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Common praxis and experiences of bitumen bound surface layers

- Swedish Transport Administration -

IRCA Conference

Bundin slitlög - betri vegir

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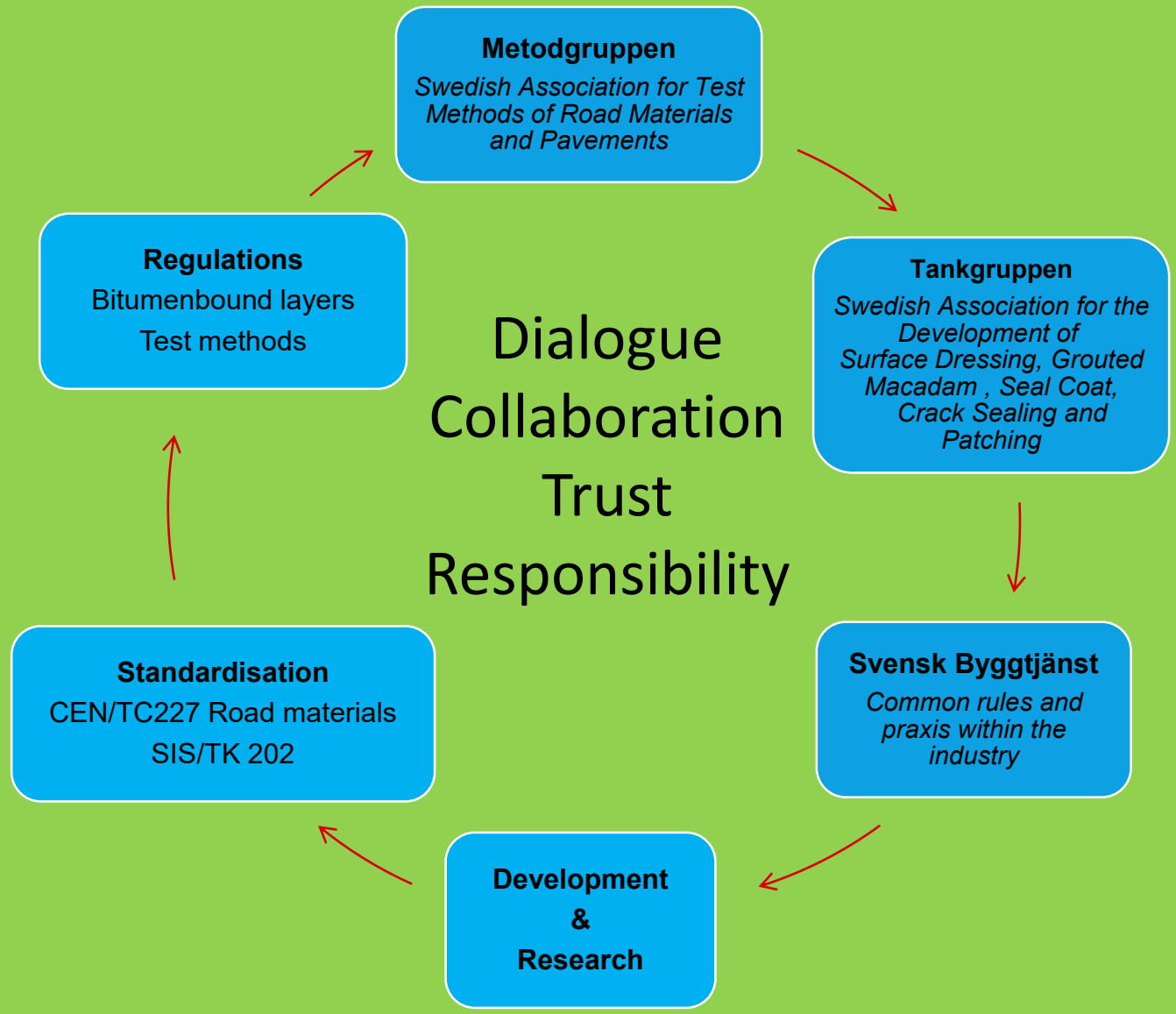

Disposition

- bitumenbound surface layers
- choice of surface layer
- quality-critical factors and failures
- performance requirements
- conclusions

Two main types of bitumenbound surface layers

Surface dressing

Surface layer of asphalt

Tank coatings

Resource-efficient technology for the low-traffic road network

Single surface dressing, Y1B (ÅDTt < 2500)

Y1B 8/11 = 14 kg aggregate + 1,7 kg bitumen per m^2

ÅDTt =
total traffic flow in
both directions

Grouted macadam, IMT(ÅDTt < 1000)

40 mm IMT 8/22 = 74 kg aggregate + 3,6 kg bitumen per m^2

Methods for maintenance

- ✓ Relatively low need of binder and aggregate
- ✓ Use of local materials
- ✓ No heating of aggregate is needed
- ✓ High laying capacity (Appr. 100 000 m^2 per shift)

- Energy consumtion Tank coatings: 1– 4 kWh/m^2
- Energy consumtion asphalt pavement: 6-12 kWh/m^2
- Lifetime tank coating: Appr. 20 year in optimal conditions

Implemented EN-standards for surface dressing

Product standards

Surface dressing - Requirements
SS-EN 12271

Aggregate
SS-EN 13043

Bitumenemulsion
SS-EN 13808

Test methods

Visuell assesment of defects
SS-EN 12272-2

Measurent of texture
SS-EN 13036-1

Rate of spread and accuracy of spread of binder and chippings
SS-EN 12272-1

There is no harmonised product standard for grouted macadam and therefore no requirements for CE-marking. However, CE-marking is required on the consituent materials such as aggregate and binder.

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Correct embedding of aggregate is important

- No embedding

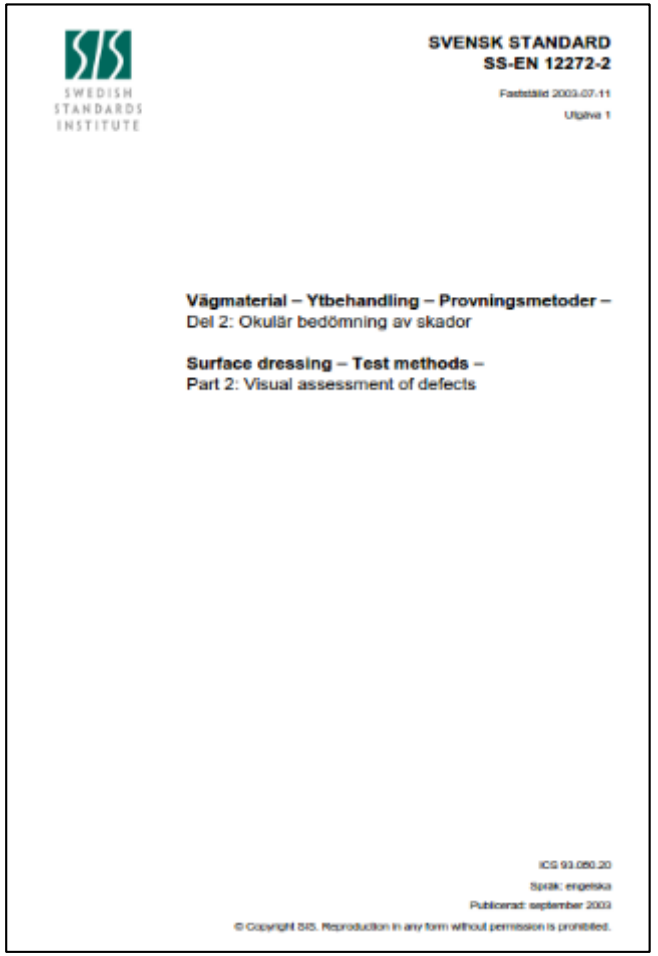
- Normal embedding

- Total embedding

Visual assesment of defects

SS-EN 12272-2

Source: M.Heslop



SWEDISH STANDARDS INSTITUTE

SVENSK STANDARD
SS-EN 12272-2

Fastställd 2003-07-11
Utgåva 1

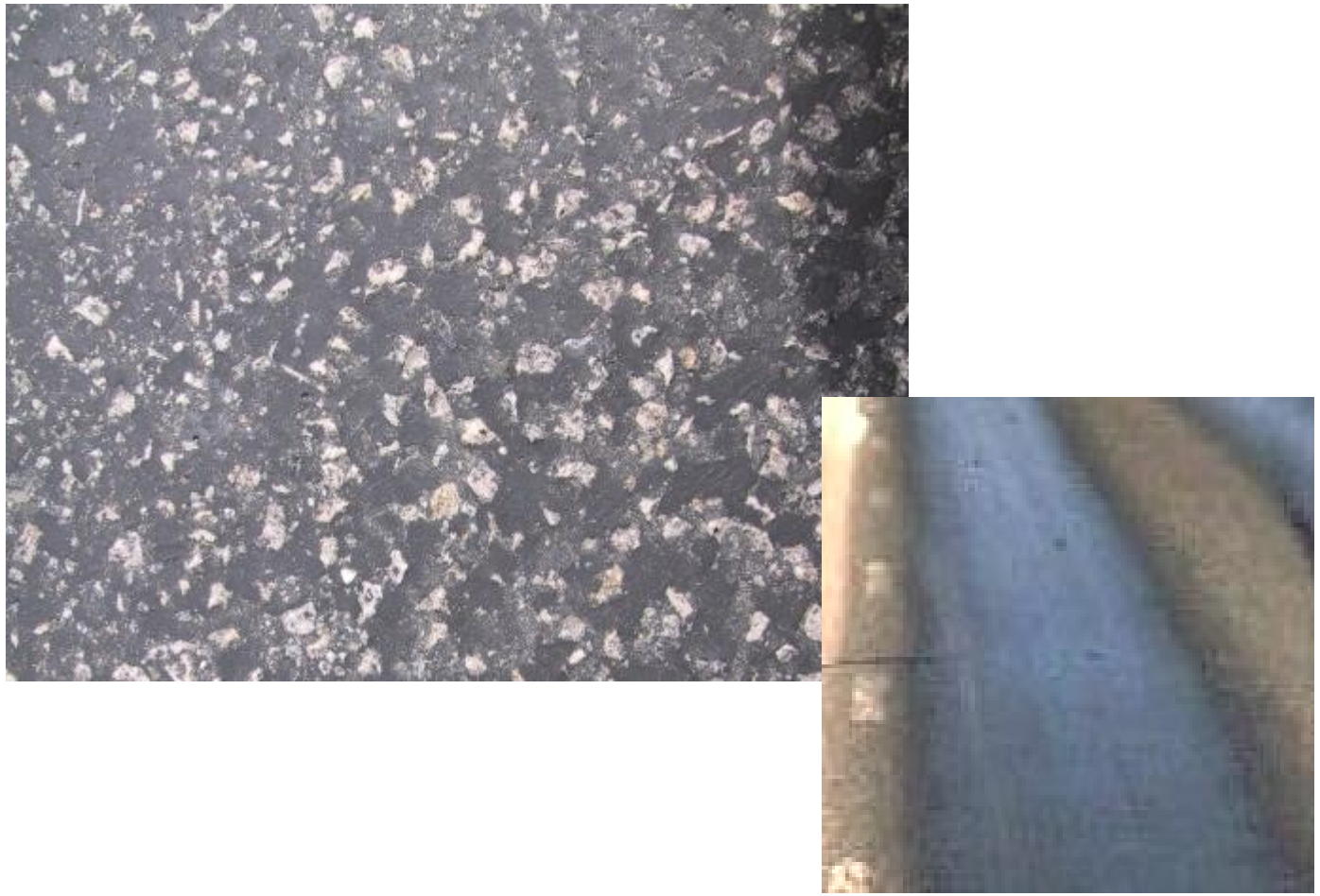
Vägmaterial – Ytbehandling – Provningsmetoder –
Del 2: Okulär bedömning av skador

Surface dressing – Test methods –
Part 2: Visual assessment of defects

ICS 93.080.20
Språk: engelska
Publicerad: september 2003

Fatting up

- Fatting up is the result of total embedding
- the macro texture and thereby the friction is reduced
- the wet friction can be very low (0.3)
- can occur if the maximum stone size is too small in relation to the prevailing traffic and the hardness of the surface



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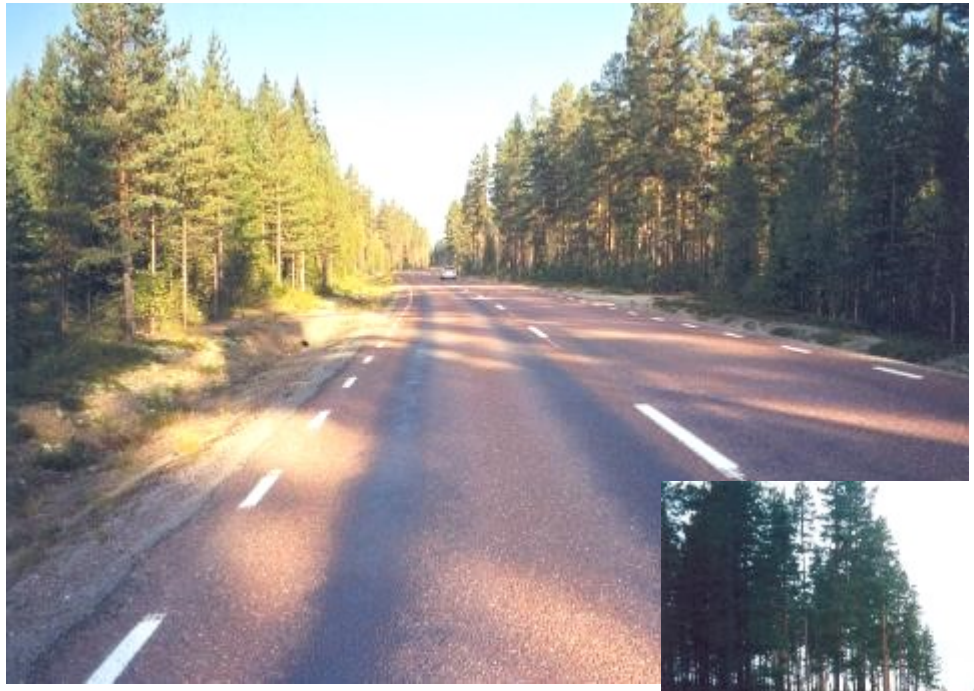
Bleeding

- The binder rises to the surface through the mosaic of stone particles
- common when using low-viscosity, fluxed binders, with too high binder yield and with a binder-rich substrate
- the macrotexture is markedly reduced, whereby friction becomes poor
- on bleeding surface treatment, the friction is 0.3
- the macro texture (MTD) is below 0.5 mm
- bleeding occurs mainly during heat waves in the summer

Tracking

- Caused by track-bound traffic
- normally disappears after the first or second winter's studded tire traffic
- tracking reduces macro texture and friction but not normally to critical levels
- common on roads with a high proportion of heavy traffic



Tracking is normally positive for the life of the surface treatment and should not be confused with bleeding

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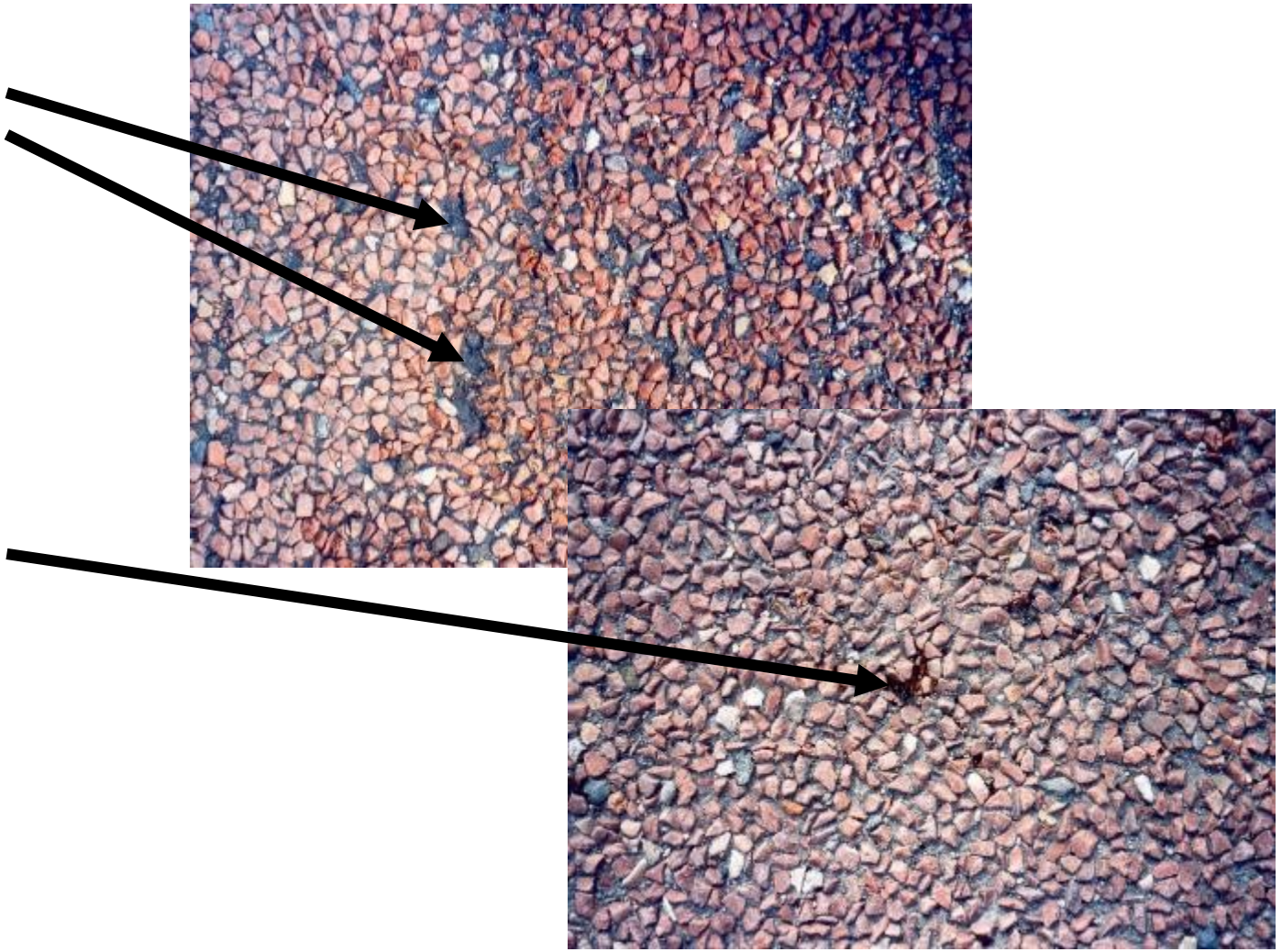
Scabbing and tearing

- Concentrated local loss of aggregate particles from the mosaic or extensive thinning over a continuous surface greater than 0.01 m²
- can occur in places with high traffic loads (eg on exit roads as in this case) and as a result of snow and ice removal
- larger loops reduce macro texture and friction

Fretting

- Random stone removal from the mosaic on a laid surface treatment
- occurs mainly where the amount of binder is insufficient or if the surface treatment has not had time to stabilize before winter
- small-scale random stone loosening, which does not affect the homogeneity of the mosaic, is not considered to be fretting
- wet and dirty aggregate is often a contributing cause of fretting



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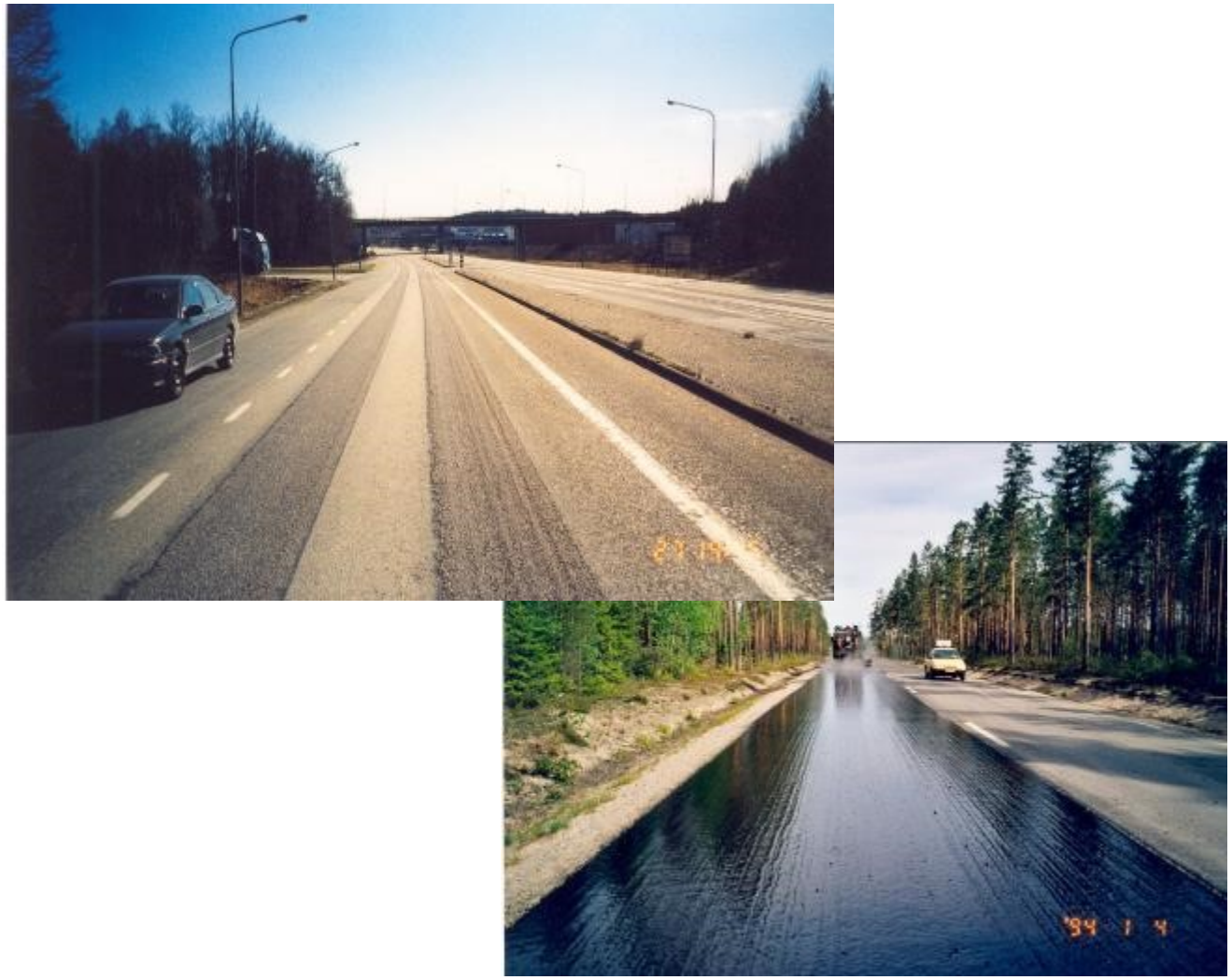
Streaking

- Loss of stone particles from a laid surface dressing so that one or more lines occur in the design direction of the surface treatment

- Caused by uneven distribution of binder in the spreading ramp or insufficient overlap of binder in longitudinal joints



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Mechanical damage

Plow damage

- Plowing and tearing can cause fretting and peeling
- affected by frostbite and freezing
- occurs mainly during the first winter and mainly on the road next to the wheel tracks.

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Mechanical damage

Wear and tear of studded tires

- Surface dressings can be worn in the wheel tracks due to wear and tear from studded tire traffic
- Too poor wear resistance of the gravel causes premature wear (high ball mill value)
- Worn surface treatment is not "defective" and should therefore not be classified or confused with loops or fretting

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Requirements and specifications

Bitumenbundna lager, TDOK 2013:0529

Specifikationer för ingående ballast till ytbehandling

Kornstorleksfördelning

Sortering	4/8	8/11	11/16	4/16	8/16	0-16
Kornstorlek D/d	$G_c85/15$	$G_c85/15$	$G_c85/15$	$G_c85/15$	$G_c85/15$	G_A85
Finmaterialhalt	f_1	f_1	f_1	f_2	f_2	-
Sikt (mm)	Andel passerande i vikt-%, min-max					
31,5	-	-	100	100	100	-
22,4	-	100	98-100	98-100	98-100	98-100
16	100	98-100	85-99	85-99	85-99	85-95
11,2	98-100	85-99	0-15	-	-	70-89
8	85-99	0-15	-	-	0-15	-
5,6	-	-	0-2	-	-	-
4	0-15	0-2	-	0-15	0-2	-
2	0-2	-	-	0-2	-	-
0,5	0-1	0-1	0-1	0-2	0-2	8-18
0,063	0-1	0-1	0-1	0-2	0-2	2-5

Krav tillåtna defekter

Typ av ytbehandling	Y1G	Y1B			Y2B
$ÅDT_k$	< 500	< 500	501 - 1000	> 1000	> 1000
P1 Uppfettning och blödning, %	≤ 1,0	≤ 0,5	≤ 0,5	≤ 0,5	≤ 0,5
P2 Avskalning och släppor, %	≤ 0,5	≤ 0,2	≤ 0,2	≤ 0,2	≤ 0,2
P3 Utglesning, %	≤ 6	≤ 3	≤ 3	≤ 3	≤ 3
P4 Randning, m	≤ 10	≤ 2	≤ 2	≤ 2	≤ 2

Krav på egenskaper ingående ballast till slitlager av Y1B

Egenskaper	$ÅDT_{k,just}$		
	< 500	501 – 1000	1001 -
Flisighetsindex, FI < 8 mm	≤ 25	≤ 25	≤ 25
Flisighetsindex, FI > 8 mm	≤ 20	≤ 20	≤ 20
Krossytegrad, C, kategori	$C_{50/30}$	$C_{50/30}$	$C_{50/30}$
Kulkvarnsvärde, A_N	≤ 14	≤ 10	≤ 7
Los Angelesvärde, LA	≤ 30	≤ 25	≤ 20

Specifikationer för bärlager av indränkt makadam, IM

Tabell 8.1.4-1 Kornstorlekfördelning

	IM 40 8/22	IM 40 16/32	IM 60 16/32	IM 60 16/32
Sortering	8/22	16/22	16/32	16/32
Kornstorlek	$G_c80/15$	$G_c90/20$	$G_c90/20$	$G_c80/15$
Finmaterialhalt	f_2	f_2	f_2	f_2
Sikt mm	Andel passerande i vikt-% min-max			
63	-	-	-	100
45	100	100	100	98-100
31,5	98-100	98-100	98-100	90-99
22,4	90-99	90-99	90-99	-
16	25-50	0-20	0-20	0-15
11,2	-	-	-	-
8	0-15	0-5	0-5	0-5
4	0-5	-	-	-
2	-	-	-	-
0,063	0-2	0-2	0-2	0-2

Tabell 8.1.4-2 Specifikationer för ingående ballast

	$ÅDT_t$ < 1000	
Antal tunga fordon, totalt [1]	< 50	51 - 100
$ÅDT_{k\,tung}$	≤ 50	51 - 100
Egenskaper		
Flisighetsindex, FI	≤ 20	≤ 20
Krossytegrad, C, kategori	$C_{50/15}$	$C_{50/10}$
Micro-Devalvärde, M_{DE}	≤ 15	≤ 15
Los Angelesvärde, LA	≤ 30	≤ 25

[1] *Avser smala vägar utan separata körfält, bredd < 6 m*

Volumetric measurement of Macro texture (MTD = Mean Texture Depth)

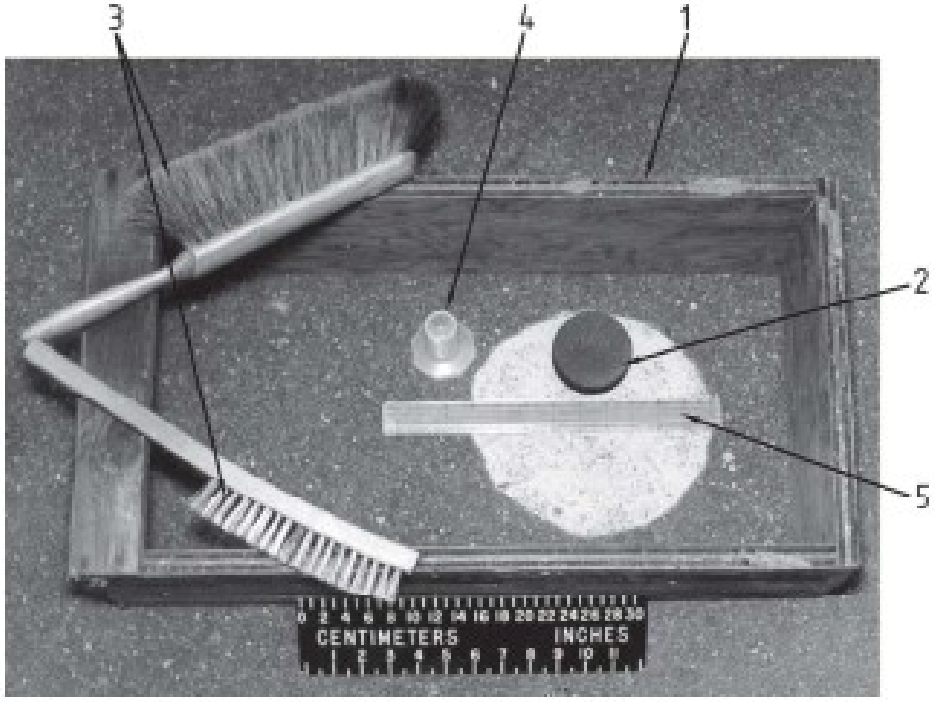
SVENSK STANDARD
SS-EN 13036-1:2010

SWEDISH STANDARDS INSTITUTE

Fastställd/Approved: 2010-06-07
Publicerad/Published: 2010-11-17
Utgåva/Edition: 2
Språk/Language: engelska/English
ICS: 17.040.20; 93.080.10; 93.120

Ytegenskaper för vägar och flygfält – Provningsmetoder – Del 1: Mätning av makrotexturens djup hos en beläggningsyta medelst en volymetrisk metod

Road and airfield surface characteristics – Test methods – Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique



Key

1 portable wind screen
2 spreading tool
3 surface cleaning brushes
4 sample cylinder
5 ruler

Figure 1 — Apparatus for measuring surface macrotexture depth

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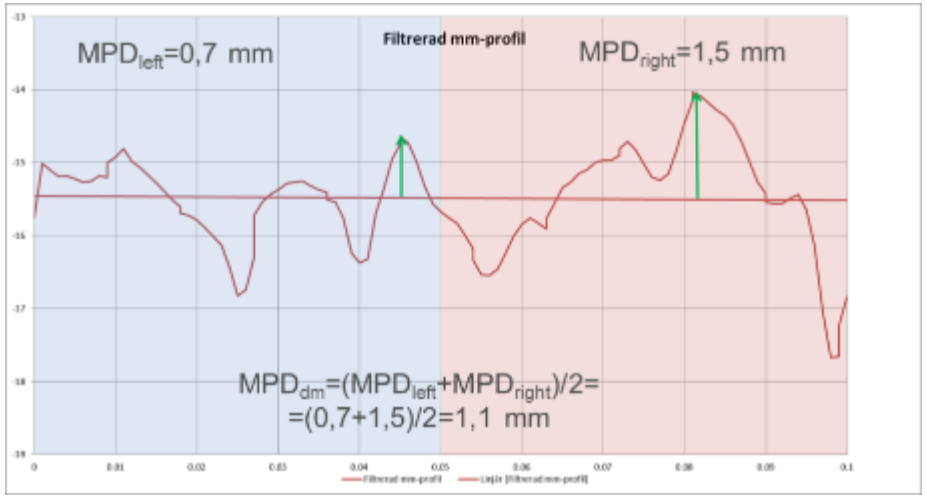
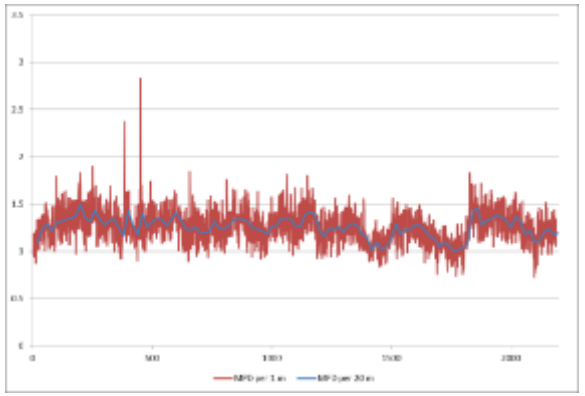
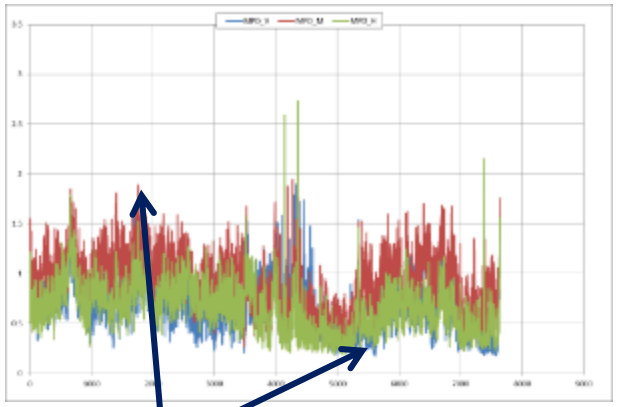
Lasermeasurement of Macro texture
(MPD = Mean Profile Depth)

ISO 13473-1

Measurement in wheel tracks

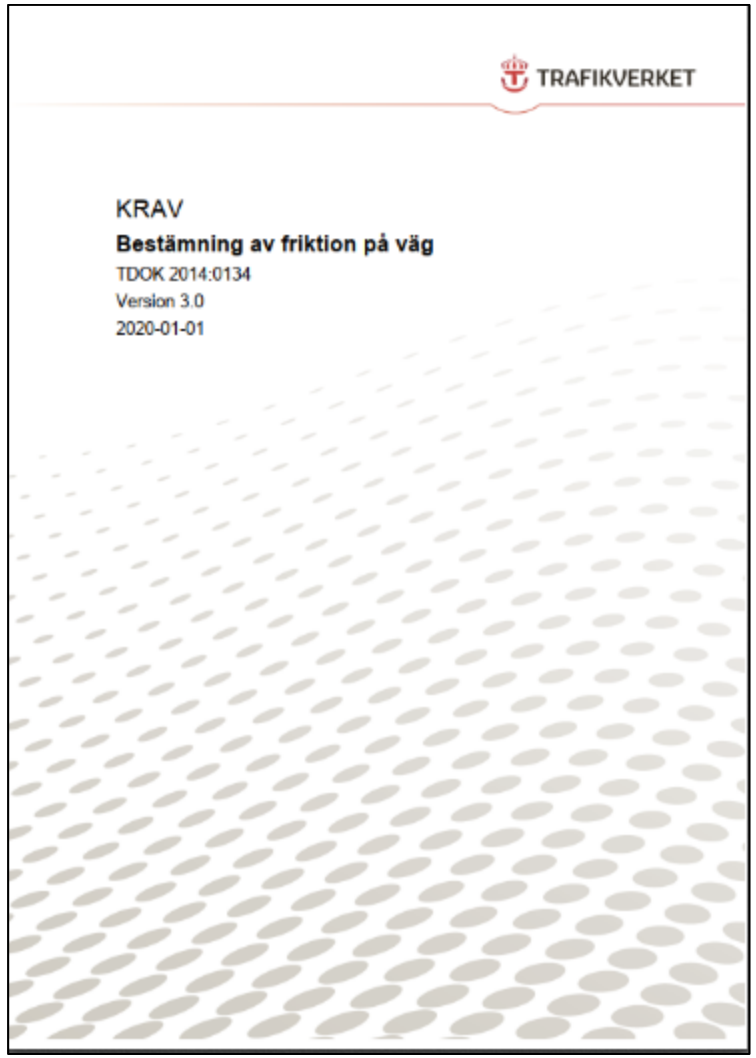






Low and **high** MPD-values = risk values

Measurement of friction (wetfriction)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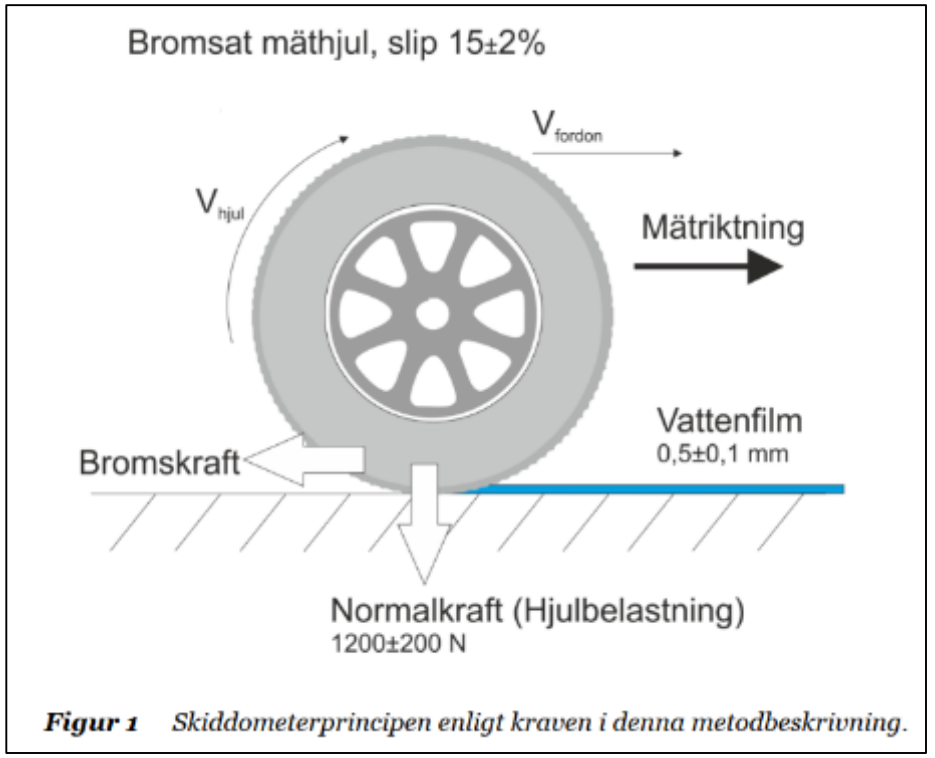
KRAV

Bestämning av friktion på väg

TDOK 2014:0134

Version 3.0

2020-01-01



Figur 1 *Skiddometerprincipen enligt kraven i denna metodbeskrivning.*

Foto: http://www.sarsys.se/sites/default/files/saab_2.png

Different types of asphalt

”Hot”/ warm cmix asphalt > 120 °C	Semi-warm asphalt > 50 - 120 °C	”Cold” asphalt < 50 °C
Hard binder 50/70 – 160/220	Soft bitumen V 6000 – V 12000	Bitumenemulsion Hard or soft base bitumen
Stable, stiff Medium- & high-traffic roads	Flexible, self-healing Low-traffic roads	Energy-efficient ”Low-traffic roads”
ABT, ABS, ABD, AG, ABb Gjutasfalt (PGJA)	MJAG, MJOG	AGBE (Base coarse)
Harmonised product standards CE-marking	Harmonised product standards CE-marking	Product standard EN 13108-31 Not harmonised

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Implemented EN-standards for asphalt

Product standards bituminous mixtures

Asphalt concrete	SS-EN 13108-1 > ABT, ABb, AG
Soft asphalt	SS-EN 13108-3 > MJAG, MJOG
Split mastic asphalt	SS-EN 13108-5 > ABS
Mastic asphalt	SS-EN 13108-6 > PGJA
Porous asphalt	SS-EN 13108-7 > ABD

Standards for demonstration of conformity

Type Test	SS-EN 13108-20
Factory Production Control	SS-EN 13108-21
Reclaimed asphalt	SS-EN 13108-8 (Declaration)

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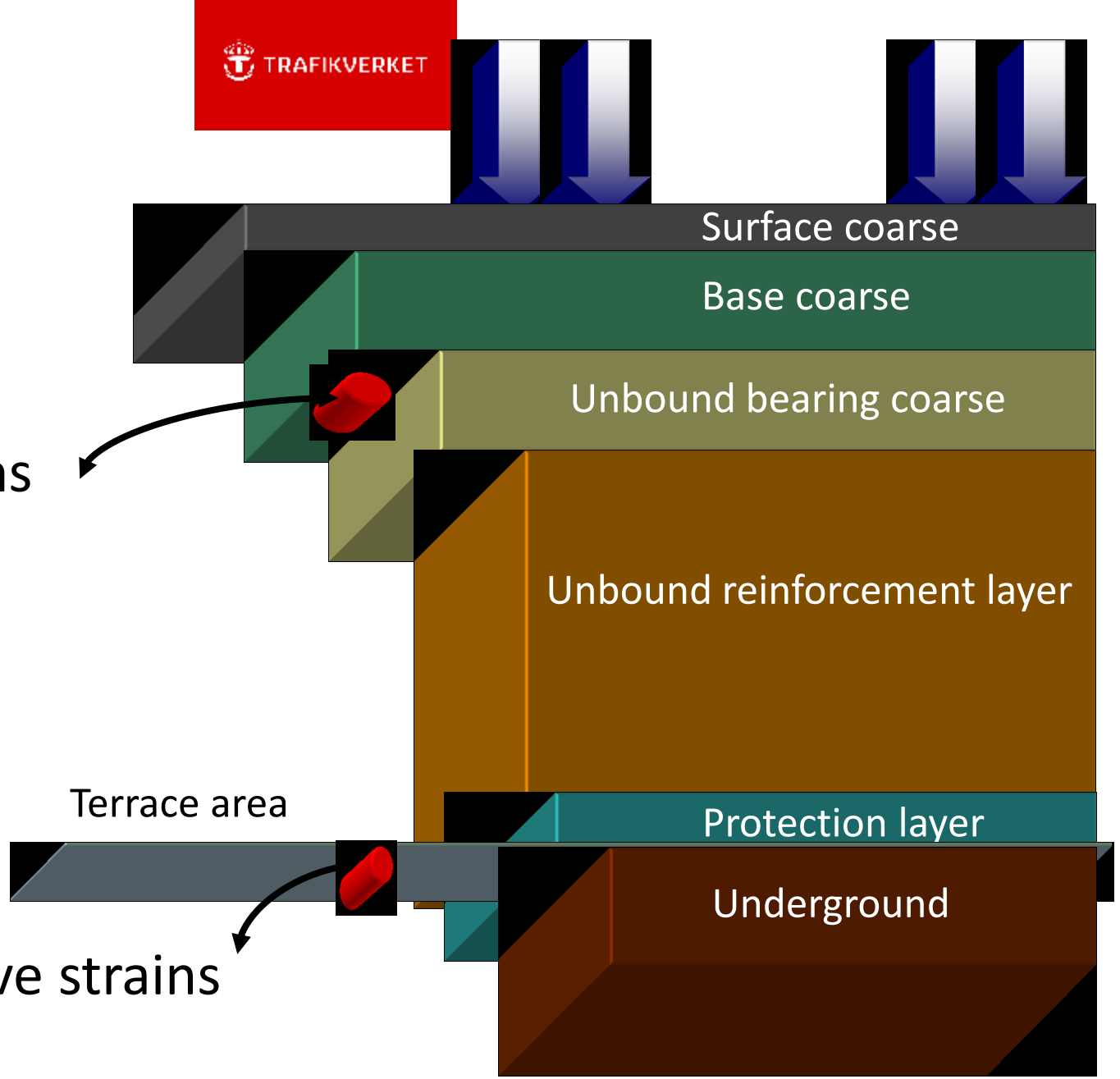
Choice of asphalt pavement and requirements for optimized resistance to deformation

Rutting caused by heavy trafik

Design/ dimensioning

Horisontal tensile strains



Vertical compressive strains

Choice of surface layer and requirements for optimized resistance to abrasion

Rutting caused by abrasion from studded tyres

Calculation of traffic with respect to abrasion

For constructive design of bituminous surface layers, the adjusted current *ÅDTk* value, *ÅDTk,just* is used , ie year-round traffic per lane, multiplied by adjustment factors for:

$$ÅDT_{k,just} = ÅDT_k \cdot J_{DD} \cdot J_{SH} \cdot J_{KF} \cdot J_{VH}$$

- traffic share with studded tires (DD)
- signposted speed (SH)
- road width / lane width (KF)
- type of winter road maintenance (VH)

The adjusted *ÅDTk* value *ÅDTk, just* is used when choosing the type of surface layer and aggregate

Quality-critical factors for asphalt

- Binder content
- Grading
- Void content (Marshall)
- Temperature
- Aggregate properties
- Bitumen properties
- Properties for reclaim asphalt
- Properties for additives

Quality-critical factors asphalt pavement

- Friction
- Longitudinal roughness
  - IRI
  - Megatexture
- Transversal irregularities
  - Rut depth
- Thickness
- Void content

Quality-critical performance requirements

- Underlay
  - Temperature
  - Bearing resistance
  - Eveness
  - Cleaning
- Tack coating (gluing)
- Compaction
- Execution of work joints for surface layers and trafficed layers of base-, binder- or adjustment coarses

AMA Anläggning = Common praxis

DCC BITUMENBOUND LAYERS FOR ROAD, AREAS…

Execution of pavements of asphalt

- Underlayer
- Tack coating
- Transport
- Laying
- Execution of work joints
- Compaction and finishing work
- Sealing of work joints

General requirement for final pavements

Covers all types of surface layers

- performed pavement must be homogeneous
- if the friction is judged to be insufficient after the compaction and finishing-work king has been carried out, friction-increasing measures must be carried out immediately

Homogenous pavement

General requirement for final pavements

- This pavement does does not meet the basic requirement of AMA
- it seems as if continuous delivery of an inhomogeneous pavement took place without any action being taken?
- both the client and contractor have a responsibility to report errors that are discovered during the execution phase
- the contractor must document and take action

Inhomogenous pavement 

General requirement for final pavements

- Should warning signs be up here?
- sanding, water blasting, fine milling, etc. are seen as "acute / temporary measures" to restore friction
- the final decision on whether or not the pavement can be approved is not only friction measurement but also by directional sampling (void content, binder content, texture measurement….)

Inhomogenous pavement

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General requirement for final pavements
Conclusions

- In extreme cases, it can differ over 1% in binder content in bleeding compared to binder content in ruts. Risk of poor durability in wheel tracks.
- binders are a big cost - is it reasonable to remove binders that would actually have been needed elsewhere in the pavement with water blasting / milling?
- attack the problem from the right direction - not by increasing the number of friction measuring vehicles - but make sure to reduce the proportion of surfaces that pose a risk of poor friction
- until the final inspection, the contractor is responsible for monitoring the pavement performed.

Dare to be a professional client and contractor


Thank you for
your attention