Hrvatsko asfaltersko društvo Croatian asphalt association

Utjecaj modificiranja veziva na ponasanje asfalta

What binder modification can do to impact the performance of a road

Markus Spiegl, OMV Refining & Marketing

Međunarodni seminar ASFALTNI KOLNICI 2018

International seminar ASPHALT PAVEMENTS 2018

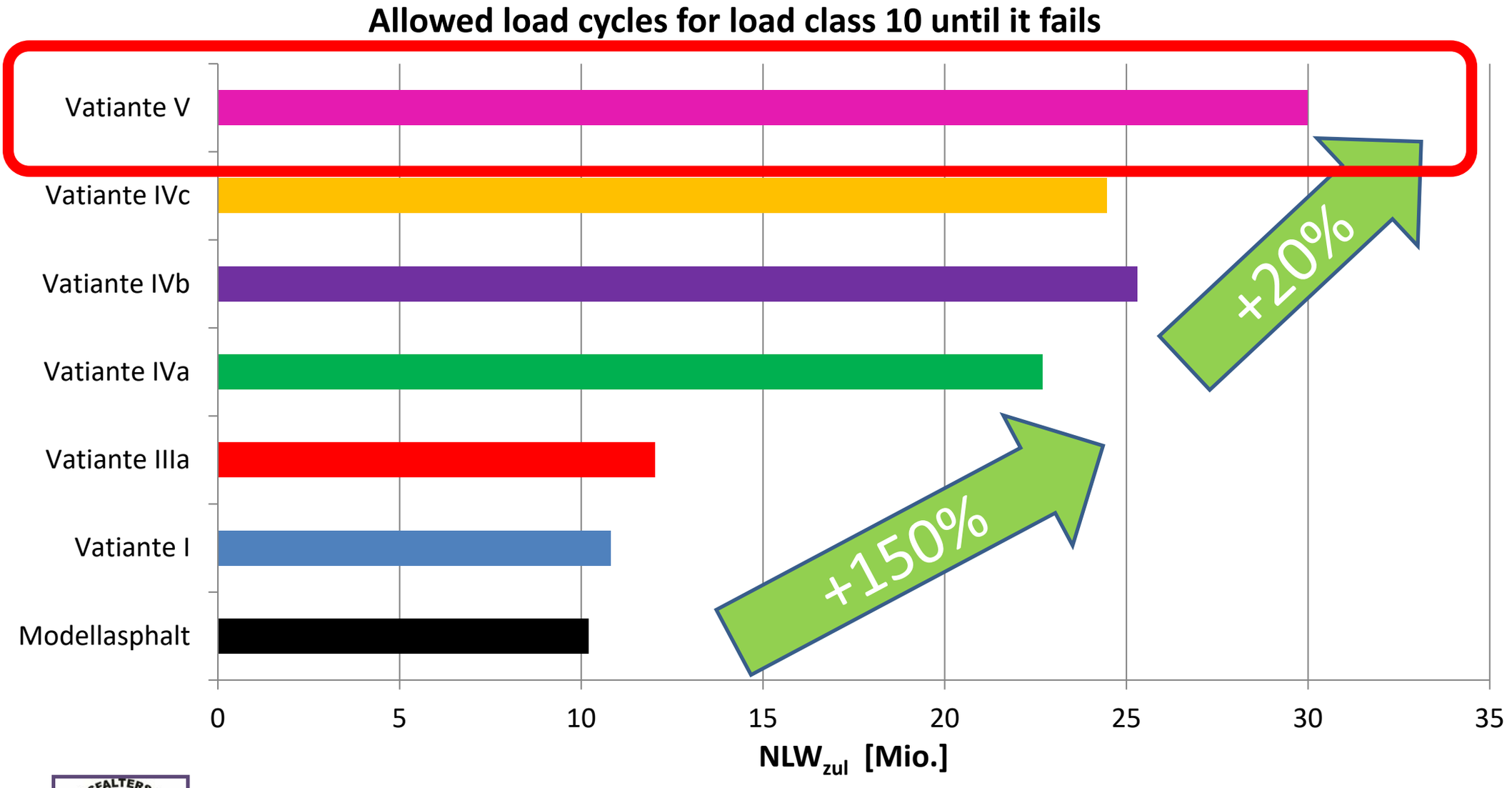
Opatija, 12.–13. 04. 2018

Content

- Recap 2017 presentation
  - Analiza troškova tijekom životnog vijeka i utjecaj kvalitete bitumena (LCCA and the impact of bitumen quality)
- Proper foundation
- Bitumen quality and the impact on
  - Fatigue behavior – Long lasting roads
  - Top down cracks and rutting
- Resume
- Outlook

Recap 2017

Pavement Design results



Recap 2017 – Life Cycle Costs Analysis – LCCA

Standard cycles in the consideration period

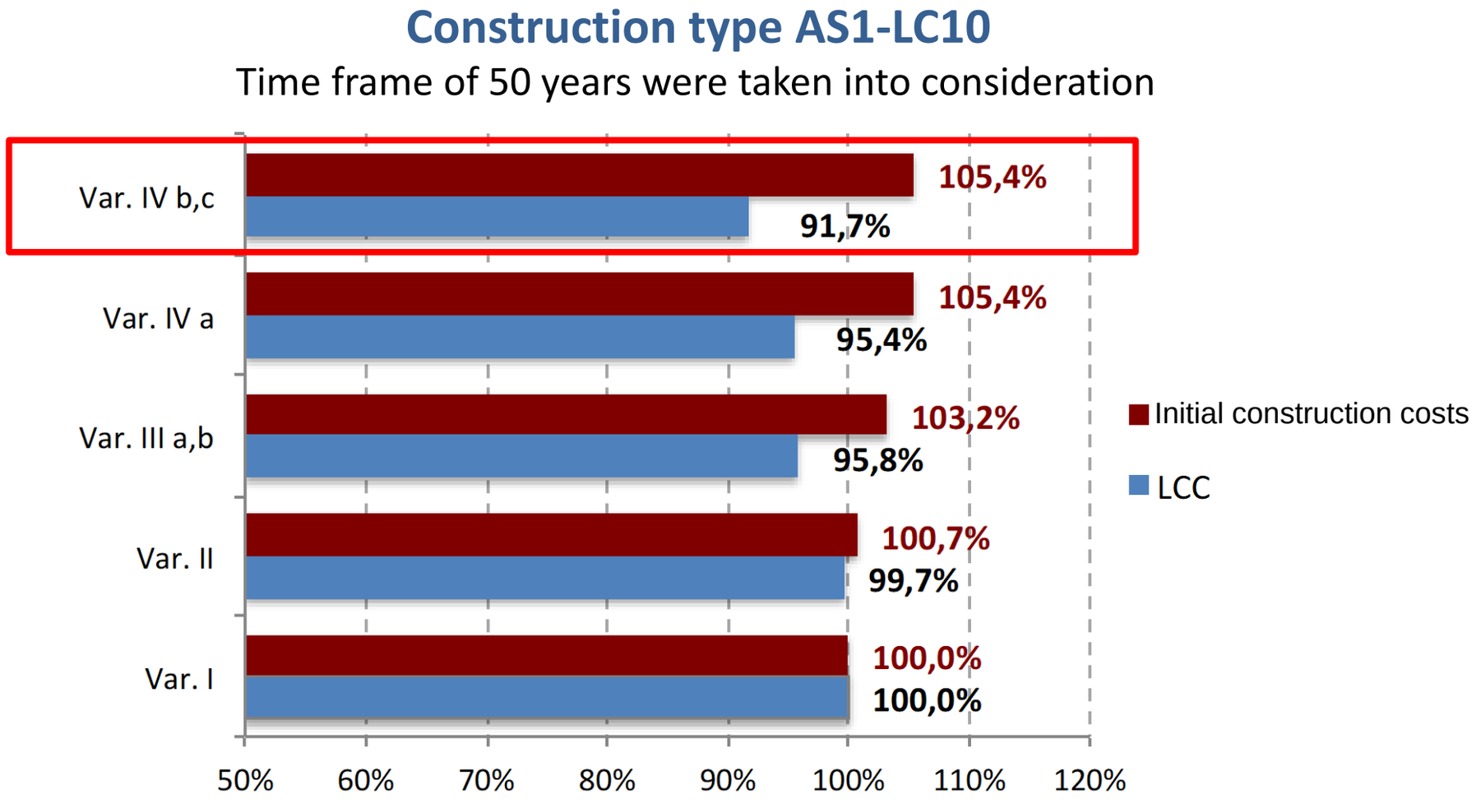
Construction type AS1-LC10

Time frame of 50 years were taken into consideration

Variant	description	maintenance measure			reconstruction of bit. bound pavement	residual value after 50 years (bit. bound pavement)
		crack maintenance		reconstruction surface layer		
		year [a]	share [%]	year [a]	Year [a]	[%]
variant I	only PgB	13/17/36/39	8,8	-	22/43	66,7
variant II	surface layer with PmB	15/37	9,0	-	22/43	66,7
variant III a/b	surface and binder layer with PmB	15/40	9,0 / 6,6	20/45	24/50	100
variant IV a	only PmB	15/30/34	9,0	20	39	71,8
variant IV b/c		15/30/34/39	9,0	20	44	86,4

Recap 2017 – Life Cycle Costs Analysis – LCCA

Construction costs vs. Life Cycle Costs



Average prices (price base 2015, construction site bigger than 5.000 m^2), interest rate i = 3%

Basic principle 1
Everything starts with a proper foundation!

Gestrata Bauseminar Jan. 2014 –
Leibniz „Geotechnics of unbound and bound base courses”

Pavement – Pavement Design (1)

⇨ Conditions to which a pavement is subjected to

- **traffic load (various truck types),**
- **climatic conditions and**
- **condition of the unbound layers / subbase**

should not negatively impact

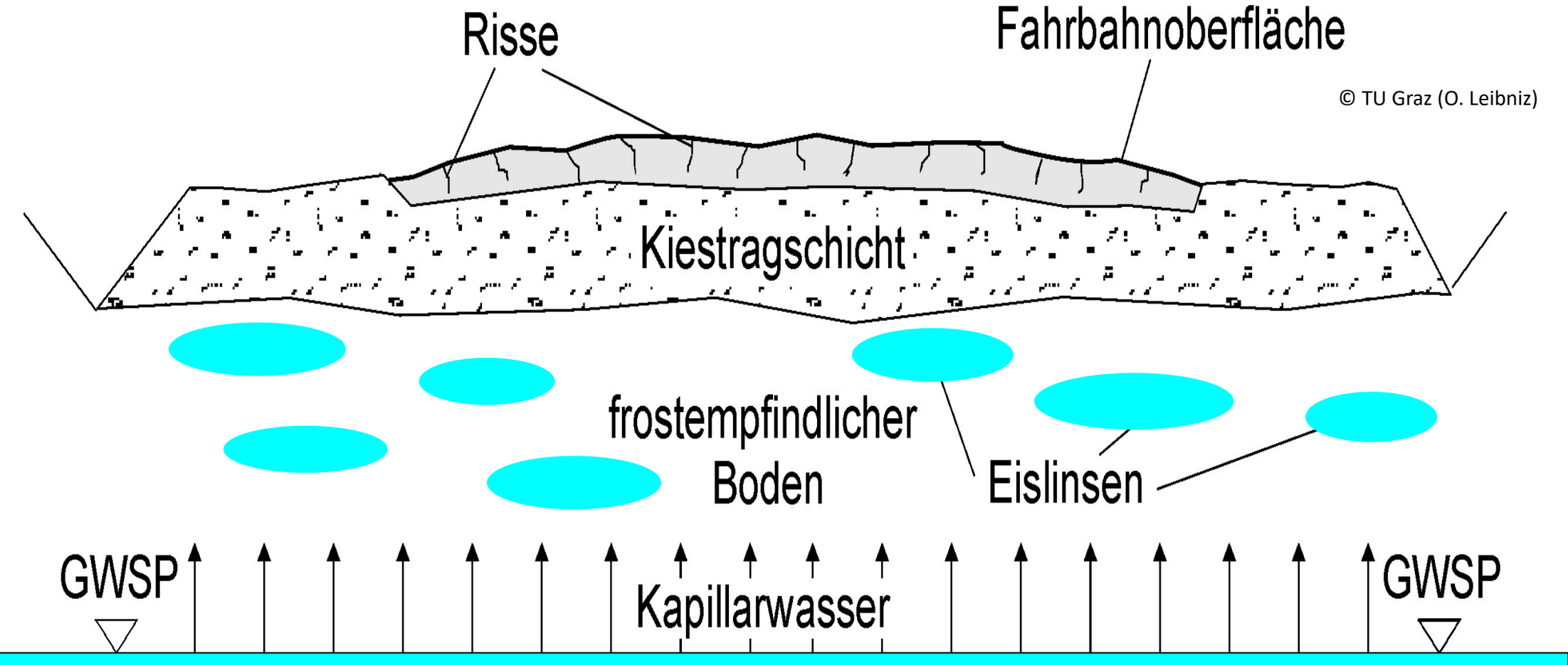
- **the stability of a pavement and**
- **the serviceability of a road due to cracks or big deformations.**

Pavement – Pavement Design (2)

⇨ An **underestimation** of the expected **traffic loads** or an **overestimation** of the **bearing capacity** of the sub base during the service time leads to a **wrong pavement design** and this causes **short life time, cracks and permanent deformation**

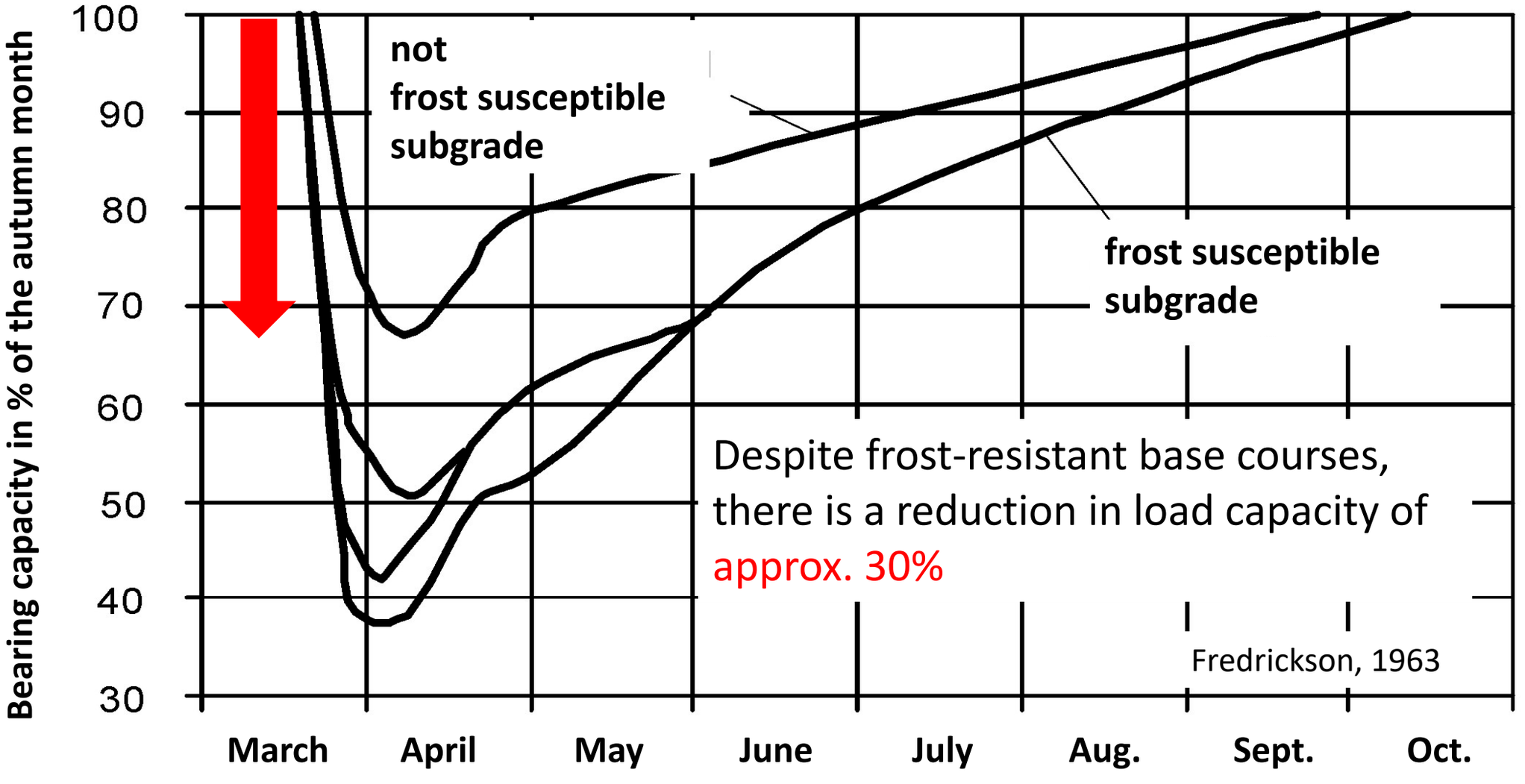
⇨ **Poor quality of the base layer** has a lower ability to distribute the traffic load which leads to a higher stress of the sub base which causes damages.

Wrong designed base layers and a sub base or foundation with a high liability to frost



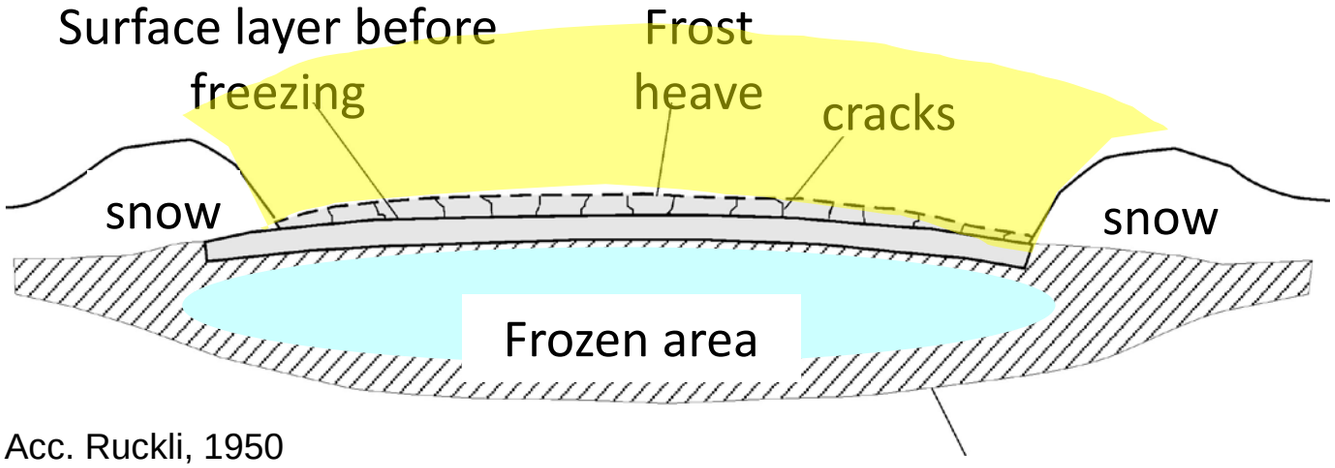
⇨ Avoiding capillary water in the sub base and proper design (layer thickness) of the unbound and bound layer is crucial (load is reducing the risk of frost heave)!

Seasonal dependence of bearing capacity

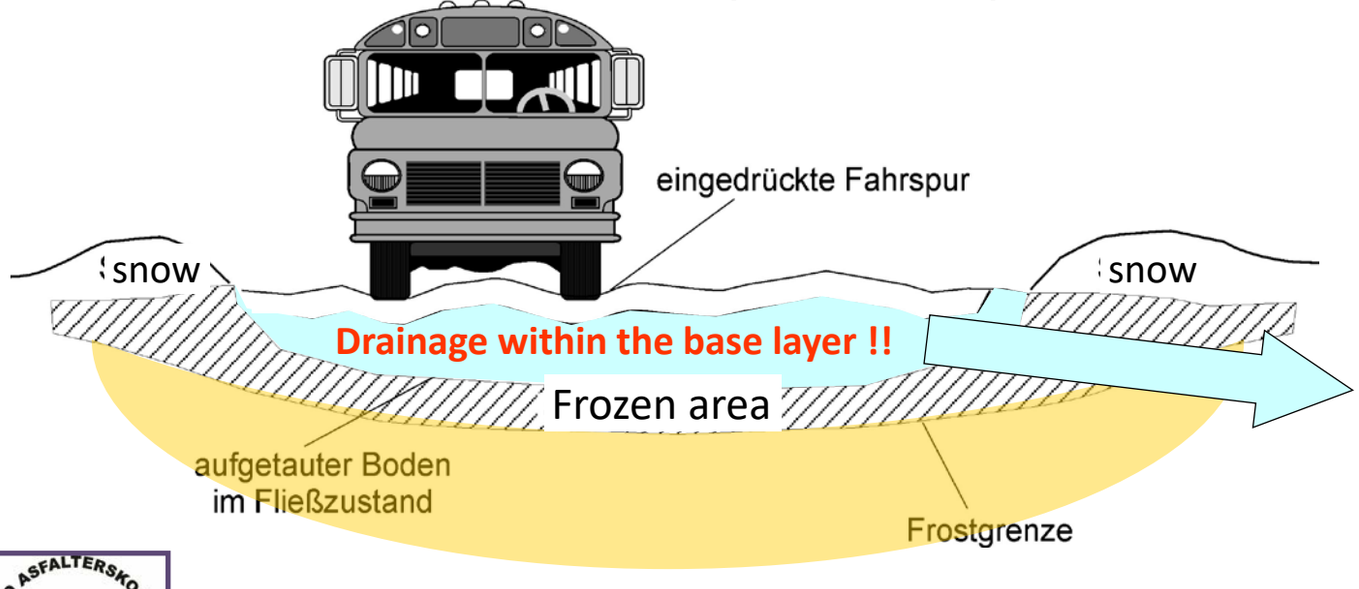


(subgrade or fundament)

Frost and or Thaw damages – due to water accumulation or limited ability for drainage



Acc. Ruckli, 1950



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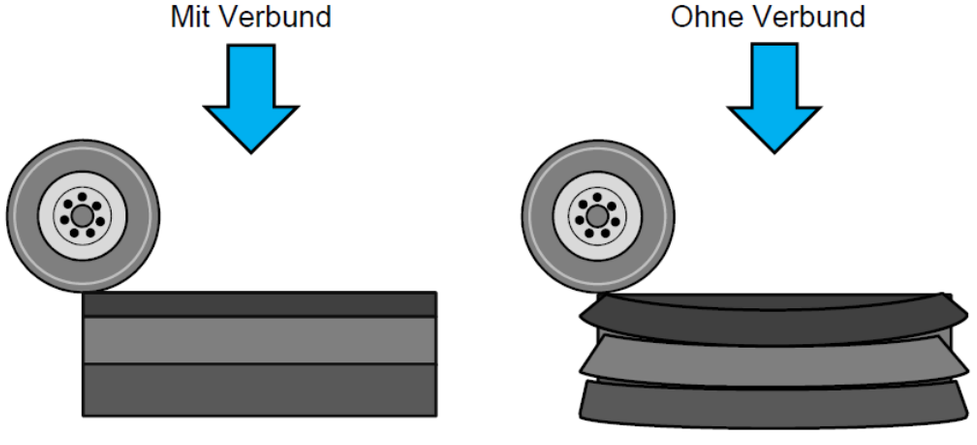
Basic principle 2
Everything starts with a proper composite!

Gestrata Bauseminar Jan. 2018 –
Dealing with connection between two layers

Basic principle 2
Proper layer composite

Welche Einwirkungen gibt es?

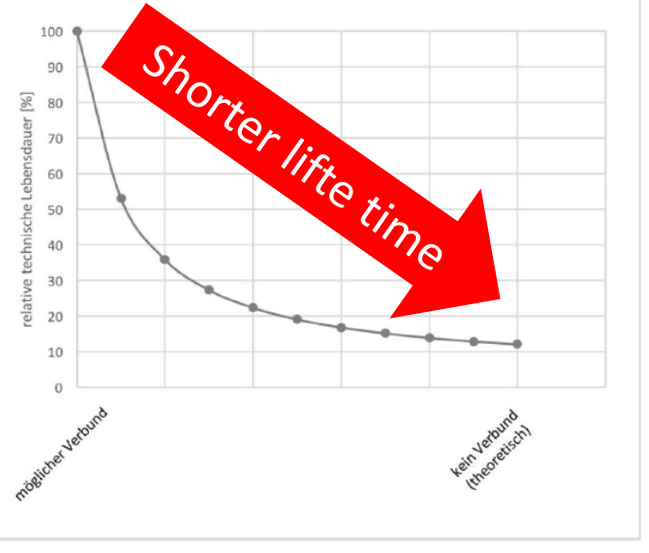
Vertikale Kräfte – Fließender Verkehr



Schichtverbund sehr wesentlich für den Widerstand gegen Einwirkungen

Einfluss von ungenügendem Schichtverbund auf die Dimensionierung?

Beispiel:
Autobahn
JDTLV = 2000 Kfz/24h
Aufbau:
LK25
Bautype AS1
(25 cm Asphalt)



Thema: Eine ewige Verbindung? Zum Schichtverbund im Asphaltstraßenbau
Vortragende(r): Bayraktarova, Eberhardsteiner, Dimitrov, Steiner
44. GESTRATA-BAUSEMINAR 2018

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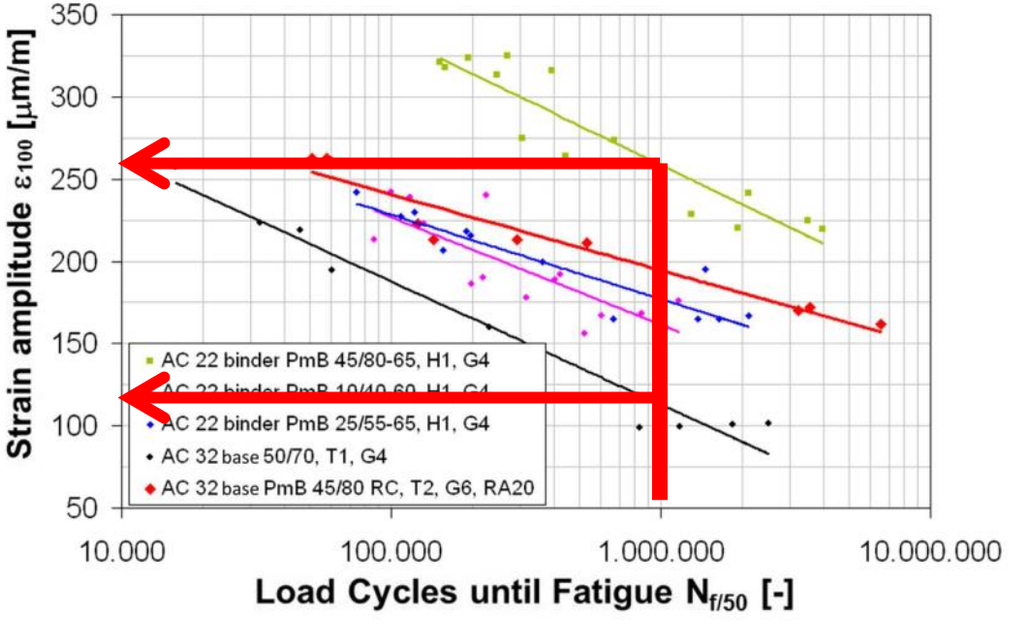
Durability of a road – Modification grade of bituminous binder

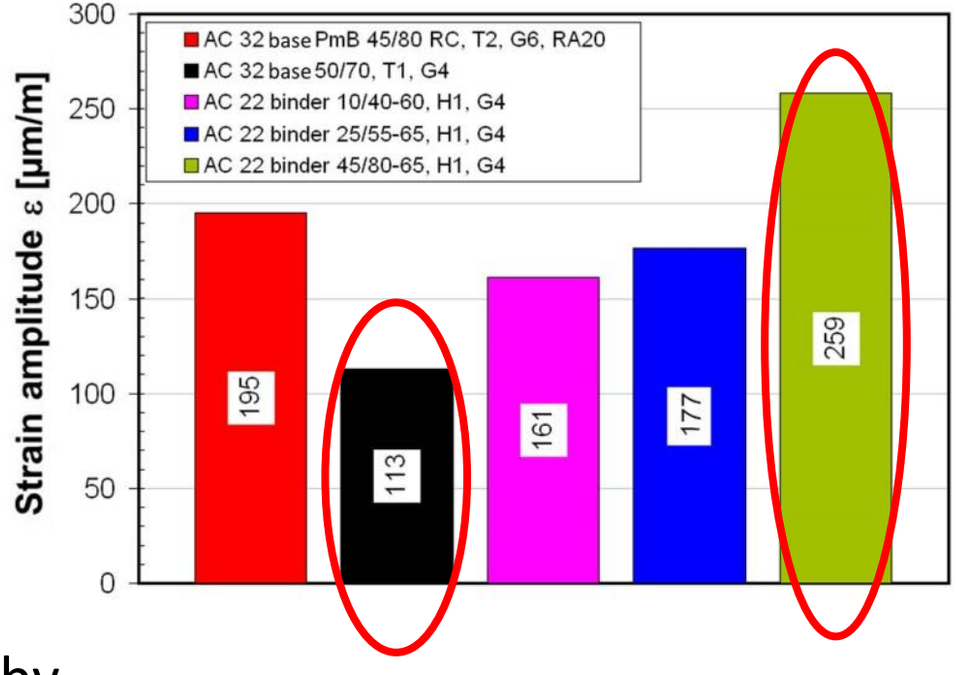
Wöhler curves

Test results of AC 22 & AC 32
with various bitumen types, with & without RA



Durability ε_6

Test results of AC 22 & AC 32
With various bitumen types, with &without RA

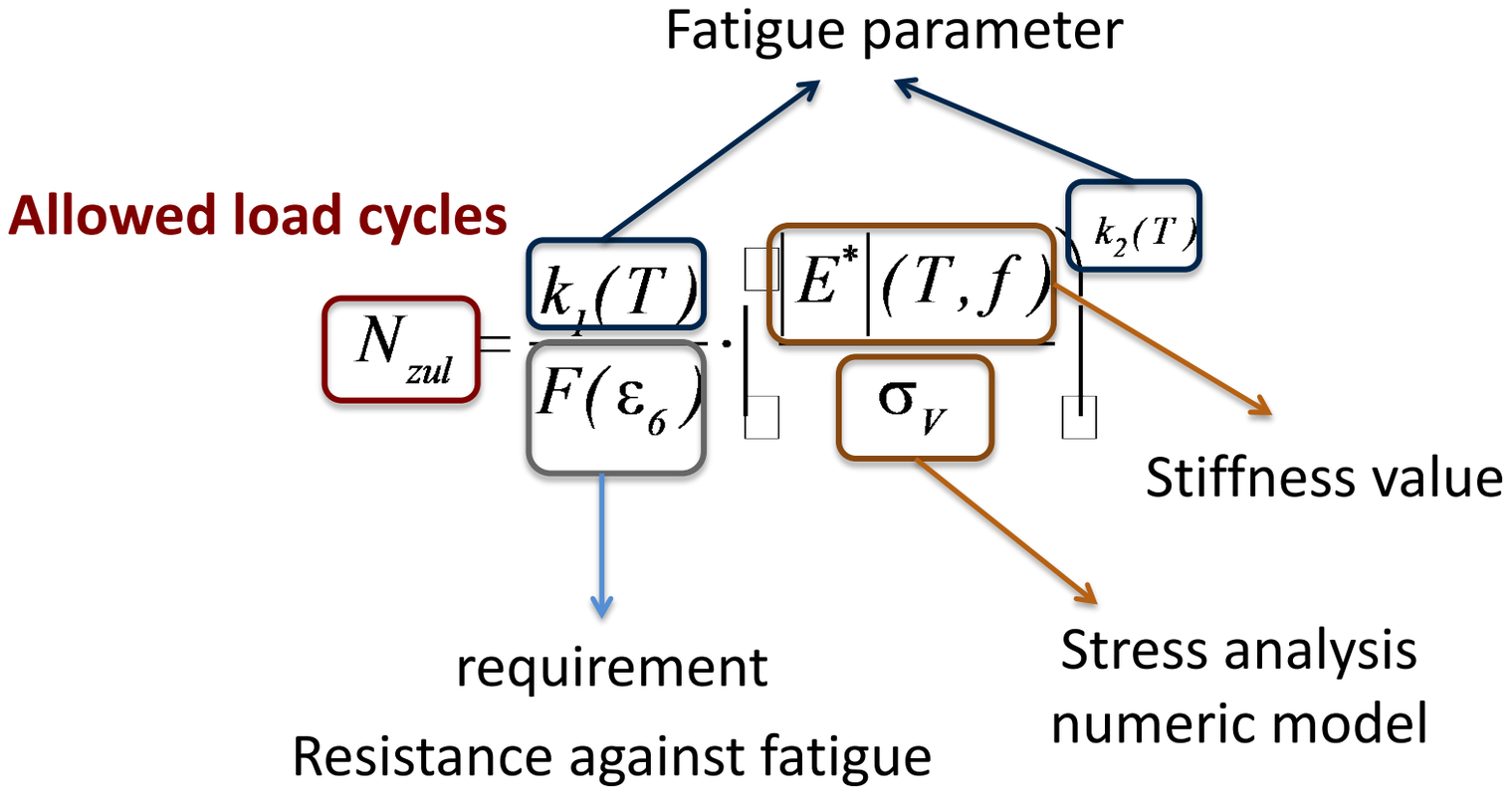


Fatigue life/Durability influence by

- Stiffness value
- ε_6- Value
- Modification grade of PmB (flexibility)

Recap of 2016 – Numeric Model

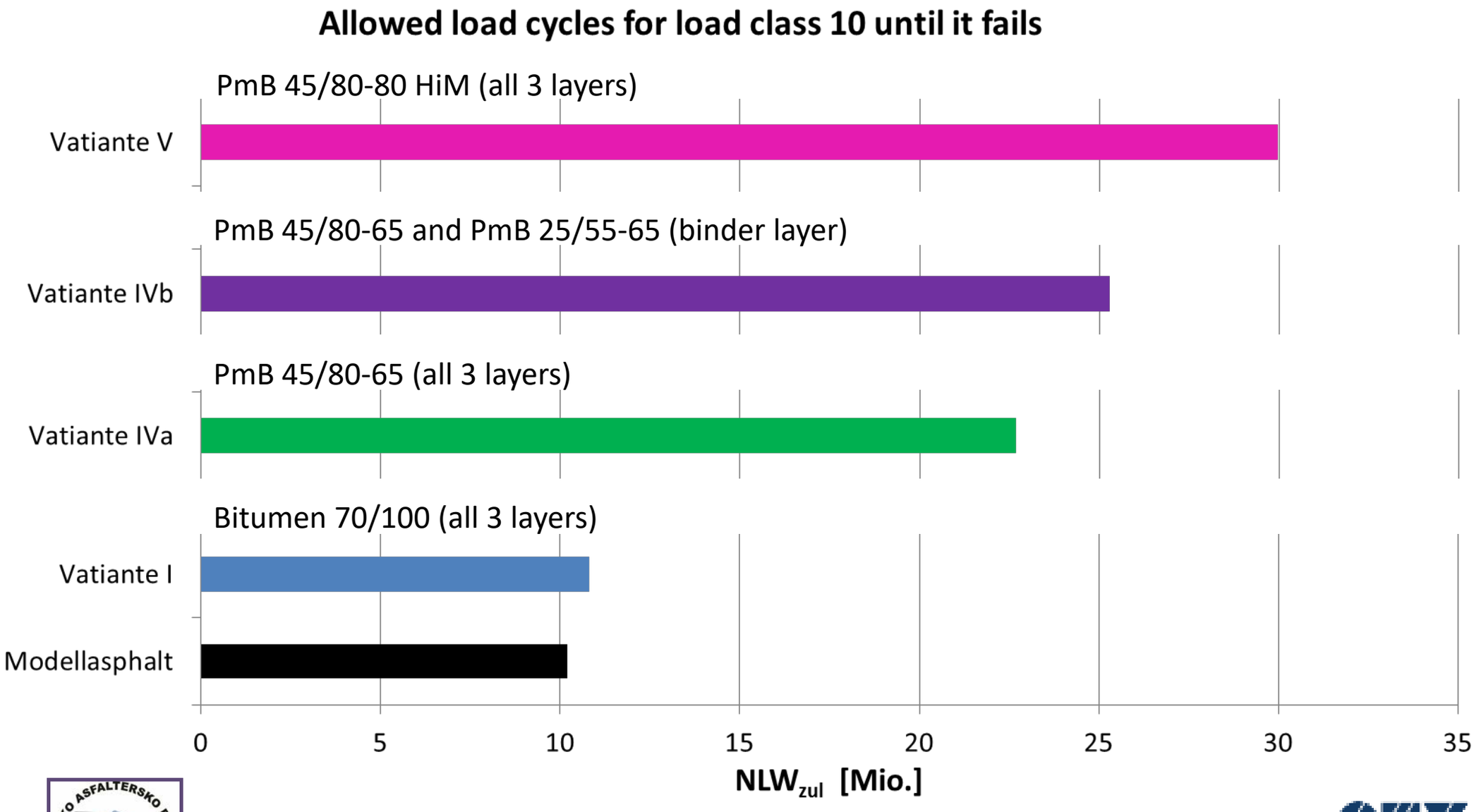
Fatigue criteria



Calculation of the allowed load cycles until the pavement failure

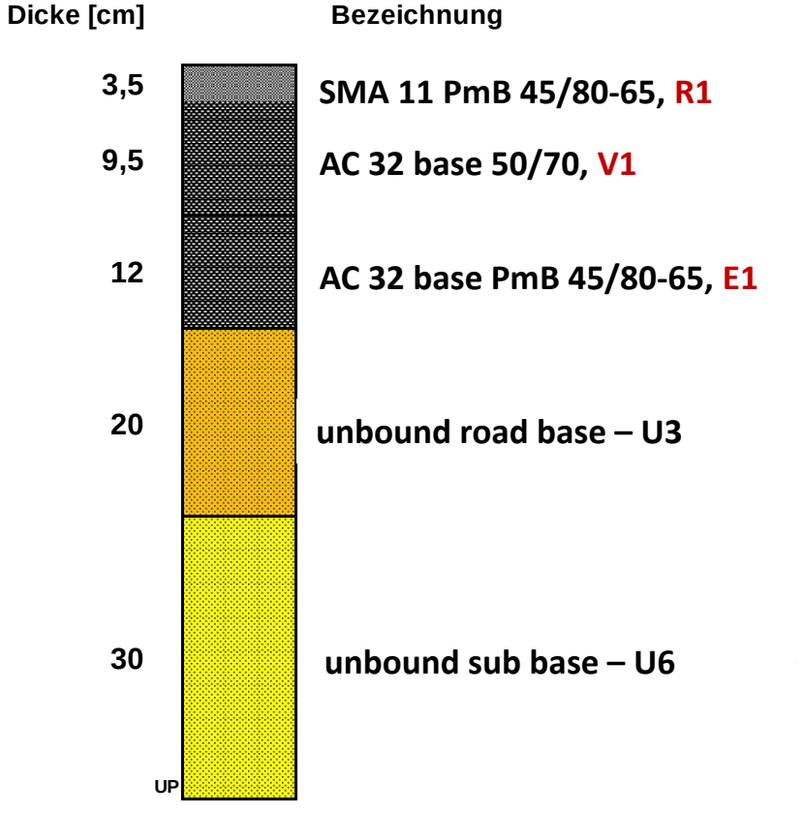
Recap 2017

Pavement Design results



Possible consequence – reduction of layer thickness (1)

Layer thickness load class 25

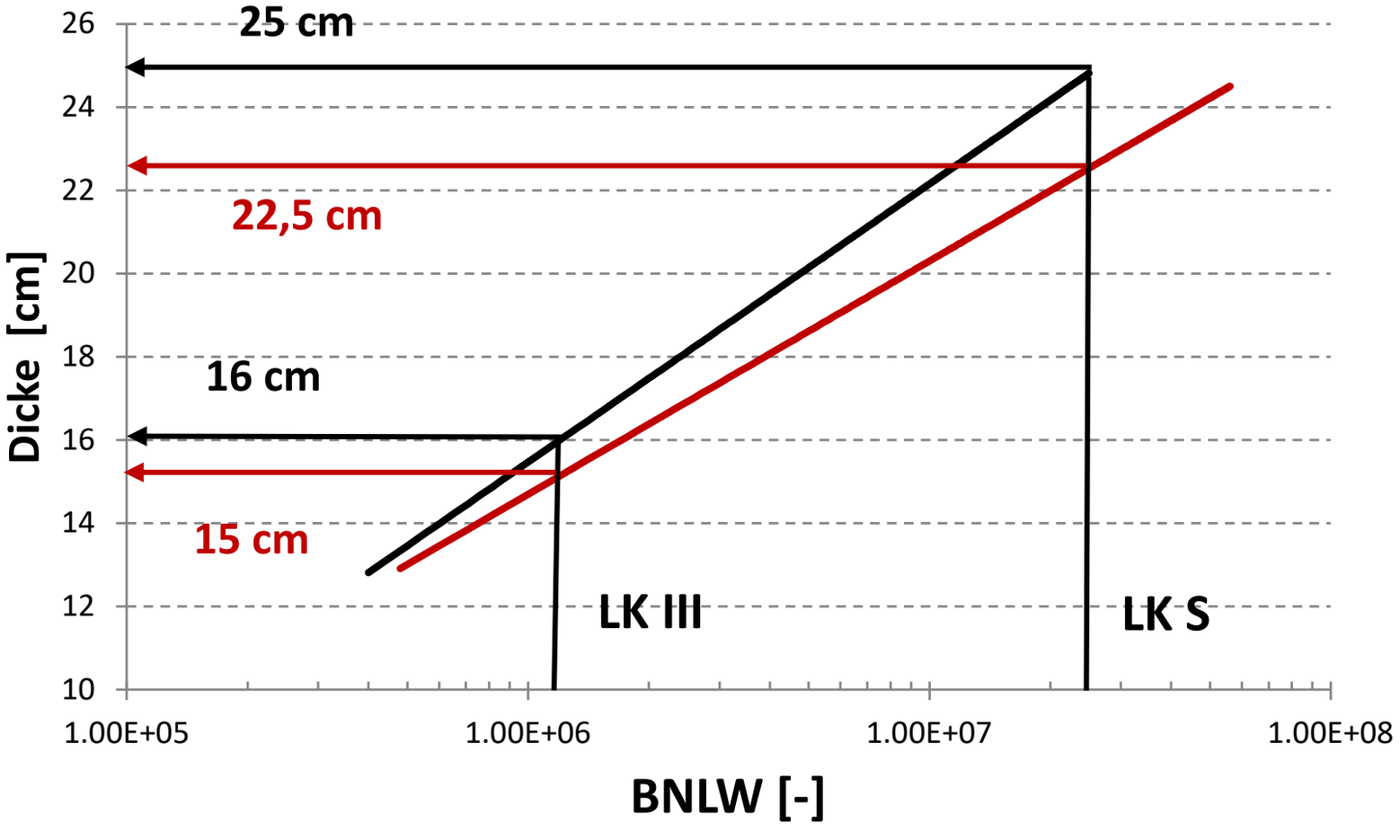


Design approach	Allowed load cycles	Theoretical life time *)
Model asphalt RVS 03.08.63	25,0 Mio.	20 years
		+120%
PR Test category E1	56,1 Mio	43,9 years

*) growth rate 3% (acc. RVS 08.03.21 for A&S)

@ Blab R, Hofko B. – Gestrata Bauseminar 2012

Possible consequence – reduction of layer thickness (2)



But proper

- subbase
- Unbounded layer
- Layer bonding

is a must!

Otherwise

- failure occurs
- Shorter life time
- Higher costs

@ Blab R, Hofko B. – Gestrata Bauseminar 2012

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Avoiding of rutting and top down cracks

Are not taken into consideration in the numeric road design model

- **Performance related test methods for bituminous binder or asphalt mix**
  - DSR or BBR testing
  - Triaxial, wheel tracking test or TSRST
- **Considered in LCCA partly (crack maintenance, reconstruction surface layer**

PgB / PmB – crack maintenance & durability

Standard cycles in the consideration period

Construction type AS1-LC10

Time frame of 50 years were taken into consideration

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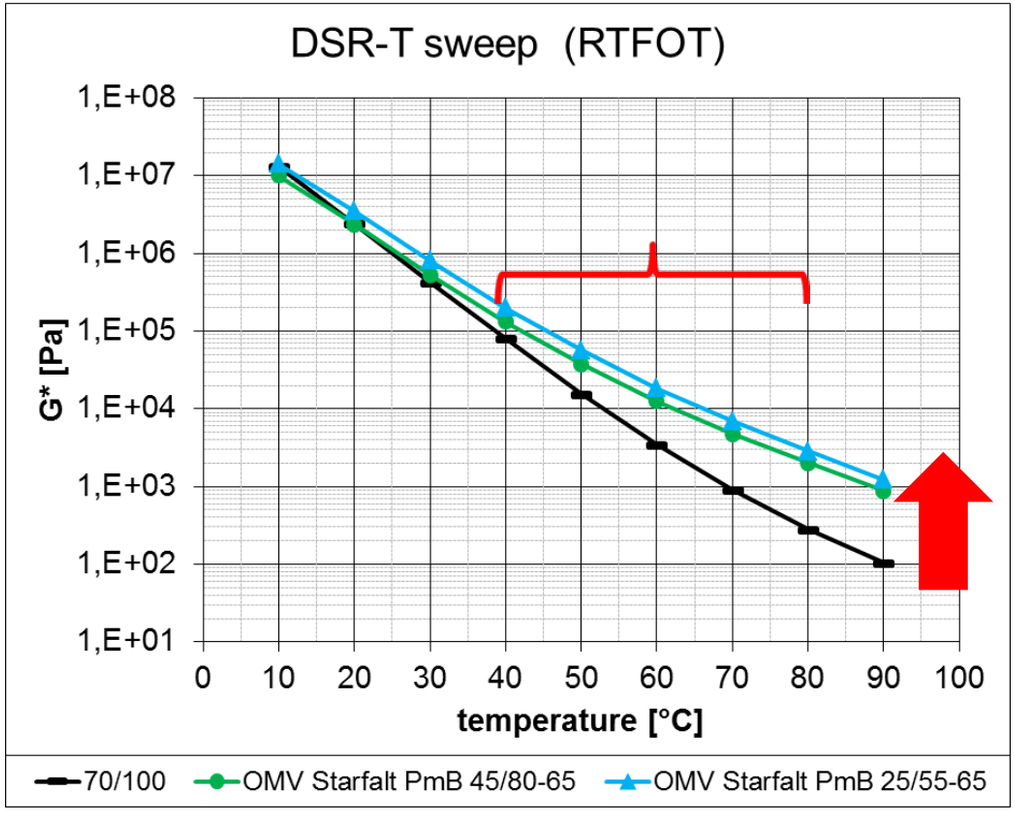
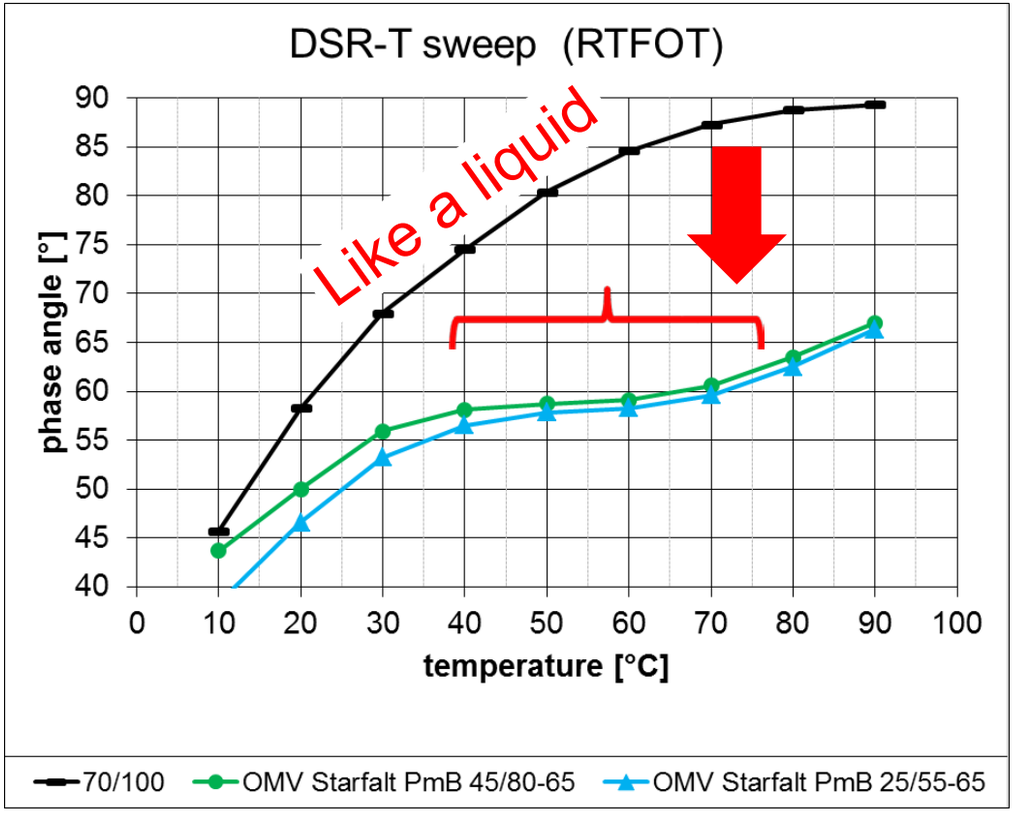
Permanent Deformation
Performance related binder tests





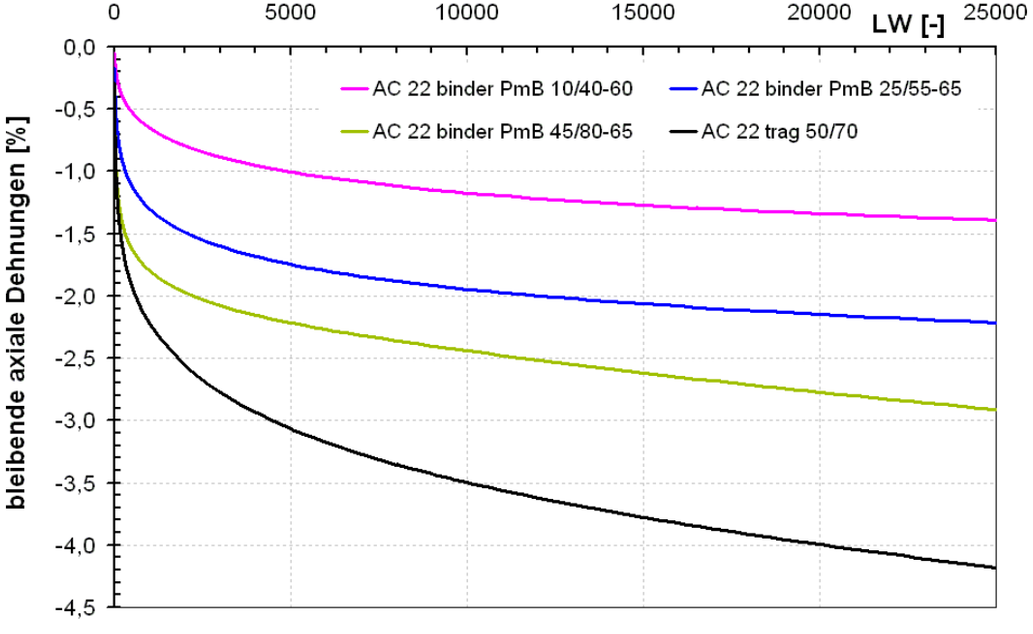
Better performance

- High complex modulus G* at higher temperatures (>40°C)
- Much lower phase angle -> elastic component

Permanent Deformation
Performance related asphalt mixture tests

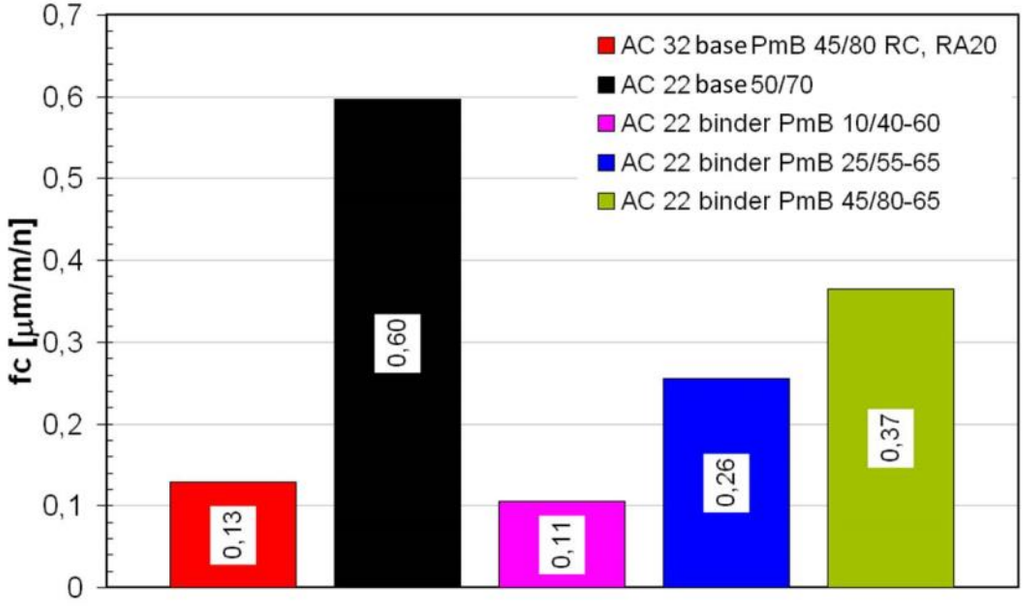
Permanent deformation (triaxial test)

Comparison of AC 22
with various bitumen types without RA



Creep parameter f_c

Comparison of AC 22 & AC 32
with various bitumen types with & without RA

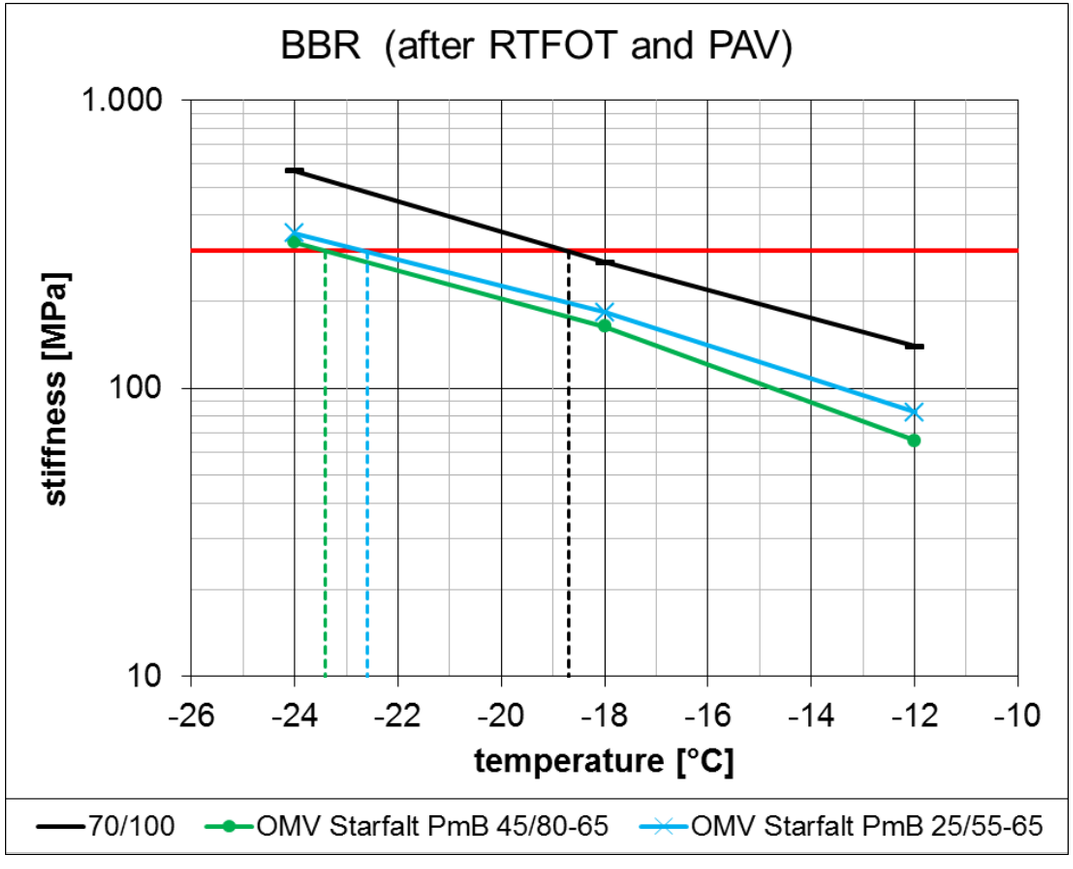


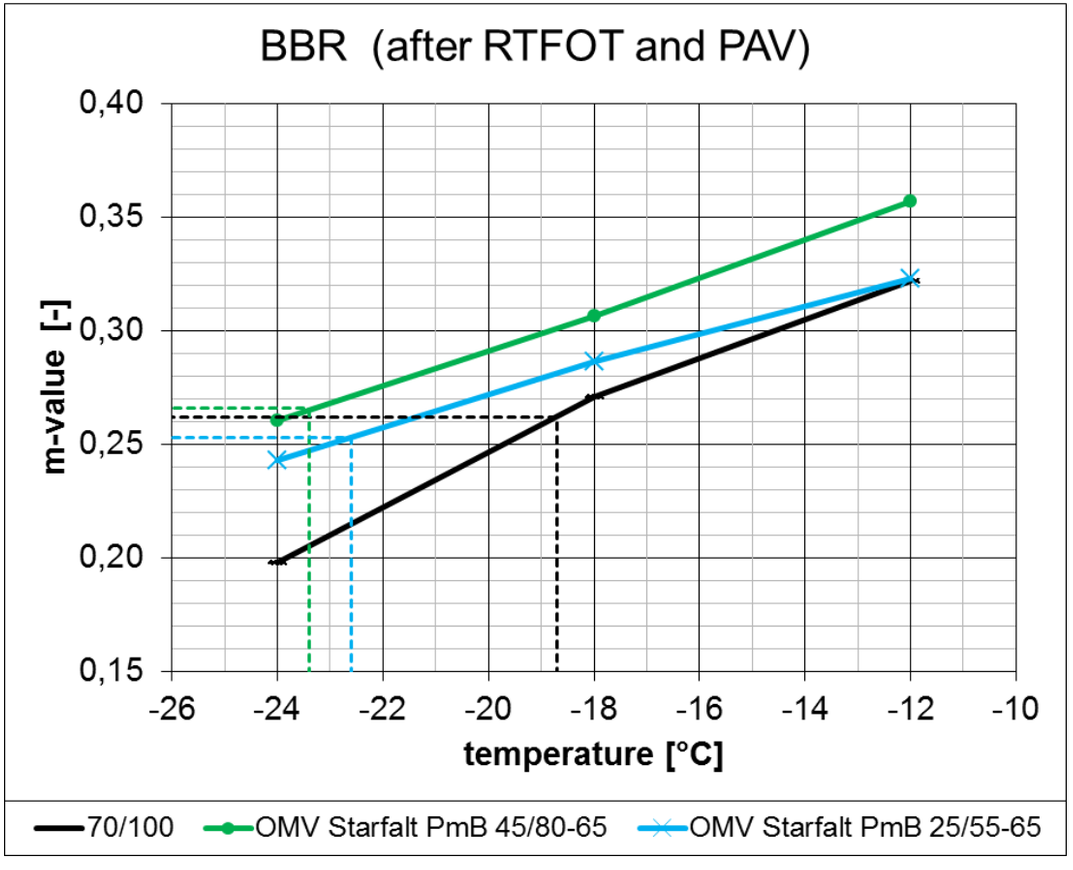
Better performance

- Lower creep parameter f_c with PmB
- Much lower permanent deformation

but it shouldn't be too stiff / brittle (ageing & low temperature cracking)

Top down cracking
Performance related binder tests



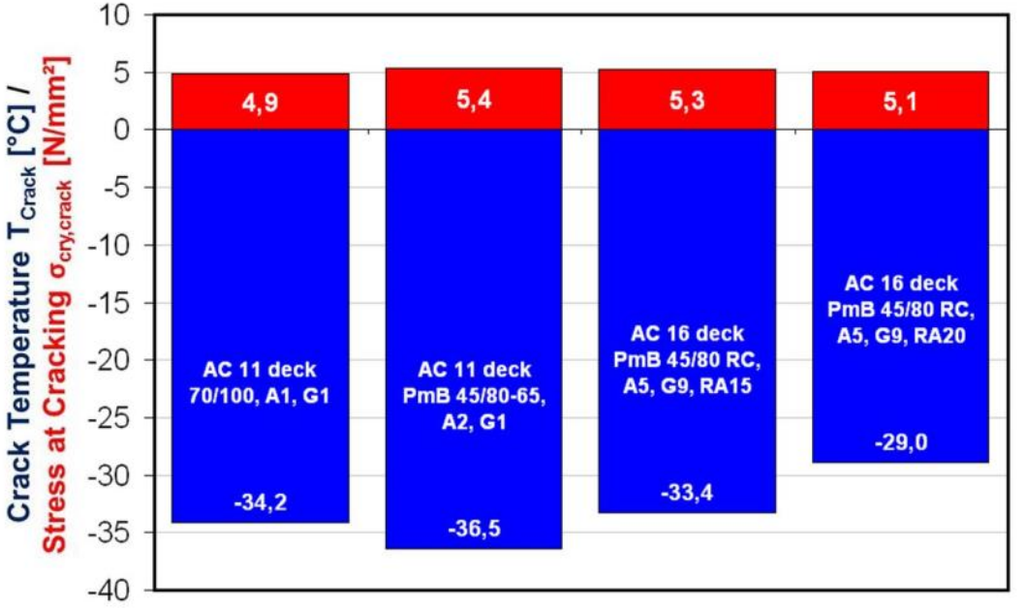


Top down cracking
Performance related asphalt mixture tests

Fracture temperature & failure stress

AC 16 surf PmB 45/80 RC, RA 15 & RA20

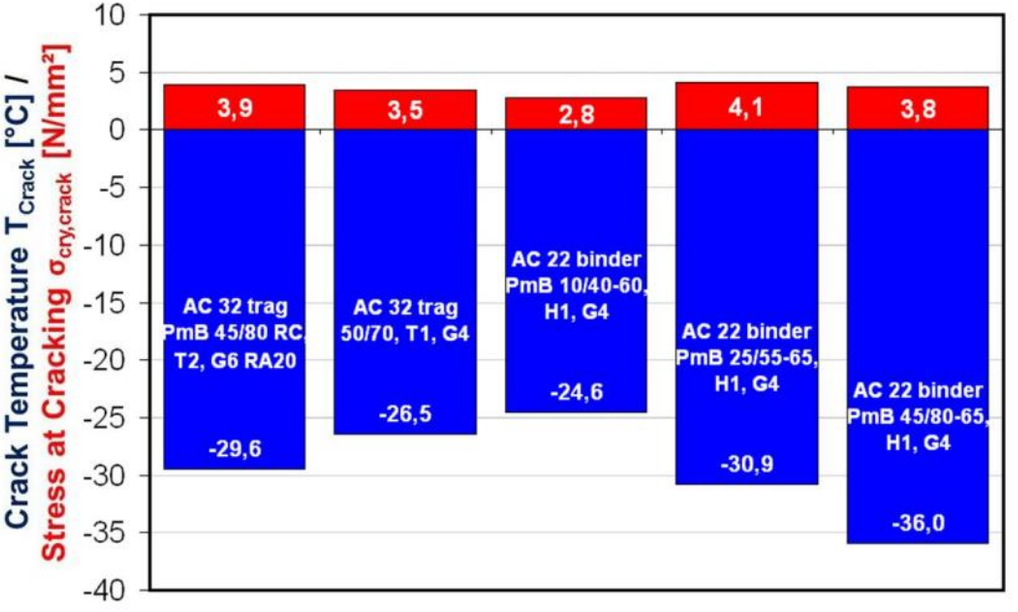
Comparison with other AC 11 with other bitumen types without RA



Fracture temperature & failure stress

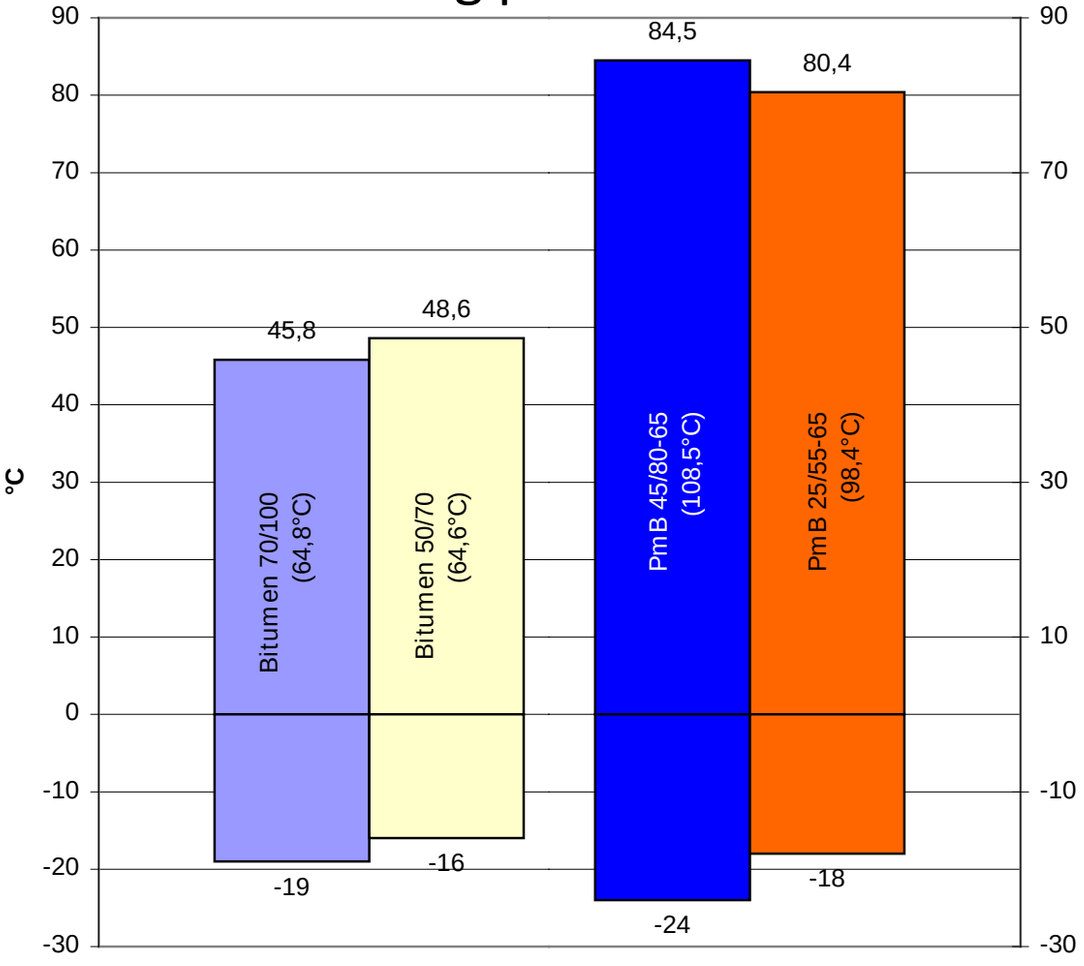
AC 32 base PmB 45/80 RC, T2, G6, RA20

Comparison with other AC 22 & AC 32 with other bitumen types without RA

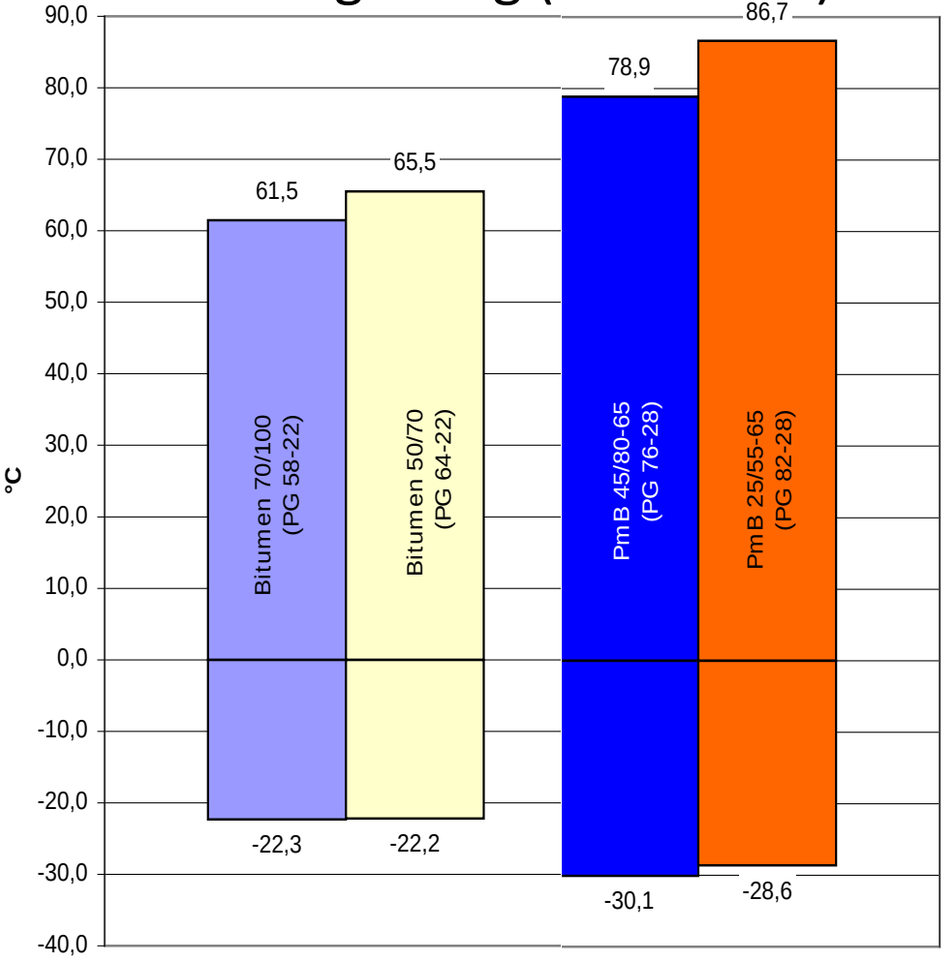


Bitumen parameter

Plasticity range
Softening point - Fraass



Plasticity range
PG grading (DSR – BBR)



Resume

- Know the bearing capacity of your subgrade and the unbound layers (don’t over estimate them)
- Take the impact of moisture and frost into consideration
- Proper layer composite
- Do performance related tests (bituminous binder and asphalt mixtures)
  - Cracking resistance
  - Permanent deformation
  - Stiffness & fatigue testing
- Change design process and take the real properties of the asphalt mixtures into consideration (higher quality - longer life time – less maintenance costs)
- Different bituminous binder types are influencing the performance

CEE Road pavement design workshop 2018

- 4th Pavement design workshop 15th-16th of November 2018 – Czech asphalt association, ZAS and OMV
- In 2016 42 experts from 8 different countries participating

E&E Event 2018 – 14th-15th June 2018

E&E EVENT 2018

EURASPHALT & EUROBITUME

14 & 15 JUNE 2018

BERLIN

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PREPARING THE ASPHALT INDUSTRY FOR THE FUTURE

Questions?

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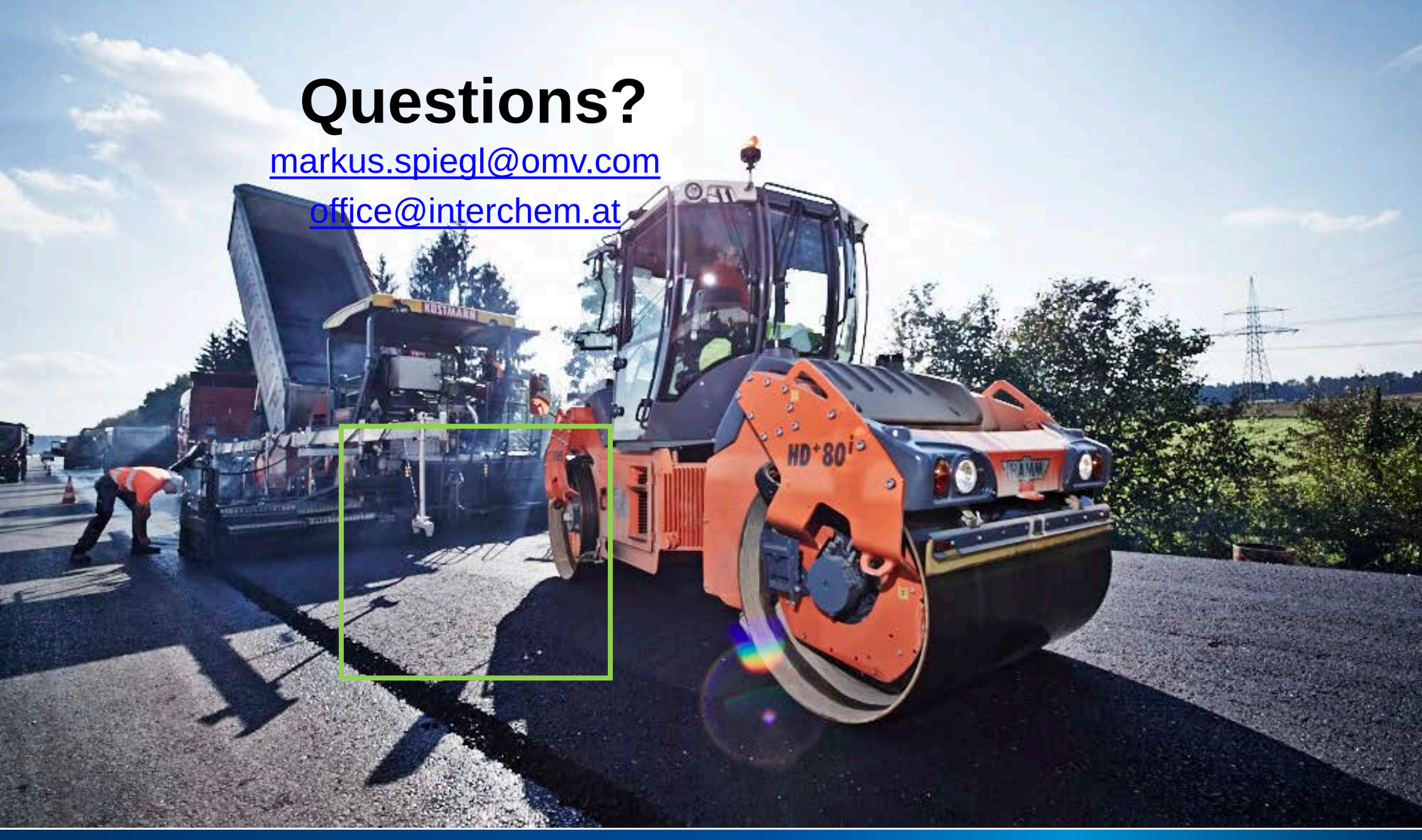

OMV STARFALT HIGH PERFORMANCE BITUMEN

Interchem

Moving more. Moving the future. OMV

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