Part 4 A

Supervising paving for road and footway works

What you need to know before work starts re materials to be used

Documents relating to asphalt paving

1. BS doc, PD6691, The guide to specifying asphalt

2. BS594987, Transport, laying and compaction

3. The Specification for Highway Works, 900 series clauses and the associated Notes for Guidance, both in HE's Design Manual.

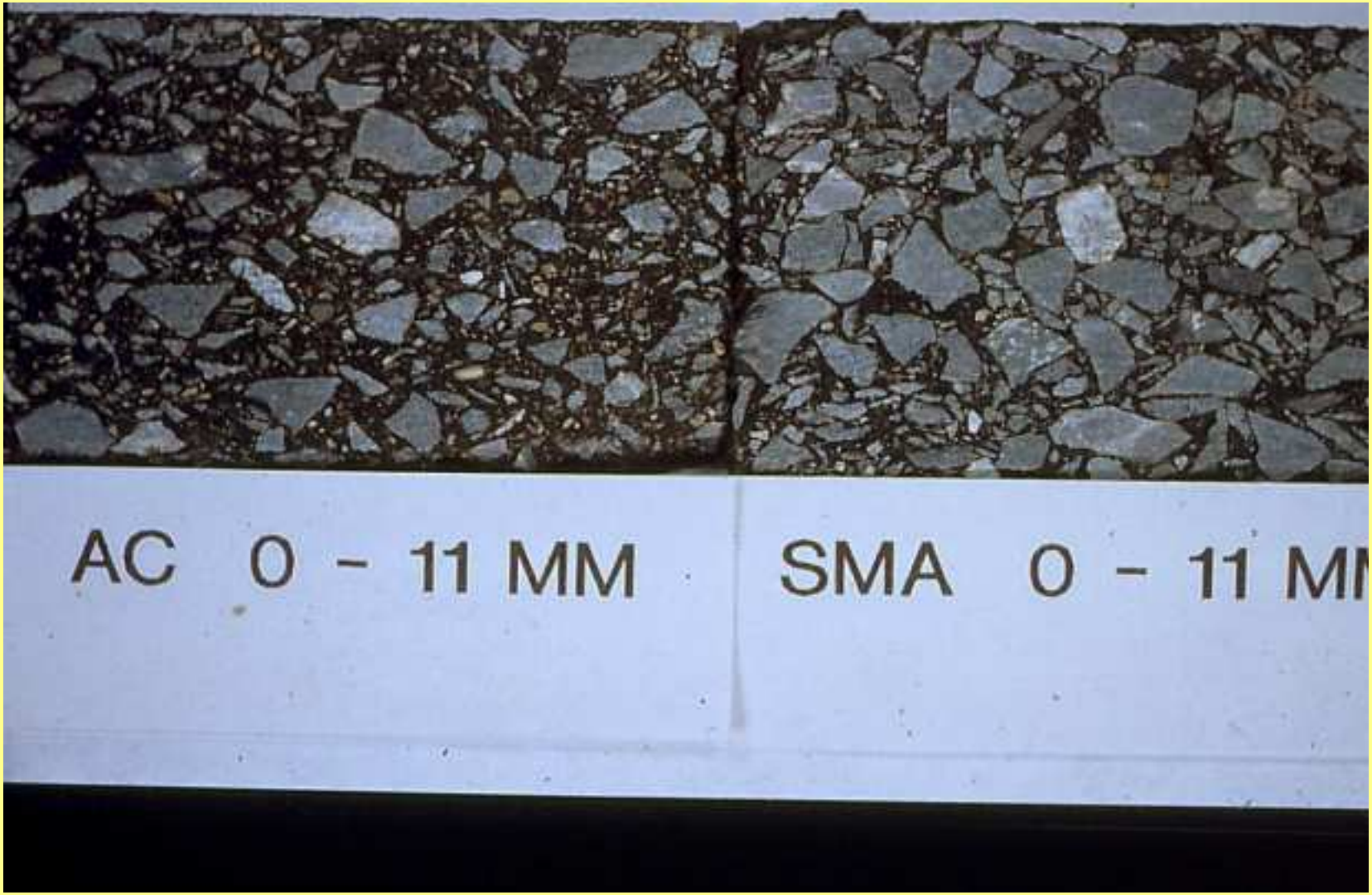
Each asphalt to be used on the job will be summarised in Appendix 7/1 of the contract.

It will also refer to either or both the Highways England (HE) Specification for Highway Works (SHW) and the British Standard Published Document PD6691.

Relevant extracts from both are shown on the following slides.

British Standard mix constituents

German, **ie real** SMA, shown with a Dense AC.



What pavement layer is to be laid ?

The BASE layer. The stiffest load spreading element of the road pavement. If it is laid directly onto the sub-base, this should have a minimum CBR of 30%

What asphalt mix? **AC32 Dense**?
40/60pen? Max temp 190C Min rolling temp 105C
100/150pen? Max temp 170C Min rolling 70C

How thick can each layer be? 70mm min, 120mm max

Is there a specified maximum air voids?
Should ideally be HE Spec, Clause 929, max. 7%

For both base and binder course mixtures SHW Clause 929 requires that ...

Mixtures with 40/60 grade binder shall conform to category Smin 1800 MPa as defined in BS EN 13108-1, clause 5.4.2.

Mixtures with 30/45 grade binder shall conform to category Smin 2800 MPa as defined in BS EN 13108-1, clause 5.4.2.

(Wheel tracking resistance may also be specified, see notes.)

The average in situ air voids for each core pair shall not exceed 7%.

AC 32 dense base (*AC 20 dense binder is similar but thinner)*
Aggregate interlock makes it very resistant to deformation under very heavy or channelised traffic if compacted to max. 7% voids.

Or **HRA Base**. This is very easy to compact because it has more bitumen than the equivalent Asphalt Concrete. It tends to be used it where real life ground conditions might not enable full compaction of a dense AC (eg, road with some doubtful NRSWA reinstatements)

HRA Base is generally made with 40-60pen bitumen,
Max temperature 190C Min rolling temp 110C but can be made with 100/150 pen, max 170C min 85C

60/32 HRA Base?
How thick? 80mm min, 150mm max

60/20 HRA Base?
How thick? 50mm min, 80mm max

HRA Base. (*Binder course is similar but thinner*) No interlocking aggregate, but voids <6%, virtually waterproof but deforms under very heavy or channelised traffic. *Can be very useful on tricky urban recon jobs.*

Binder course

AC20 Dense Binder

40/60pen..... Max temp 190C Min rolling 100C

100/150pen..... Max temp 170C Min rolling 90C

Thickness, ideally 3D ie 3 x 20 = 60mm.

Is there a specified maximum air voids in App. 7/1 ?
Should ideally be HE Spec, clause 929, max. 7%

20mm HRA Binder

Generally made with 40/60pen. Can be 50% of 20mm (55/20) aggregate or 60% (60/20) .

Max temp 190C min rolling 105C. Sometimes made with 100/150 pen, max temp 170C, min rolling 85C

Thickness, ideally 3D ie 3 x 20 = 60mm.

Is there a specified maximum air voids?
No, HRA binder should be very easily compacted *to void contents of less than 6%*

For both HRA base and binder asphalts, wheel tracking may be specified, see course notes

Surface course.

Acts as the “roof of the road” to keep rainwater out.

Also importantly it provides the road with its skid resistance.

The polished stone value of the aggregate (psv) and the surface texture of the surface itself serve as surrogates for skid resistance.

What psv should be specified? See IAN 156/12

What texture depth specified? See course notes which give ADEPT values for urban roads

DRAFT REVISIONS TO SHW 900 SERIES

These includes new guidance for texture depths for Clause 942 “thin surfacing” on classes B,C and U roads at all traffic speeds and retained texture in urban areas.

Note that “thin surfacing” includes sma’s and these are very similar in grading to close textured AC

DRAFT Table 9/14: Requirements for Initial Texture Depth for Roads (*other than Trunk Roads and Motorways*) for Thin Surface Course Systems

Road Classification	Posted traffic speed	Average per 1,000 m section, mm		Average for a set of 10 Measurements, mm (minimum)
		Minimum initial (mm)	Maximum Initial (mm)	
A	≥ 50mph	1.0	1.5	0.9
A	All other traffic speeds	0.8	1.3	0.7
B,C,U	All traffic speeds	0.8	1.3	0.7

DRAFT TABLE 9/17: Retained Surface Macrotexture Requirements for thin surfacings, after 2 years

[1] or the complete carriageway lane where this is less than 1,000 m.

[2] verification of high speed friction performance required

Surfacing Type	**Average texture depth per 1,000m section, mm[1]**
Systems with an upper (*D*) aggregate size of 14mm laid on motorway trunk and high speed A roads	0.9
Systems with an upper (*D*) aggregate size of 10mm laid on motorway trunk and high speed A roads	0.8
Systems with an upper (*D*) aggregate size of 6mm laid on motorway trunk and high speed A roads	0.7 [2]
Systems with all aggregate sizes laid on non-trunk low speed A, and all B, C and U classification roads	**0.6**

Types of surface course asphalt

Thin surfacings to SHW Clause 942

Stone mastic asphalts to BSEN13108/5

Hot rolled asphalts to BSEN 13108/4

Close graded asphalt concrete to BSEN13108/1

Clause 942 asphalts are all proprietary mixtures with BBA/HAPAS certificates. They are laid with a 5 year warranty on HE roads and 2 years elsewhere.

They are either thin asphalt concretes made with modified bitumens OR mixtures based on stone mastic asphalt . They are made with either (50pen bitumen and cellulose fibres) OR modified bitumens.

Weather conditions for laying these asphalts and their temperature control as delivered and laid are ***entirely*** *the responsibility of the asphalt paving contractor, so none are stated here.*

Cl. 942, 14mm thick, 3 roller passes and finished.

(1992 traffic control, old chapter 8)

Stone mastic asphalts (SMA's)

Many SMA's were designed
to comply with HA's 1.5mm texture depth
specification for high speed roads.

This, plus very low bitumen contents and poor site work, all caused VERY many early failures.

Common failure type, SMA thin surfacing

Asphalt companies are now producing proper SMA's to BSEN 13108/5

Based on dense, durable, German mixes made with 40/60pen bitumens, have a max temp. of 190C and min rolling temp of 110C

For most jobs, 10mm SMA should be used but 6mm SMA is a very quiet surfacing, but needs to be laid on a very sound sub-strate, ideally, a new binder course.

AVOID 14MM SMA

German SMA, laid on A51 in Rugeley, Staffs in 1994, photo April 2014

Chipped HRA surface course

Generally made with 40/60 pen bitumen and either 30% coarse aggregate, “30/14”, laid 40mm thick or 35% coarse aggregate, “35/14”, laid 45 or 50mm thick.

HRA may be a “recipe mix”, or “designed mix” to have a specified resistance to wheel-tracking deformation or
for heavily trafficked sites , a “performance specified” mix, which has even greater resistance to wheel tracking deformation.

Chipped HRA surface course is generally made with 40/60 pen bitumen and

either 30% coarse aggregate, “30/14”, laid 40mm thick

or 35% coarse aggregate, “35/14”, laid 45 or 50mm thick.

Chipped HRA mixes may be.....

“recipe”
“designed”
or “performance specified”

Hand chipped on this site

A chipping machine is usually used

Recipe mix chipped HRA's have no specified resistance to wheel-tracking deformation. They generally have a higher bitumen content than the other types of chipped HRA and so are easier to lay by hand BUT deform relatively easily in very hot summers. For this reason they are now rarely specified.

Design mix chipped HRA's are designed to have good resistance to wheel-tracking deformation, and have lower bitumen contents than "recipe mixes". (See notes re guidance)

They are suitable for both low speed urban roads and rural high speed roads.

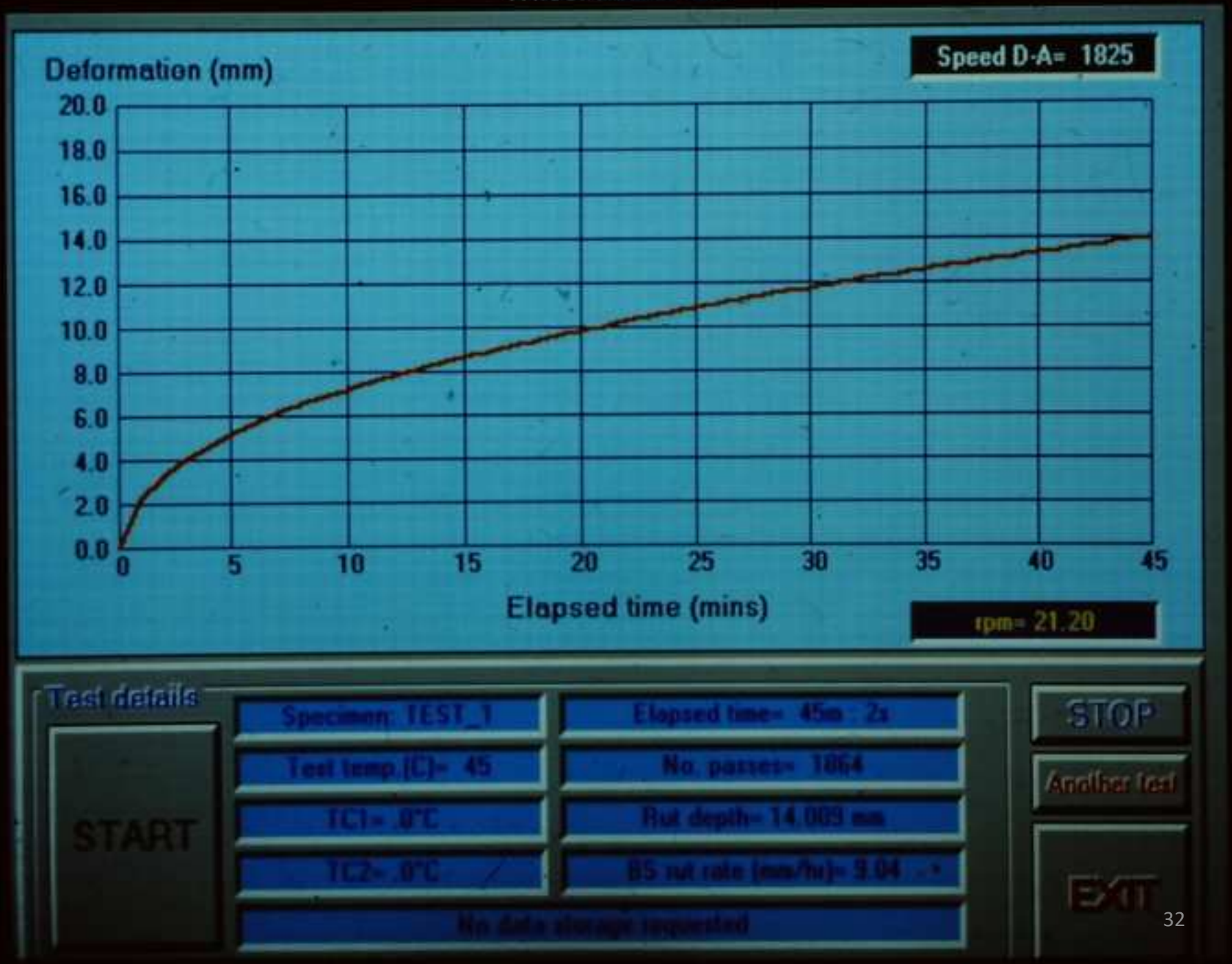
The rate of spread of the pre-coated chippings and the texture depths are the only differences when used on these different site categories.

For the most heavily trafficked sites the performance specified mix is used.

This is **always** produced using modified bitumens and laid to comply with HE spec clause 943.

It is the most expensive type of chipped HRA.

Wheel tracker test



However, as far as site work is concerned,
ALL the chipped HRA's made with 40/60pen bitumens, have a max temp. of 190C and min rolling temp of 110C

The unchipped, high stone content HRA's, 55/10, 55/14-6 and 55/14, are generally made with grade 100/150 pen bitumen and are once again becoming widely used especially in urban areas.

(55/14-6 is a good mix but non-standard).

If they are made with 40/60 bitumens they are OK for laying by paver BUT extremely difficult to hand lay, even in small areas so avoid wherever possible.

Max and min rolling temps if made with grade 100/150 bitumen are 170C and 85C respectively.

55/10 unchipped HRA

Urban chipped HRA & 55/10

55/10 HRA, hand-lay problem area

Close graded Asphalt Concrete

Also known as “Dense” incorrectly.

This is the cheapest standard surface course asphalt and is produced in both 14mm and 10mm nominal size mixtures.

Even when fully compacted, void contents exceed 6% so the asphalts are permeable to both air and water, resulting in **lives commonly being less than 9 to 12 years**.

Max and min rolling temps when usually made with grade 100/150 bitumen, are 170C and 90C respectively.

With grade 160/220 bitumen, 165C and 85C.

Texture depths are generally 0.8mm to 1.0mm

Hard stone close graded AC, 12 years old

ALWAYS surface dress after 8 to 10 years.

When specifying surface courses it is sometimes advisable to specify their resistance to wheel tacking deformation.

The course notes include the necessary information.

Supervising asphalt road and footway works.

Part 4 B

Preparation work (“prepping”) including planing for laying “in-lays” and “over-lays”,

Adjusting levels of ironwork etc.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Surfacing “in-lays” on kerbed roads are laid to the same levels as the existing surface which is to be replaced.

The in-lays therefore do not reduce the existing kerb face.

This kerb face was 125mm, is now 65mm.
Before laying a new surface, some planing is needed to avoid the loss of more kerb face

“ Profile planing”

Before laying a new surface course as an overlay, *say 40mm thick*, or a new surface treatment,

to avoid losing more kerb face, a varying depth

of existing asphalt or 3 or more old surface treatments

are planed off from, 30mm or 40mm at the kerb,

tapering to 0 mm at 2m from the kerb

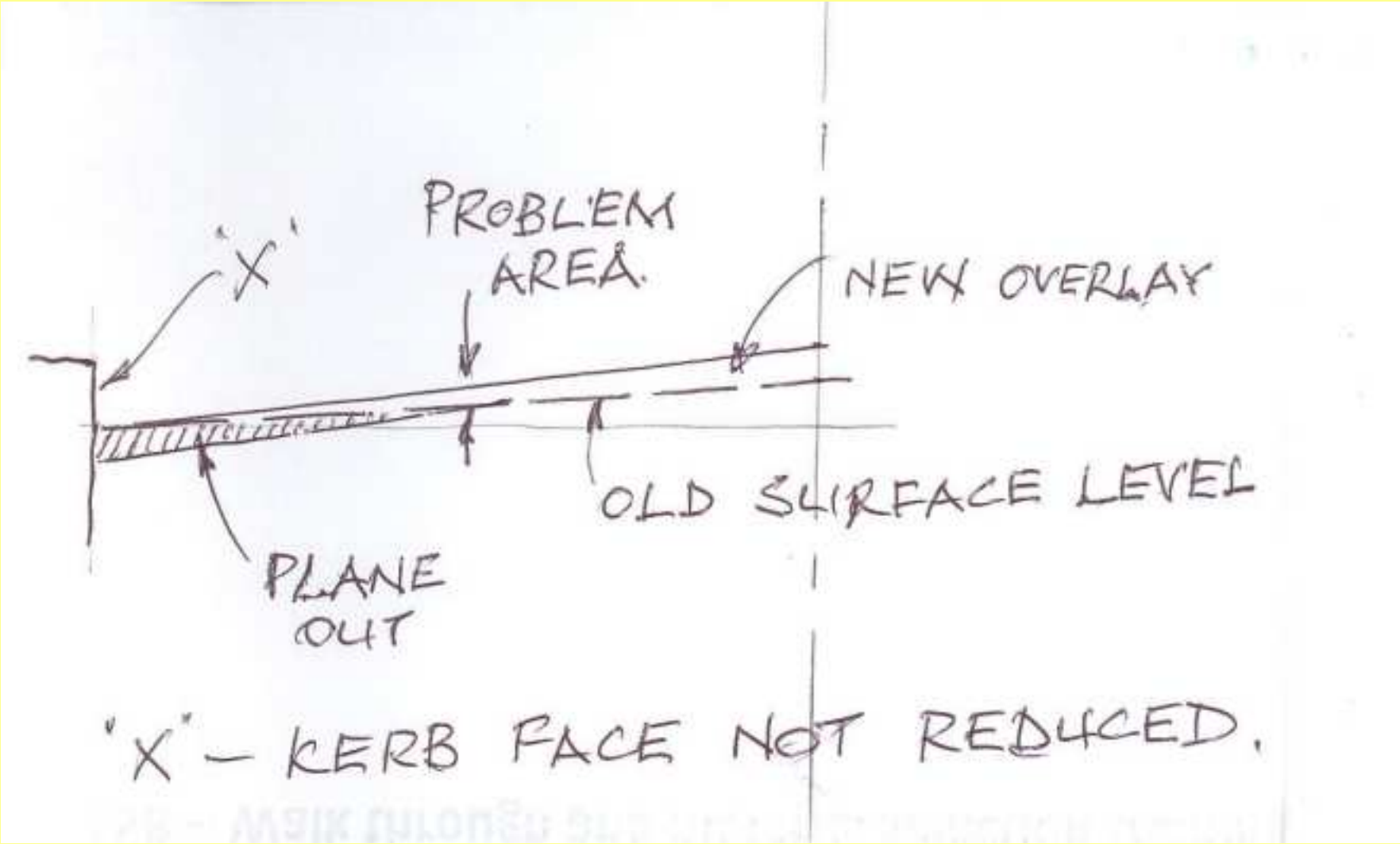
This is profile planing

Profile planing can sometimes result in a strip of the new surfacing being too thin,

see next slide>>>

It does not affect new surface dressings or micro-asphalts.

Note the possibility of the new overlay being too thin in the problem area



A first class example of planing. No traces of the old surface course, all swept clean and used as a temporary running surface for a week

Not a good example of planing and prep work.

Note brown bond coat in the channel, washed off by rain, and roughened areas of damaged old binder course

Profile planing but the un-planed area must be also be planed-off or removed with other tools. It must NOT be left.

Bad planing job. Another pass was needed to remove this thin, **loose**, residual layer of old asphalt

(Original tack coat had been sprayed onto a dirty binder course so the 25 year old HRA surface course had never been bonded)

After planing, the area must be swept clean

Note profile planed area

“ Prepping” also includes lifting ironwork, removing temporary ramps and painting vertical faces with hot 50 or 70pen bitumen.

Dealing with loose surface ironwork

Sometimes loose ironwork, such as a loose manhole cover and frame, is a symptom of the manhole shaft and perhaps the chamber being severely damaged, especially if old brickwork.

Preliminary survey work should therefore include examining manhole shafts and chambers to see if they need to be rebuilt or repaired.

This repair work needs to be completed well before the road is resurfaced.

Adjusting the levels of surface ironwork

Assuming all defective shafts and chambers have been dealt with.....

Adjusting and re-bedding ironwork is typically done with pre-bagged materials, such as flowable concretes.

Some are very rapid setting, with no solvents.
They must comply with HA104/02.
Some have setting times as little as 10 minutes, AND can be used in wet weather.

This ironwork was adjusted after paving. The asphalt reinstatement failed after 2 years, a common sight !!

MH cover level adjusted before paving BUT was bedded on broken roof tile as shims and cement mortar !!! This area of asphalt has been patched 5 times

The surface to be bond coated must be CLEAN with NO standing water, but damp is OK. *If you can see a reflection of the sky, it is too wet . This is too wet.*

Soiled areas need to be high pressure jetted to remove dirt then brushed to get rid of the water.

Bond coats and tack coats

Tack coat is simply sprayed bitumen emulsion

Bond coat is sprayed, polymer-modified bitumen emulsion, much stickier but more expensive

Bond coats and tack coats

1. Bond layers together

2. Assist in protecting the road pavement against damage due to rain water ingress

The BS594987 Clause 5.5 default is to use a BOND COAT between ALL asphalt layers.

Annex J allows specifiers to require a tack coat if they wish.

SHW Clause 920 deals with the application in more detail.

Copies of Clause 5.5, Annex J and Clause 920 are included in your course notes.

For application to planed or milled asphalt, the minimum rate of spread for **bond coats** is 0.35 kg/m² of residual binder.

For application to newly laid asphalt, the minimum rate of spread for **bond coats** is lighter at 0.2 kg/m² of residual binder.

The rate of spread for **tack coats** should be

0.15 kg/m^2 or 0.2 kg/m^2 of residual bitumen

when applied to newly laid asphalt and

existing surfaces respectively

Rates of spread in l/sq m

Table 2 – An example of bond coat minimum target rate of spread in litres per square metre of emulsion		
Class of polymer modified bituminous emulsion[A)]	**Newly laid asphalt substrate** **Residual binder 0.2kg/m^2**	**Planed (milled) and existing substrates** **Residual binder 0.35kg/m^2**
C50BP(2 to 5)	**0.40 L/m^2**	**0.70 L/m^2**
C60BP(2 to 5)	**0.33 L/m^2**	**0.58 L/m^2**
C65BP(2 to 5)	**0.31 L/m^2**	**0.54 L/m^2**
[A)] *The breaking class 2 to class 5 from BS EN 13808: 2013 is shown in brackets and does not affect binder content, but is agreed between producer and purchaser for the intended use.*		

Micro-asphalt, unbonded because laid on dirty sub-strate. *The thinner, so weaker, a layer is, the more important it is to have bonded to the layer beneath.*

How NOT to spray tack coat.

Tanker applied bond coat is the default. Hand spraying should only be used where it is impossible to access an area with a tanker, or in very small areas.

We are now ready to start the paving work.

Any questions?