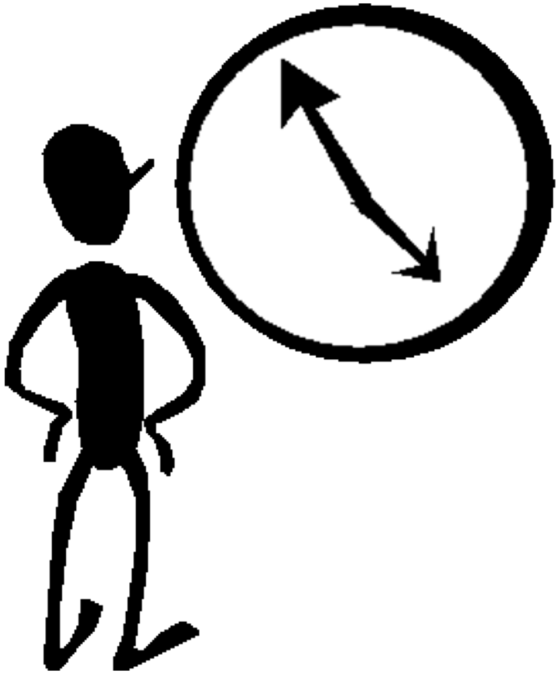
IGOR RUTTMAR

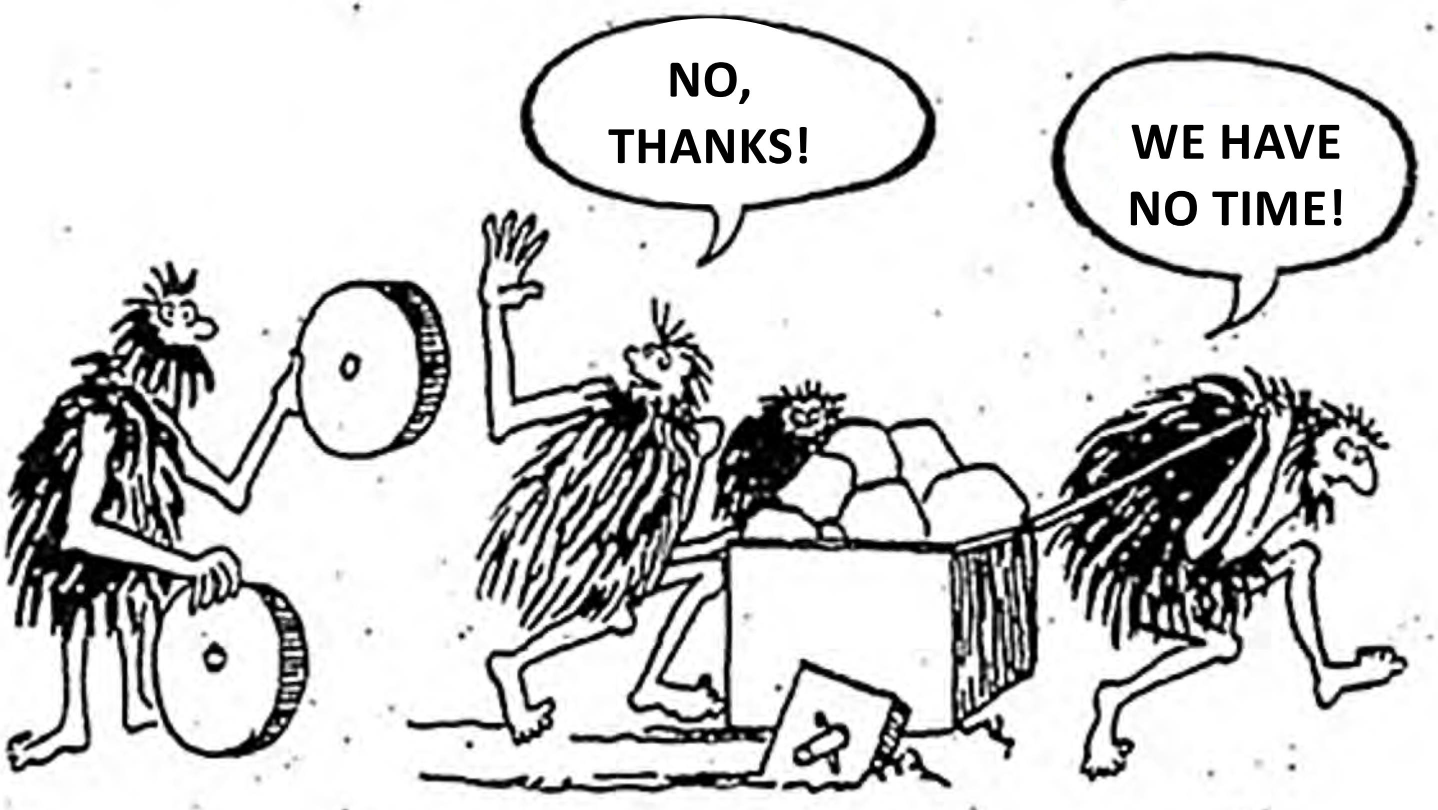
PERPETUAL PAVEMENTS



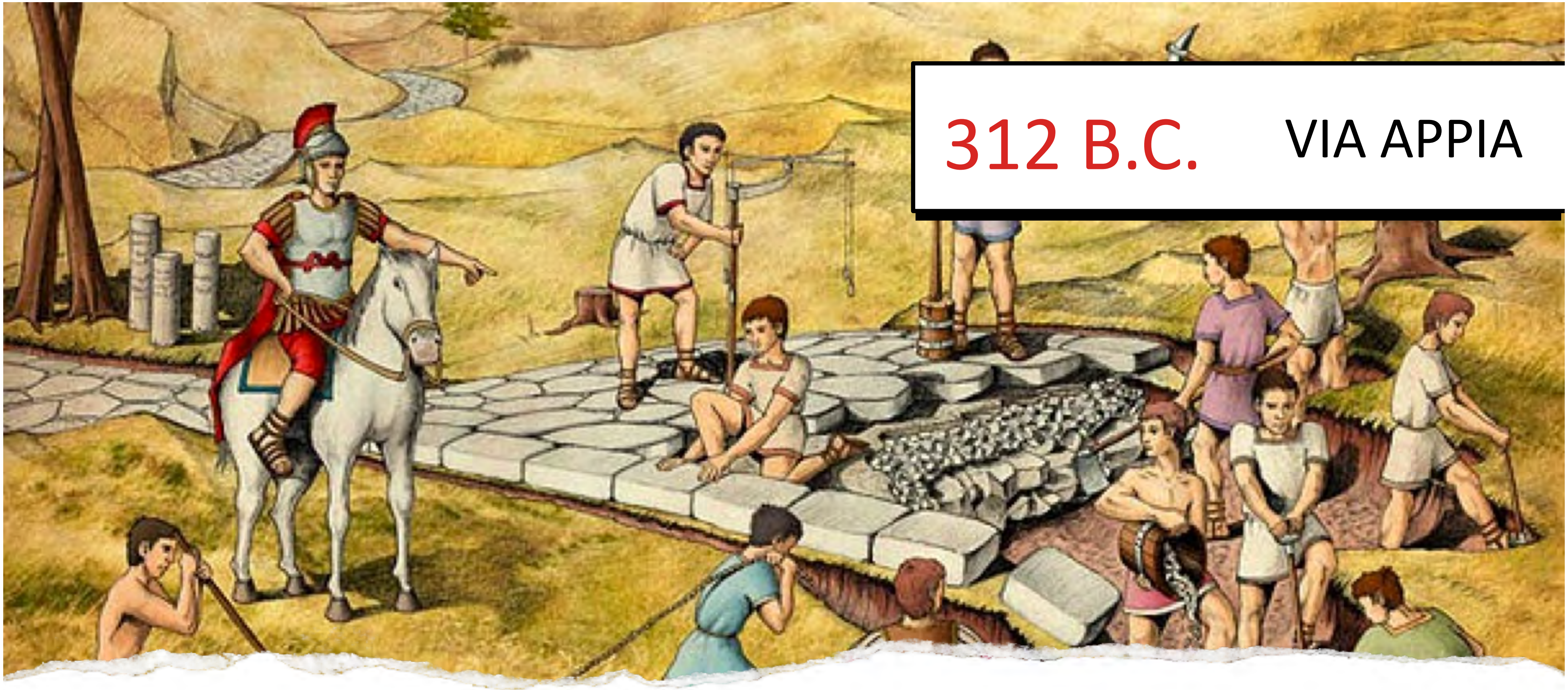
Confidence through Quality
IAT Conference
Edinburgh 2019

DISCLAIMER

WE DO NOT
WANT TO
RE-INVENT
THE WHEEL !

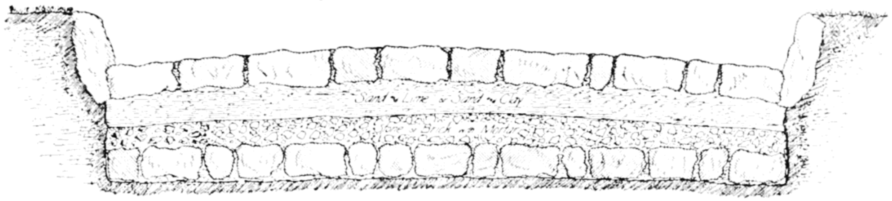

NO,
THANKS!
WE HAVE
NO TIME!

PAST AND PRESENT



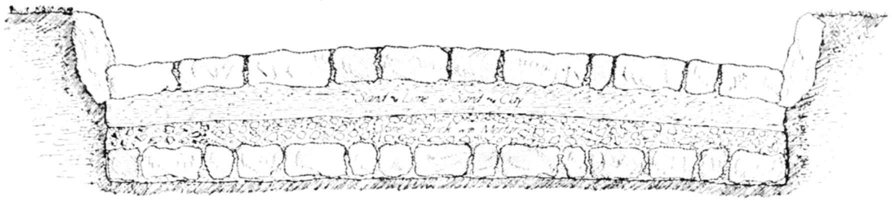
312 B.C. VIA APPIA

ROMAN ROADS



NOW VIA APPIA

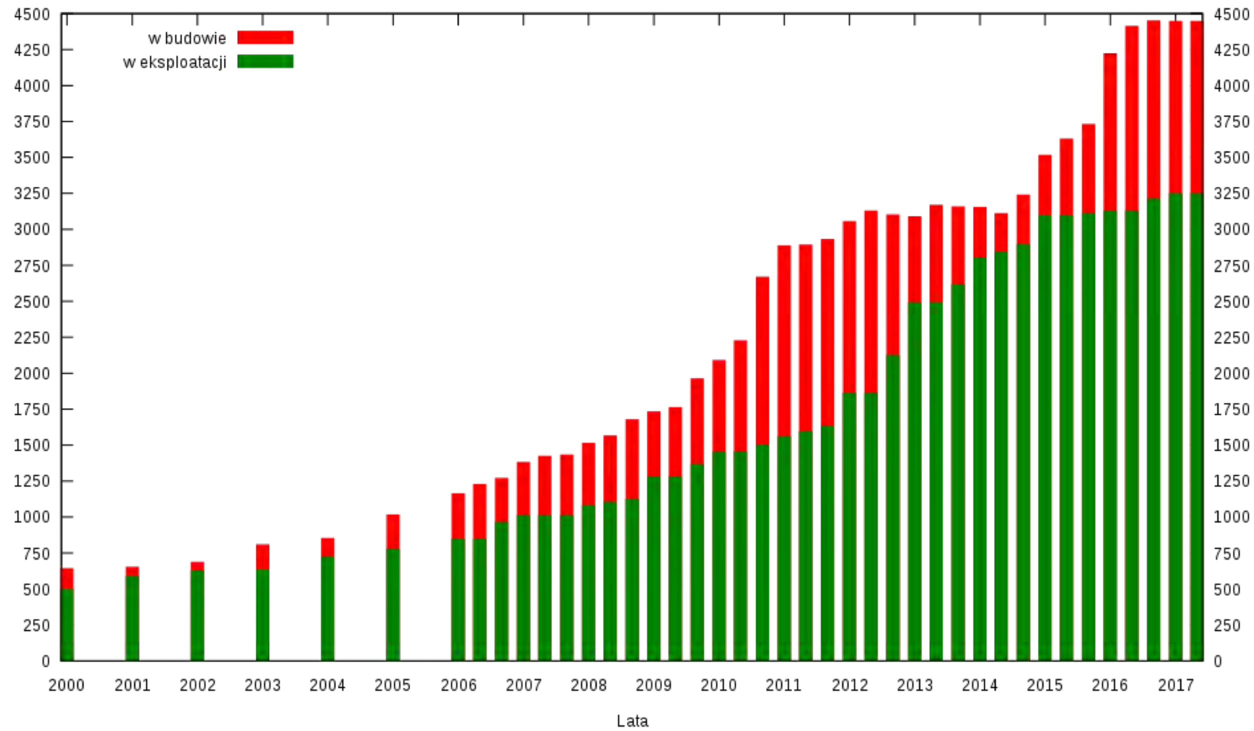
PERPETUAL




1823
MACADAM ROAD CONSTRUCTION
Confidence trough Quality!
John Loudon McAdam
(1756 –1836)

PRESENT ASPHALT PAVEMENTS IN POLAND

HIGHWAYS AND EXPRESSWAYS CONSTRUCTION IN POLAND




2000
TRADITIONAL ASPHALT PAVEMENT


2000
4 cm
SMA 0/11 B-50
8 cm
AC 0/20 B-50
17 cm
AC 0/25 B-50
15 mln
115 kN
ESALs


2004
HIGH STIFFNESS MODULUS AC (EME)


2004
9 cm
AC 20
PMB
4 cm
SMA 11
13 cm
AC „EME” 20
20/30
17 mln
115 kN
ESALs


2011
HIGH STIFFNESS MODULUS AC (AC WMS)
STRABAG
UEFA
EURO2012
POLAND-UKRAINE


2011
4 cm
SMA 11
PMB 45/80-55
8 cm
AC WMS 16
PMB 25/55-60
17 cm
AC WMS 16
20/30
54 mln
115 kN
ESALs


2012
LOW
TEMPERATURE
CRACKING
TOO
STIFF!
uncontrolled
„wild" crack

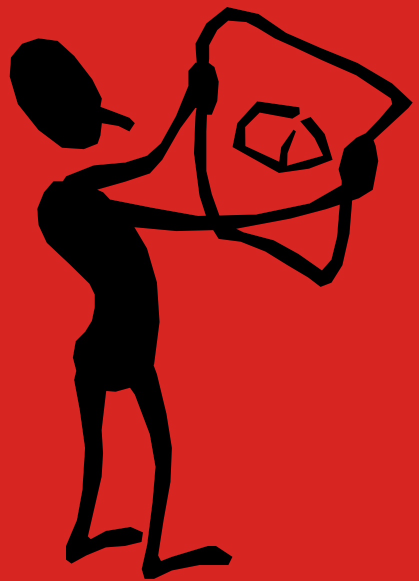
"Mind what you have learned. Save you it can.

Yoda, *The Empire Strikes Back*

LOW-TEMPERATURE TESTING

„GET BACK TO THE LAB!”

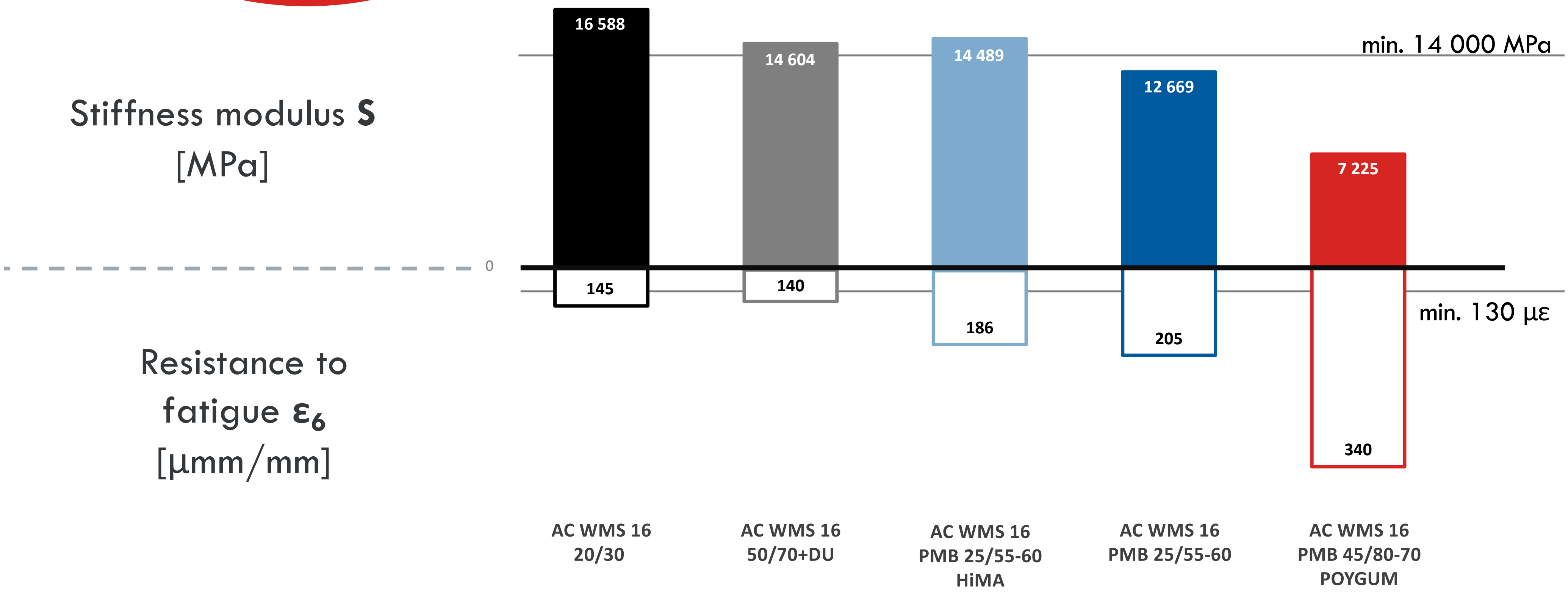
TPA LAB, PRUSZKÓW 2012



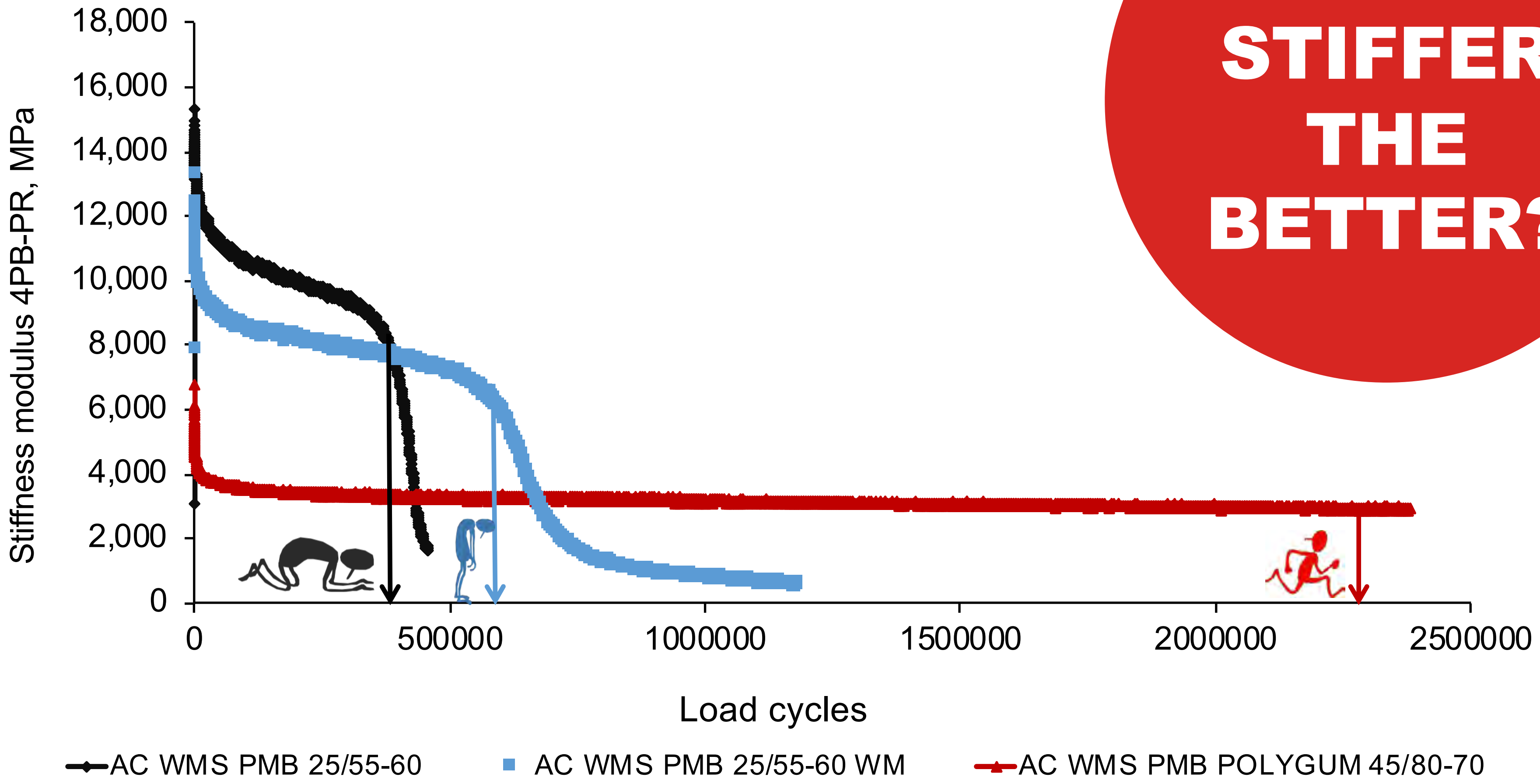
STIFFNESS VS. FATIGUE

STIFFNESS MODULUS AND FATIGUE RESISTANCE

4PB-PR (10°C, 10 Hz)



FATIGUE TESTS ON AC WMS 16 (EME)



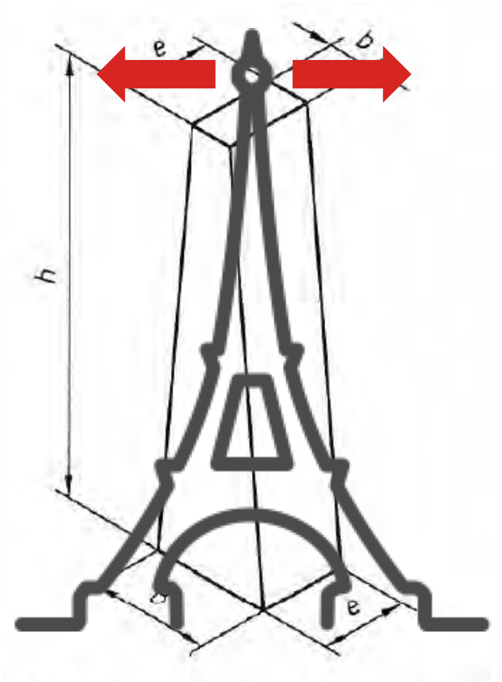
THE STIFFER THE BETTER?

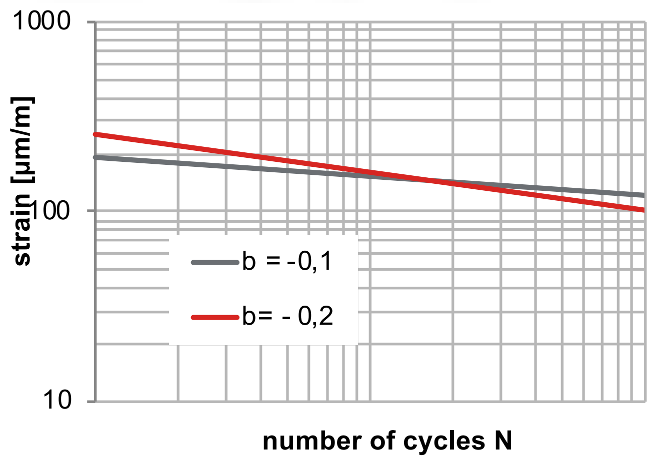
FRENCH DESIGN METHOD

FATIGUE CRITERION

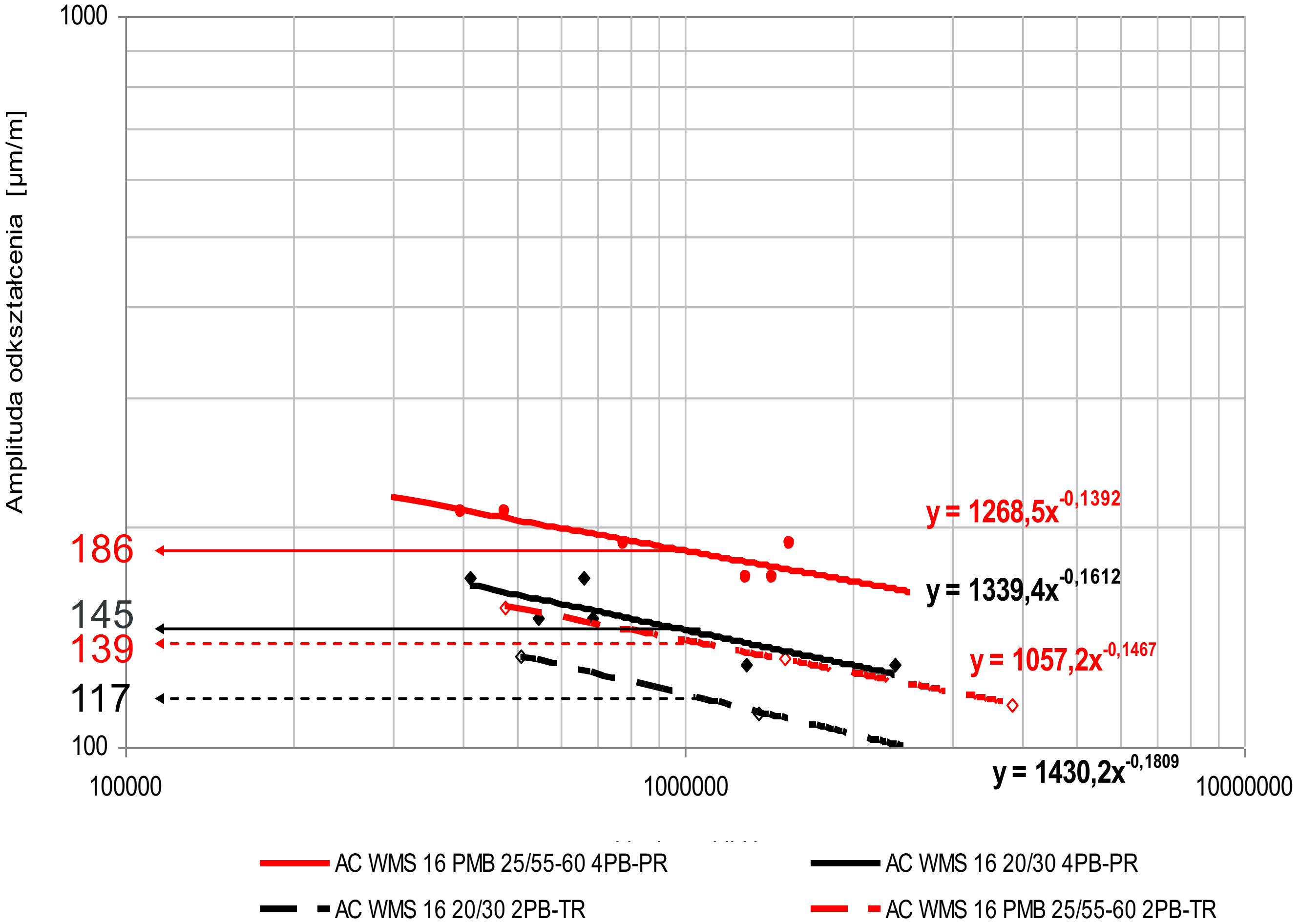
2PB-TR (15°C, 10 Hz)

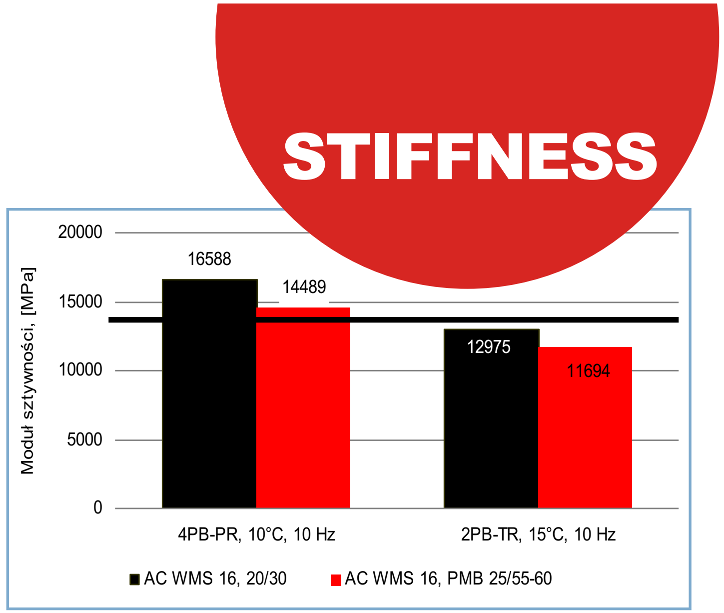
$$NE = \left(\frac{\varepsilon_{t,ad}}{\varepsilon_6(10°C, 25Hz) \cdot \left[\frac{E(10°C)}{E(\theta_{eq})}\right]^{0,5} \cdot k_r \cdot k_c \cdot k_s} \right)^{\frac{1}{b}} \cdot 10^6$$

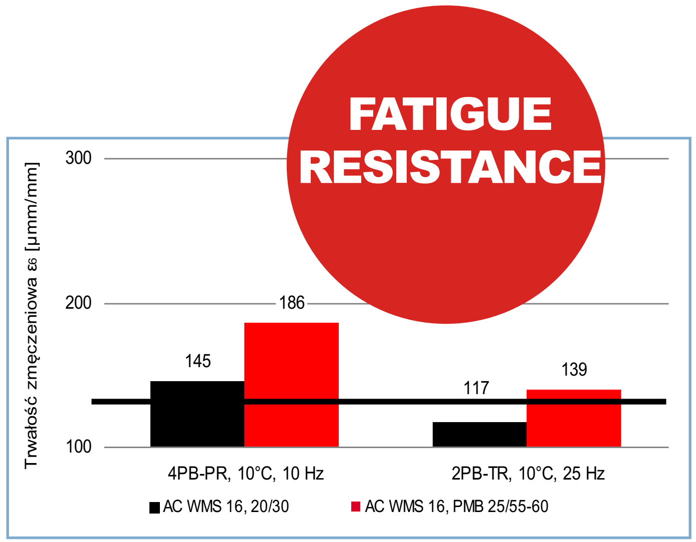


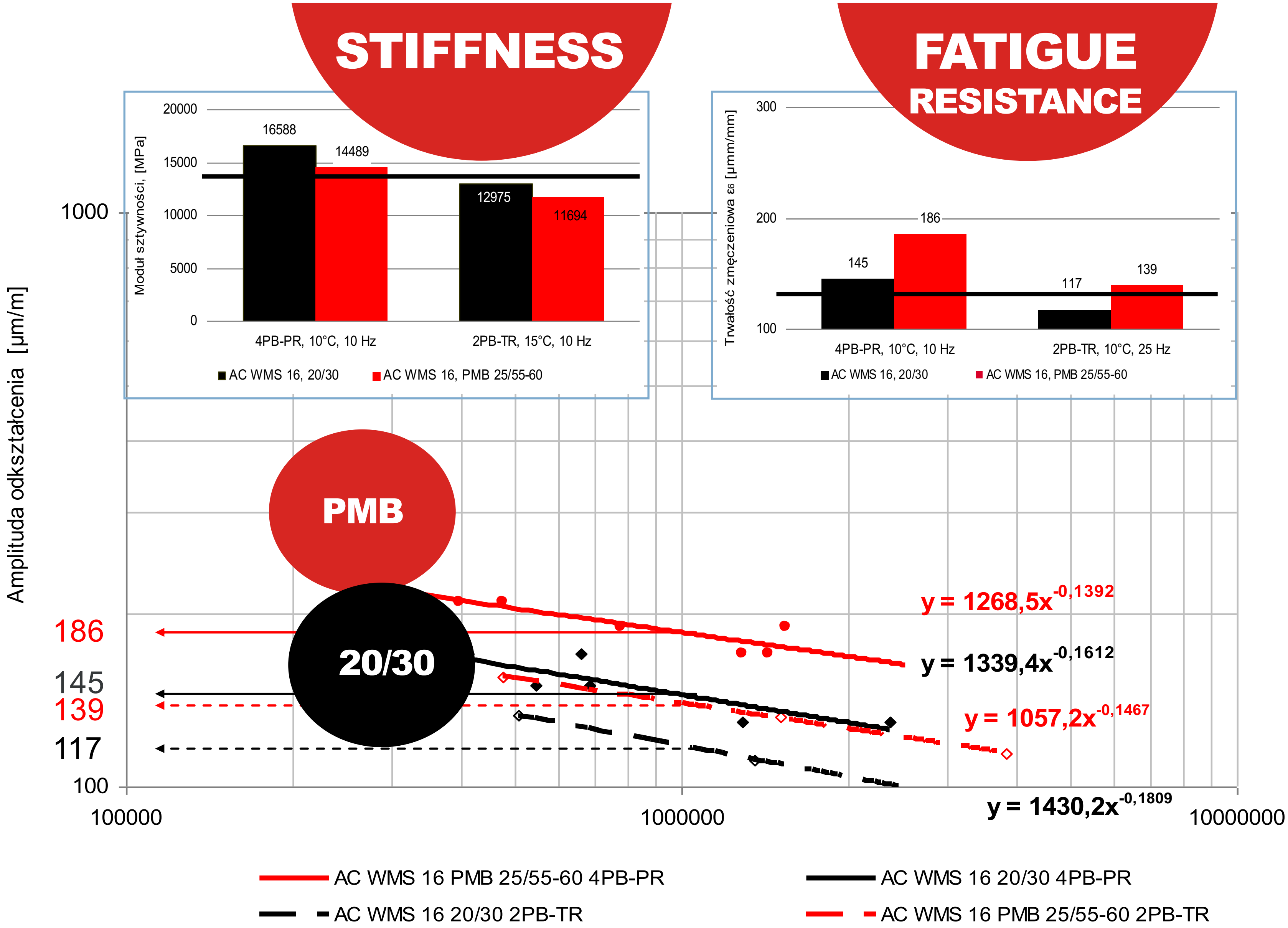


4PB-PR (10°C, 10 Hz) VS. 2PB-TR (15°C, 10 Hz)







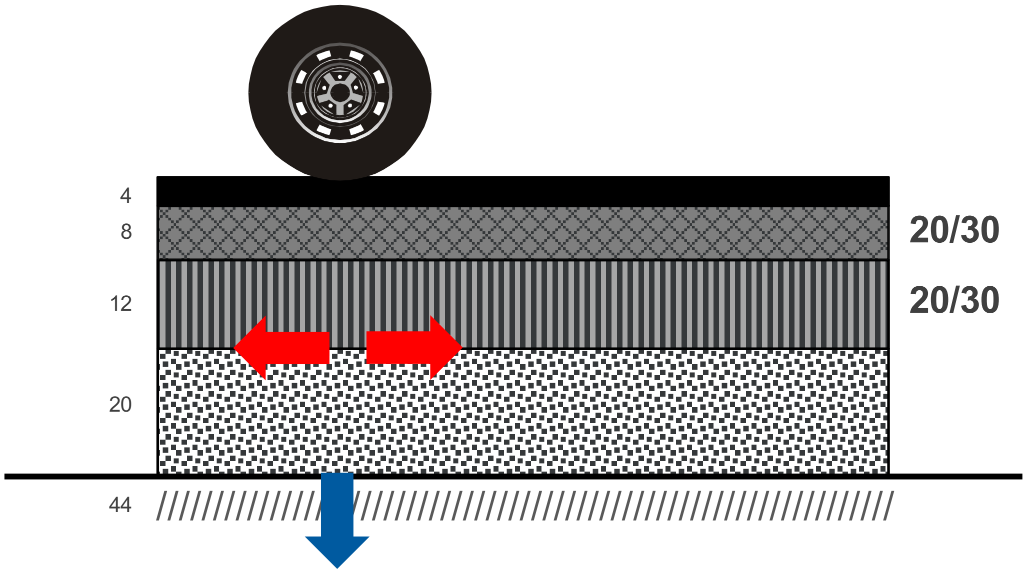


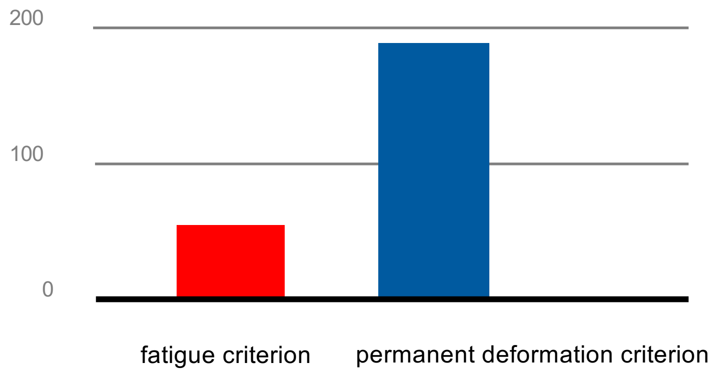
STIFFNESS
FATIGUE RESISTANCE
Moduł sztywności, [MPa]
20000
15000
10000
5000
0
16588
14489
12975
11694
4PB-PR, 10°C, 10 Hz
2PB-TR, 15°C, 10 Hz
AC WMS 16, 20/30
AC WMS 16, PMB 25/55-60
Trwałość zmęczeniowa ε6 [μmm/mm]
300
200
100
145
186
117
139
4PB-PR, 10°C, 10 Hz
2PB-TR, 10°C, 25 Hz
AC WMS 16, 20/30
AC WMS 16, PMB 25/55-60
Amplituda odkształcenia [μm/m]
1000
186
145
139
117
100
PMB
20/30
y = 1268,5x-0,1392
y = 1339,4x-0,1612
y = 1057,2x-0,1467
y = 1430,2x-0,1809
100000
1000000
10000000
AC WMS 16 PMB 25/55-60 4PB-PR
AC WMS 16 20/30 4PB-PR
AC WMS 16 20/30 2PB-TR
AC WMS 16 PMB 25/55-60 2PB-TR

AC WMS (EME) PAVEMENT DESIGN

TRAFFIC LOAD CLASS KR5

AC WMS USING 20/30 AND/OR PMB 25/55-60

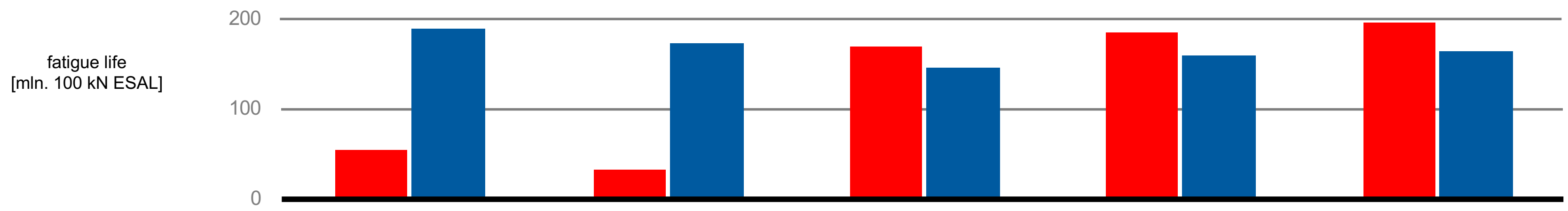


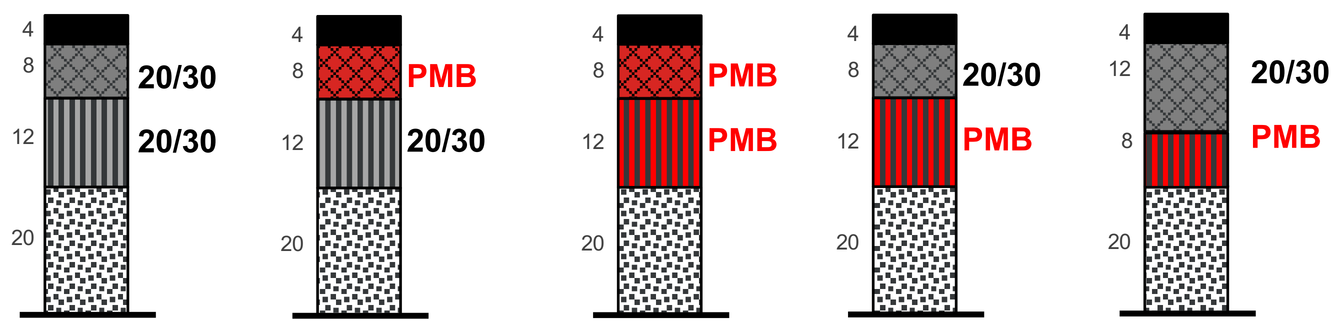


AC WMS (EME) PAVEMENT DESIGN

TRAFFIC LOAD CLASS KR5

AC WMS USING 20/30 AND/OR PMB 25/55-60





AC WMS 16 PMB 25/55-60

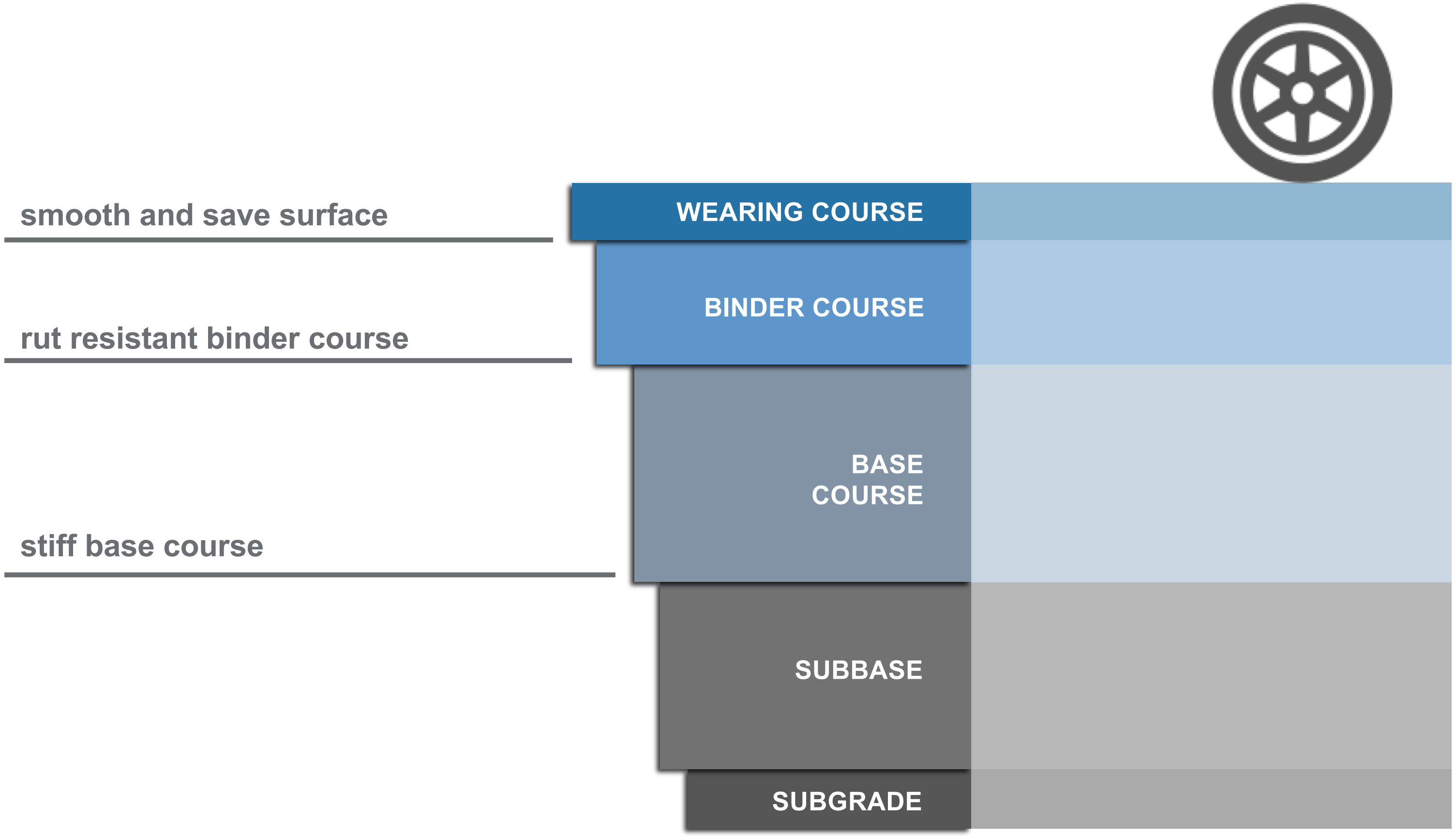
AC WMS 16 20/30

Perpetual pavement is „an asphalt pavement designed and built to last longer than 50 years without requiring major structural rehabilitation or reconstruction, and needing only periodic surface renewal (...)"

APA definition

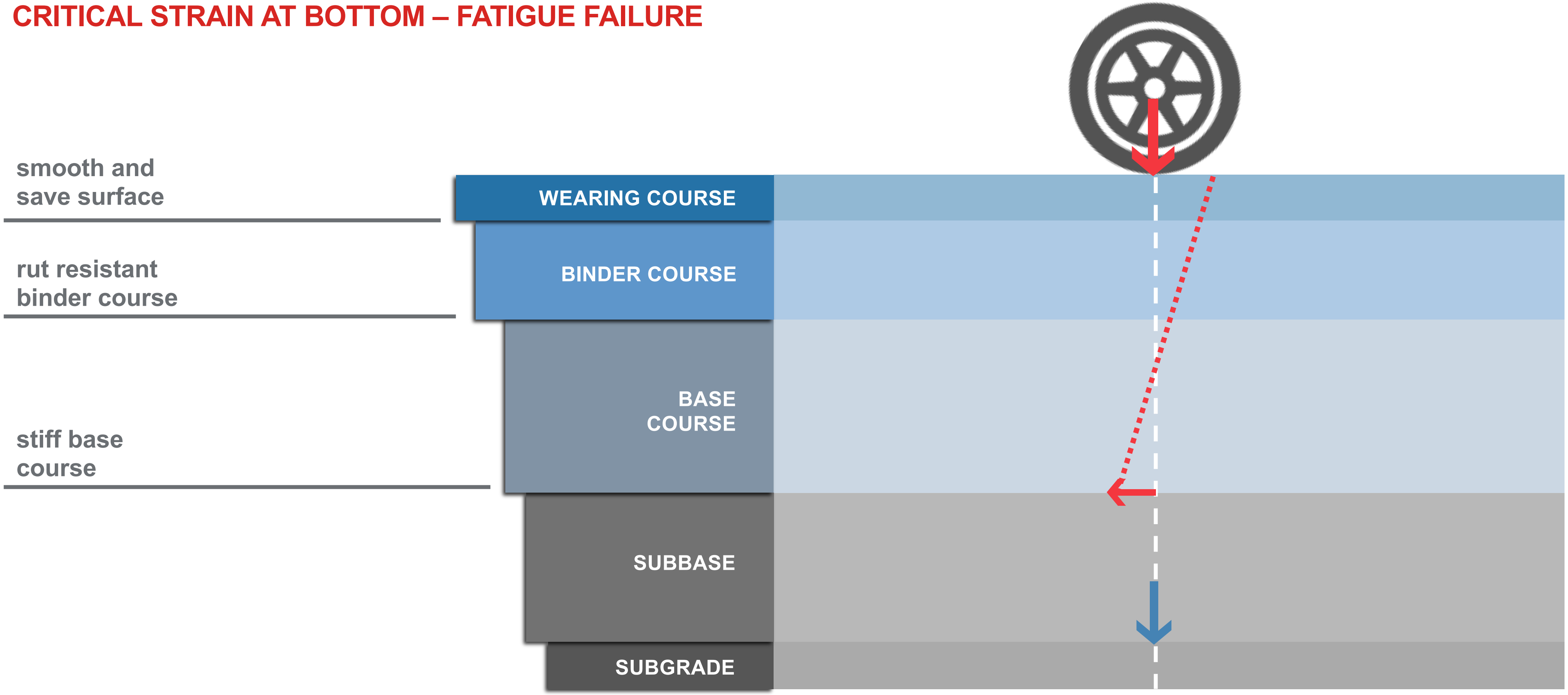
TRADITIONAL ASPHALT PAVEMENT

CRITICAL STRAIN AT BOTTOM – FATIGUE FAILURE



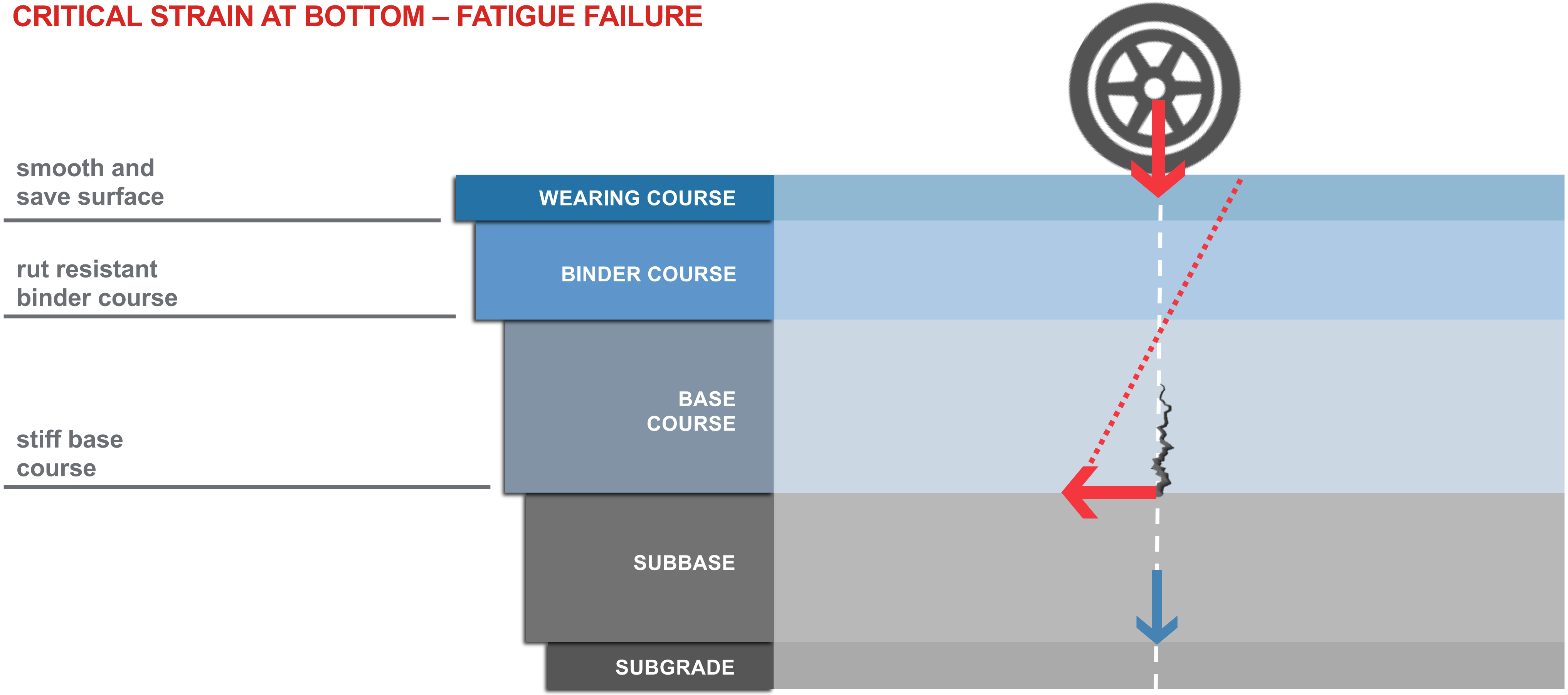
TRADITIONAL ASPHALT PAVEMENT

CRITICAL STRAIN AT BOTTOM – FATIGUE FAILURE

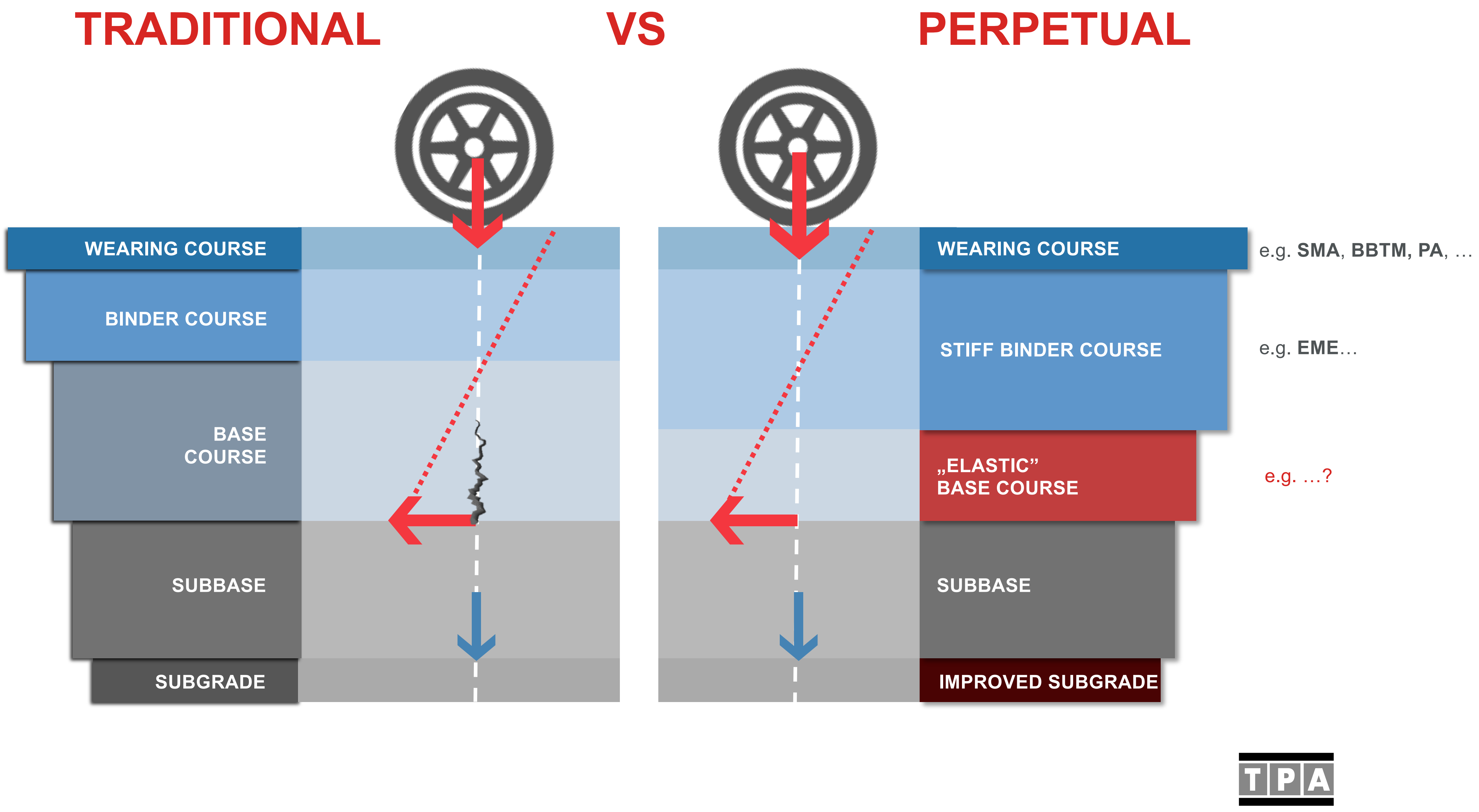


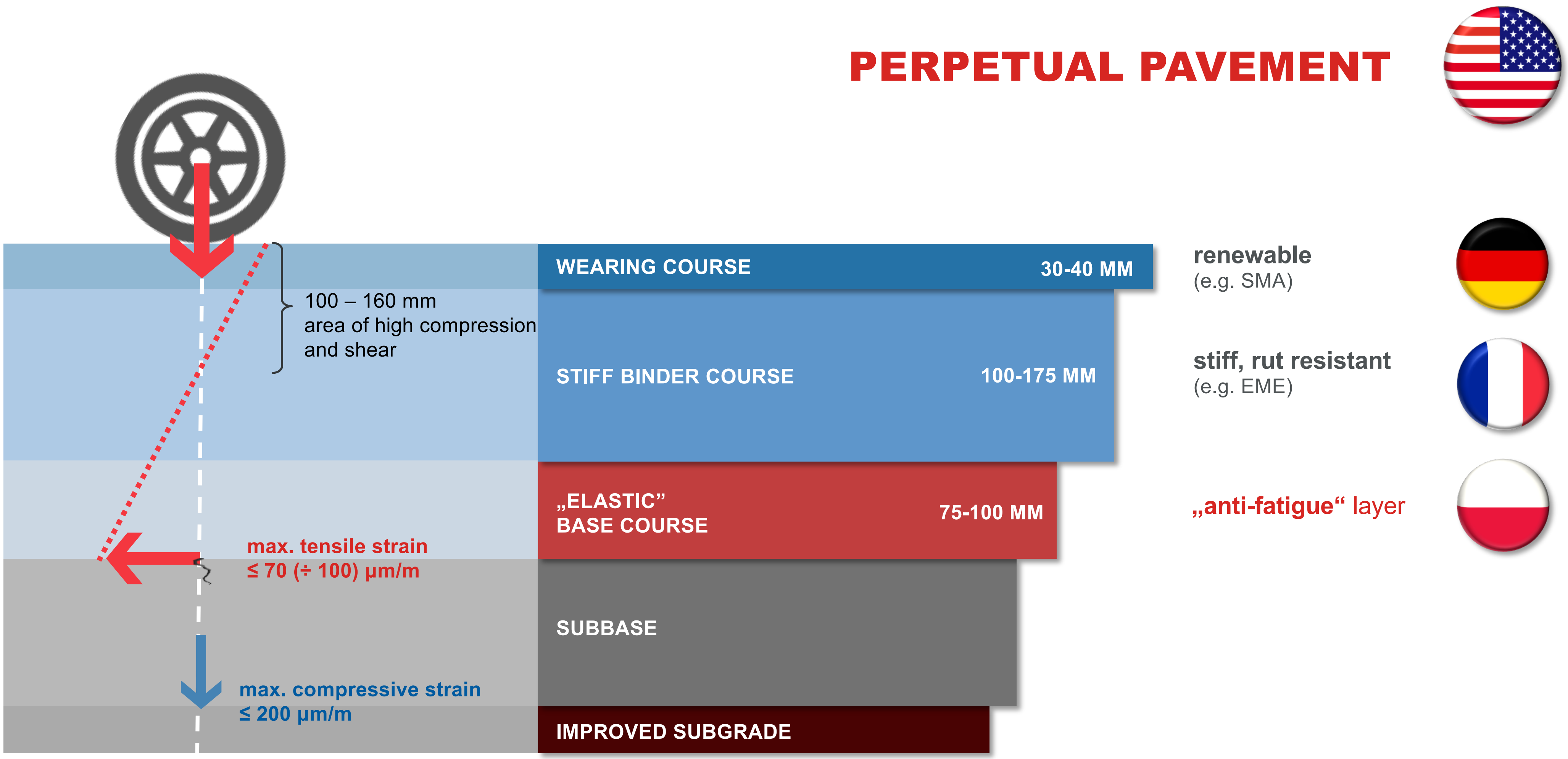
TRADITIONAL ASPHALT PAVEMENT

CRITICAL STRAIN AT BOTTOM – FATIGUE FAILURE



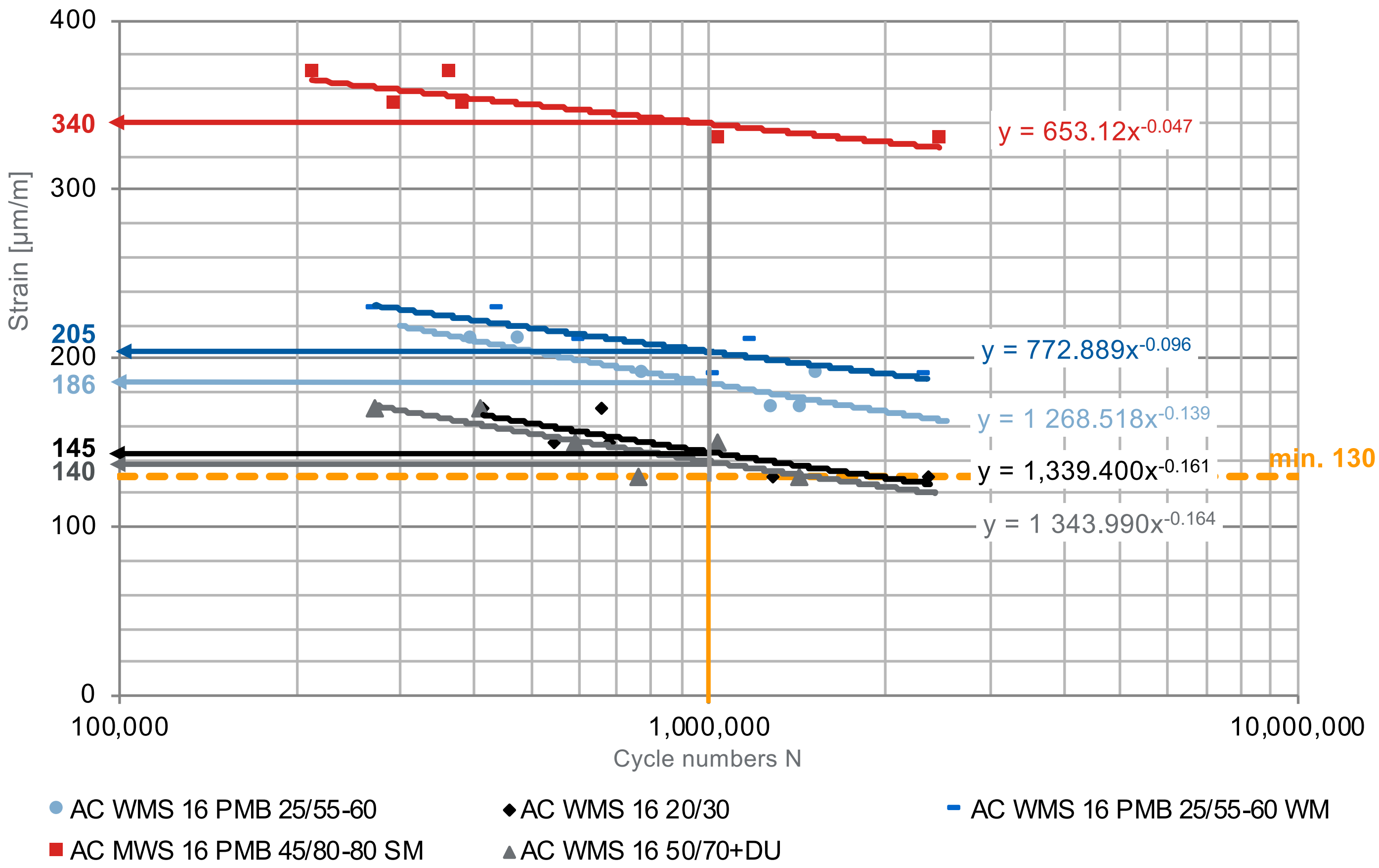
TPA


TRADITIONAL
VS
PERPETUAL
WEARING COURSE
BINDER COURSE
BASE COURSE
SUBBASE
SUBGRADE
WEARING COURSE
STIFF BINDER COURSE
„ELASTIC" BASE COURSE
SUBBASE
IMPROVED SUBGRADE
e.g. SMA, BBTM, PA, …
e.g. EME…
e.g. …?
TPA

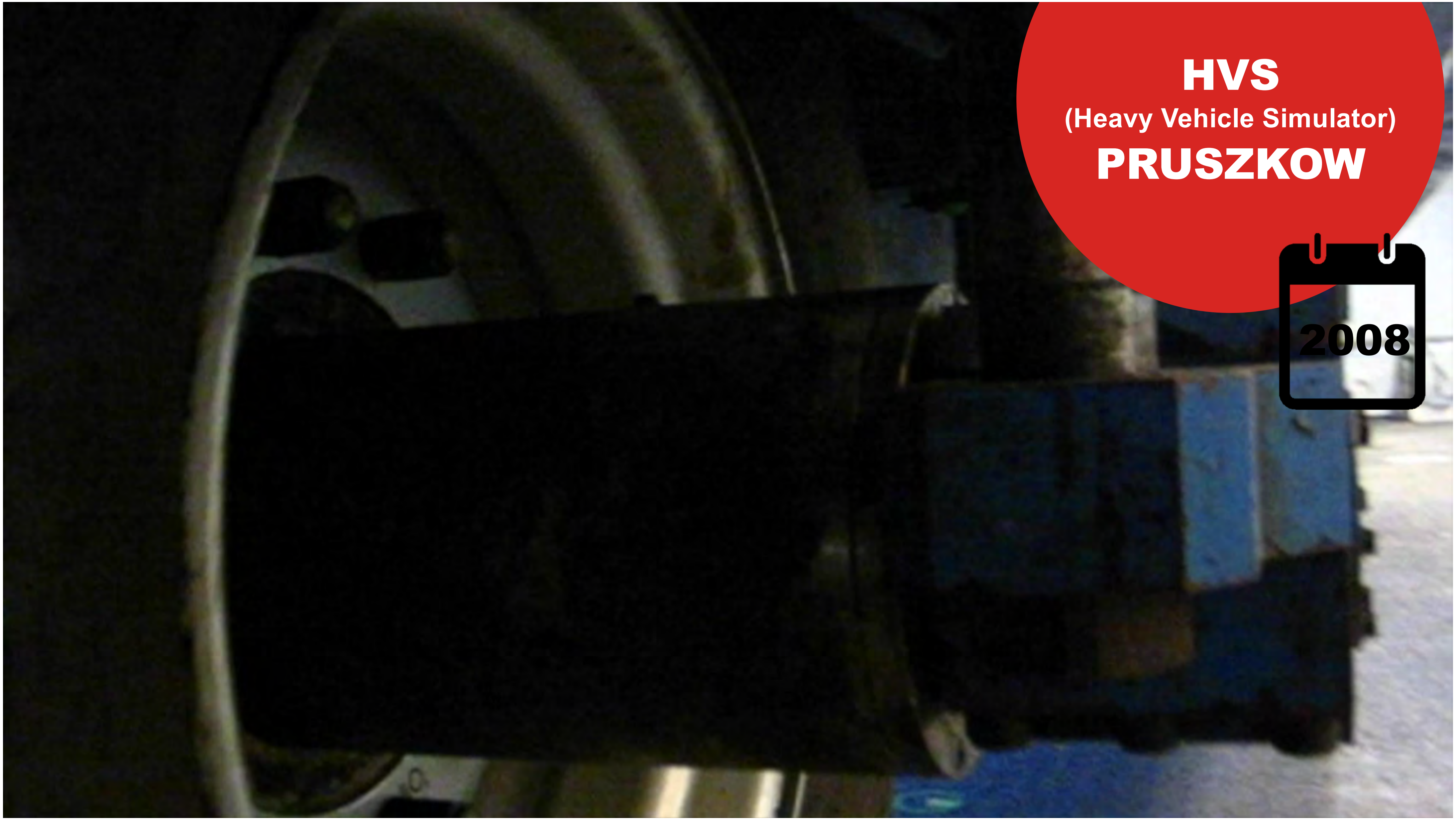

PERPETUAL PAVEMENT
WEARING COURSE
30-40 MM
STIFF BINDER COURSE
100-175 MM
„ELASTIC”
BASE COURSE
75-100 MM
SUBBASE
IMPROVED SUBGRADE
100 – 160 mm
area of high compression
and shear
max. tensile strain
≤ 70 (÷ 100) µm/m
max. compressive strain
≤ 200 µm/m
renewable
(e.g. SMA)
stiff, rut resistant
(e.g. EME)
„anti-fatigue“ layer

ANTI-FATIGUE MIX

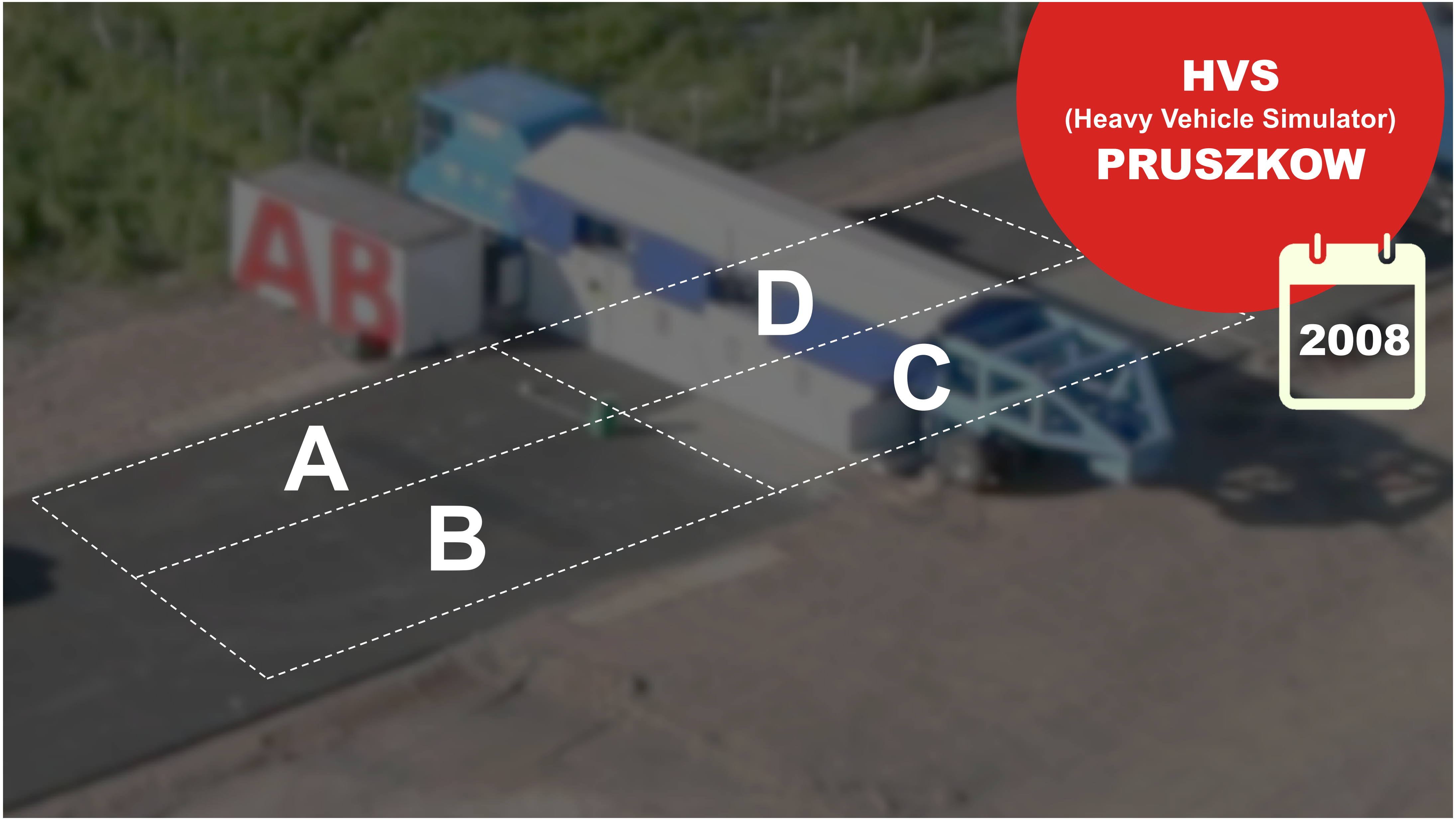
4PB-PR (10°C, 10 HZ) ACC. PN-EN 12697-24



BACK TO THE **REALITY**


HVS
(Heavy Vehicle Simulator)
PRUSZKOW
2008

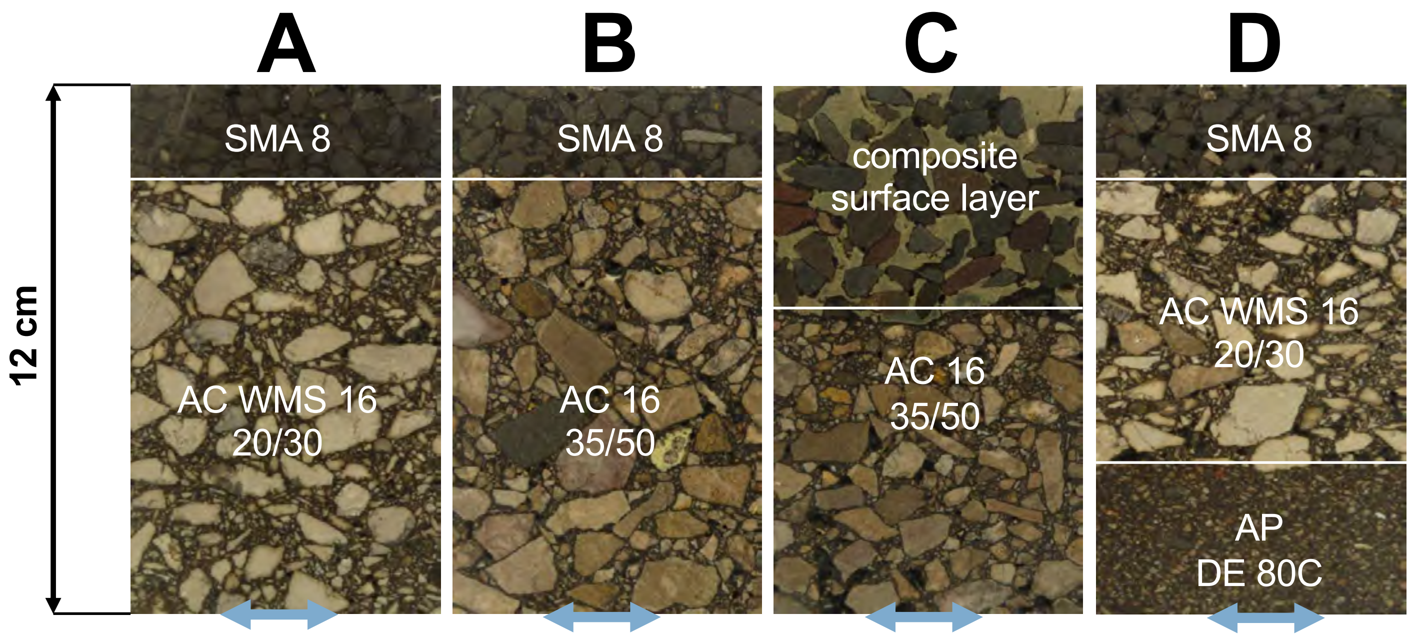

HVS
(Heavy Vehicle Simulator)
PRUSZKOW
2008


HVS
(Heavy Vehicle Simulator)
PRUSZKOW
2008
A
B
C
D

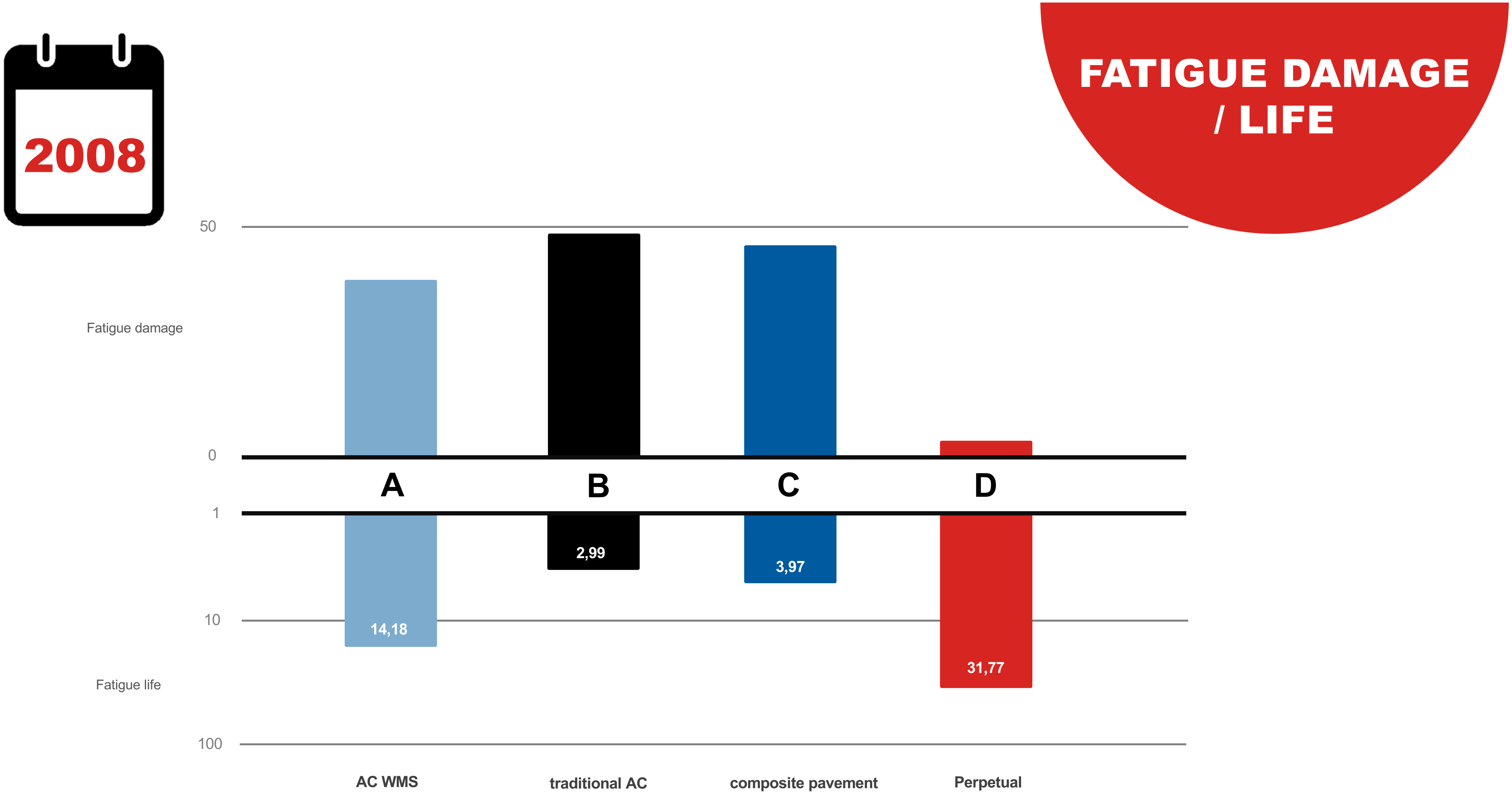
2008

SPENS RESEARCH PROGRAM

TESTED PAVEMENT TYPES



Mini „Perpetual Pavement


2008
FATIGUE DAMAGE / LIFE
50
Fatigue damage
0
A
B
C
D
1
2,99
3,97
10
14,18
31,77
Fatigue life
100
AC WMS
traditional AC
composite pavement
Perpetual

Perpetual Pavement

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ
ROZWOJU REGIONALNEGO

PARP

INNOWACYJNA
GOSPODARKA

2013

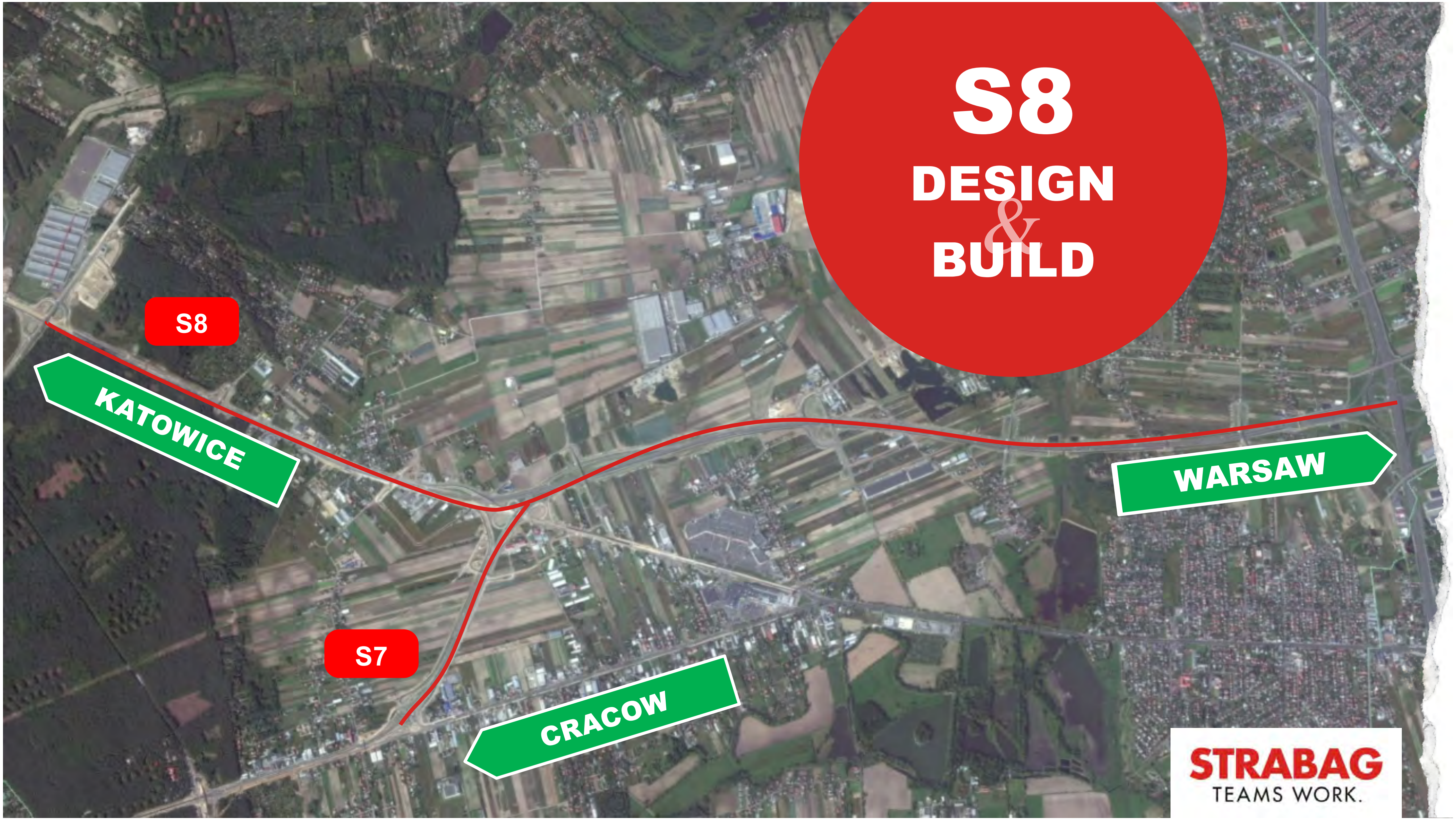
PROJECT PARTICIPANTS:

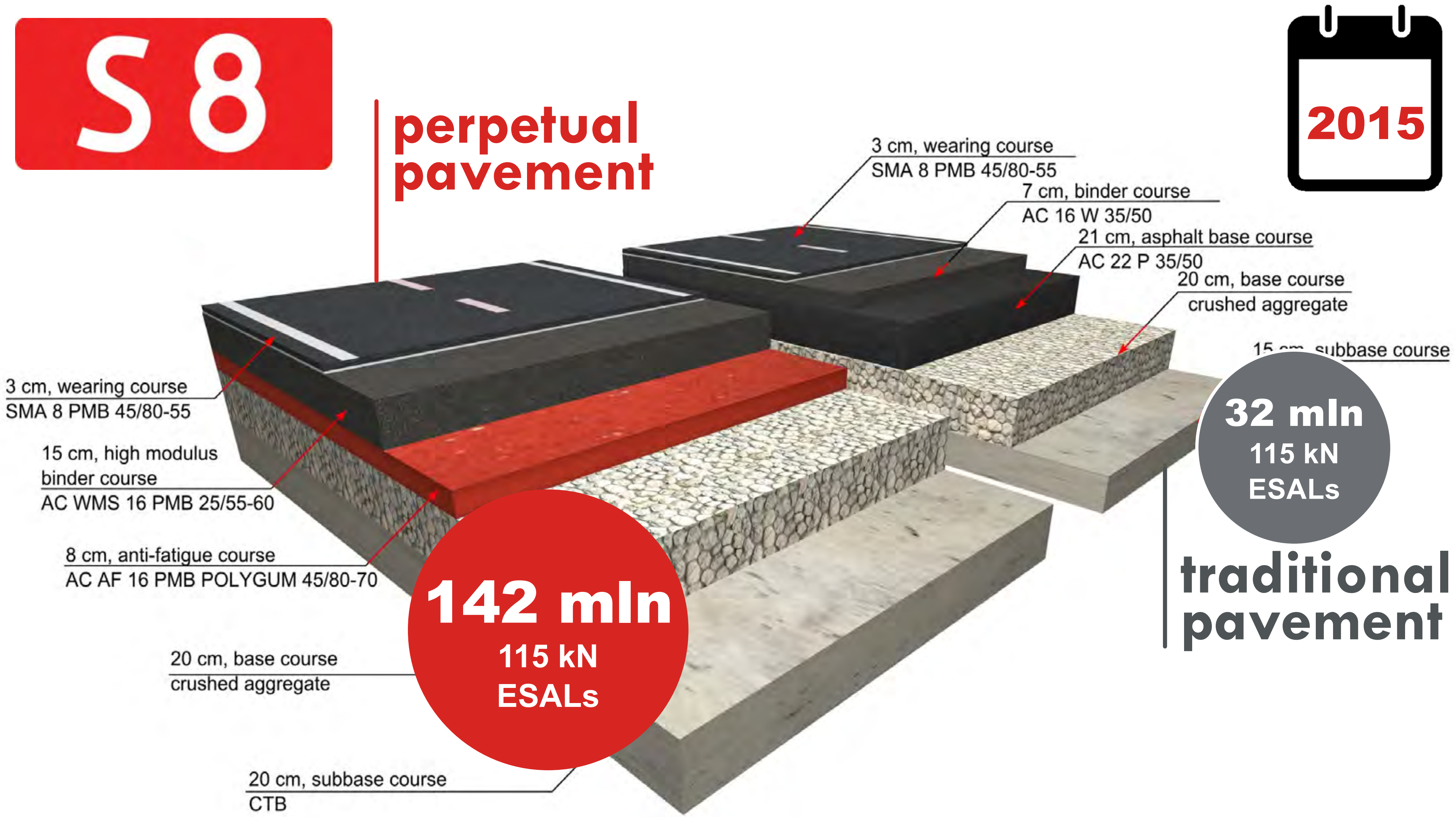
STRABAG TEAMS WORK.

TPA

BMTI

FIRST PERPETUAL PAVEMENT IN EUROPE


S8
DESIGN & BUILD
S8
KATOWICE
WARSAW
S7
CRACOW
STRABAG
TEAMS WORK.


S8
perpetual pavement
2015
3 cm, wearing course
SMA 8 PMB 45/80-55
7 cm, binder course
AC 16 W 35/50
21 cm, asphalt base course
AC 22 P 35/50
20 cm, base course
crushed aggregate
subbase course
32 mln
115 kN
ESALs
traditional pavement
3 cm, wearing course
SMA 8 PMB 45/80-55
15 cm, high modulus
binder course
AC WMS 16 PMB 25/55-60
8 cm, anti-fatigue course
AC AF 16 PMB POLYGUM 45/80-70
142 mln
115 kN
ESALs
20 cm, base course
crushed aggregate
20 cm, subbase course
CTB


S8
TRIAL SECTION
ANTI-FATIGUE
LAYER
(150 m)
2014
STRABAG


S8
TRIAL SECTION
ANTI-FATIGUE LAYER
(150 m)
2014

Informacje Magazyny Na żywo

NEWS OF THE DAY

2014

| Źródło: Fakty TVN

13.09.2014 | Superasfalt prosto z Polski – 18 lat gwarancji, 50 lat bez remontu

Drogowa rewolucja to nie żarty. Testowe 150 metrów superasfaltu leży już na S8. Żadnych dziur, kolein i nierówności – to będzie nowa polska specjalność. Drogowcy sprawdzają, czy asfalt się nie męczy, a zmęczeni kierowcy pewnie ... rozwiń


WIADOMOŚCI
START
O NAS
NEWS OF THE DAY
2014
DŁUGOWIECZNA DROGA
Publikacja: 13 września 2014, 19:53
TVP 1 HD
warstwa ścieralna
warstwa wiążąca
podbudowa
warstwa ścieralna
warstwa wiążąca
podbudowa antyzmęczeniowa
19:45
Lubię to! 0
Dobrych dróg w Polsce przybywa, ale dziury i koleiny, są wciąż zmorą wielu z nas. Kierowcy płaczą i płacą. Drogowcy zazwyczaj tłumaczą się klimatem, że albo mamy upał albo siarczysty mróz. Ale uwaga, nadchodzi rewolucja - pod Warszawą jest właśnie testowany
TWARZE W
TOP 10
1. Anna Przybylska 1978-2014
2. Pożegnanie
3. (Nie)trzeźwy poranek
4. Groźny zabójca
5. Wojny stadionowe
6. Putin jak Herkules
7. System obrony
8. W spirali długu
9. Tragedia pod ziemią
10. Wirus strachu


9:05
WSTAJESZ
I WIESZ
MEC. P. SCHRAMM,
KANCELARIA
GESSEL
tvn24
21:47
ŚWIAT
PREMIER DONALD TUSK ZŁOŻYŁ DYMISJĘ NA RĘCE PREZYDENTA
PILNE
NDERSKIEJ KOMISJI: MALEZYJSKI BOEING 777 ZOSTAŁ STRĄCONY
Polska i Świat
00:02/02:15

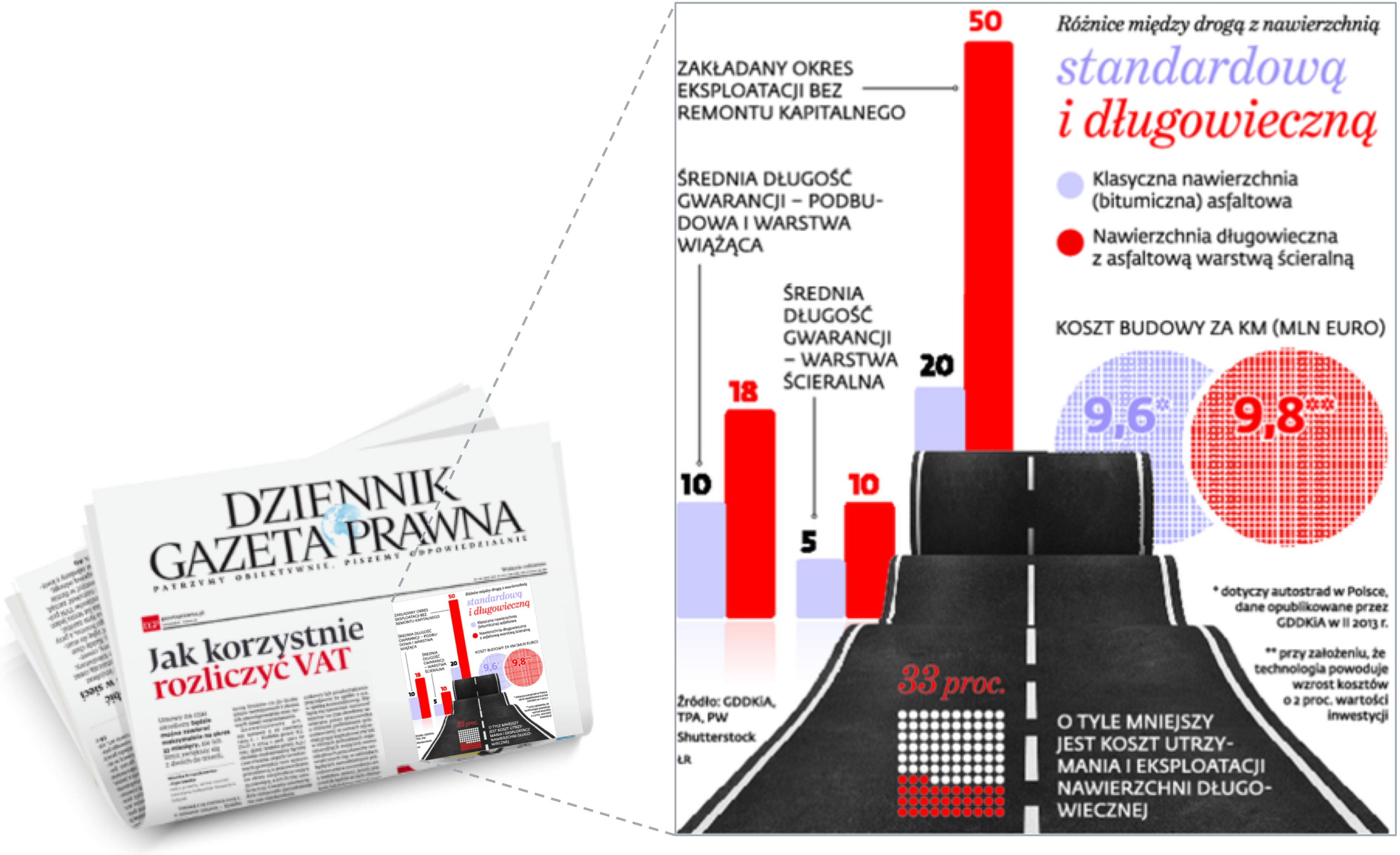

„GESTRATA"
SITE-SEEING
2014
MAZURKAS
Transport
VDL
VIP


„GESTRATA”
SITE-SEEING
2014
STRABAG

LONG LIVE 50 YEARS

2015


DZIENNIK GAZETA PRAWNA
PATRZYMY OBIEKTYWNIE. PISZEMY ODPOWIEDZIALNIE
Jak korzystnie rozliczyć VAT
standardową
i długowieczną
50
20
18
10
10
5
9,6
9,8



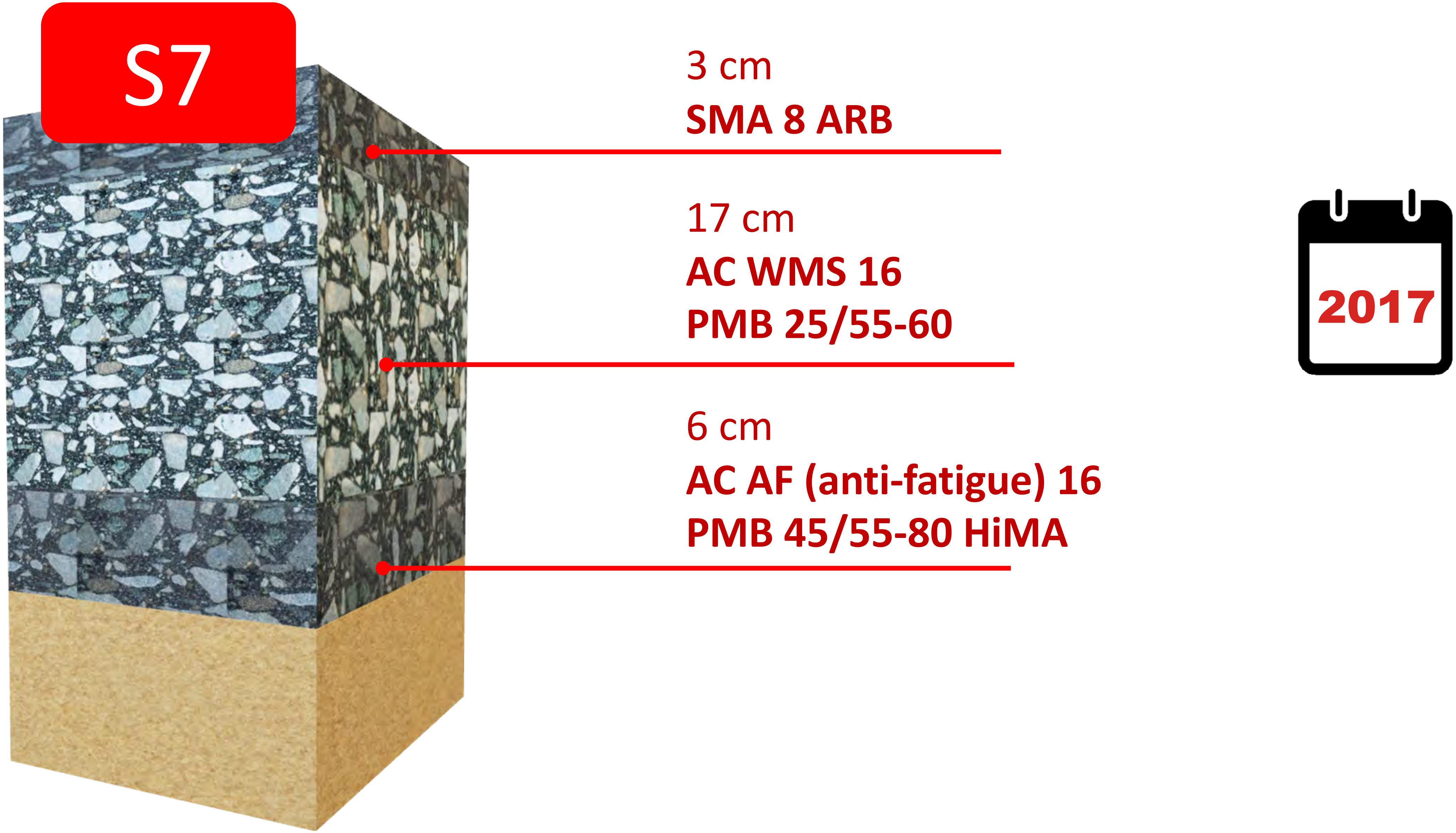
DZIENNIK GAZETA PRAWNA
PATRZYMY OBIEKTYWNIE. PISZEMY ODPOWIEDZIALNIE
Jak korzystnie rozliczyć VAT
Różnice między drogą z nawierzchnią
standardową
i długowieczną
Klasyczna nawierzchnia (bitumiczna) asfaltowa
Nawierzchnia długowieczna z asfaltową warstwą ścieralną
ZAKŁADANY OKRES EKSPLOATACJI BEZ REMONTU KAPITALNEGO
20
50
ŚREDNIA DŁUGOŚĆ GWARANCJI – PODBUDOWA I WARSTWA WIĄŻĄCA
10
18
ŚREDNIA DŁUGOŚĆ GWARANCJI – WARSTWA ŚCIERALNA
5
10
KOSZT BUDOWY ZA KM (MLN EURO)
9,6*
9,8**
* dotyczy autostrad w Polsce, dane opublikowane przez GDDKiA w II 2013 r.
** przy założeniu, że technologia powoduje wzrost kosztów o 2 proc. wartości inwestycji
33 proc.
O TYLE MNIEJSZY JEST KOSZT UTRZYMANIA I EKSPLOATACJI NAWIERZCHNI DŁUGOWIECZNEJ
Źródło: GDDKiA, TPA, PW
Shutterstock
ŁR

AND THE STORY GOES ON…

S7
HiMA

2017


Asfalt
Asfalt drogowy zwykły
Polimer SBS
Asfalt
Asfalt modyfikowany
Polimer SBS
Asfalt
Asfalt


S7
3 cm
SMA 8 ARB
17 cm
AC WMS 16
PMB 25/55-60
6 cm
AC AF (anti-fatigue) 16
PMB 45/55-80 HiMA
2017

S6 HiMA

2018

VOGELE

Asfalt
Asfalt drogowy zwykły
Polimer SBS
Asfalt
Asfalt modyfikowany
Polimer SBS
Asfalt

3 cm
SMA 8 ARB

12 cm
AC WMS 16 W
PMB 25/55-60

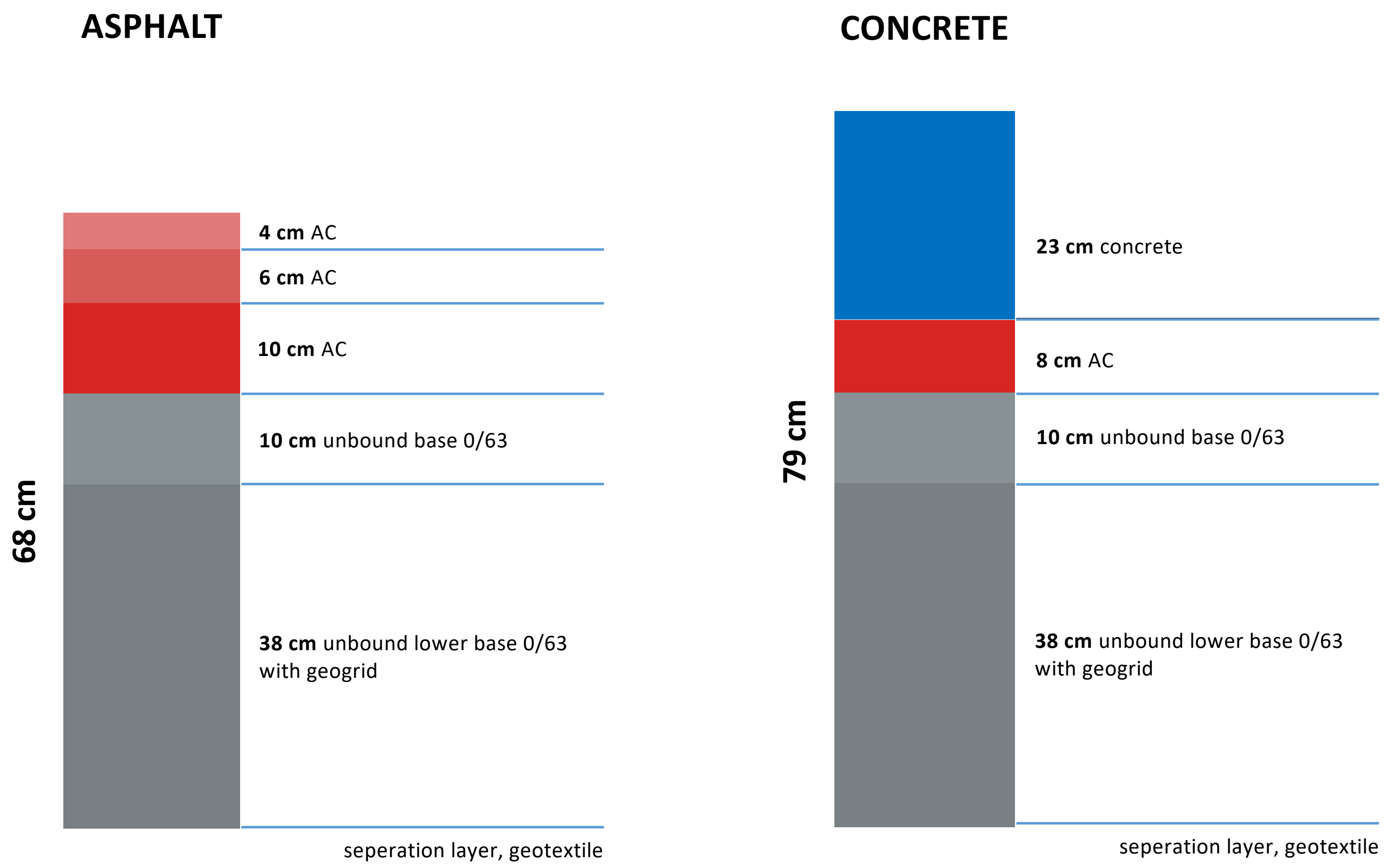
7 cm
AC AF (anti-fatigue) 16
PMB 45/80-80 HiMA

2018

AND THE STORY GOES ON...


EFRA
EFEKTYWNA RAFINACJA
GDANSK
RAFINERY
2018

TENDER (TRAFFIC LOAD CLASS KR4)

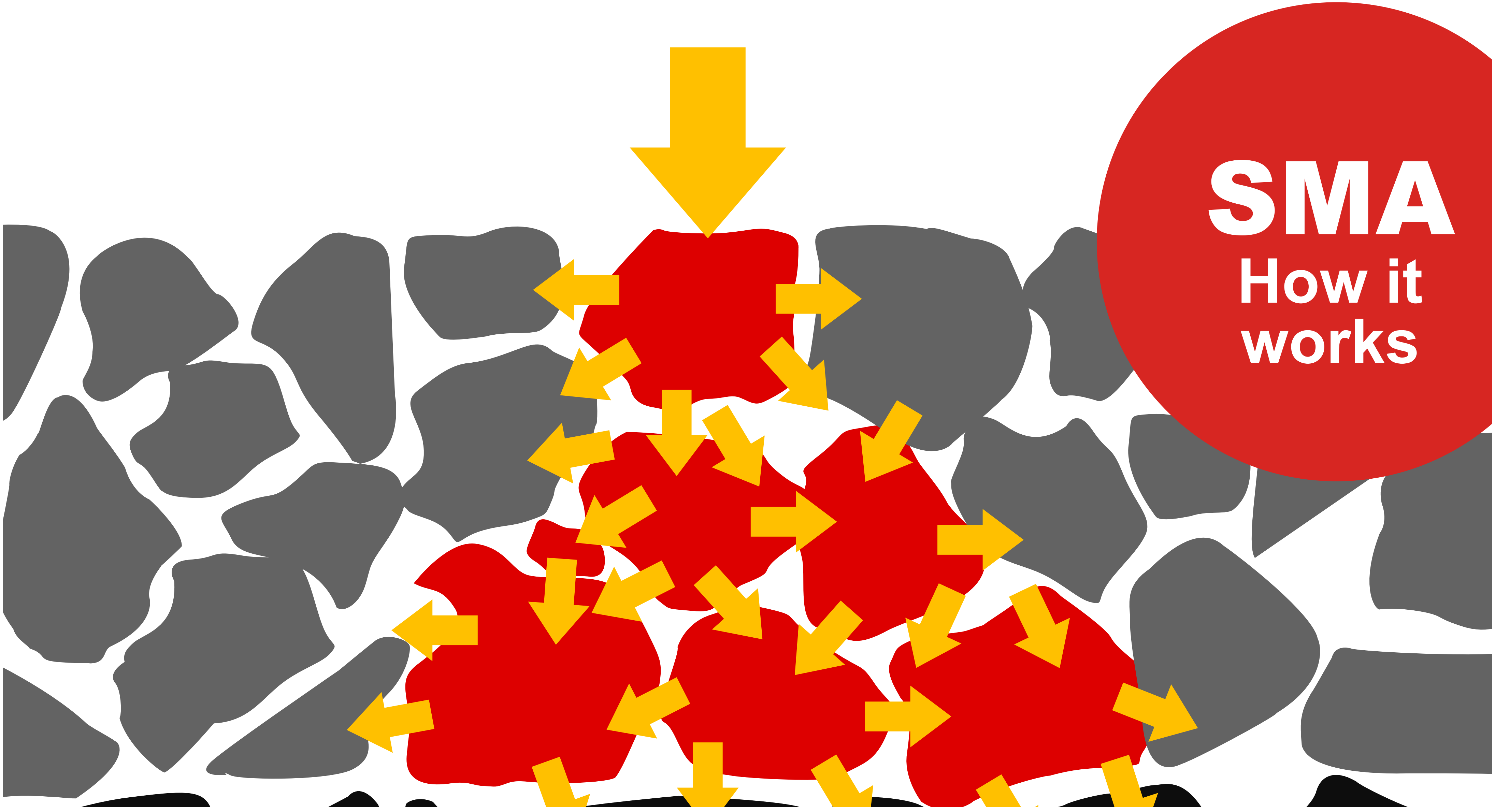


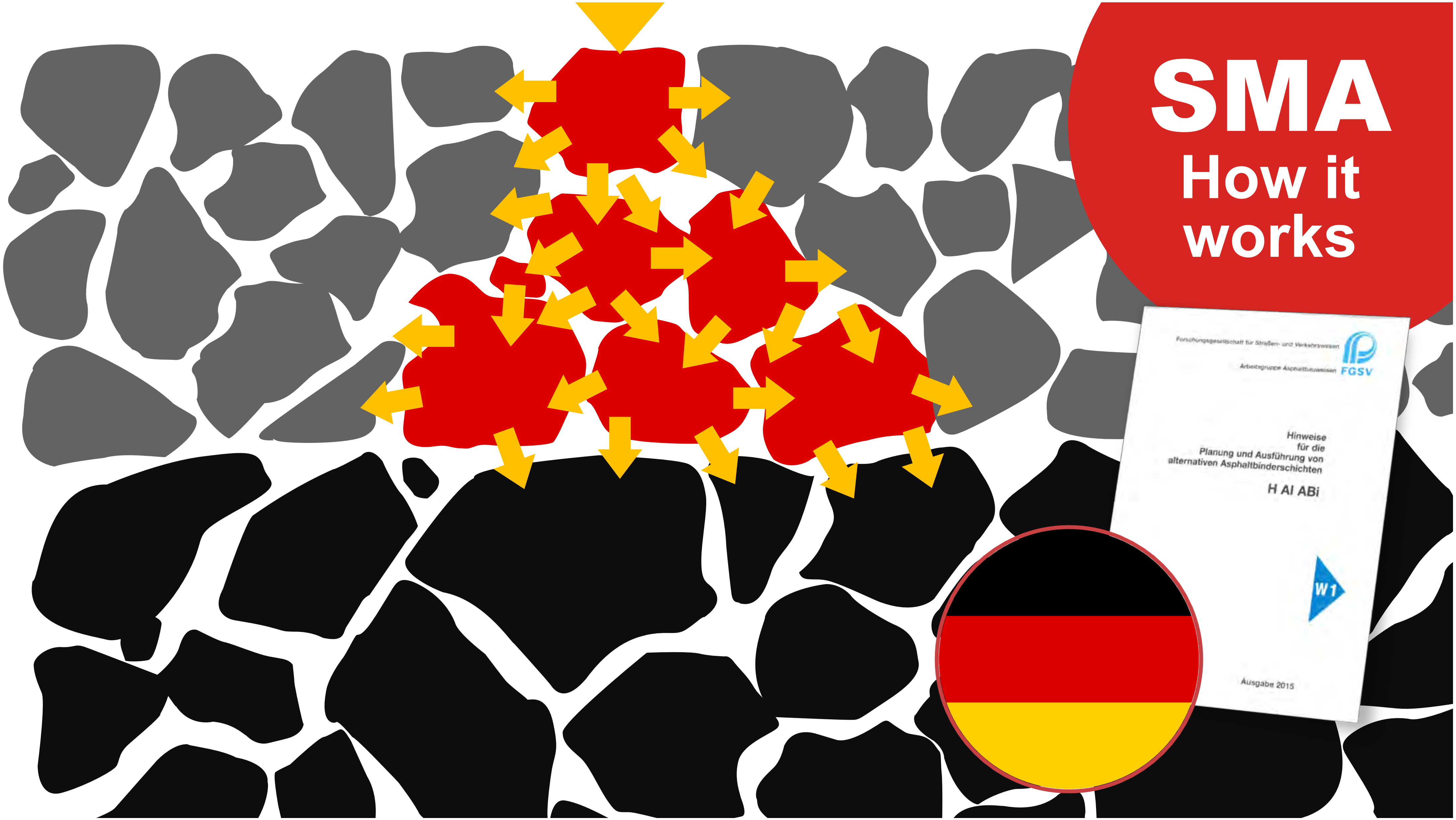
LOAD ANALYSIS

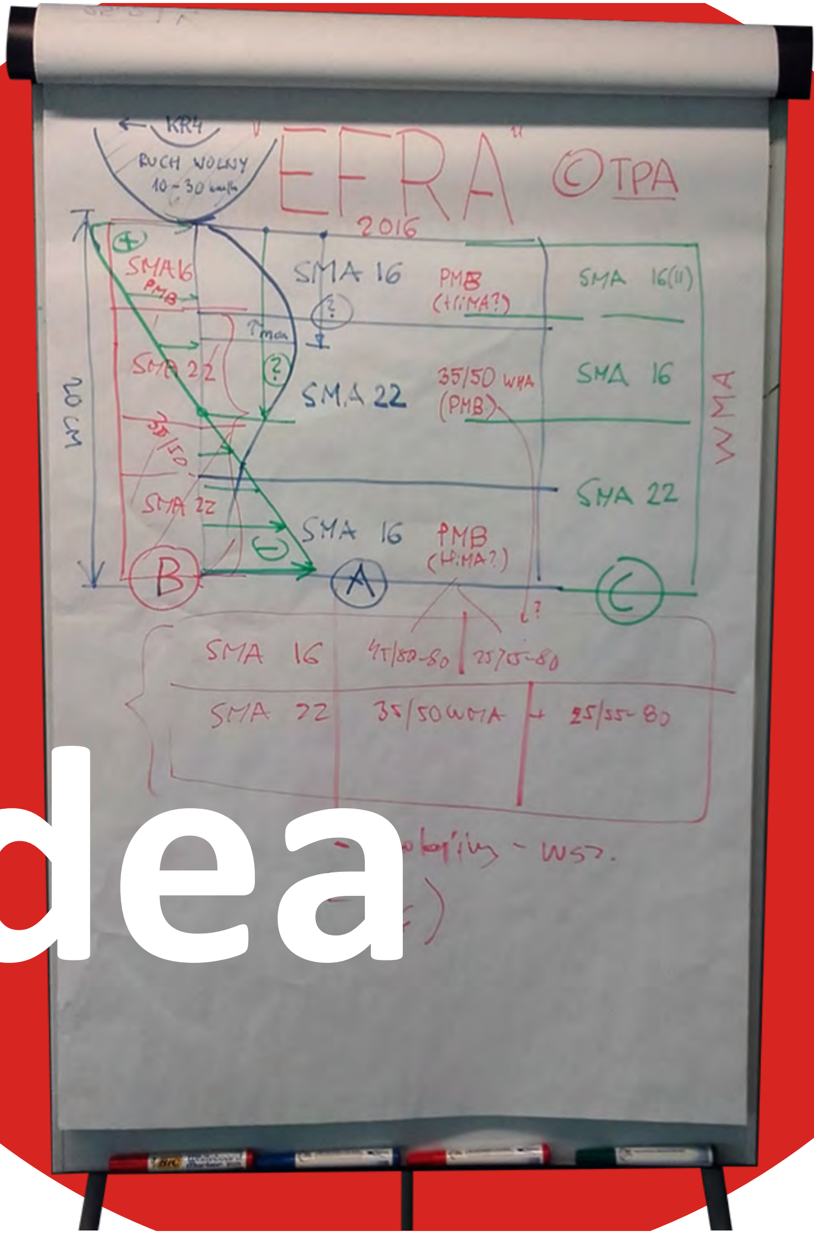
TRAFFIC LOAD CLASS KR4, BUT...

HEAVY DUTY PAVEMENT

...HEAVY LOAD AND MAX 20 KM/H

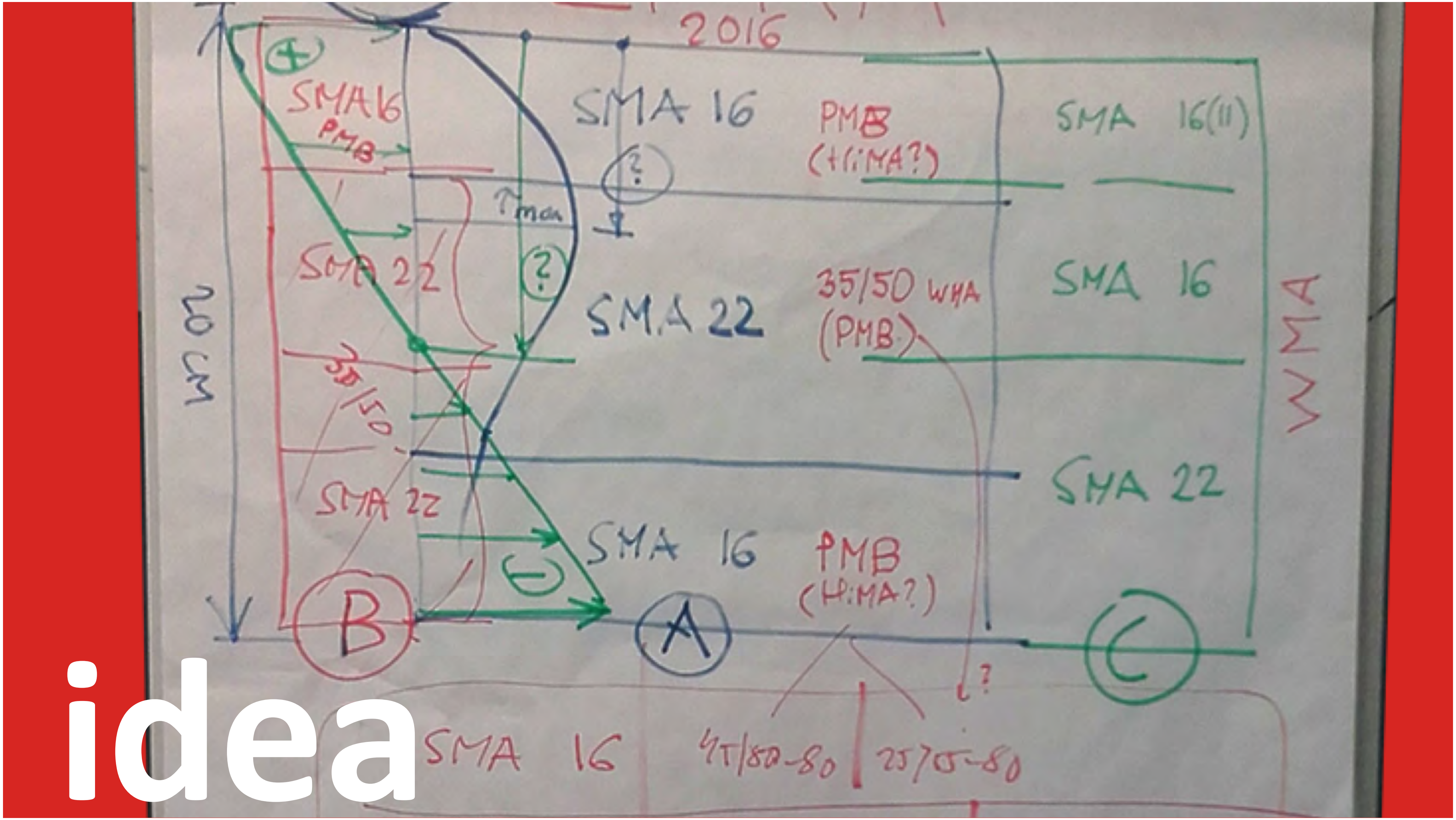

SMA
How it works


SMA
How it
works
Forschungsgesellschaft für Straßen- und Verkehrswesen
Arbeitsgruppe Asphaltbauweisen
FGSV
Hinweise
für die
Planung und Ausführung von
alternativen Asphaltbinderschichten
H Al ABi
W 1
Ausgabe 2015

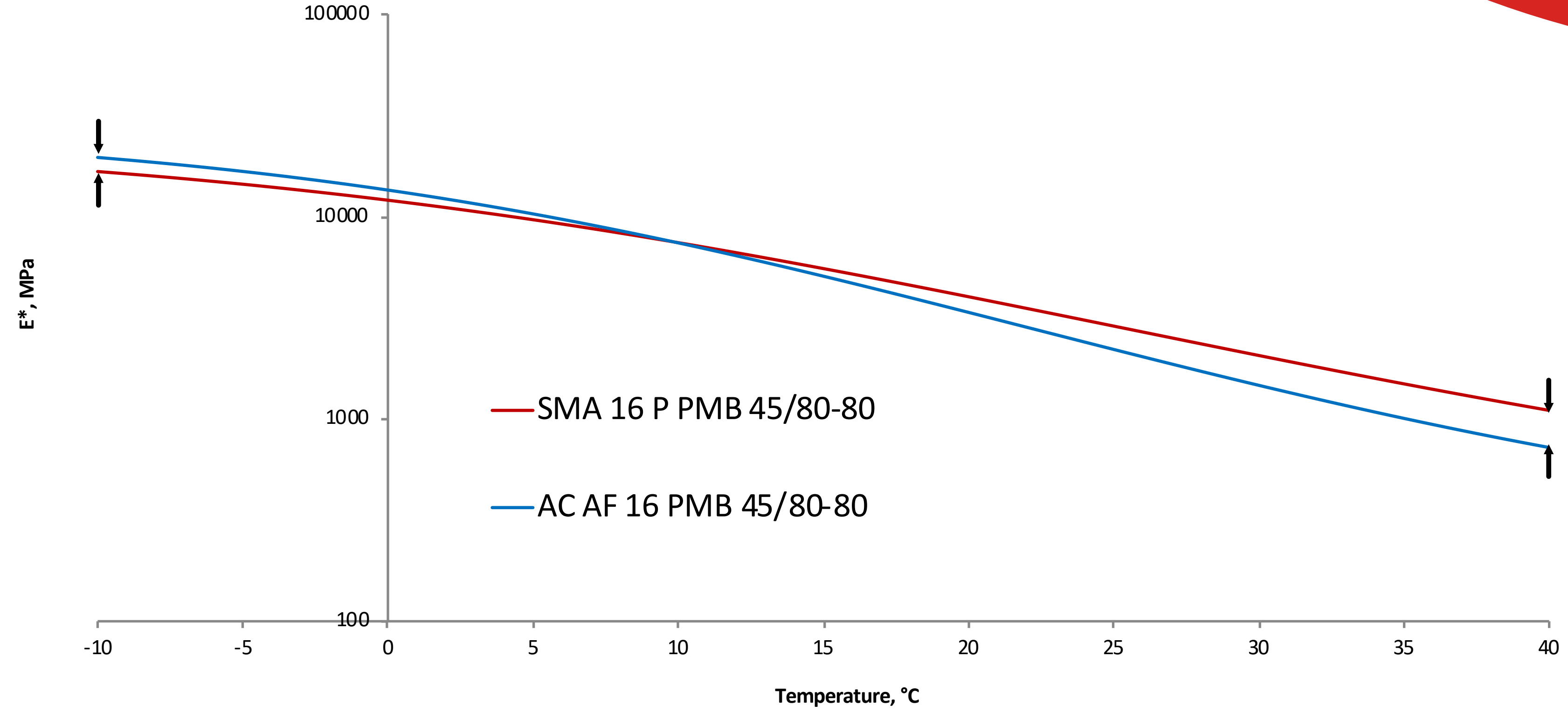

"EFRA"
©TPA
2016
KR4
RUCH WOLNY
SMA 16
PMB
SMA 22
35/50 WMA
(PMB)
SMA 16 (II)
WMA
10 cm
B
A
C

idea

idea

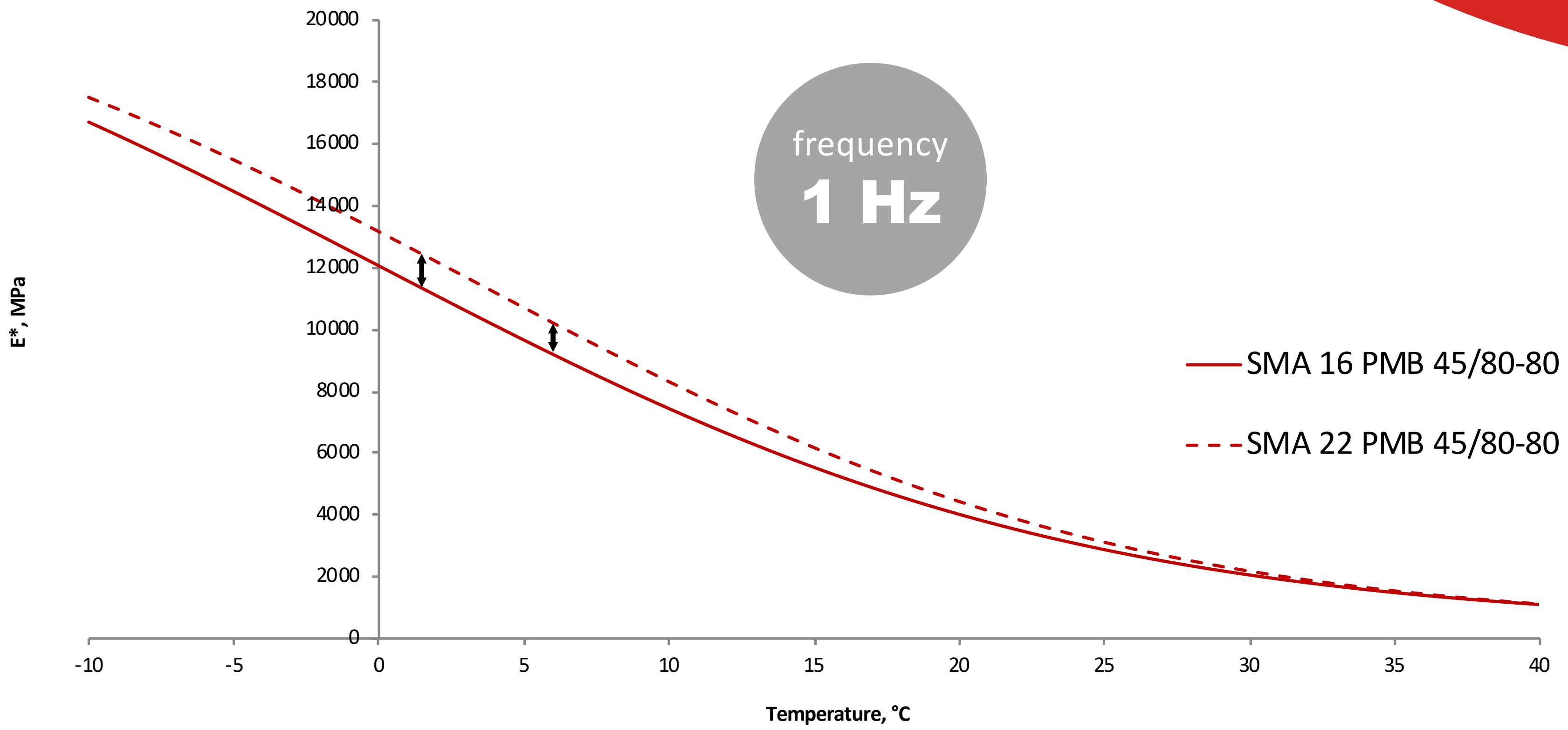

2016
SMA 16
PMB
SMA 16
PMB
(+HiMA?)
SMA 16(11)
?
τmax
SMA 22
?
SMA 22
35/50 WMA
(PMB)
SMA 16
20 cm
35/50
WMA
SMA 22
SMA 22
SMA 16
PMB
(HiMA?)
B
A
C
SMA 16
45/80-80
25/55-80

COMPLEX MODULUS E* VS TEMPERATURE
SMA 16 vs AC AF 16
AASHTO T-342



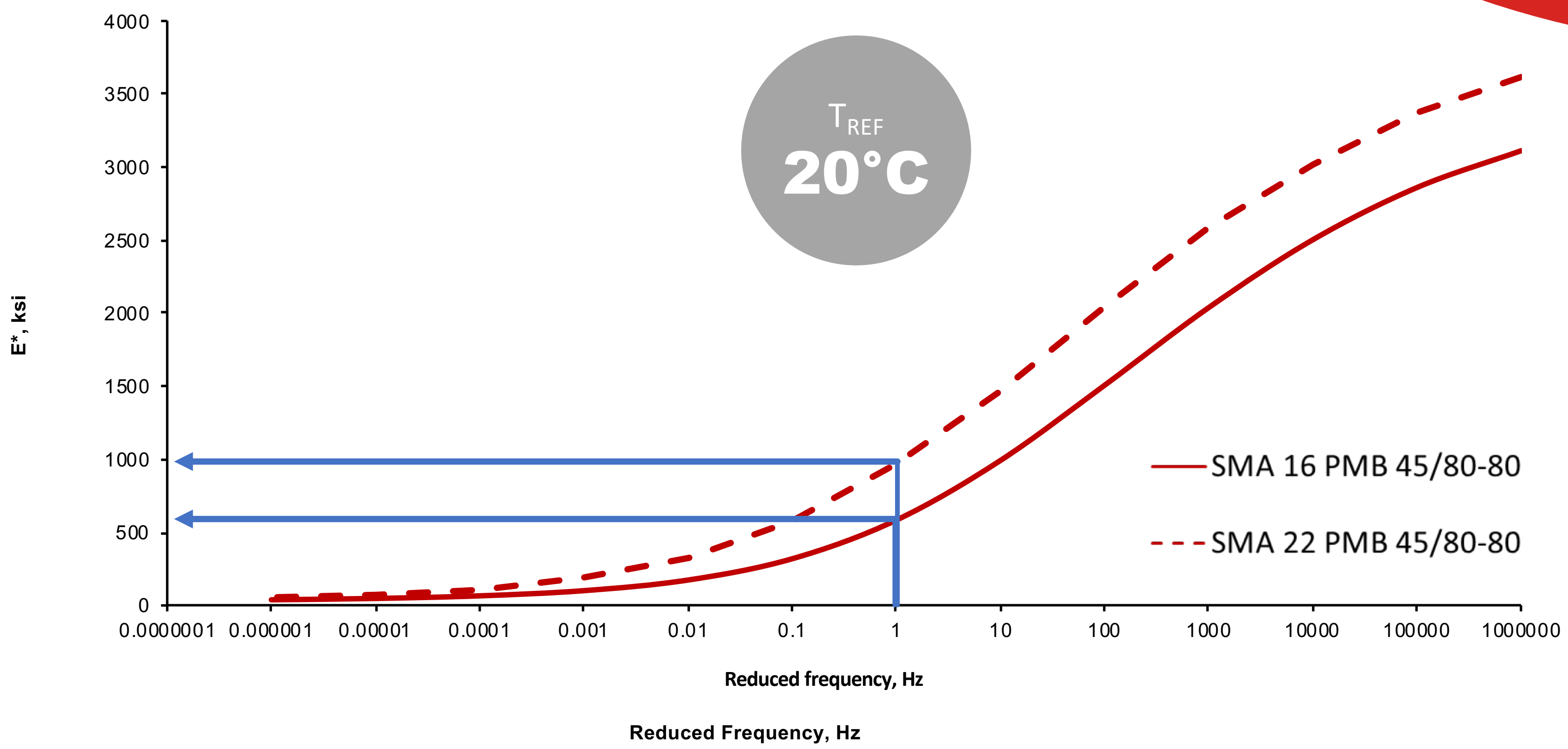
COMPLEX MODULUS E* VS TEMPERATURE
SMA 16 AND SMA 22
AASHTO T-342

which GRADING ?

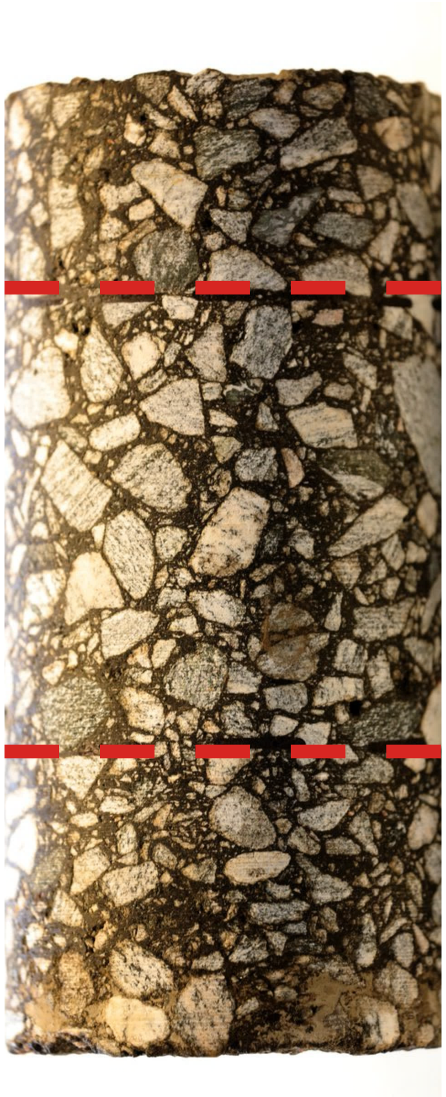


MASTER CURVES E*
SMA 16 AND SMA 22
AASHTO T-342

which
GRADING ?



NEW!
TRIPLE SMA



SMA 16 **PMB 45/80-80**
5 CM

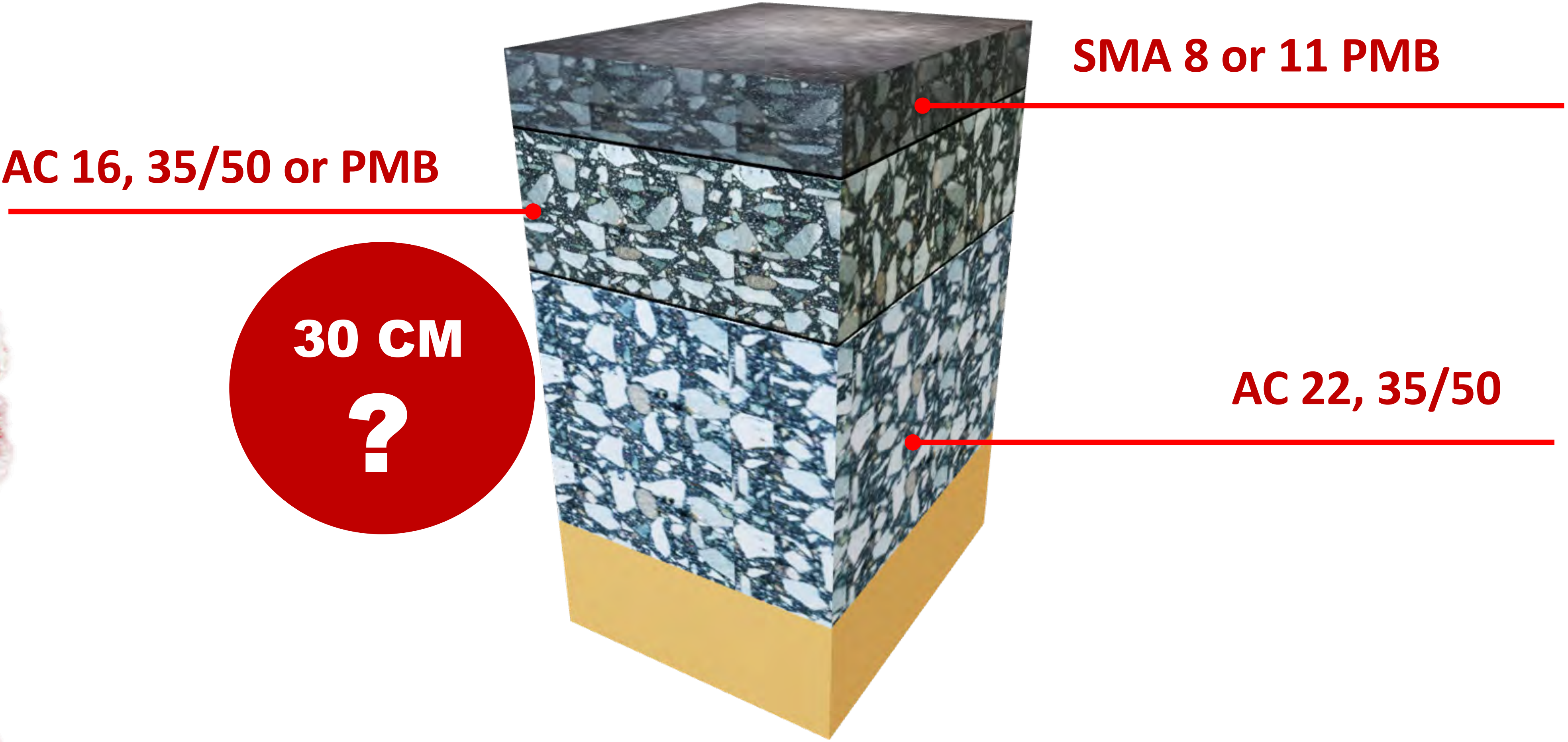
SMA 22 **PMB 25/55-80**
9 CM

SMA 16 **PMB 45/80-80**
6 CM


HEAVY
DUTY
MAMMOET

AND THE STORY GOES ON…?

FOR HOW LONG YET ?



> You must unlearn what you have learned.

Yoda, *The Empire Strikes Back*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