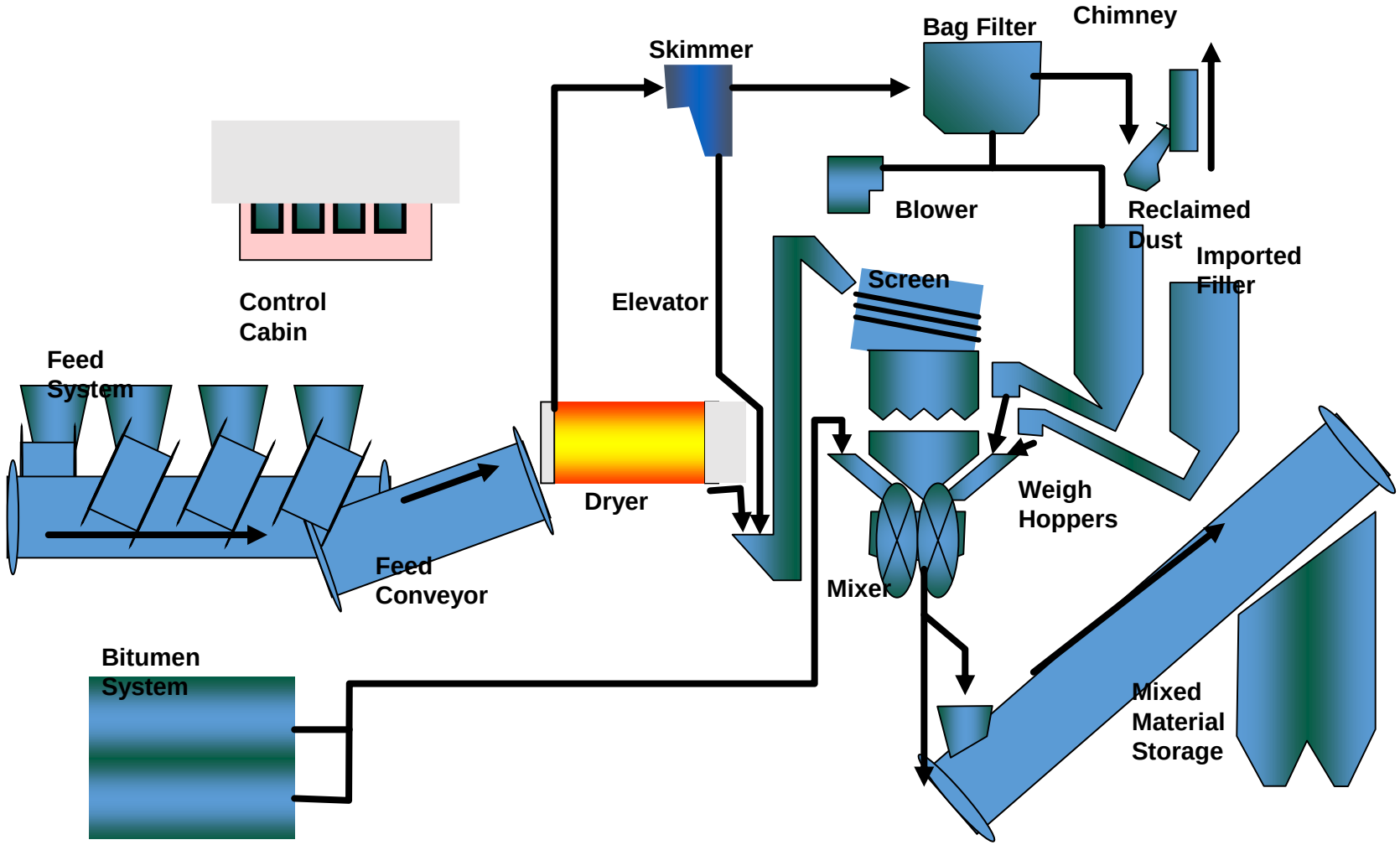
Asphalt Production



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Asphalt Mix Specifications

The EN 13108 Family

EN 13108-1 Asphalt Concrete

EN 13108-2 Asphalt Concrete for Very Thin Layers

EN 13108-3 Soft Asphalt (Nordic countries)

EN 13108-4 Hot Rolled Asphalt

EN 13108-5 Stone Mastic Asphalt

EN 13108-6 Mastic Asphalt

EN 13108-7 Porous Asphalt

EN 13108-8 Reclaimed Asphalt (ingredient)

EN 13108-9 Asphalt for Ultra-Thin Layers (AUTL)

EN 13108-20 Type Testing

EN 13108-21 Factory Production Control

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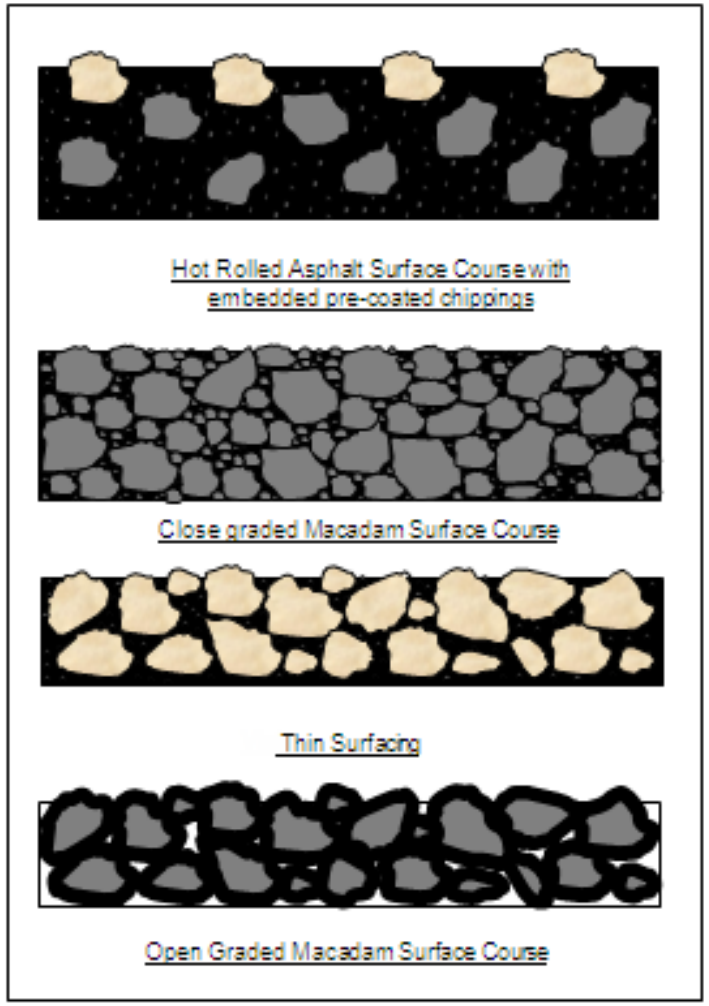
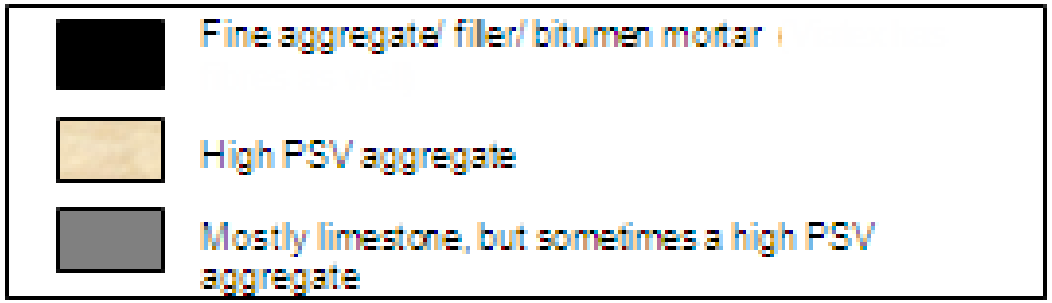
Asphalt Mixes





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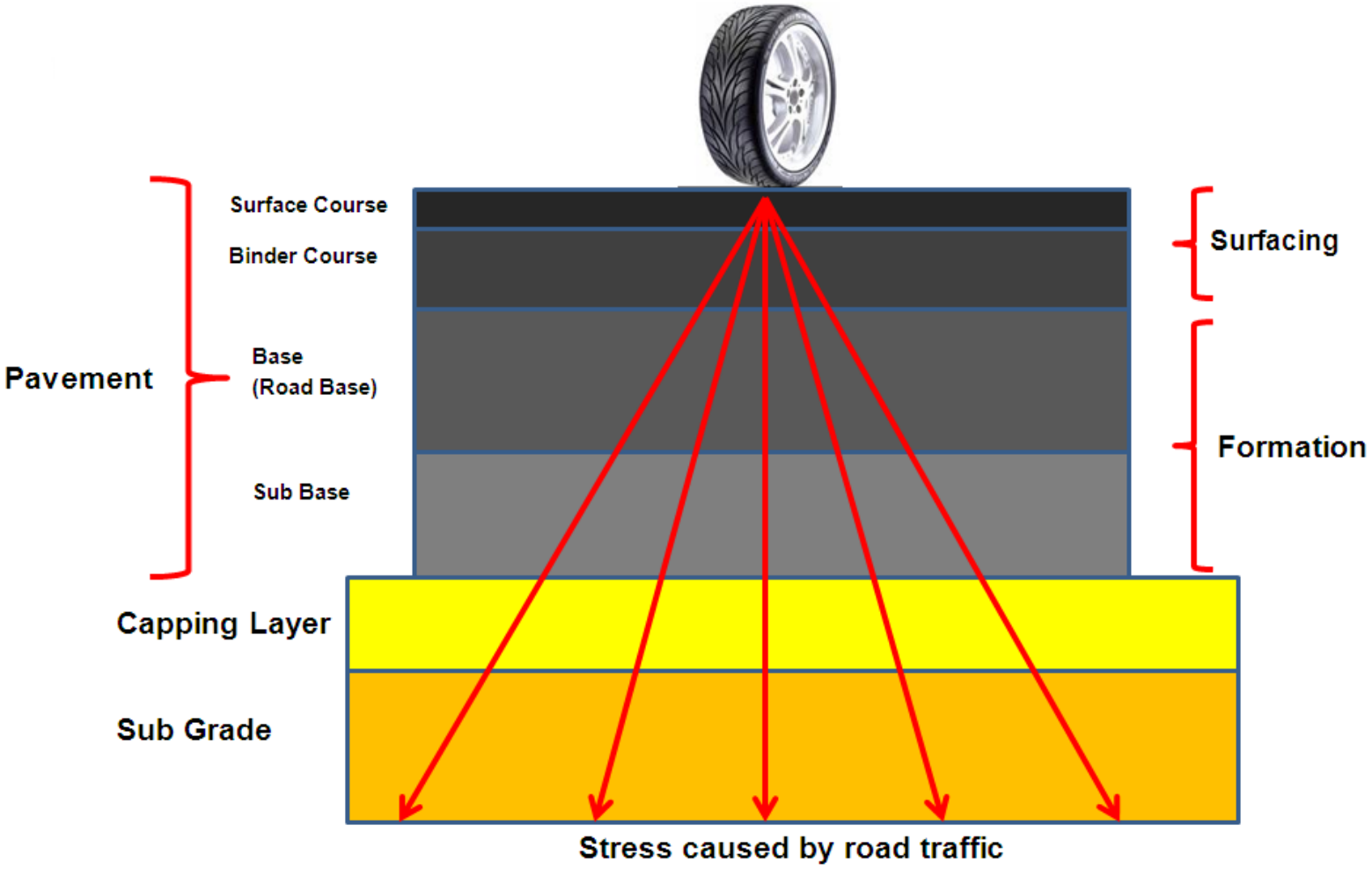
Flexible Pavement



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Products

- Product Development
  - Light Reflective Surfaces
  - Low Temperature Asphalt
    - EN13018, Part 31 – ACBE
- Recycling
  - Recycled Asphalt
  - Crumb Rubber
  - Recycled Plastic

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Light Reflecting Surface

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Light Reflecting Surface

- Suitable aggregate in surface course
- Natural Light reflection
  - Improves night-time and wet weather visibility
  - Reduces lighting requirements (tunnels and lit roads)
  - Reduces surface temperature by up to 10 deg.
- Durable aggregate – not all are suitable
- Blended with other aggregates to improve SRV
- Common practice in Denmark & Germany
- Trial sights needed in UK

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Cost Savings

Development

Road type / 1 km length	Cap ex Savings
Urban motorway, 1 Carriageway	28,000 Euro
Inner-city main road, one-lane	25,000 Euro
Residential street	27,000 Euro

Maintenance

Road type / 1 km	Annual savings on operator costs	Cap ex for Brightening	Amortisation / pay back period
Stadtautobahn	7,800 Euro	11,500 Euro	1,5 years
Inner-city main road, one-lane	6,800 Euro	10,000 Euro	1,5 years
Residential street	1,600 Euro	10,000 Euro	4,7 years

[3]German Report from 2009 by Dr. Hans Meseberg – “Report to identify optimal luminance coefficient q0 of road-surfaces”, Concluded with the following savings by using light reflecting aggregates in the asphalt:

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Low Temperature Asphalt

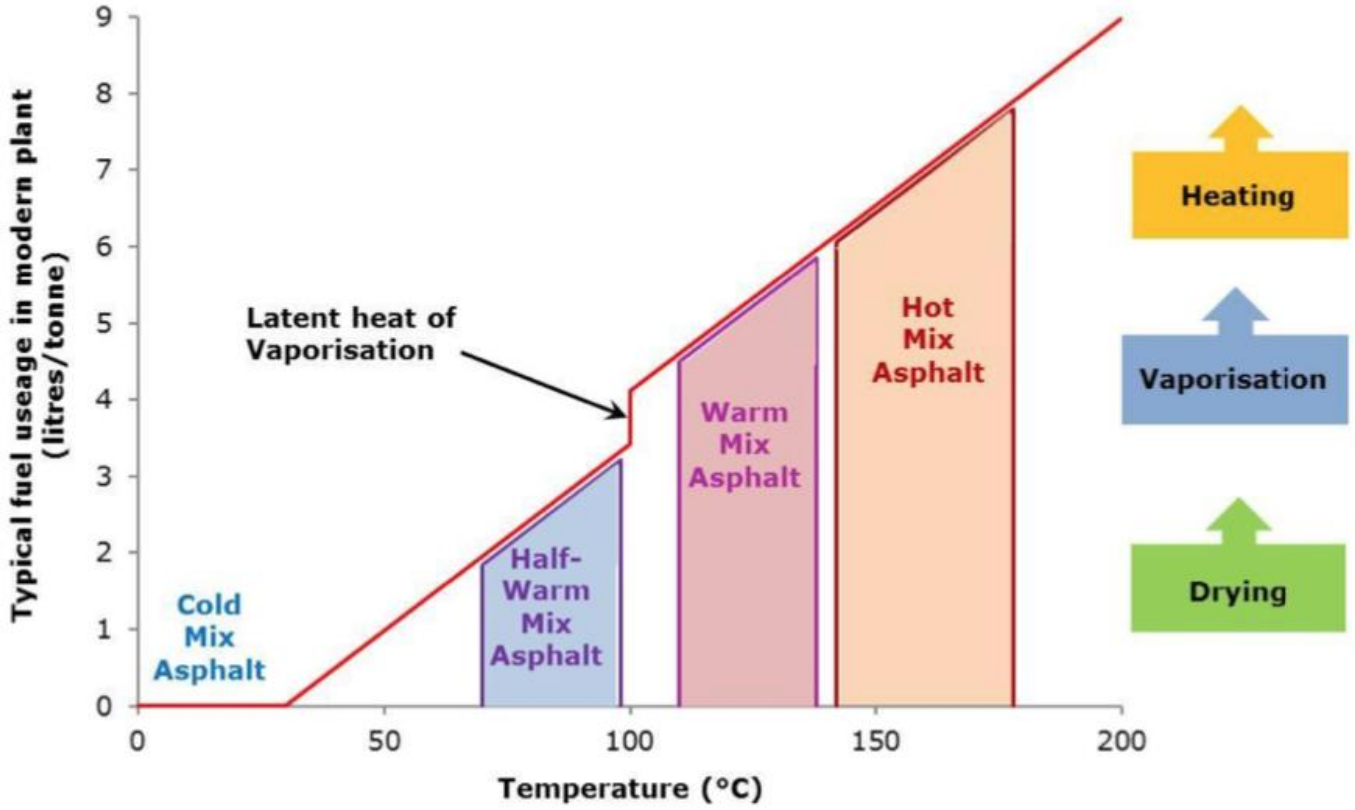

Figure 1.1 - Schematic of classification for hot, warm, half-warm and cold mix asphalt mixtures

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ACBE

- EN 13108 - Part 31; Asphalt Concrete with Bituminous Emulsion
- Currently Draft document
- January 2020??
- emulsion-based cold mix asphalt
  - cold mix asphalt in which the binder is a bituminous emulsion with a viscosity such that the mix is workable at ambient temperature

- Benefits
  - Reduced fuel use
  - Reduced transport costs
  - Reduced fumes
  - Potentially reduced costs
- Challenges
  - Traffic volumes / loading
  - Whole life costs?

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Recycling

- Asphalt is *100% recyclable or reusable in some way*. It can either be recycled back into asphalt or reused as a fill or sub-base material in constructing roads, footways, car parks and similar paved areas.

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Recycling Methods

- Off-site hot recycling - adding reclaimed materials into fresh hot-mixed asphalt (common practice)
- Off-site cold recycling - adding reclaimed materials into fresh cold-mixed asphalt (using bitumen emulsions e.g. Foamix)
- in situ hot recycling - reheating an existing surface, scarifying and, after some processing, re-laying the hot planings either as found or mixed with fresh asphalt (e.g. Remix and Repave)
- in situ cold recycling - as for hot in situ recycling, but using emulsion bitumen (e.g. Re-tread, in situ Foamix)

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Recycled Products

- Crumb Rubber
  - End of life tyres
  - Already used extensively in USA
  - Tarmac launched product on trials with HE and Coventry in 2019
- Recycled Plastic Waste
  - Shredded plastics
  - Mixed with polymer as bitumen additive to extend and modify
  - Number of trials already in UK

Automated Quality Assurance

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The Intelligent Materials Testing Laboratory

Conventional Testing

Site Issues

Quality

Health & Safety

Efficiency

Technology

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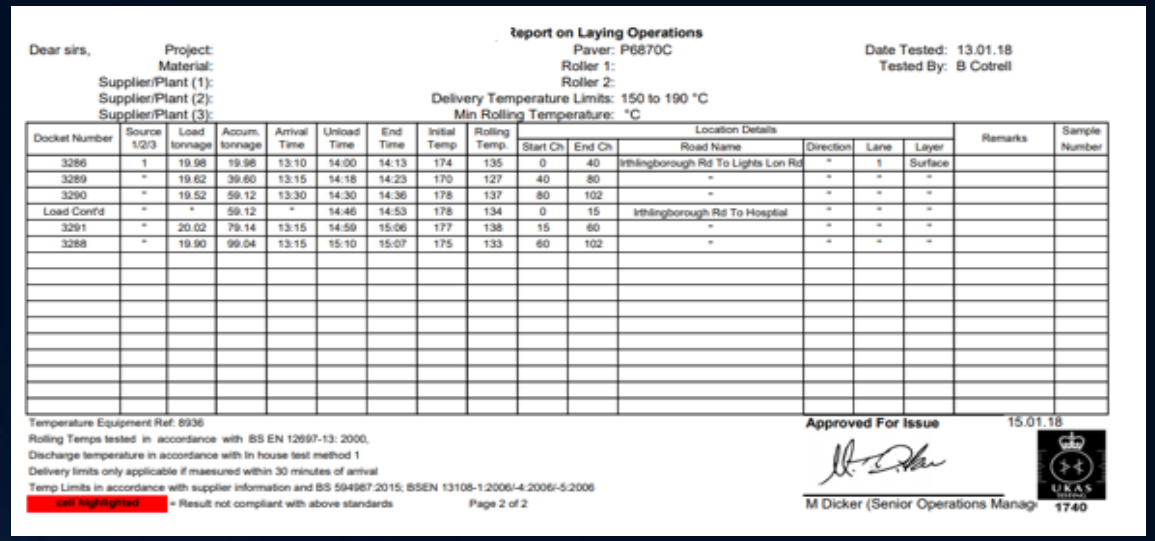
Conventional Testing

Data Issues



Report on Laying Operations

Dear sirs, Project: Material: Supplier/Plant (1): Supplier/Plant (2): Supplier/Plant (3):

Paver: P6870C Roller 1: Roller 2: Delivery Temperature Limits: 150 to 190 °C Min Rolling Temperature: °C

Date Tested: 13.01.18 Tested By: B Cotrell

Docket Number	Source 1/2/3	Load tonnage	Accum. tonnage	Arrival Time	Unload Time	End Time	Initial Temp	Rolling Temp.	Location Details: Start Ch	End Ch	Road Name	Direction	Lane	Layer	Remarks	Sample Number
3286	1	19.98	19.98	13:10	14:00	14:13	174	135	0	40	Irthlingborough Rd To Lights Lon Rd	"	1	Surface		
3289	"	19.62	39.60	13:15	14:18	14:23	170	127	40	80	"	"	"	"		
3290	"	19.52	59.12	13:30	14:30	14:36	178	137	80	102	"	"	"	"		
Load Cont'd	"	"	59.12	"	14:46	14:53	178	134	0	15	Irthlingborough Rd To Hosptial	"	"	"		
3291	"	20.02	79.14	13:15	14:59	15:06	177	138	15	60	"	"	"	"		
3288	"	19.90	99.04	13:15	15:10	15:07	175	133	60	102	"	"	"	"		

Temperature Equipment Ref: 8936

Rolling Temps tested in accordance with BS EN 12697-13: 2000.

Discharge temperature in accordance with In house test method 1

Delivery limits only applicable if maesured within 30 minutes of arrival

Temp Limits in accordance with supplier information and BS 594987:2015; BSEN 13108-1:2006/-4:2006/-5:2006

cell highlighted = Result not compliant with above standards

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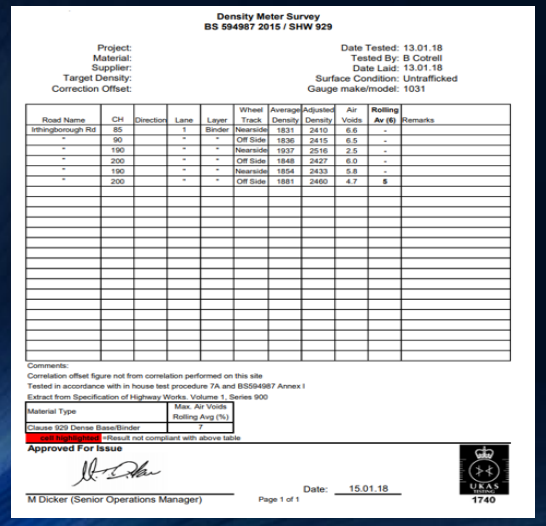
Approved For Issue 15.01.18

M Dicker (Senior Operations Manag

UKAS TESTING 1740



Density Meter Survey
BS 594987 2015 / SHW 929

Project: Material: Supplier: Target Density: Correction Offset:

Date Tested: 13.01.18 Tested By: B Cotrell Date Laid: 13.01.18 Surface Condition: Untrafficked Gauge make/model: 1031

Road Name	CH	Direction	Lane	Layer	Wheel Track	Average Density	Adjusted Density	Air Voids	Rolling Av (6)	Remarks
Irthingborough Rd	85		1	Binder	Nearside	1831	2410	6.6	-	
"	90		"	"	Off Side	1836	2415	6.5	-	
"	190		"	"	Nearside	1937	2516	2.5	-	
"	200		"	"	Off Side	1848	2427	6.0	-	
"	190		"	"	Nearside	1854	2433	5.8	-	
"	200		"	"	Off Side	1881	2460	4.7	5	

Comments:

Correlation offset figure not from correlation performed on this site

Tested in accordance with in house test procedure 7A and BS594987 Annex I

Extract from Specification of Highway Works. Volume 1, Series 900

Material Type	Max. Air Voids Rolling Avg (%)
Clause 929 Dense Base/Binder	7

cell highlighted =Result not compliant with above table

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M Dicker (Senior Operations Manager) Date: 15.01.18

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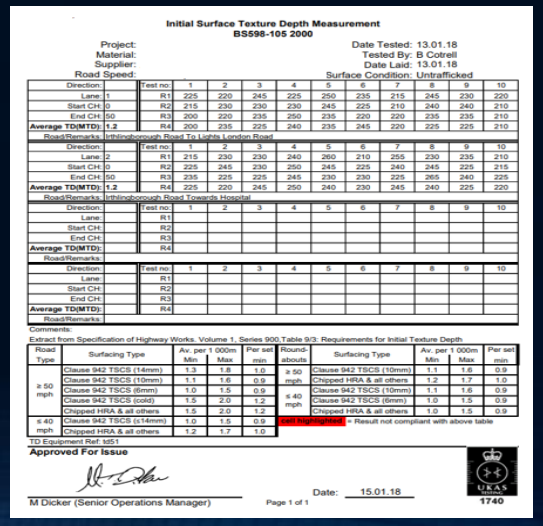

Initial Surface Texture Depth Measurement
BS598-105 2000

Project: Material: Supplier: Road Speed:

Date Tested: 13.01.18 Tested By: B Cotrell Date Laid: 13.01.18 Surface Condition: Untrafficked

Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:	1	R1	225	220	245	225	250	235	215	245	230	220
Start CH:	0	R2	215	230	230	230	245	225	210	240	240	210
End CH:	50	R3	200	220	235	250	235	220	220	235	235	210
Average TD(MTD):	1.2	R4	200	235	225	240	235	245	220	225	225	210
Road/Remarks:	Irthlingborough Road To Lights London Road											
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:	2	R1	215	230	230	240	260	210	255	230	235	210
Start CH:	0	R2	225	245	230	250	245	225	240	245	225	215
End CH:	50	R3	235	225	225	245	230	230	225	265	240	225
Average TD(MTD):	1.2	R4	225	220	245	250	240	230	245	240	225	220
Road/Remarks:	Irthlingborough Road Towards Hospital											
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:		R1										
Start CH:		R2										
End CH:		R3										
Average TD(MTD):		R4										
Road/Remarks:												
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:		R1										
Start CH:		R2										
End CH:		R3										
Average TD(MTD):		R4										
Road/Remarks:												

Comments:

Extract from Specification of Highway Works. Volume 1, Series 900,Table 9/3: Requirements for Initial Texture Depth

Road Type	Surfacing Type	Av. per 1 000m Min	Av. per 1 000m Max	Per set min	Round-abouts	Surfacing Type	Av. per 1 000m Min	Av. per 1 000m Max	Per set min
≥ 50 mph	Clause 942 TSCS (14mm)	1.3	1.8	1.0	≥ 50 mph	Clause 942 TSCS (10mm)	1.1	1.6	0.9
	Clause 942 TSCS (10mm)	1.1	1.6	0.9		Chipped HRA & all others	1.2	1.7	1.0
	Clause 942 TSCS (6mm)	1.0	1.5	0.9	≤ 40 mph	Clause 942 TSCS (10mm)	1.1	1.6	0.9
	Clause 942 TSCS (cold)	1.5	2.0	1.2		Clause 942 TSCS (6mm)	1.0	1.5	0.9
	Chipped HRA & all others	1.5	2.0	1.2		Chipped HRA & all others	1.0	1.5	0.9
≤ 40 mph	Clause 942 TSCS (≤14mm)	1.0	1.5	0.9	cell highlighted = Result not compliant with above table				
	Chipped HRA & all others	1.2	1.7	1.0					

TD Equipment Ref: td51

Approved For Issue

M Dicker (Senior Operations Manager) Date: 15.01.18

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UKAS TESTING 1740

- Siloed
- Unengaging
- Stored poorly
- Not searchable
- Not interrogatable

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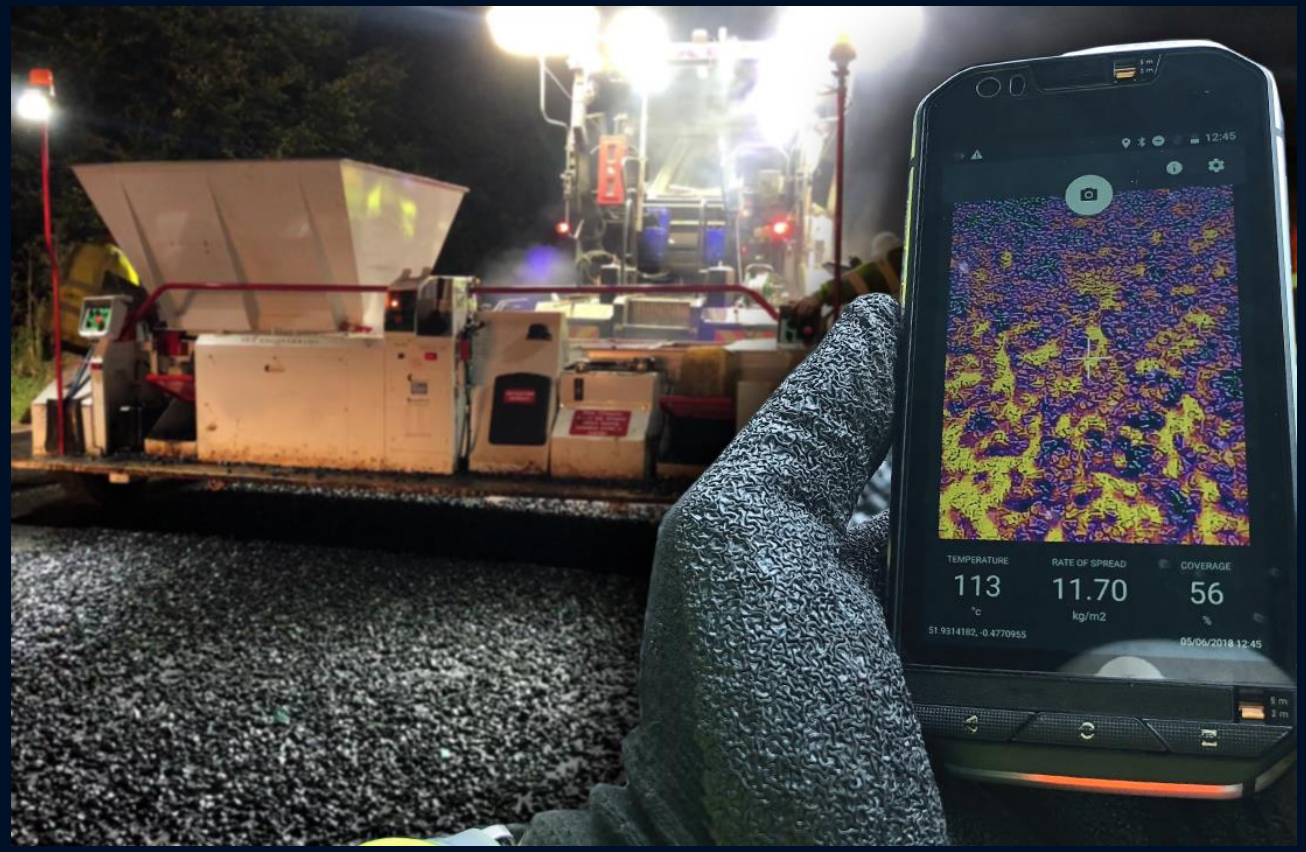
HDS Innovations

The Rate of Spread App



Correlates directly to trays

HSE Improvements

GPS accuracy

Gives results in % coverage

Texture

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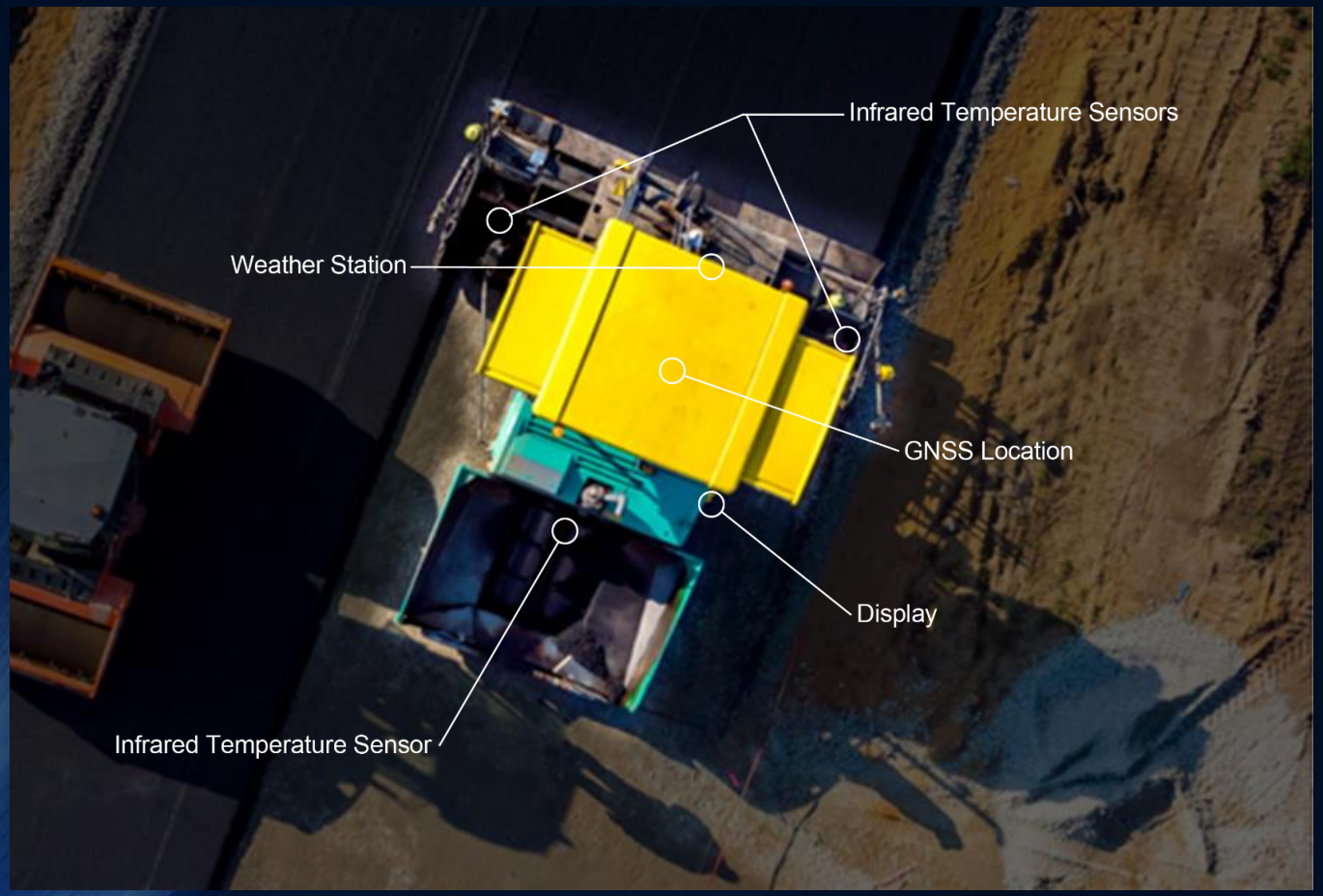
How is automated quality assurance data collected?

Paver instrumentation



Average of temperatures

Constant environmental recording

GPS accuracy

On-site data presentation

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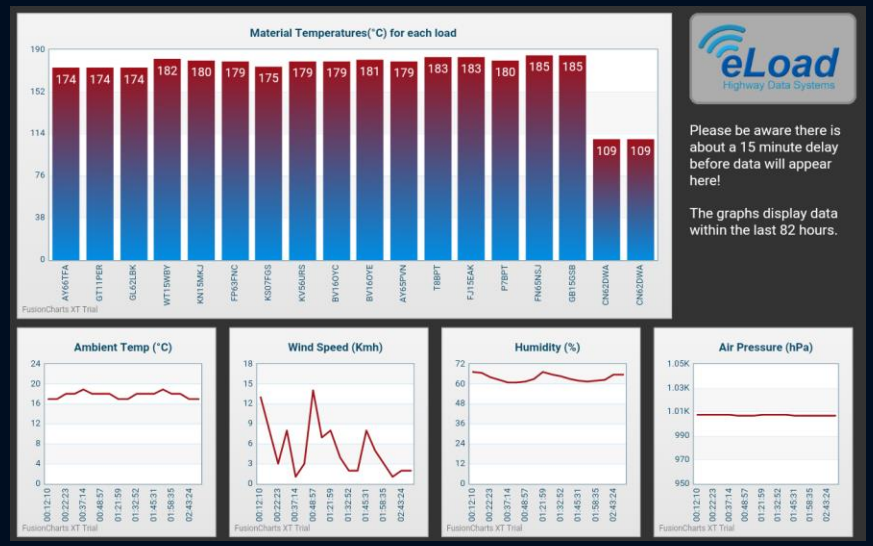
How is automated quality assurance data collected?

eLoad



Easy to operate

Promotes better material flow

Helps the gang

Temperatures

Environmental information

Room for comments

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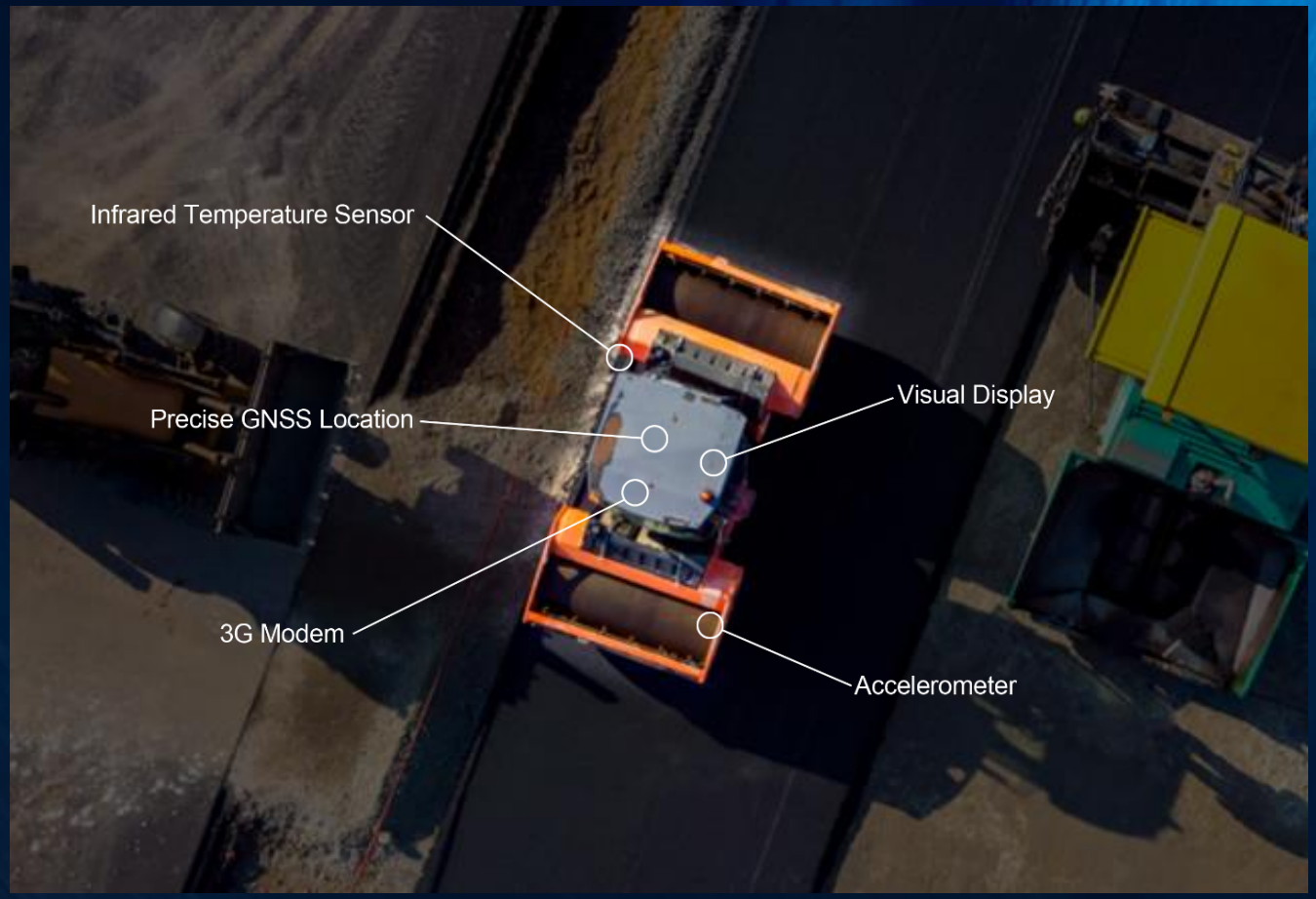
How is automated quality assurance data collected?

Roller instrumentation



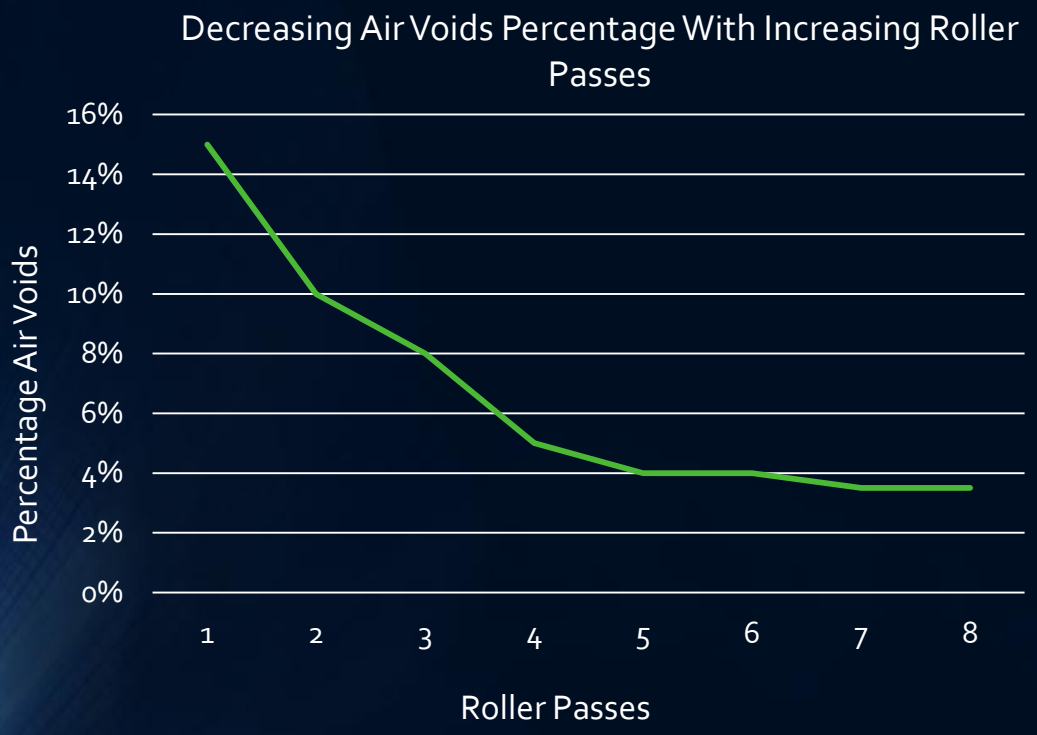
Constant temperature monitoring

GPS accuracy

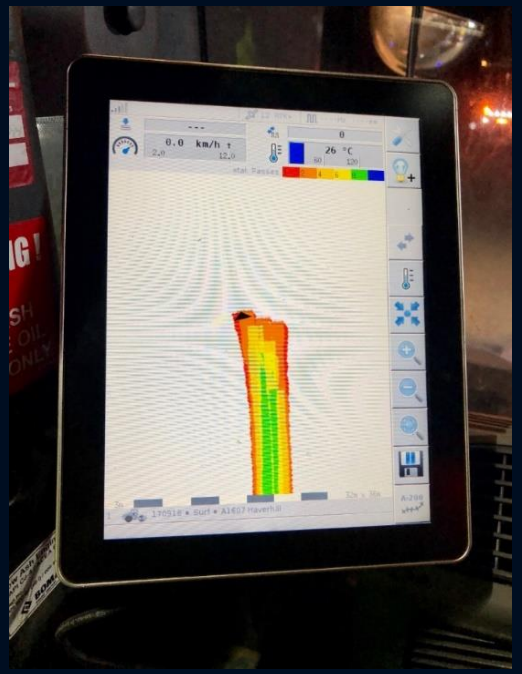
On-site data presentation

How is automated quality assurance data collected?

Roller calibration



Roller driver view



The US Federal Highway Administration and 26 state Departments of Transport have written Intelligent Compaction specifications.

The Public Works Authority of Qatar, Ashghal, (KBR and PB) uses a method compaction specification.

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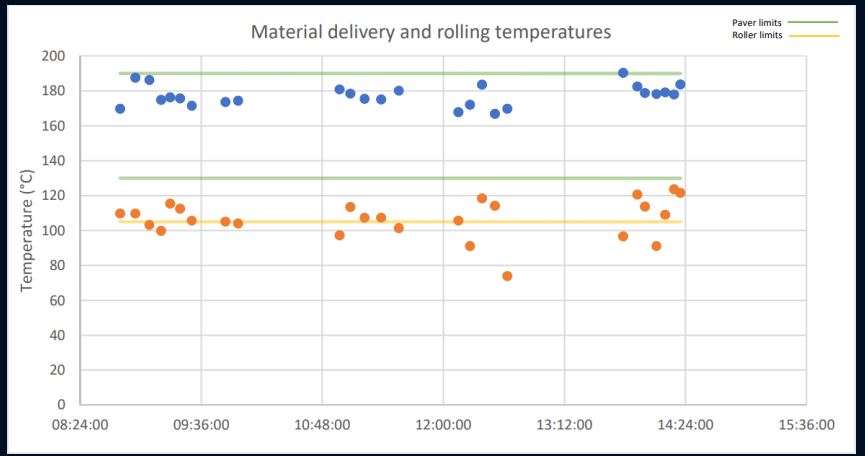
How is automated quality assurance data represented?

Laying records

Site	Client	JobNo	Date	Paver ID	Ticket ID	Registration	Plant	Product Code	Material	Tonnage	Load Time
x	x	27875830	2018-04-06	BARTEC01	GBV108-IGN-3	AY66TGO	x	8634H	x	19.8	2018-04-06 23:20:00
x	x	27875830	2018-04-06	BARTEC01	GBV108-IIA-3	KP13MHY	x	8634H	x	19.68	2018-04-06 23:27:00
x	x	27875830	2018-04-06	BARTEC01	GBV108-IEU-3	AB65ASB	x	8634H	x	19.54	2018-04-06 23:26:00
x	x	27875830	2018-04-06	BARTEC01	GBV108-IBH-3	AY18LWR	x	8634H	x	19.98	2018-04-06 23:42:00
x	x	27875830	2018-04-06	BARTEC01	GBV108-IEA-3	KY12LZK	x	8634H	x	19.8	2018-04-06 23:46:00
x	x	27875830	2018-04-07	BARTEC01	GBV108-IQJ-3	KY61JZU	x	8634H	x	20.04	2018-04-07 00:03:00

Time at Paver	Latitude / Easting	Longitude / Northing	Distance (m)	Material Temp (°C)	Rain / Humidity	Air Temperature (°C)	Air Pressure (hPa)	Wind Speed (km/h)	Rolling Temperature (°C)	Roller Passes (Average)	Comments
2018-04-07 00:23:16	52.6562834	-1.8908025	59	163	75	5	989	6	102	6	NA
2018-04-07 00:32:49	52.6562917	-1.8900578	122	166	75	6	989	5	103	11	NA
2018-04-07 00:40:34	52.6562489	-1.8908022	185	161	75	5	989	3	107	4	NA
2018-04-07 01:03:55	52.6562623	-1.8899054	248	171	73	7	989	6	102	10	NA
2018-04-07 01:10:28	52.6562752	-1.8891124	311	171	73	6	989	4	104	13	NA
2018-04-07 01:24:32	52.6563084	-1.8884323	374	165	75	6	989	3	113	13	NA



Very similar to current records

GPS rather than chainages

Roller passes

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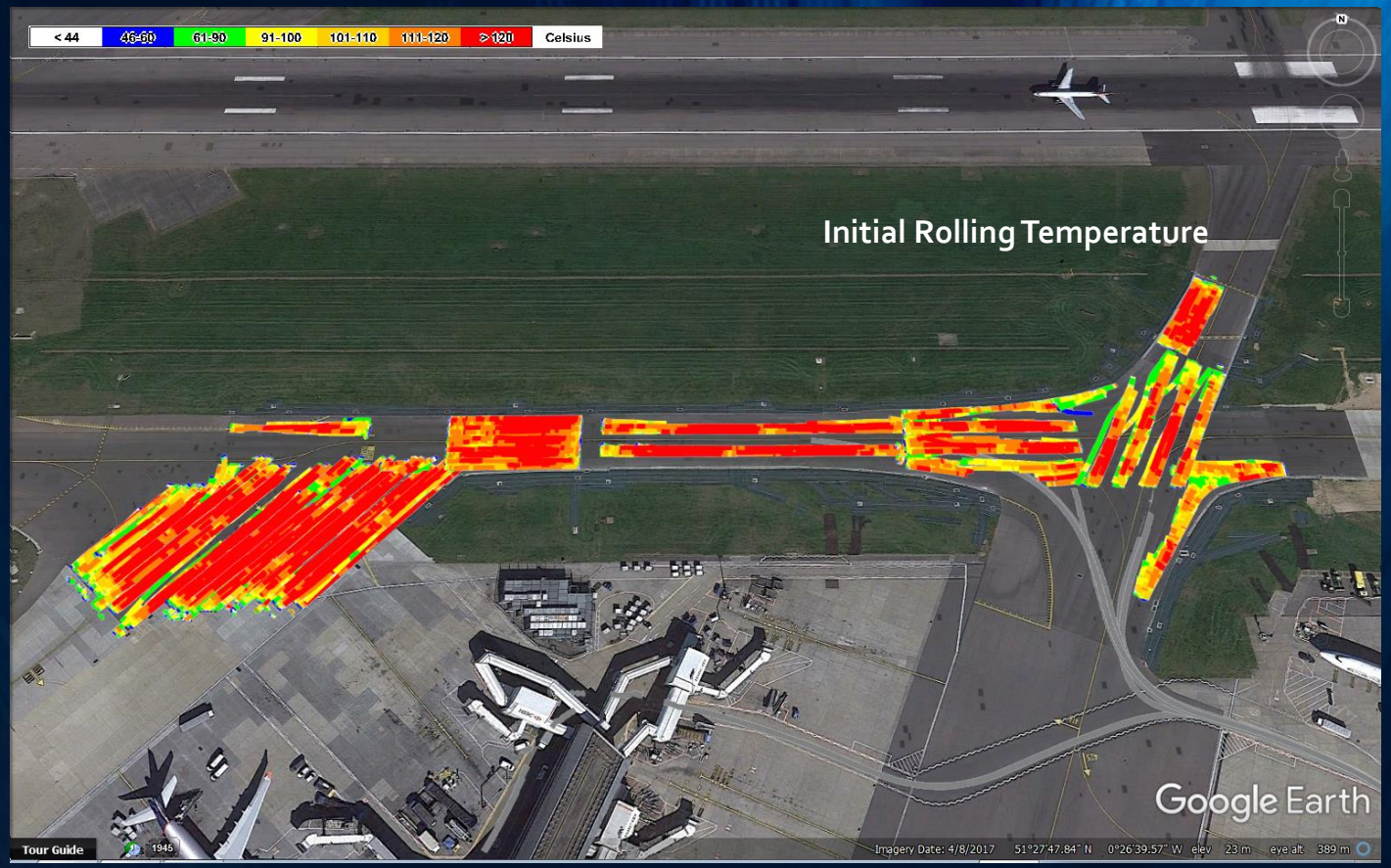
How is automated quality assurance data represented?

Getting the most from the data



Much larger data sets

Comparable and relatable data

Engaging and usable

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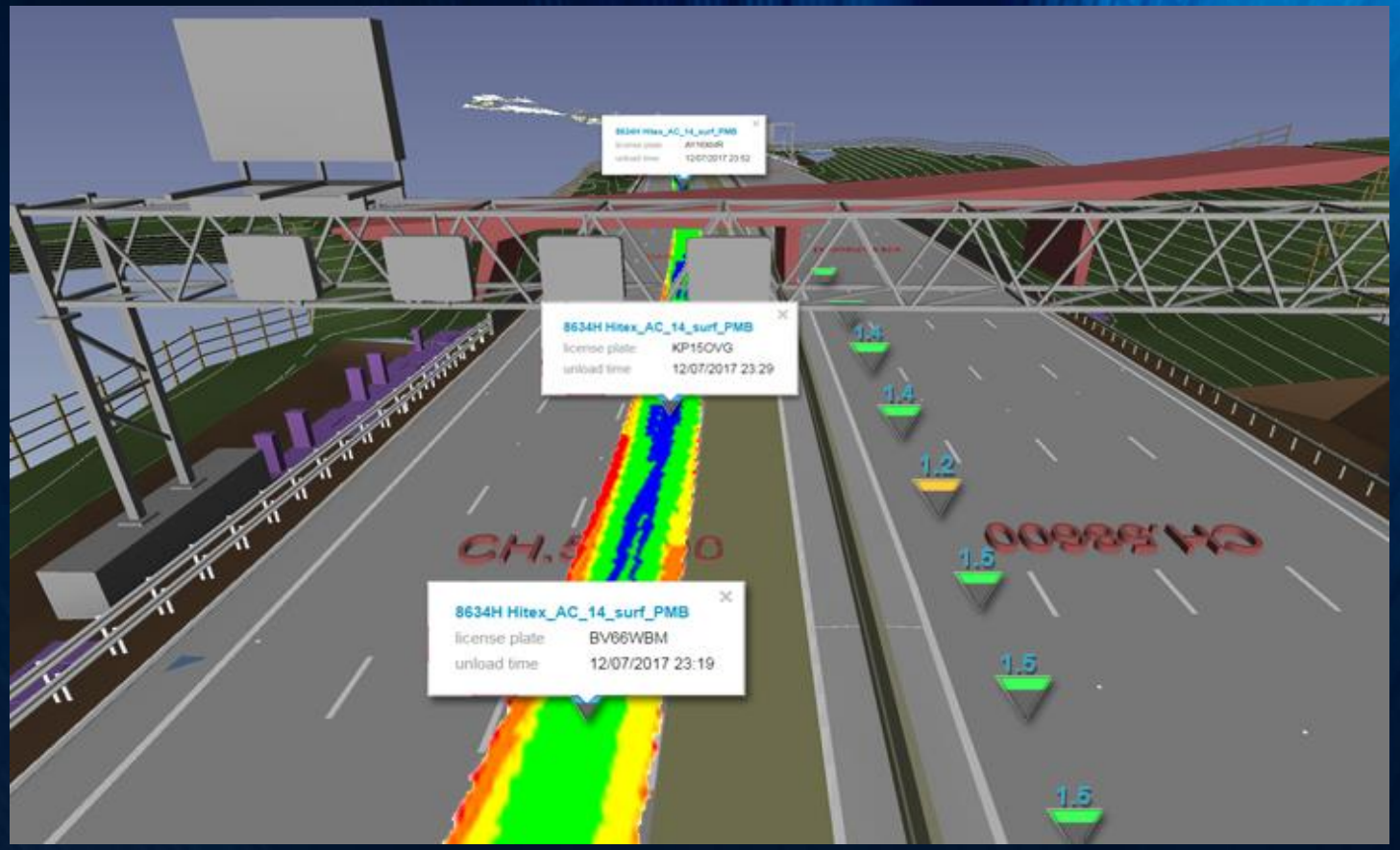
How is automated quality assurance data represented?

BIM



Layered data

Integrable data

BIM applicable

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How is automated quality assurance data represented?

Asset management systems

QA data used as an asset management tool

Use in deterioration modelling

Useful for recycling high-value material

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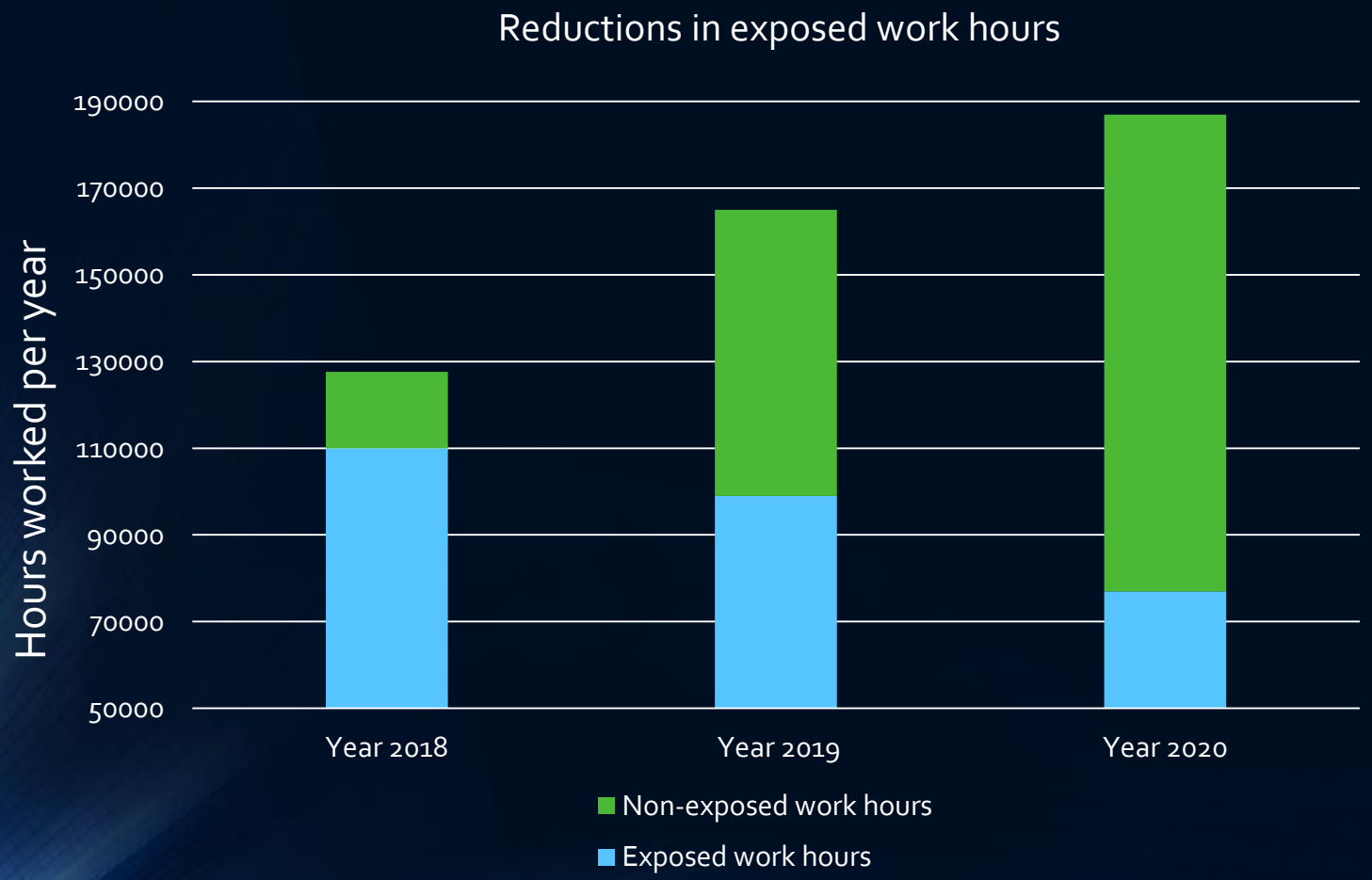
What potential benefits are there from improvement?

Health and safety



Year	2018	2019	2020
Exposed work hours	110000 (50)	99000 (45)	77000 (35)
Non-exposed work hours	17600 (8)	66000 (30)	110000 (50)

MATtest/HDS worker allocation and projection, August 2018

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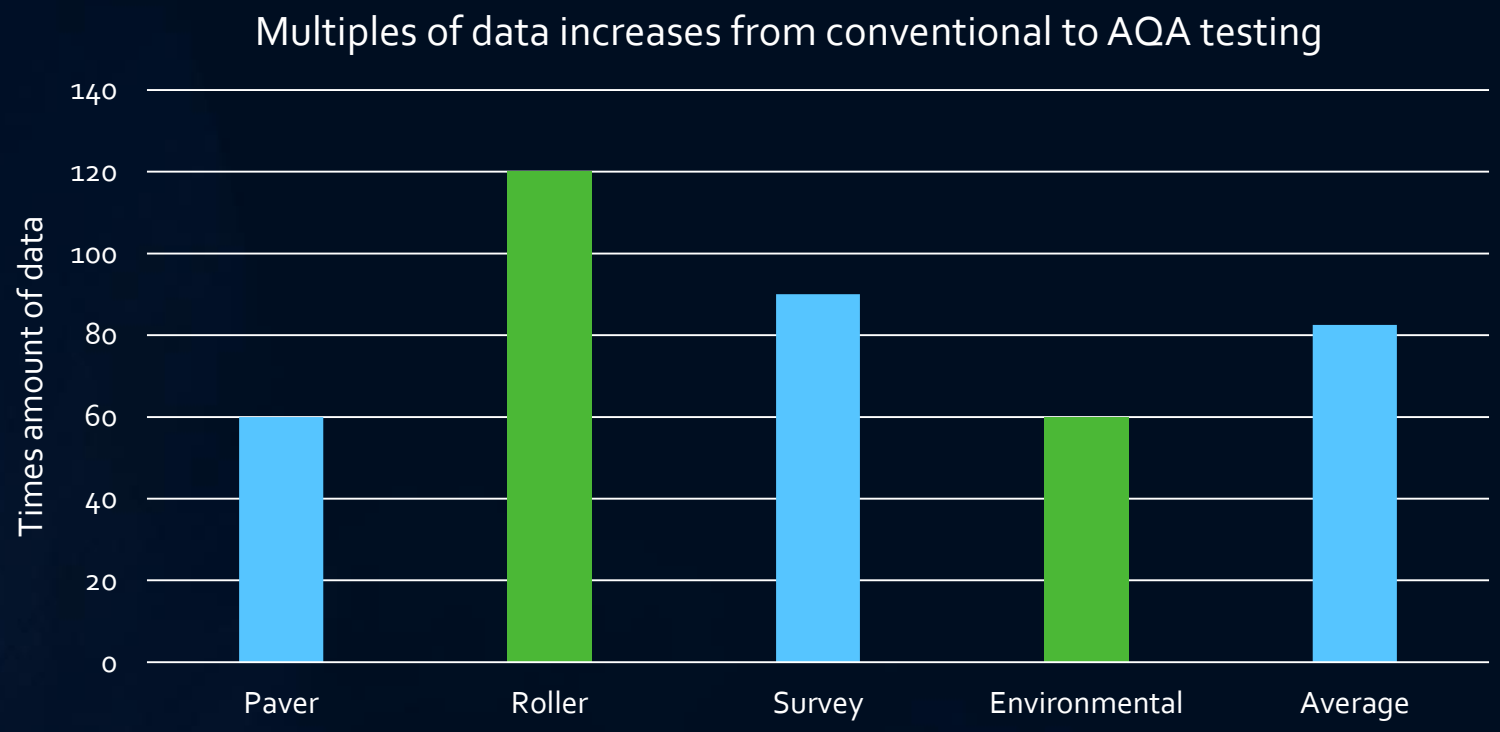
What potential benefits are there from improvement?

Data capture



"There are clear advantages technically, practically, in efficiency and from a safety perspective with all the new methodologies tested within this trial"

WSP: "Automatic Data Collection Review – Systems and Methodology" March 2018

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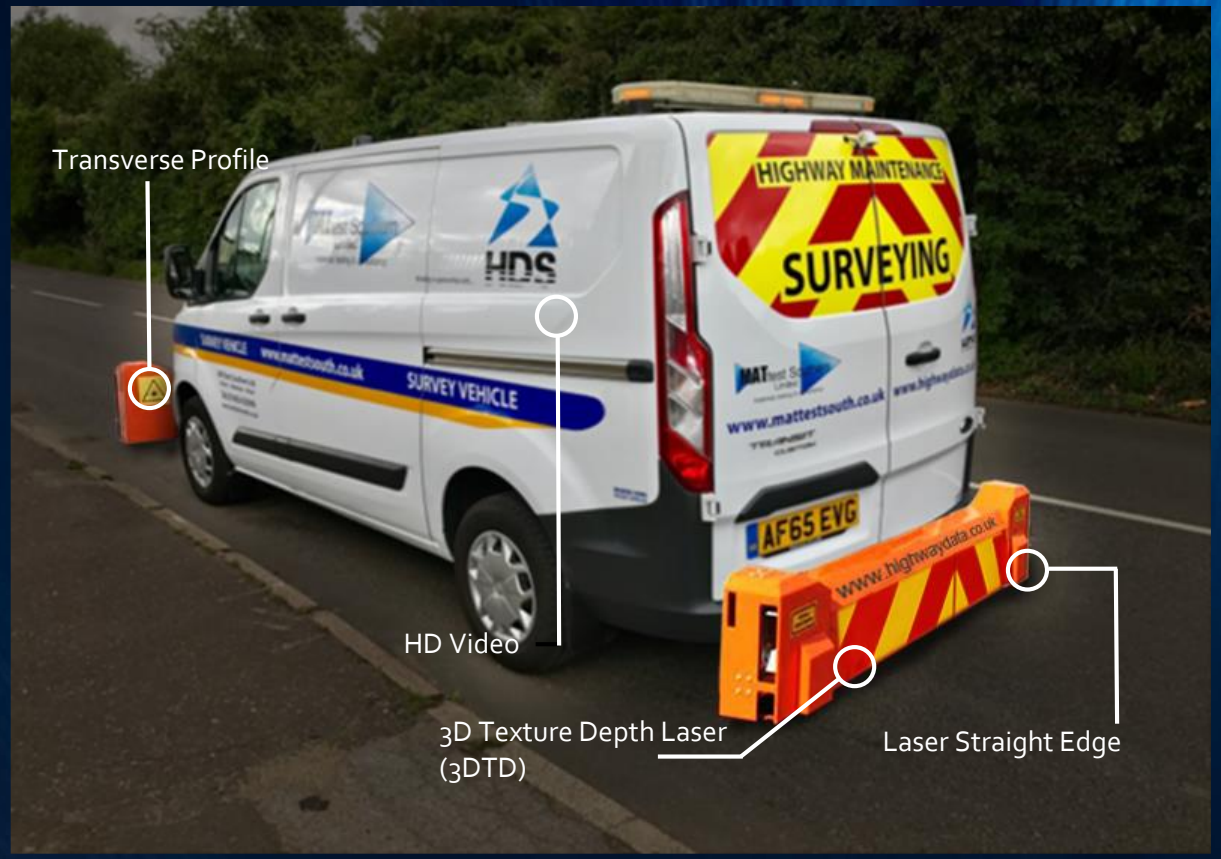
How is automated quality assurance data collected?

Laser surveying



No more hazardous working

GPS and time stamped

Traffic speed surveying

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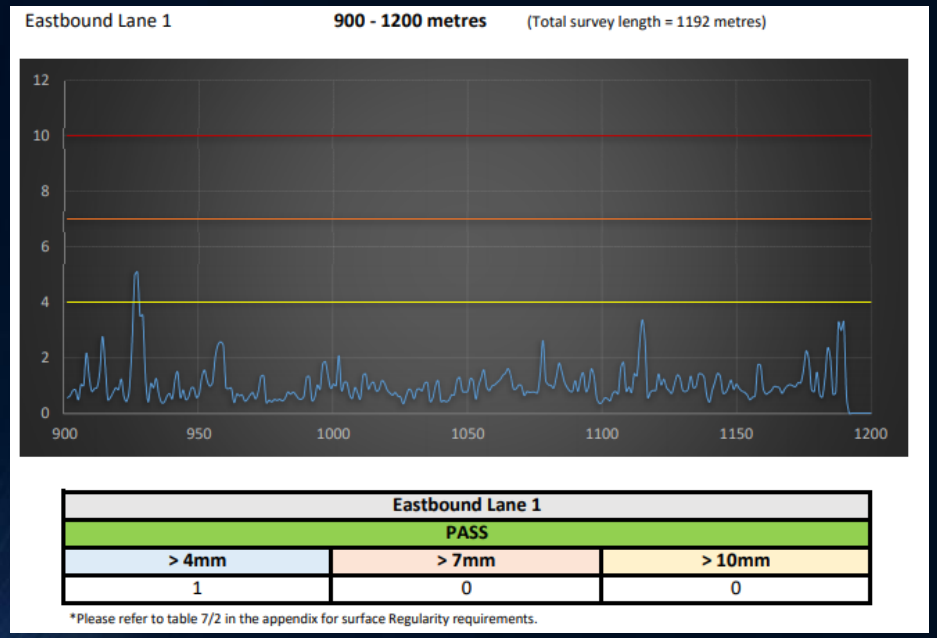
How is automated quality assurance data represented?

Surface regularity and surface macrotexture



Eastbound Lane 1		
PASS		
> 4mm	> 7mm	> 10mm
1	0	0

*Please refer to table 7/2 in the appendix for surface Regularity requirements.

Same investigation levels as conventional testing

GPS instead of chainages

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Low Volume Asphalt

In-situ Low Volume Asphalt

- Identifying the problem
- The solution
- The Process
- Benefits of LVA

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What is In-situ LVA?

- In-situ hot asphalt, conforming to all relevant material specifications

  EN 13108/PD6691/SHW/ SROH

- First developed between 2012-14

- Used in conjunction with mobile low volume asphalt heaters

- 0.25t, 0.5t, 1t. asphalt on demand

- All grades available

  AC6/AC10/HRA/SMA

- Highways UK Innovation award winning product for efficiency in materials(Armaphalt)

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The Process for In-situ LVA

- Load tools & bags of Low Volume Asphalt
- Travel to site
- Load LVA (eg. Armaphalt) into low volume asphalt heater
- Discharge heated material into wheelbarrow or directly into patch.
- Reinstate area
- Head to next to site

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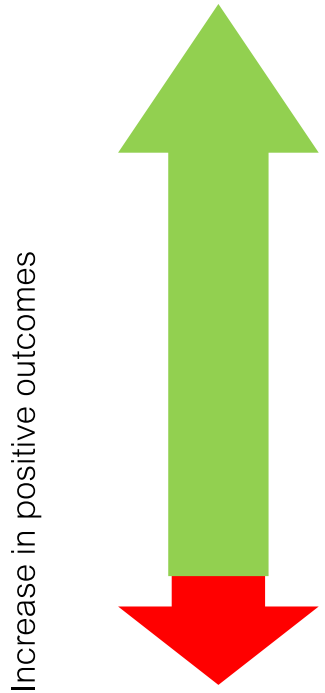
Outcomes of using LVA

- Decrease in costs
- Decrease in time spent on site
- Decrease in delays/inconvenience/disruption for public
- ZERO production of waste
- Decrease in carbon footprint
- Right first time
- Increase in quality
- Increase in productivity/efficiency
- Increase in longevity of repairs
- Overall increase in sustainability



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MATERIALS INNOVATION HUB 2018

IN ASSOCIATION WITH

mpa essential materials sustainable solutions

EFFECIENCY OF PAVEMENT MATERIALS CATEGORY WINNER

A PART OF Highways UK ROADS FOR A MODERN BRITAIN

ARMAPHALT - ITS A WINNER!

The materials you want, when you want it, exactly where you want it.

Contact us today for more information on our award winning Armaphalt

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Mastic Asphalt

- EN 13108 – Part 6
- Used extensively in ROI
  - Retrospective rising of Ironworks after resurfacing
  - Ironwork repairs
  - Patching repairs
- Heated on site in quantities as required
- Durable and waterproof
- No need for rollers or large pieces of plant on site.
- No travelling to or waiting at Asphalt plant
- Left over material can be re-cycled

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Mastic Boilers

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Laying Mastic

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Gully Reinstatement

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Manhole Reinstatement

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Competence

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What is Competence?

- Competence can be described as the combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely. Other factors, such as attitude and physical ability, can also affect someone's competence. – HSE

- The person is regarded as competent if they have 'sufficient training and experience or knowledge and other qualities to properly assist the employer to meet his safety obligations.' – Zurich

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Competence -v- Training

Competence

- Attribute
- Combination of
  - practical and theoretical knowledge
  - skills
  - experience
- To improve performance

Training

- Process
  - educating
  - developing skills
  - maintain / update knowledge
- Specific goals of improving capability, capacity, productivity and performance

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Why?

- The **Health and Safety at Work etc Act 1974** requires you to provide whatever information, **instruction, training and supervision** as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of your employees.

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Why is Competence important?

- SHW – Clause 104 – NHSS
- Sector Schemes all contain Competency requirements
- Appendix C

- DMRB
  - Volume 0, Section 2, Part 1
  - GG 102 – Quality Management System for Highway Works
  - Version 0, May 2019
  - Numerous references and requirement for "Competence"

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NHSS

- Quality Management schemes specific to Highways sector
- Extension of ISO9001:2015
- Compliance required by Specification of Highway Works (SHW)
- Appendix C – Training & Competence Assessment
- Scheme 0 – Intro & Guidelines to NHSS

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NHSS (off-highway)

- 3 – Mechanical Fasteners
- 3B - Structural Steel
- 4 – Treatment of Timber
- 5A – Manufacture of Parapets for Road Restraint Systems
- 6 – Minor Structures
- 9A – Road Traffic Signs
- 19A – Corrosion Protection
- 20 – Steelwork in Infrastructure Assets

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NHSS (on-highway)

- 2A – Fencing
- 2C – Environmental Barriers
- 6 – Minor Structures
- 7 – Road Markings & Road Studs
- 8 – Highway Electrical Equipment
- 10B/C – Permanent Vehicle Restraint (inc 2B & 5B)
- 12A/B – Static TTM on Motorways and Dual c/ways
- 12C – Mobile Lane Closures
- 12D – TTM on Rural and urban roads
- 13 – Surface Treatments

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NHSS (on-highway …contd.)

- 16 – Laying Asphalt
- 17/17B – Vehicle Recovery
- 18 – Natural Environment & Landscaping
- 19A – Corrosion Protection
- 20 – Steelwork in Infrastructure Assets
- 22 – Road Tunnels
- 23 – Small Scale Pavement Repairs
- 29A – Geotechnical Drilling
- 30 – Modular Paving

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NHSS 8 – Appendix C

Qualified Supervisor

A Qualified Supervisor can supervise work within the scope of their own knowledge and competence.

MINIMUM TECHNICAL QUALIFICATIONS	Qualified Supervisor Experience Levels	
CBQ-NVQ Level 2 or equivalent in Highway Electrical Systems plus successful completion of the HERS Administrator's (HEA) Qualified Supervisor's course and required updates.	Route 1	Sufficient Initial and Continuing Professional development to show competence (This does not have a minimum time period, as it is the outcome which is measured. It would be unusual however for anyone with less than three years' experience to have attained the breadth and depth of competence required)
	Route 2	Sufficient Initial and Continuing Professional development to show competence (This does not have a minimum time period, as it is the outcome which is measured. It would be unusual however for anyone with less than two years post qualification experience to have attained the breadth and depth of competence required) and holding a qualification at a higher level than the required entry level.

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NHSS 12d – Appendix C

(06/17) 1.3 **TABLE C1 – SUMMARY OF TRAINING AND ASSESSMENT MODULES**

MODULE/ TRAINING	TYPE OF ROAD WORKS	PURPOSE OF COURSE	TRAINING COURSE	SITE ASSESSMENT	REFRESHER TRAINING
TTMBC (as of 01 April 2018)	All	Basic training in TTM	TTMBC (0.5 Day) includes test paper	Nil	Full course Failure to progress to M1 will result in the TTMBC having to be renewed every 6 months
M1	Mobile and Short-Duration Works up to 15 minutes on Single Carriageways	For candidates requiring MWO status	T1 (0.5 Day) includes test paper Note: other training may also be required e.g. equipment competency and environmental awareness	Nil	To be introduced April 2019
M2	Short-Duration Works between 15 and 60 minutes (between 15 and 30 minutes in Scotland) and Static works including the use of positive traffic control	For candidates requiring RTMO status	Must achieve M1 first T2 (0.5 Day) includes test paper followed by a 1-day Centre based assessment (Recorded in Log Book)	Units 1 to 9 NOTE: For organizations who do not use temporary traffic signals, the assessment of those operative will not include Unit 7 (temporary traffic signals) of the logbook	To be introduced April 2019
M3	Dual carriageways restricted to 40 mph or less	Optional module for RTMO's (holding Modules M1 & M2)	T3 (0.5 Day) includes test paper Note1: Module 3 does not include contraflow works, 12A/B training required. Note 2: holders of 12A/B Smart Skills Registration Card who have completed 12D modules M1 and M2 are automatically qualified (must be applied for)	Unit 11	To be introduced April 2019
M4	Convoy Working on all categories of roads excluding motorways.	Optional module for RTMO's (holding Modules 1 & 2)	T4 (0.5 Day) includes test paper Note: For convoy operations on high speed dual carriageways the Static TM shall be carried out by 12A/B qualified personnel	Unit 12*	To be introduced April 2019
M5	Multi-Phase Traffic Signals	Optional module for RTMO's (holding Modules 1 & 2)	T5 (1 day) includes test paper and Centre based assessments	Unit 13	To be introduced April 2019 Refresher 0.5 day training only.

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Evidence of Competence

- Card Schemes - Many
  - Not Legislative requirement
- Smart Cards
  - Technological advance
  - Recent changes / withdrawals led to confusion
- Audits
  - Training records
  - Portfolios of evidence

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Questions?

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- www.instituteofasphalt.org/index.php?id=videos