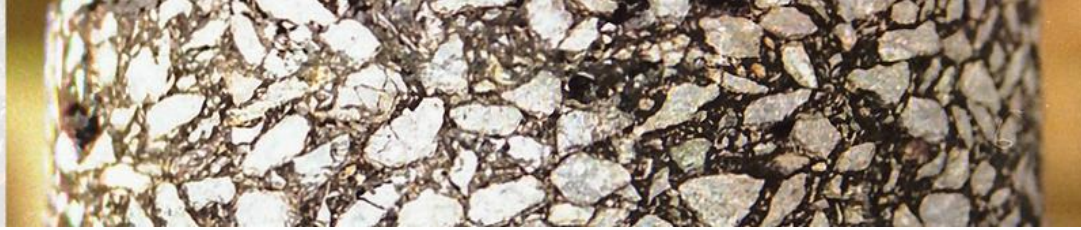


SMA

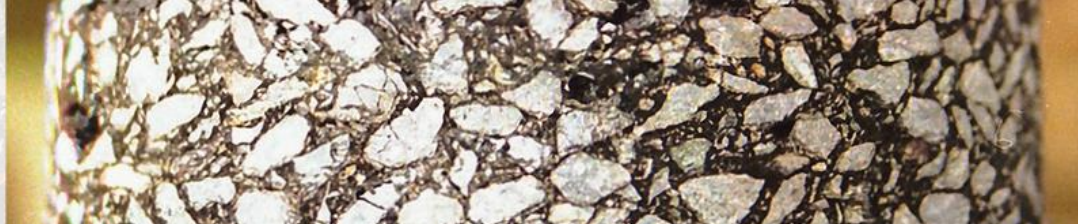
The History



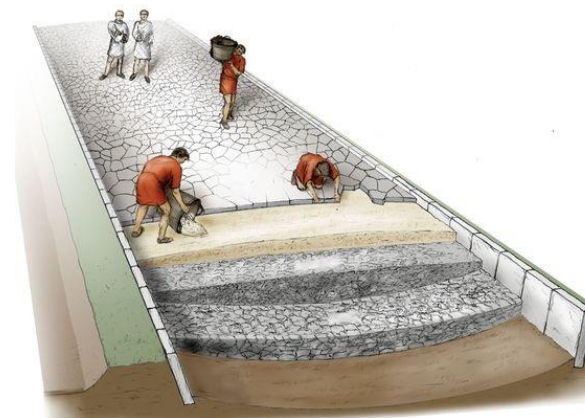
SMA

The History

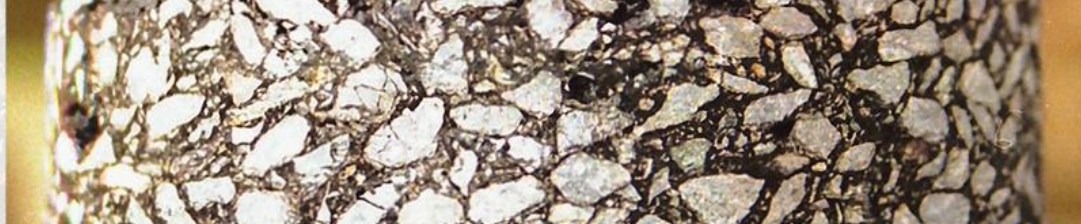
The History of **DURABILITY**



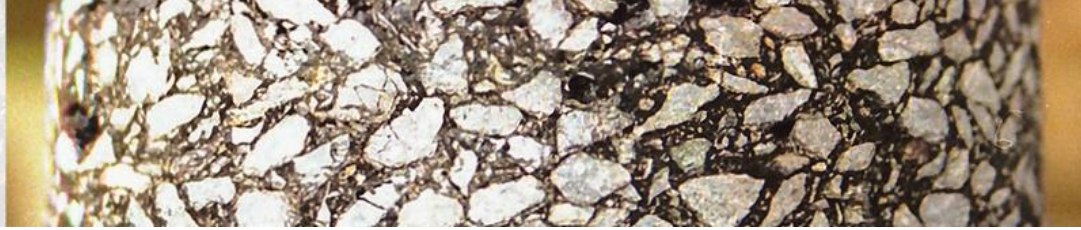
2000 BC



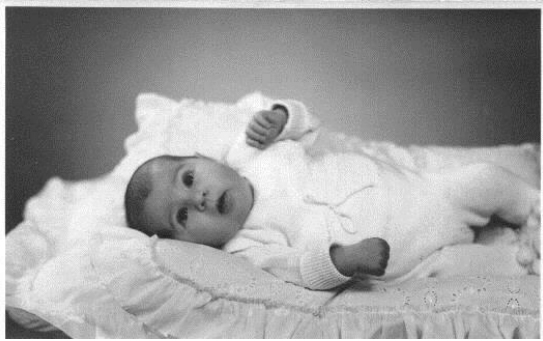
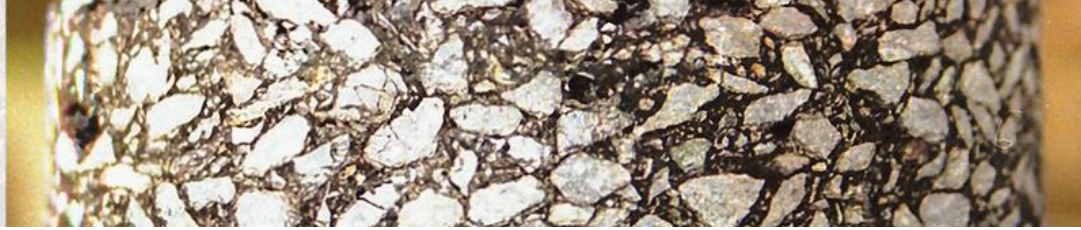
Via Appia



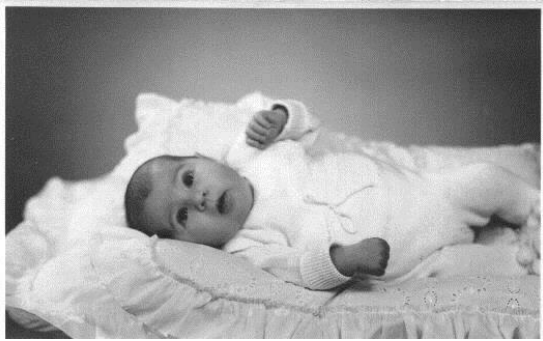
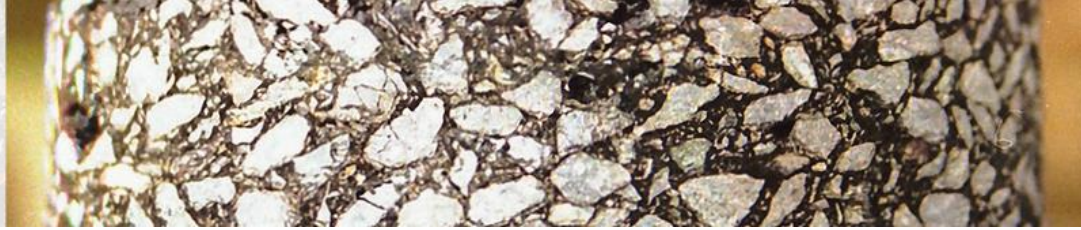
2000 BC



1961

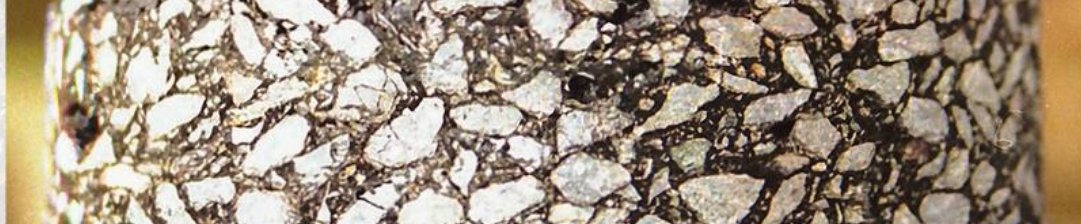


1961

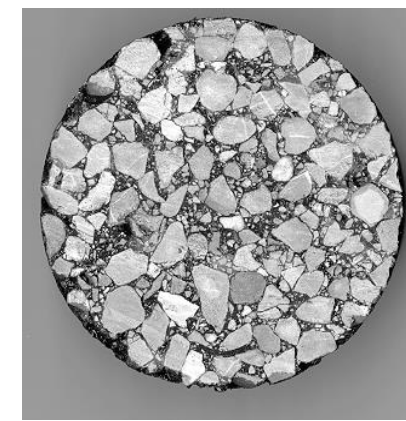
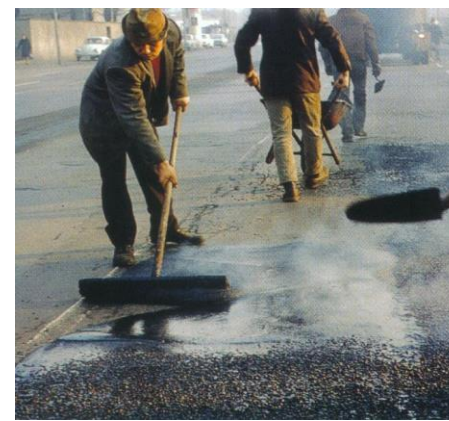
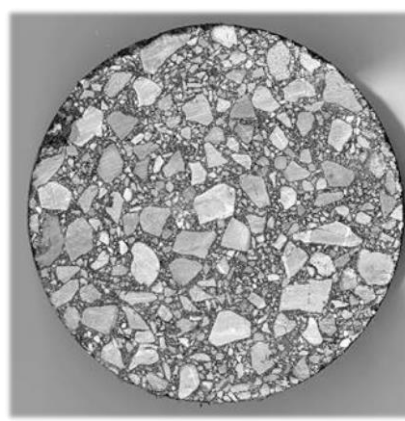
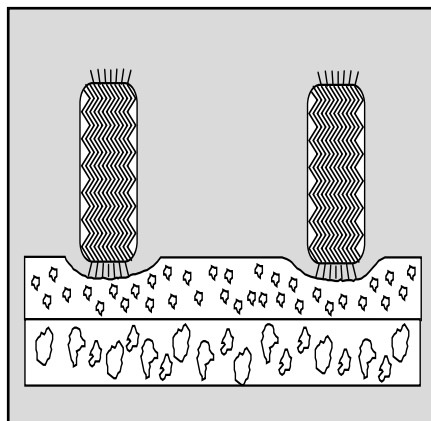


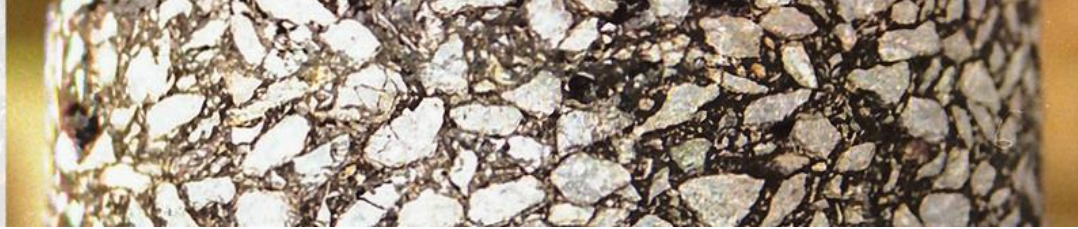
Berlin Wall

1961



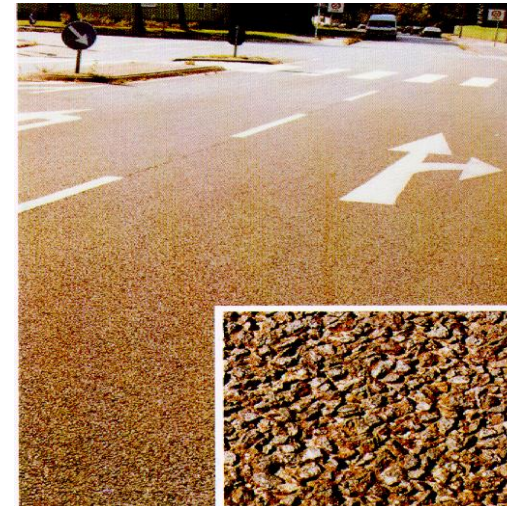
1961



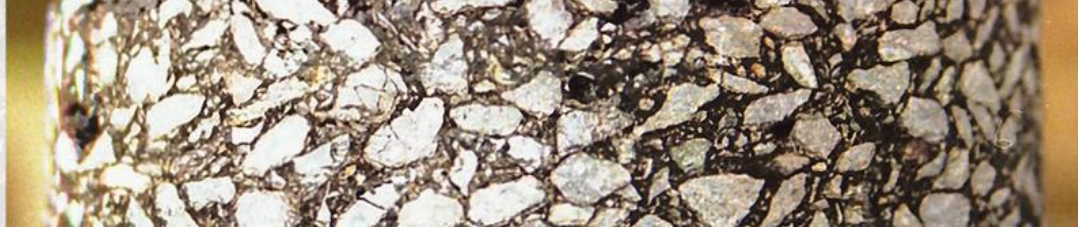


Apollo 8

1968



1ST INTERNATIONAL CONFERENCE ON Stone Matrix Asphalt

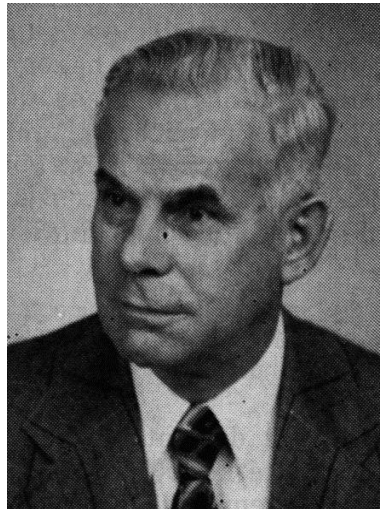


Elvis Presley
Concert Hawaii

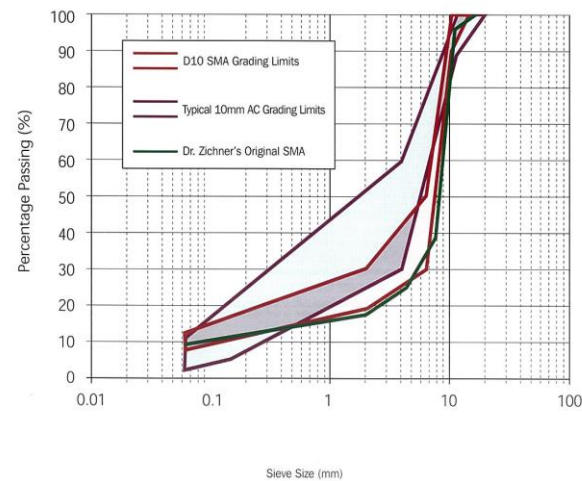


Bosphorus Bridge
Istanbul

1973



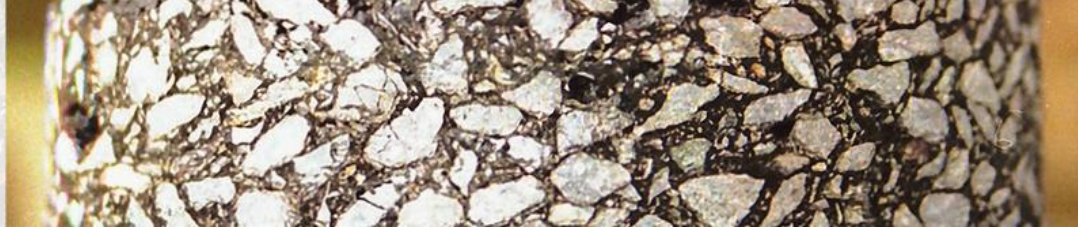
STRABAG
Dr. ZICHNER



J. RETTENMAIER & SÖHNE
GMBH + CO KG



Fibers designed
by Nature



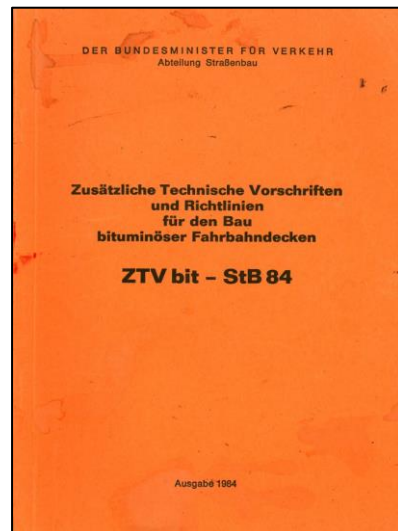
Floppy disk



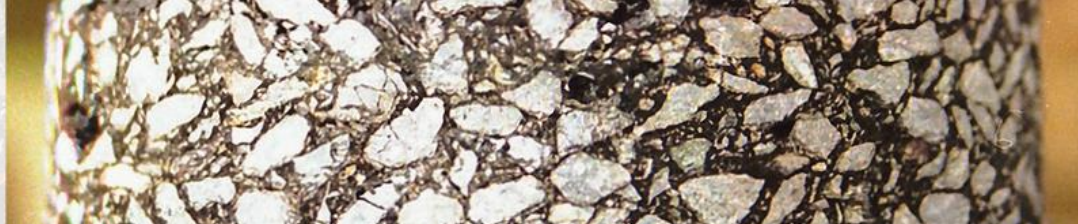
No more Berlin Wall

1984

1990



1ST INTERNATIONAL CONFERENCE ON Stone Matrix Asphalt



International Year
of the Family



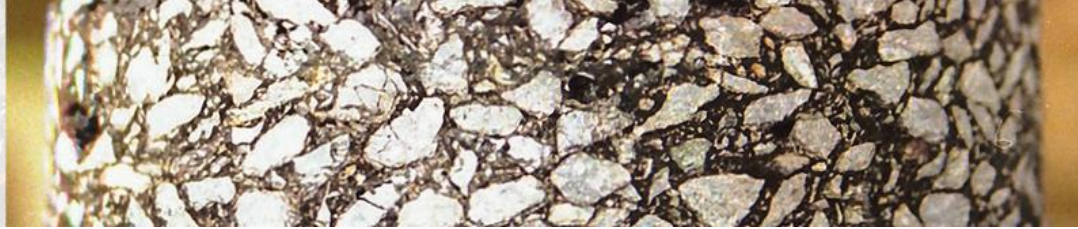
1994



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Fibers designed
by Nature



€ currency launch in Europe

1998

Forschungsgesellschaft für Straßen- und Verkehrswesen
Arbeitsgruppe Asphaltstraßen

**Zusätzliche Technische
Vertragsbedingungen und Richtlinien
für den Bau
von Fahrbahndecken aus Asphalt**

ZTV Asphalt – StB 94

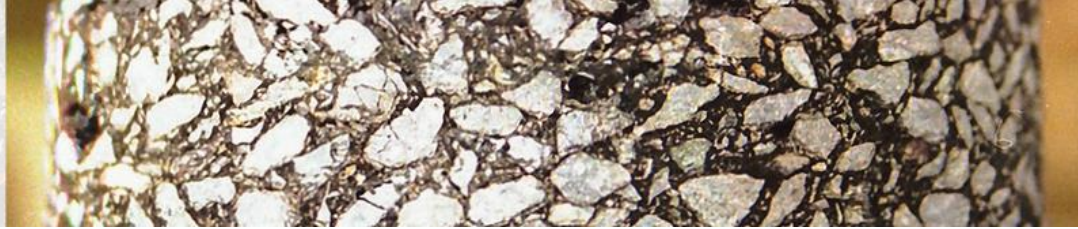
Ausgabe 1994

mit

Änderungen und Ergänzungen

Ausgabe 1998





Loveparade Berlin – Germany

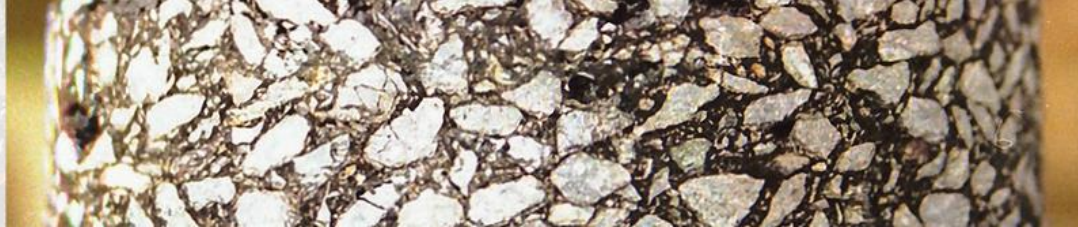
2001

Forschungsgesellschaft für Straßen- und Verkehrswesen
Arbeitsgruppe Asphaltstraßen

Zusätzliche Technische
Vertragsbedingungen und Richtlinien
für den Bau
von Fahrbahndecken aus Asphalt

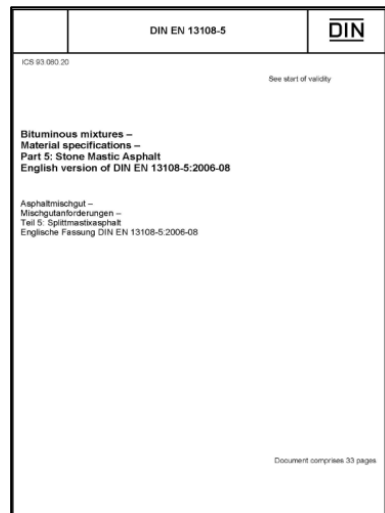
ZTV Asphalt-StB 01





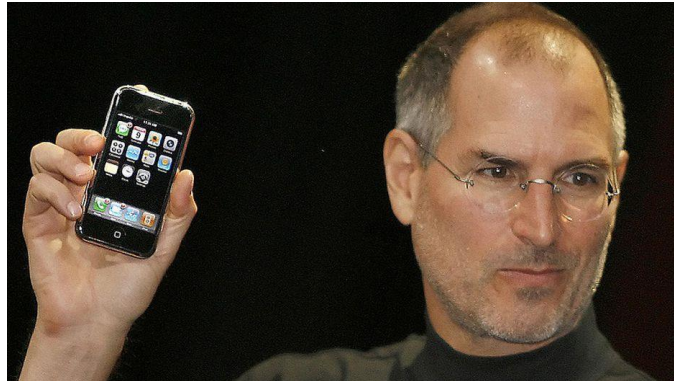
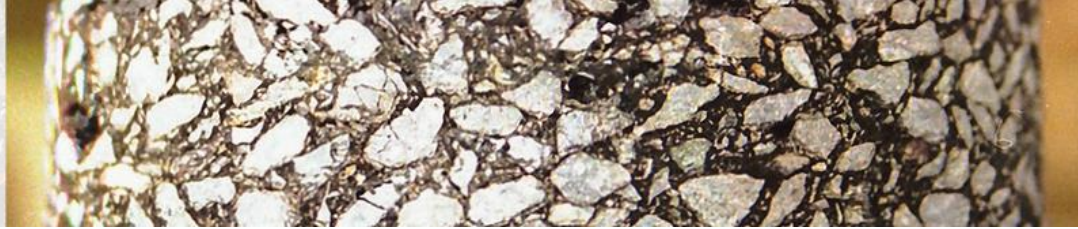
Year of Mozart in Austria (250th birthday)

2006



1st European
Standard for SMA
(EN 13108-5)

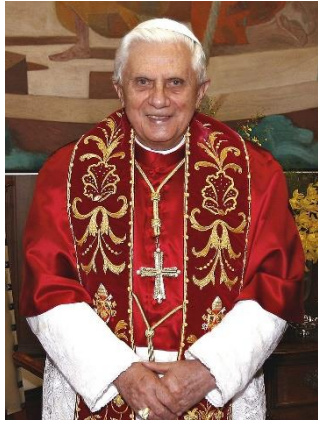
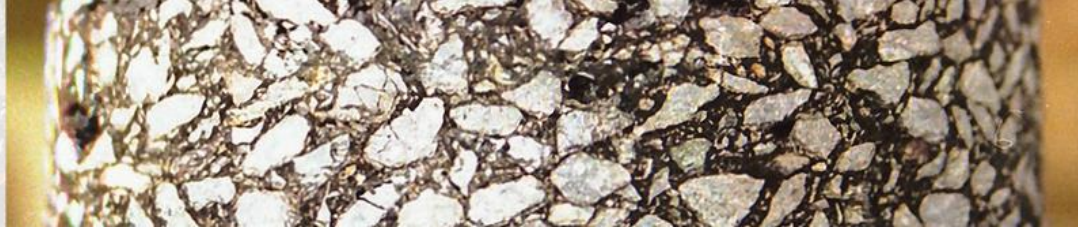




First Apple iPhone

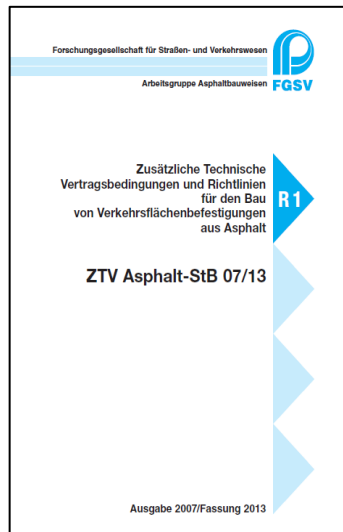
2007

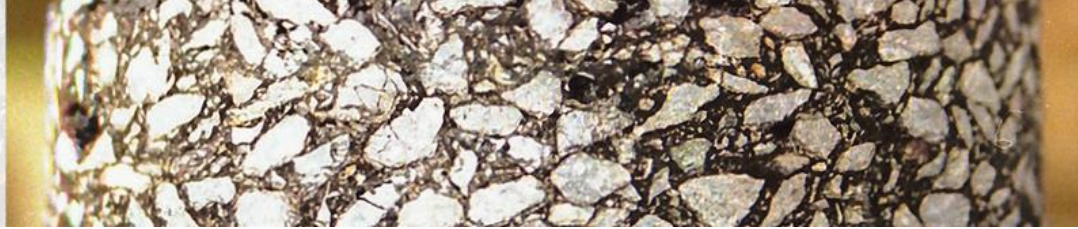




Benedikt XVI. decided to retire - first pope after year 1294

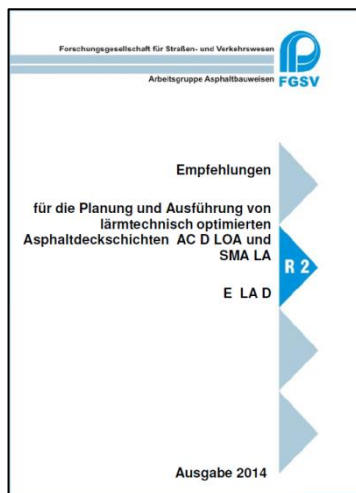
2013



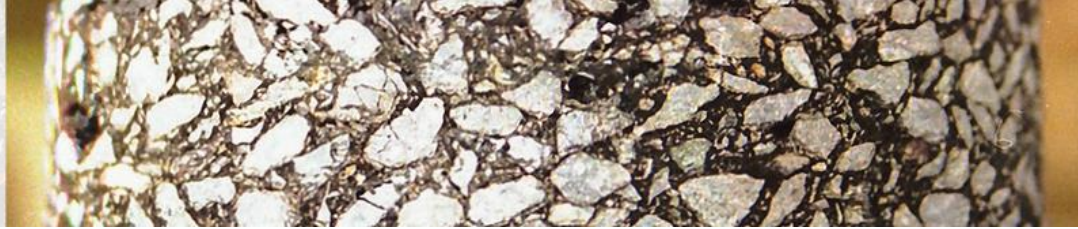


20th World Soccer Championship in Brazil

2014

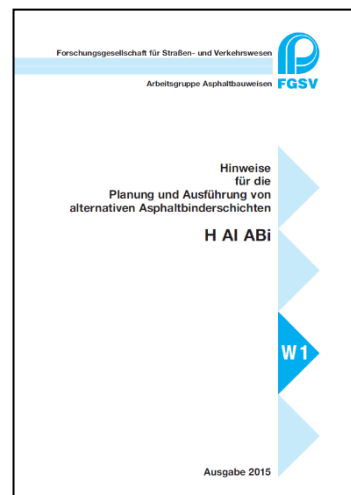


SMA plus with noise reducing properties

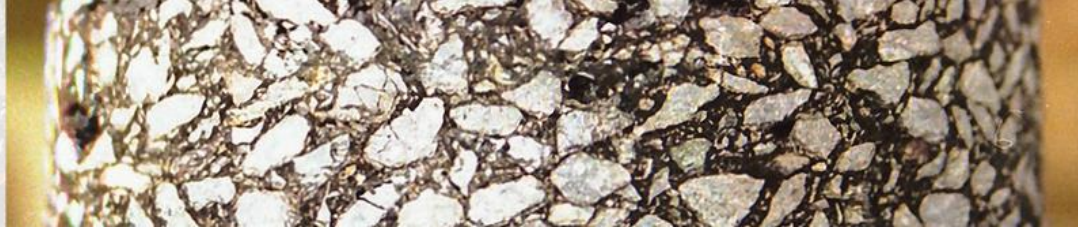


100th Birthday of Frank Sinatra

2015



SMA Binder Course – structural layer



February 9th

Santa Clara California

Levi's Stadium

Superbowl 50

Carolina Panthers 10

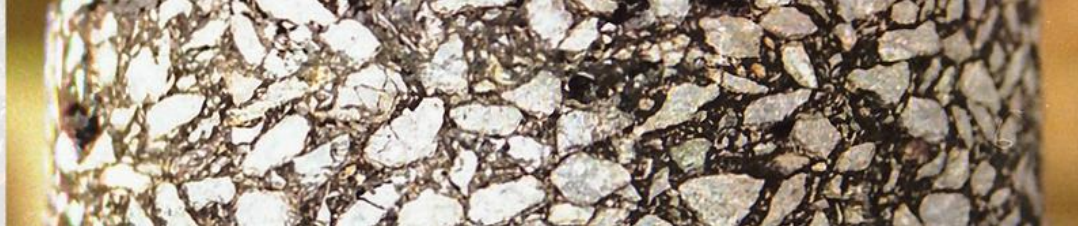
Denver Broncos 24



2016

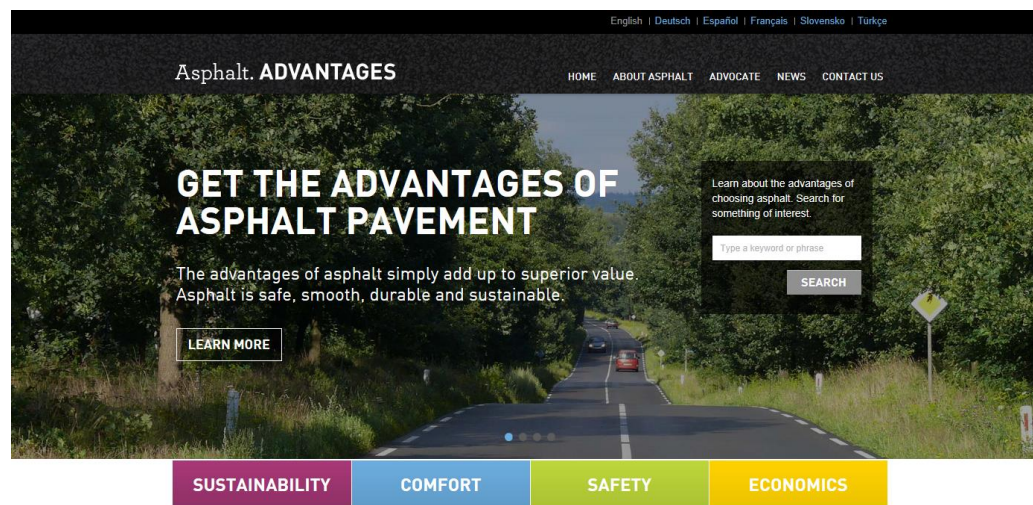


SMA – Olympic area Rio de Janeiro
Brazil 2016

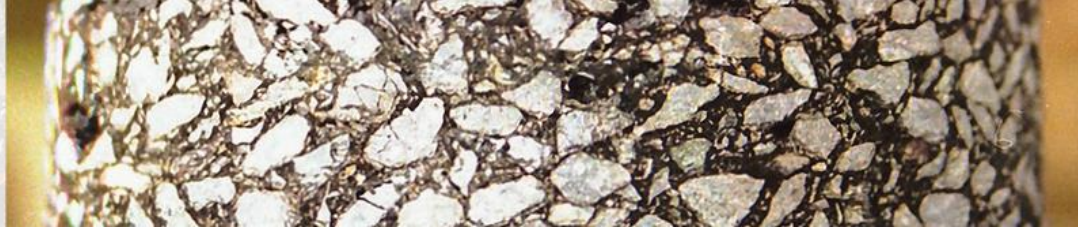


Horst Erdlen – 1st EAPA Asphalt Advocate of the Year Award

2017



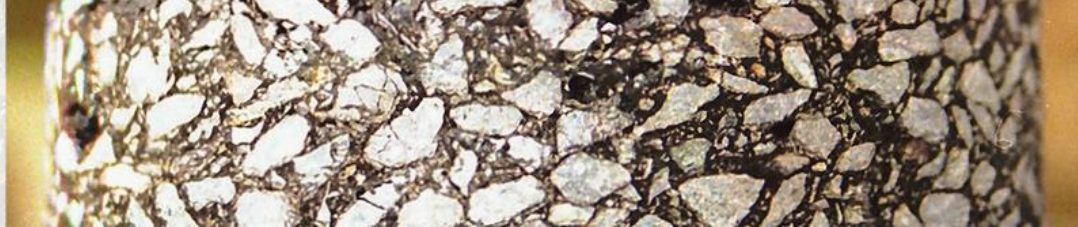
www.asphaltadvantages.com



German national soccer team knocked out during preliminary round at the world soccer championship in Russia

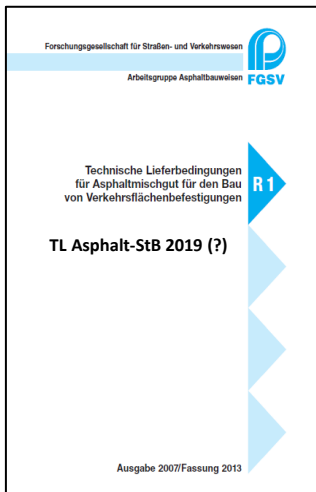
2018





2019 (?)

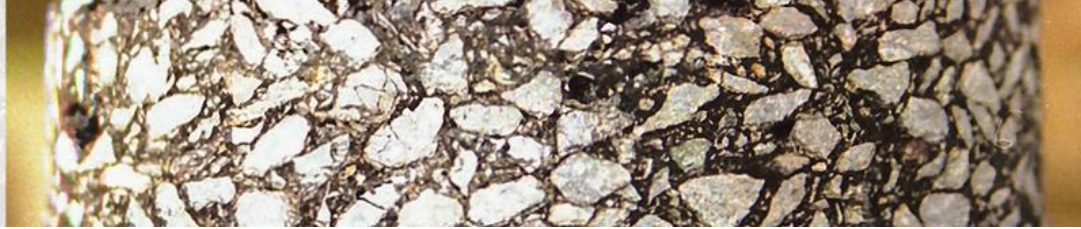
2020



Revision of the German Specifications

- Use of RAP in SMA?
- SMA Binder Course? (W1 => R1)
- SMA plus? (R2 => R1)

1ST INTERNATIONAL CONFERENCE ON
Stone Matrix Asphalt



20xx

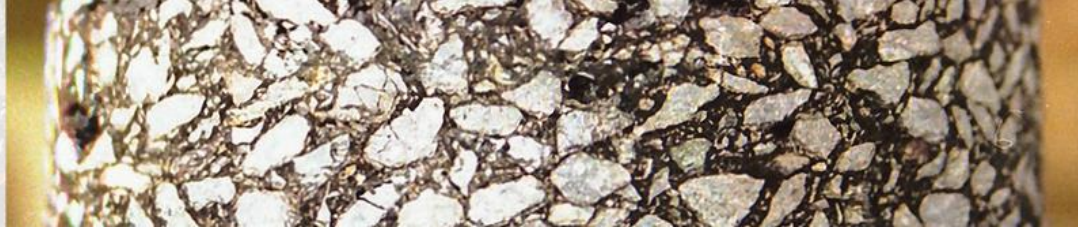
2nd INTERNATIONAL CONFERENCE ON
Stone Matrix Asphalt

J. RETTENMAIER & SÖHNE
GMBH + CO KG



Fibers designed
by Nature

1ST INTERNATIONAL CONFERENCE ON
Stone Matrix Asphalt



20xx

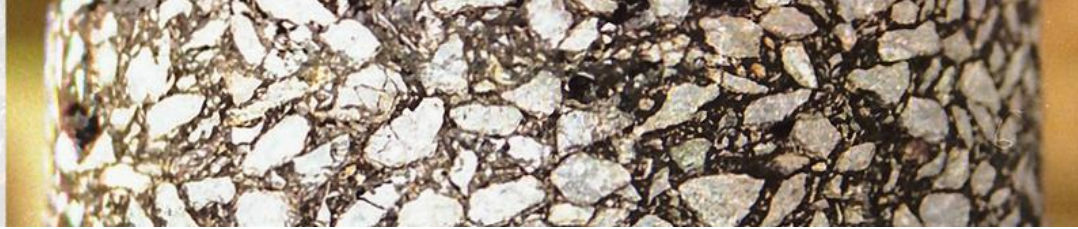
2nd INTERNATIONAL CONFERENCE ON
Stone Matrix Asphalt



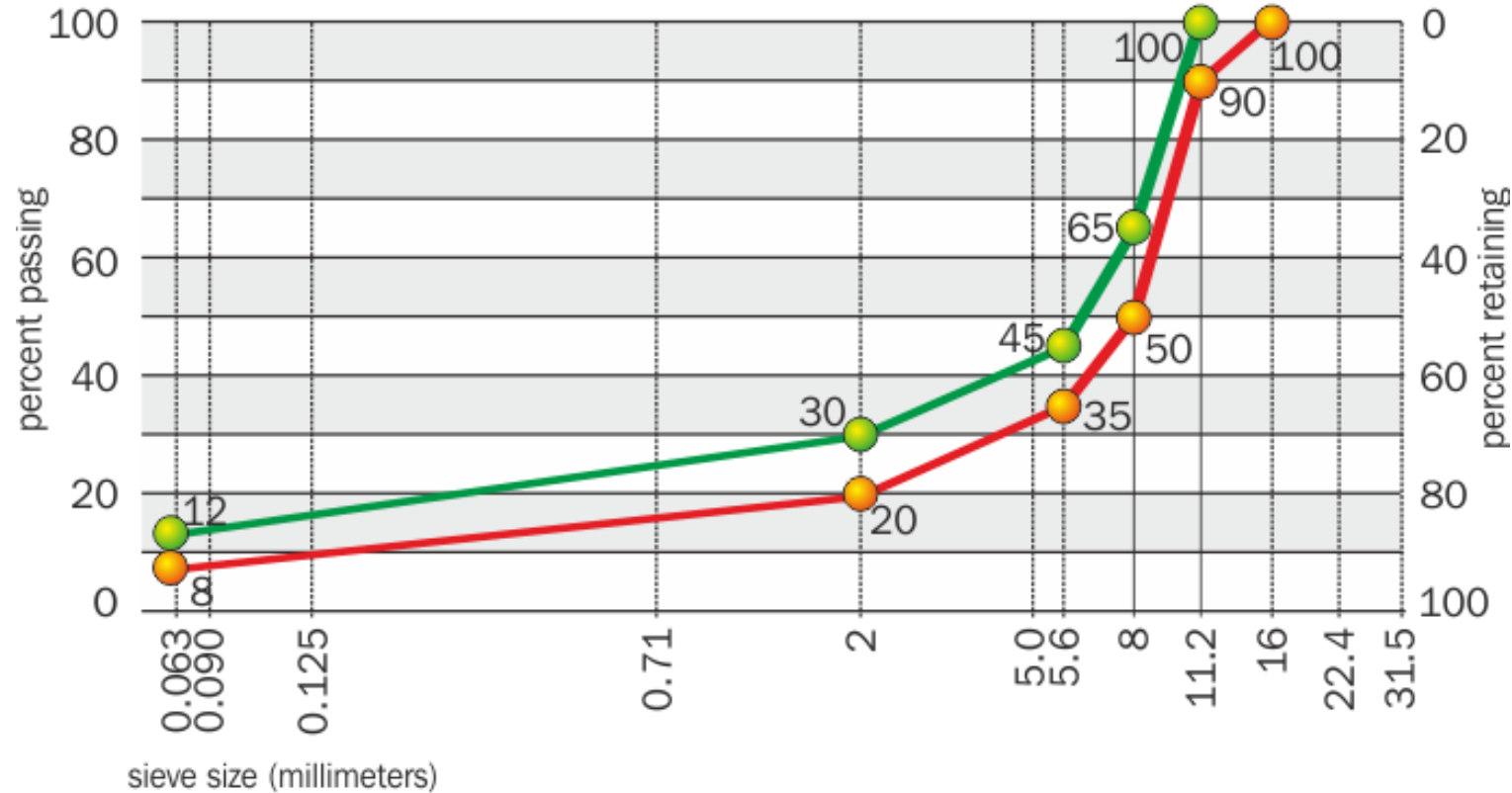
J. RETTENMAIER & SÖHNE
GMBH + CO KG



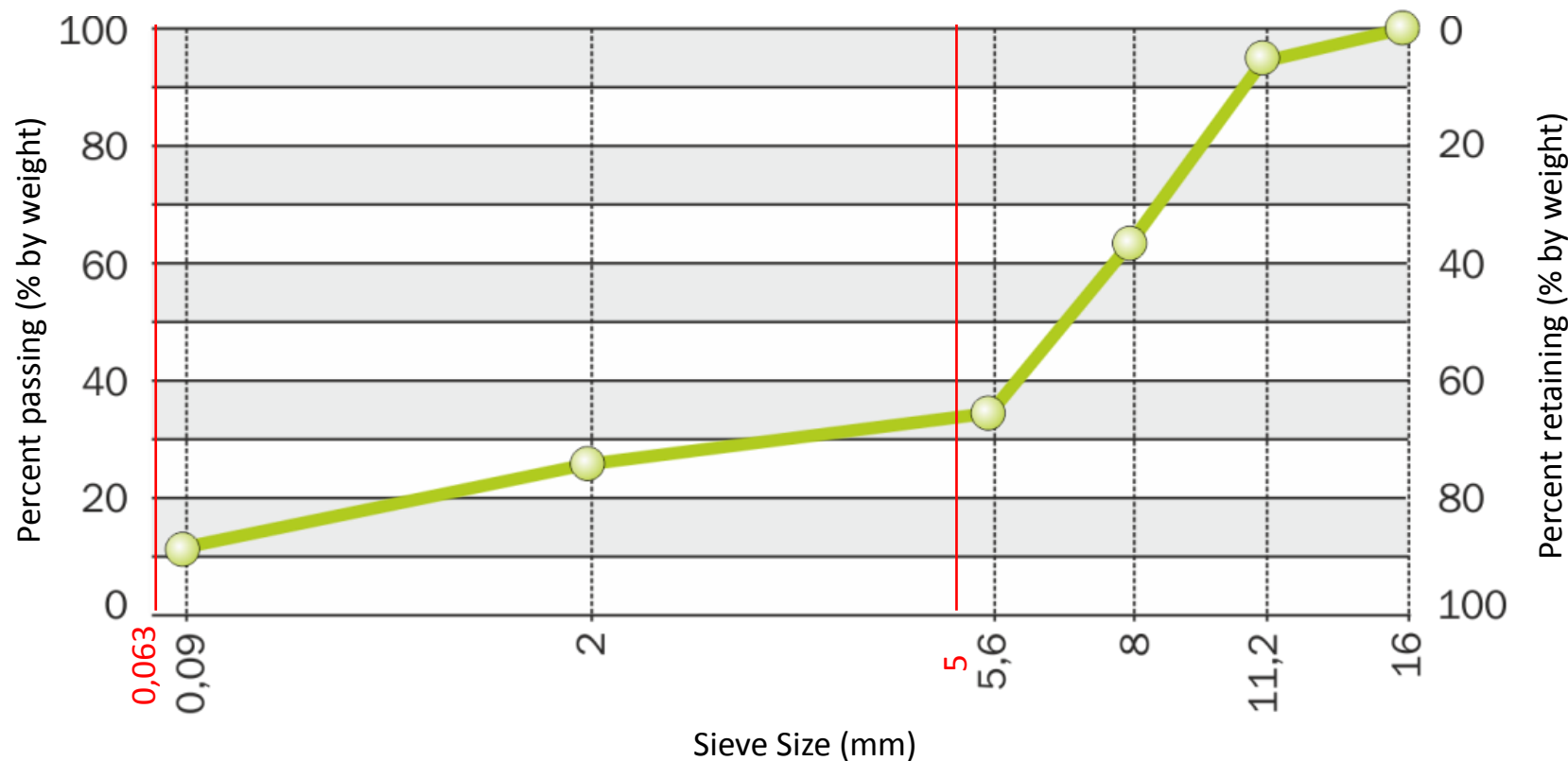
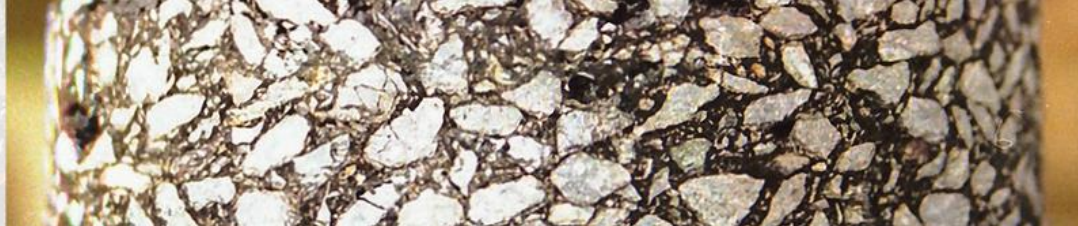
Fibers designed
by Nature



Stone Mastic Asphalt 11 S



TL Asphalt-StB 2007/2013

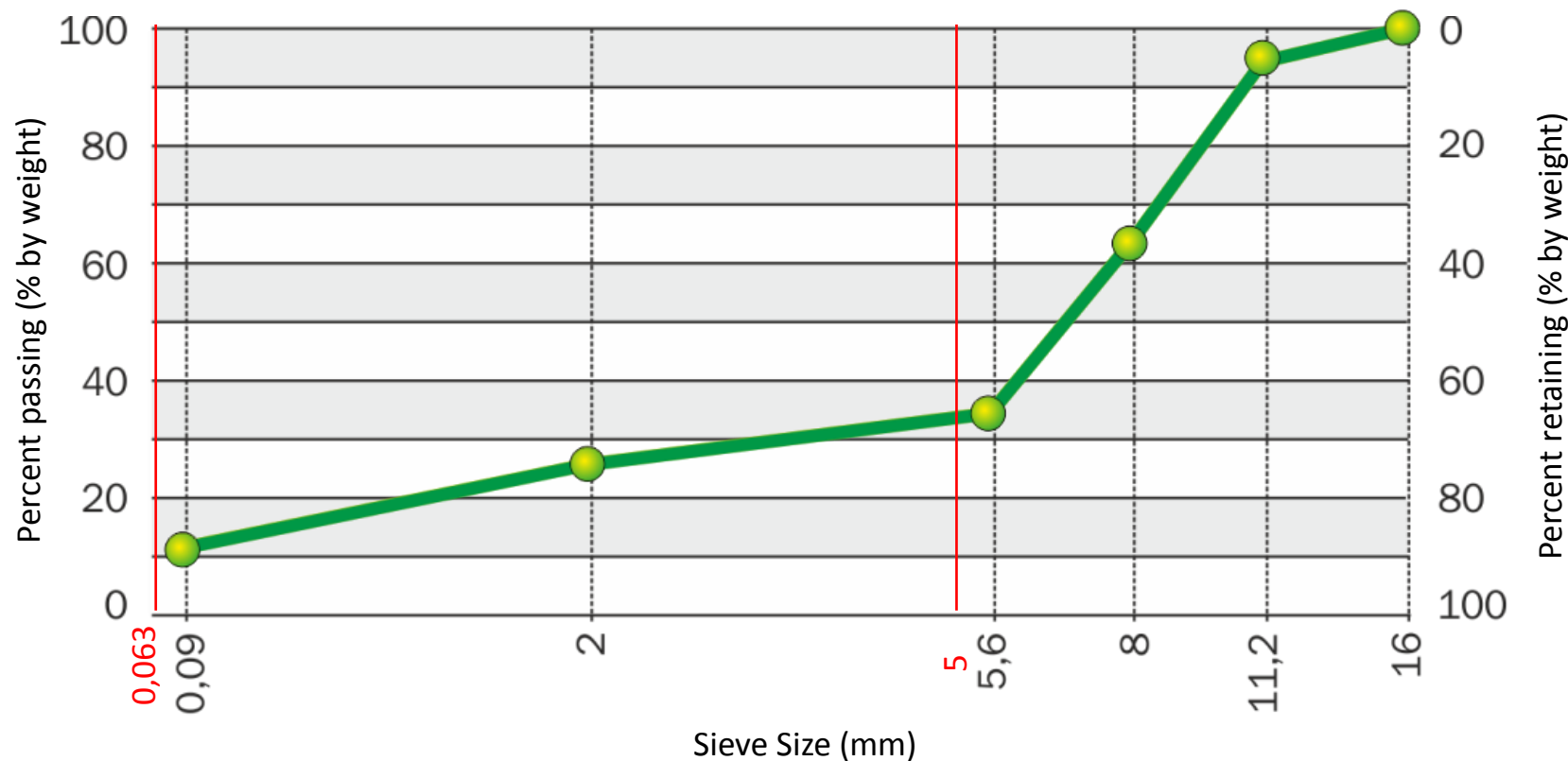
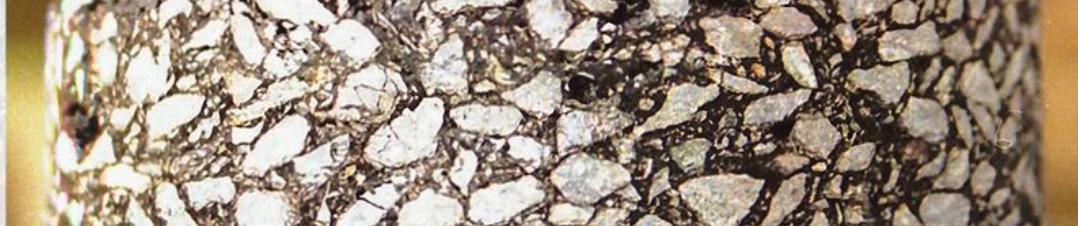


ZTV bit – StB 84
ZTV Asphalt-StB 94

ZTV Asphalt-StB 94/98
ZTV Asphalt-StB 2001

TL Asphalt-StB 07
TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S

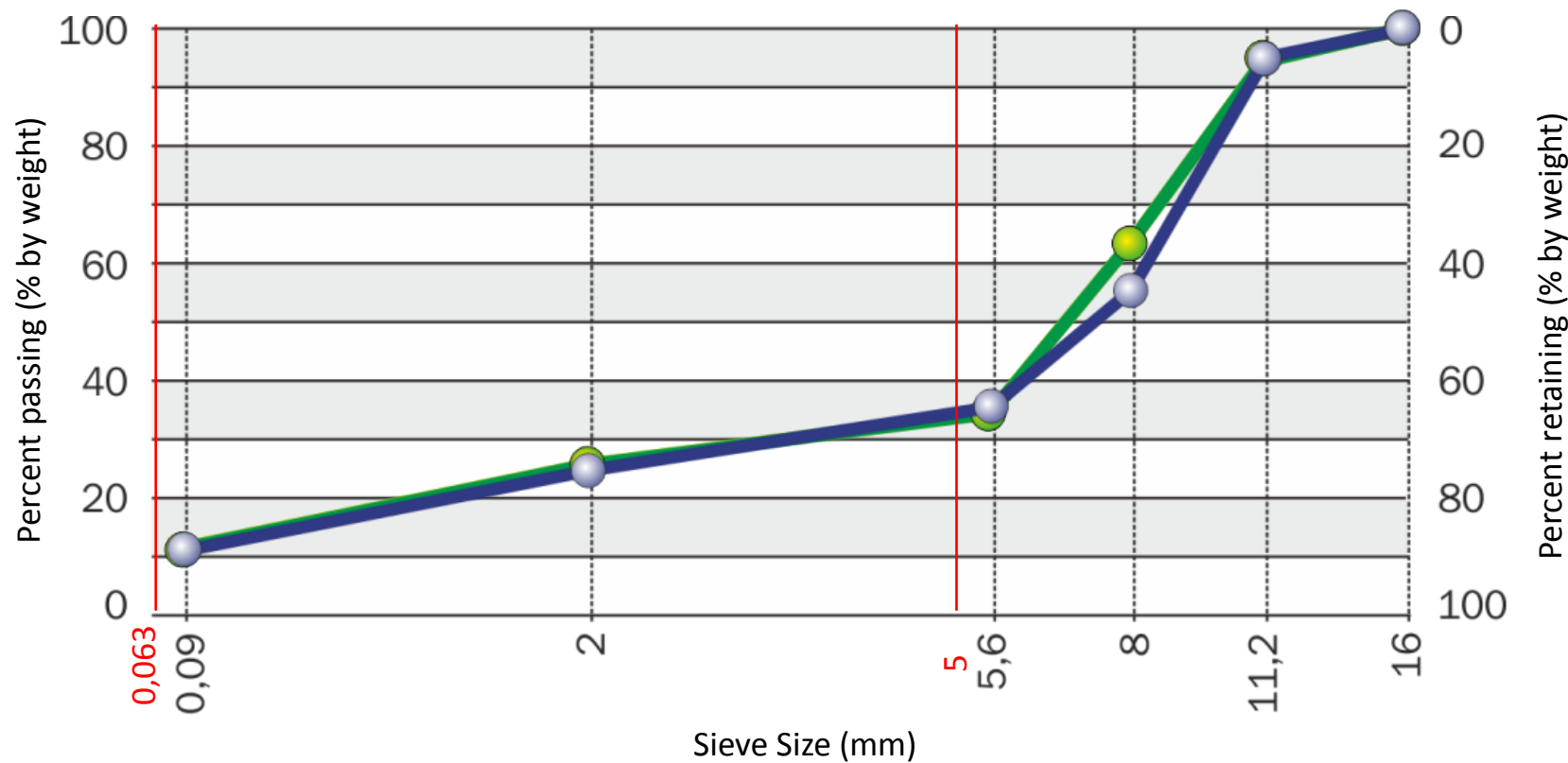
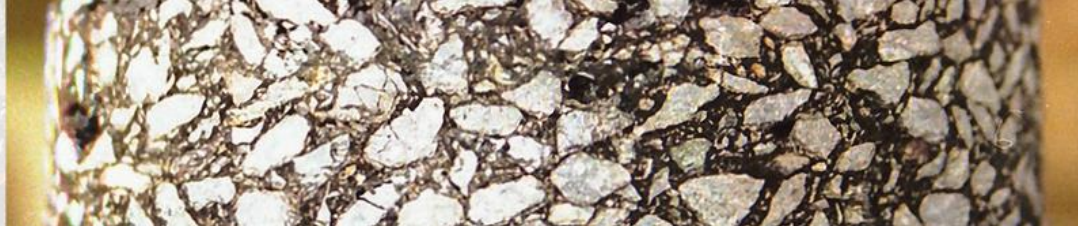


— ZTV bit – StB 84
— ZTV Asphalt-StB 94

ZTV Asphalt-StB 94/98
ZTV Asphalt-StB 2001

TL Asphalt-StB 07
TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S



ZTV bit - StB 84

ZTV Asphalt-StB 94/98

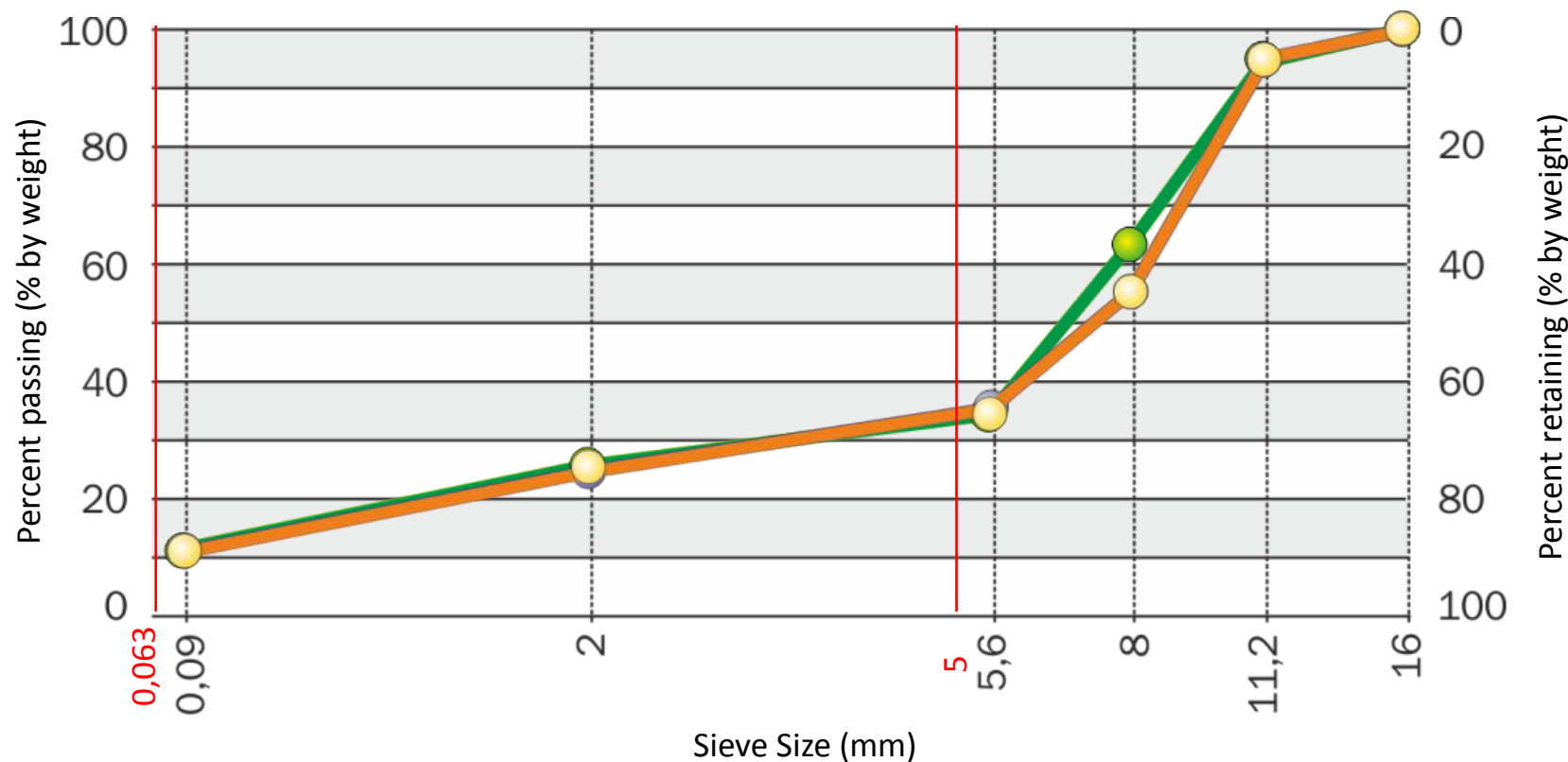
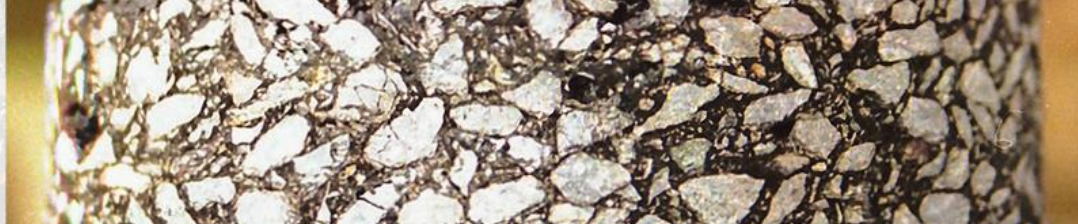
TL Asphalt-StB 07

ZTV Asphalt-StB 94

ZTV Asphalt-StB 2001

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SMA 0/11 S
SMA 11 S



ZTV bit – StB 84

ZTV Asphalt-StB 94/98

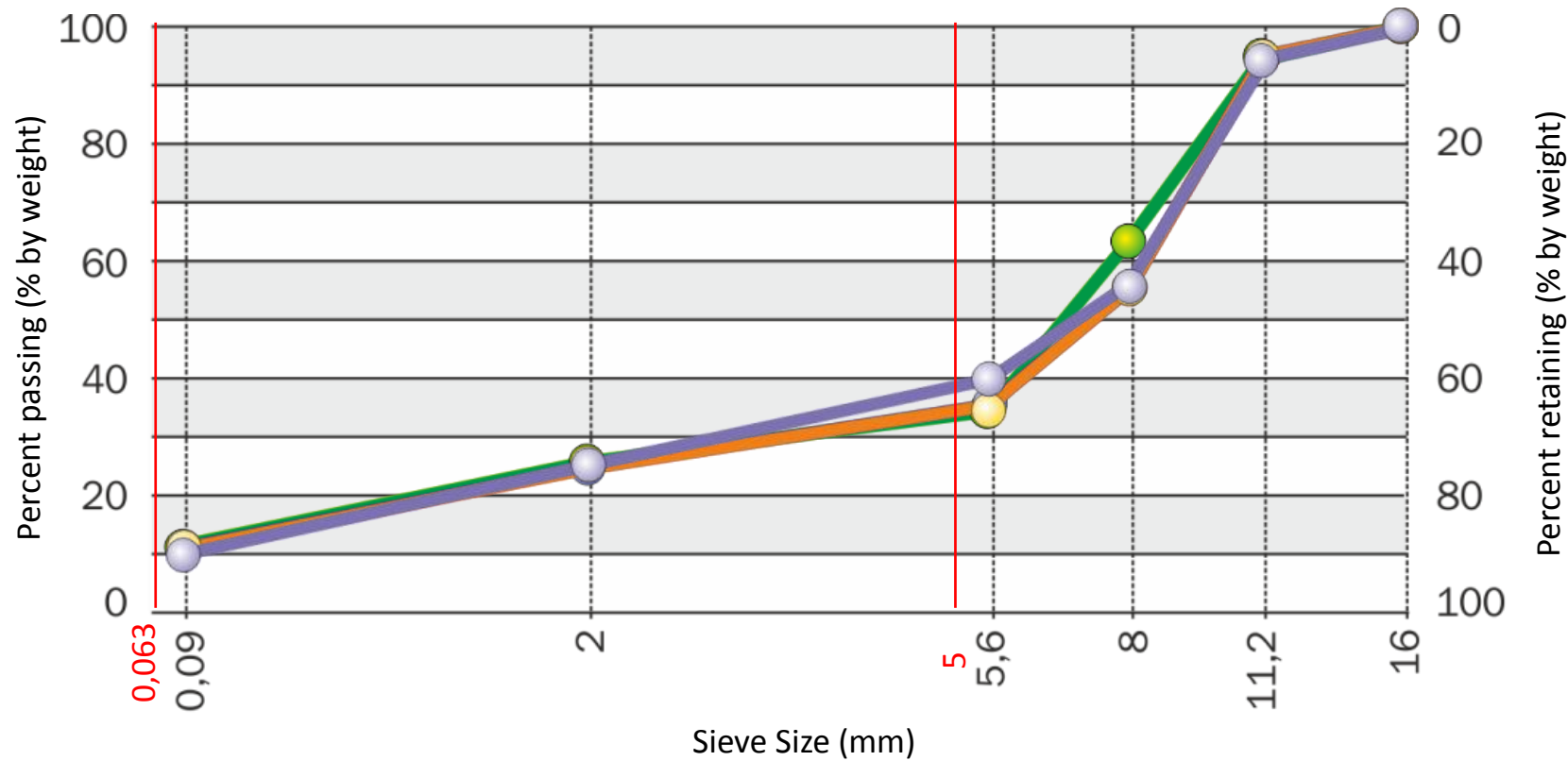
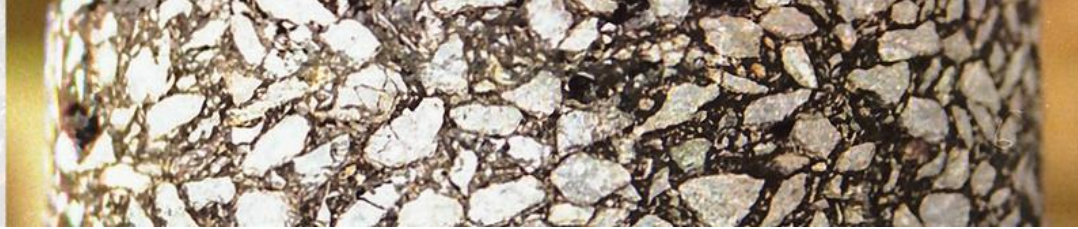
TL Asphalt-StB 07

ZTV Asphalt-StB 94

ZTV Asphalt-StB 2001

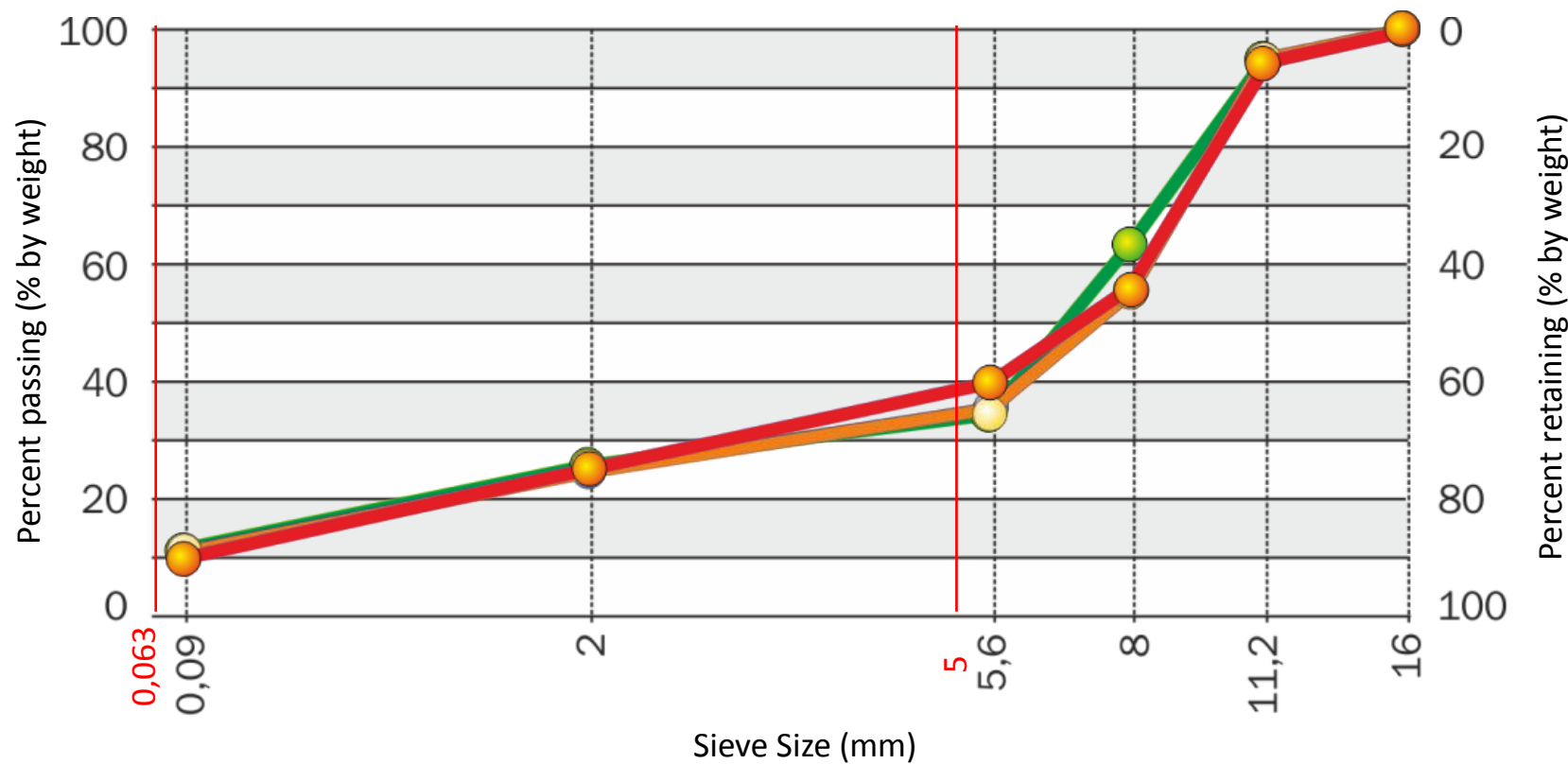
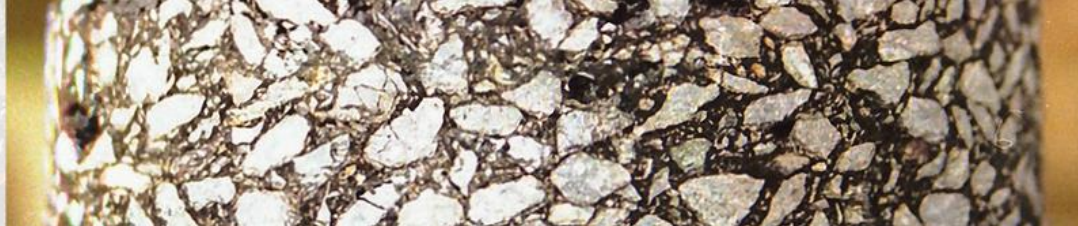
TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S



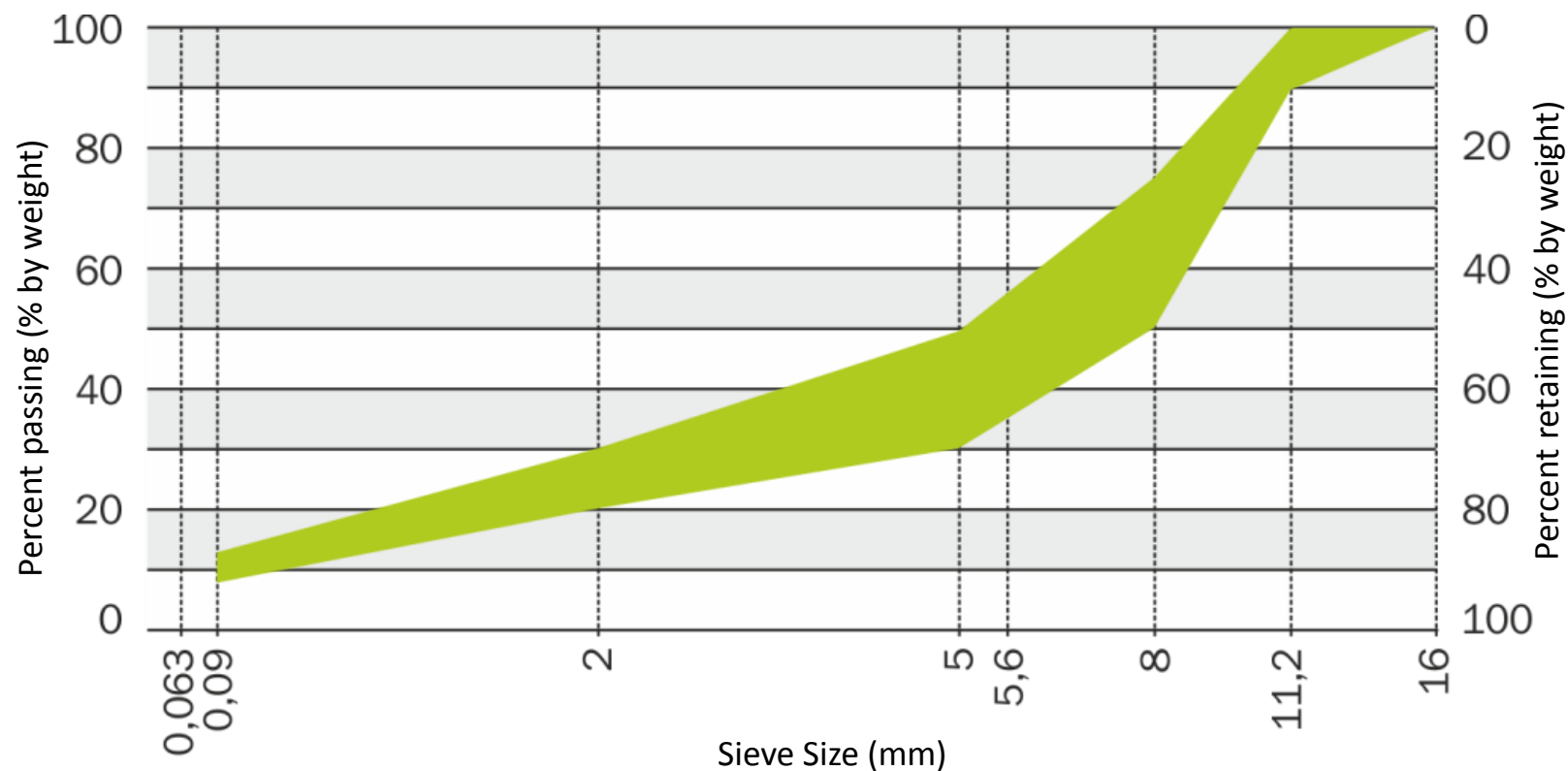
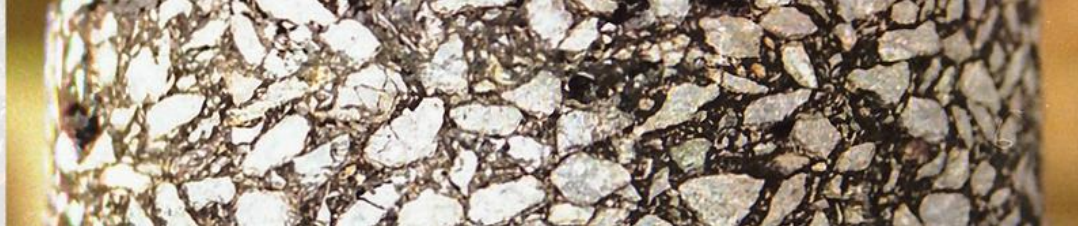
- ZTV bit – StB 84
- ZTV Asphalt-StB 94
- ZTV Asphalt-StB 94/98
- ZTV Asphalt-StB 2001
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- TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S



- | | | |
|---|---|---|
| ■ ZTV bit – StB 84 | ■ ZTV Asphalt-StB 94/98 | ■ TL Asphalt-StB 07 |
| ■ ZTV Asphalt-StB 94 | ■ ZTV Asphalt-StB 2001 | ■ TL Asphalt-StB 07/13 |

SMA 0/11 S
SMA 11 S

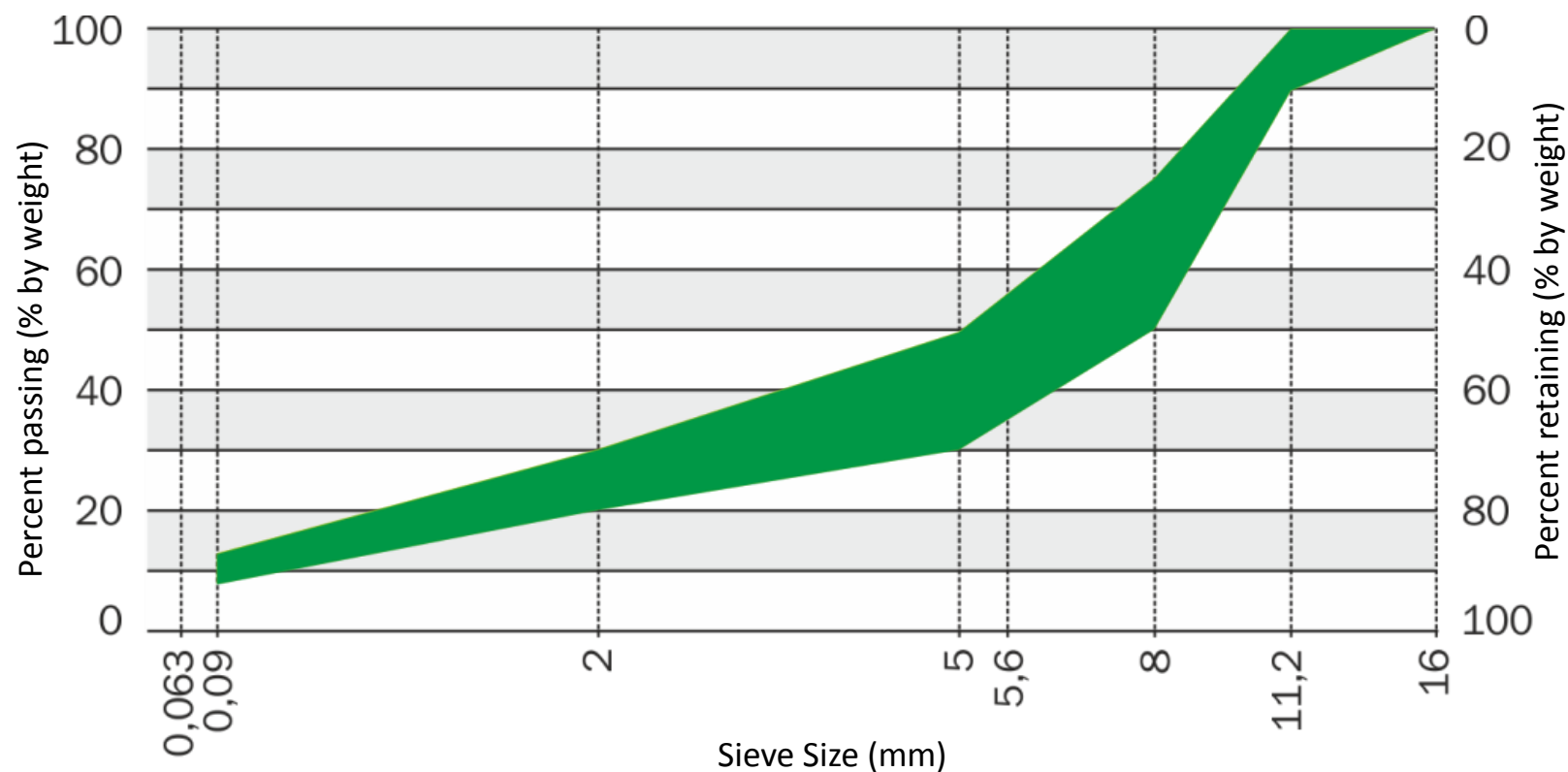
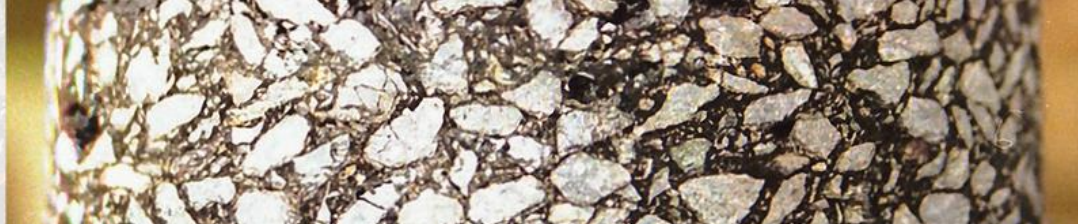


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ZTV Asphalt-StB 94

ZTV Asphalt-StB 94/98
ZTV Asphalt-StB 2001

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TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S



— ZTV bit – StB 84

ZTV Asphalt-StB 94/98

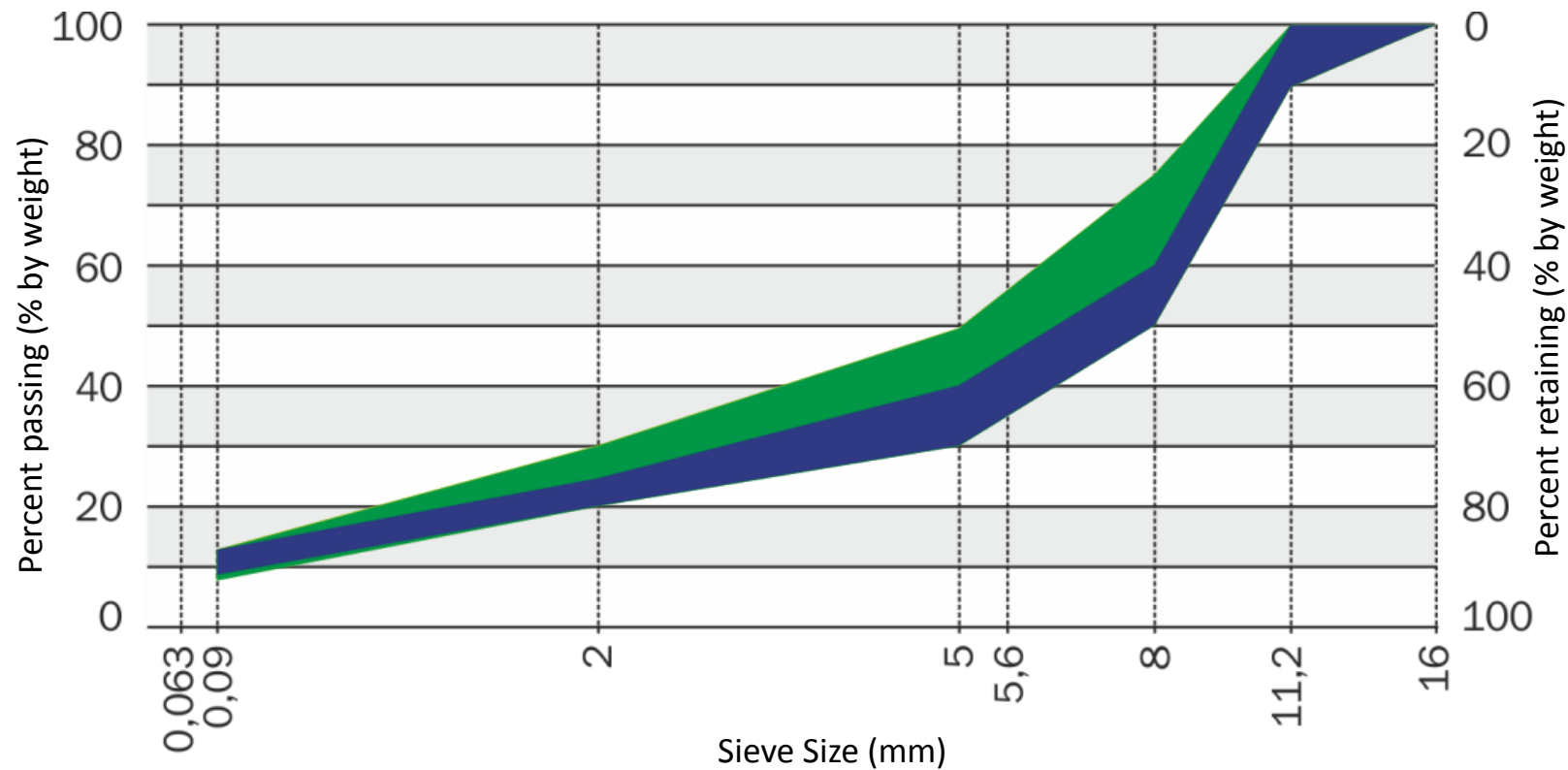
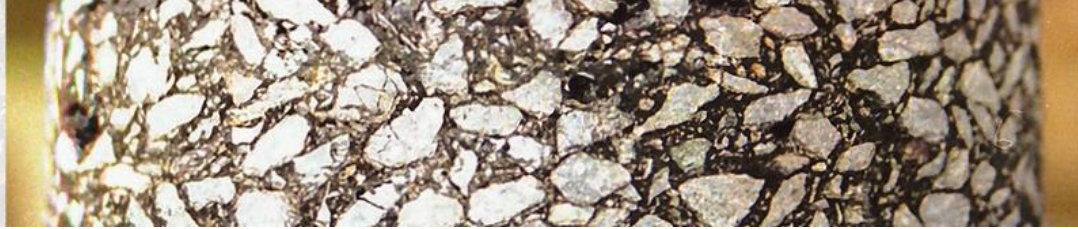
TL Asphalt-StB 07

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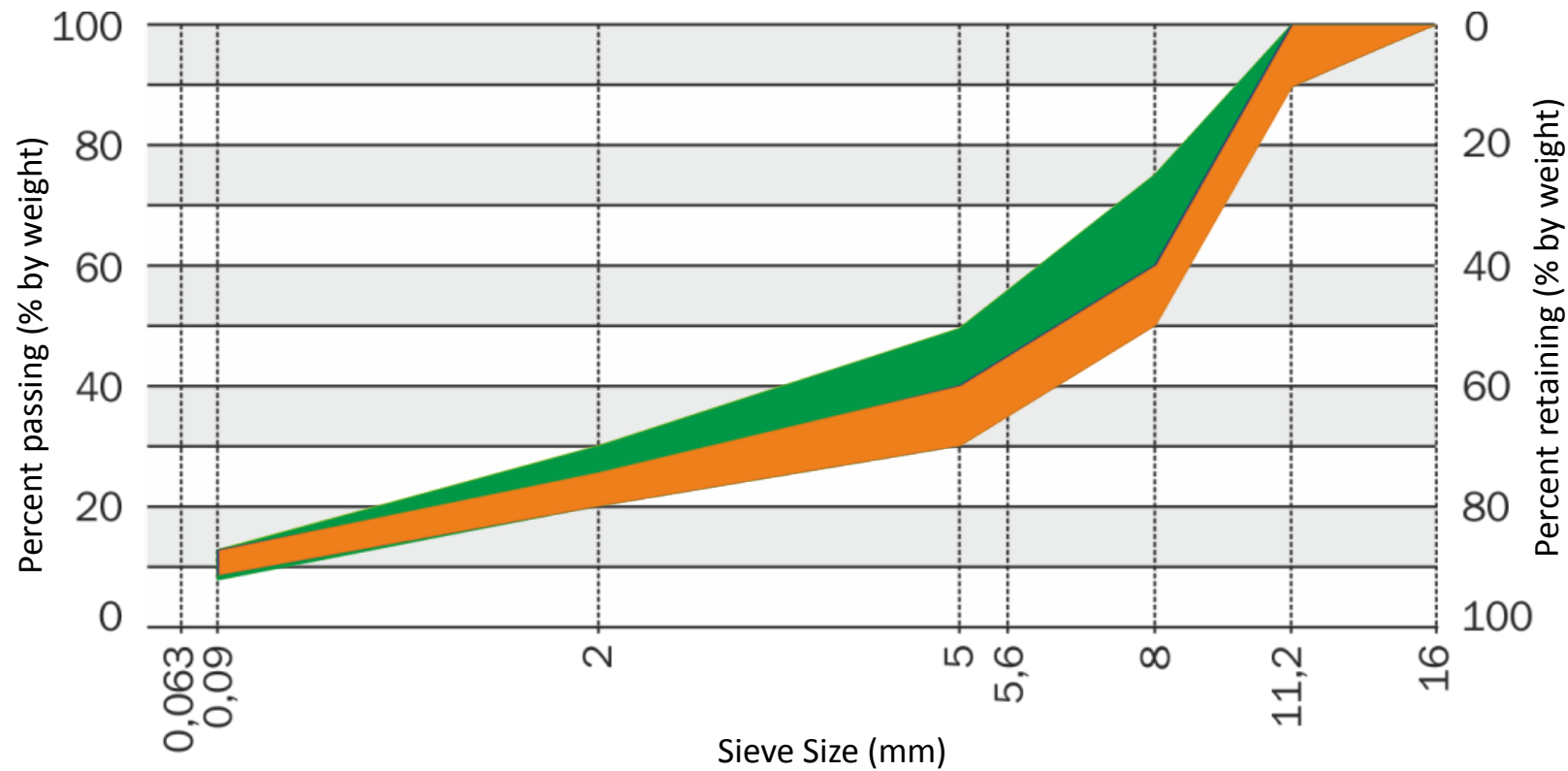
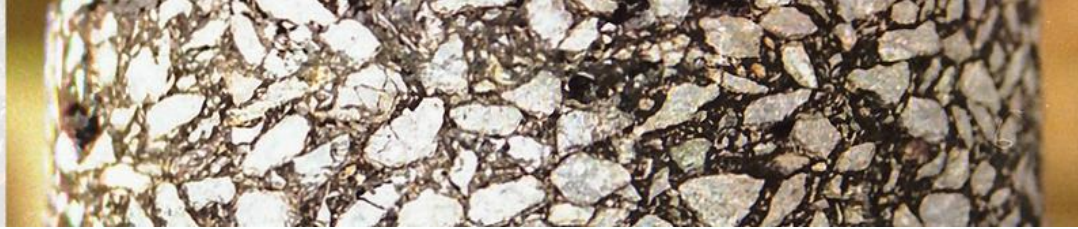


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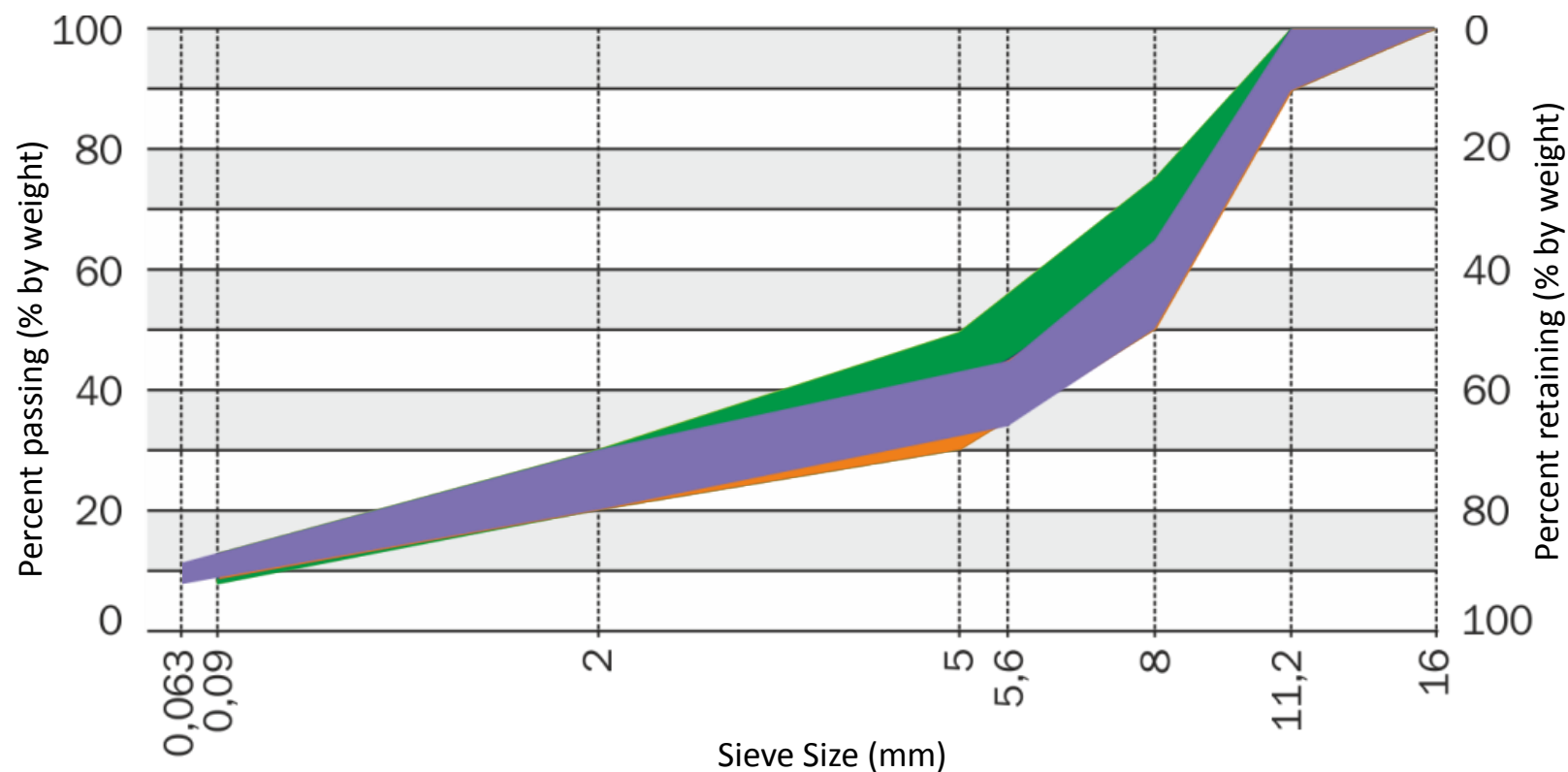
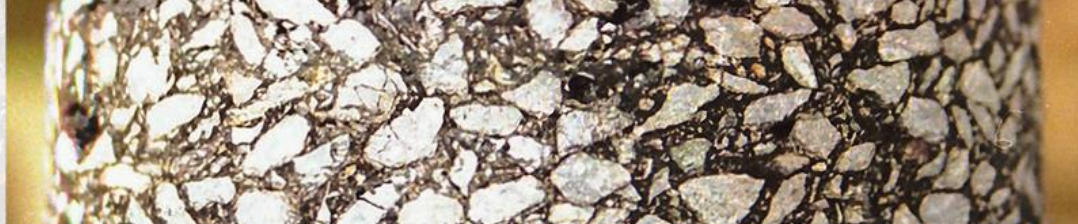
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ZTV Asphalt-StB 2001

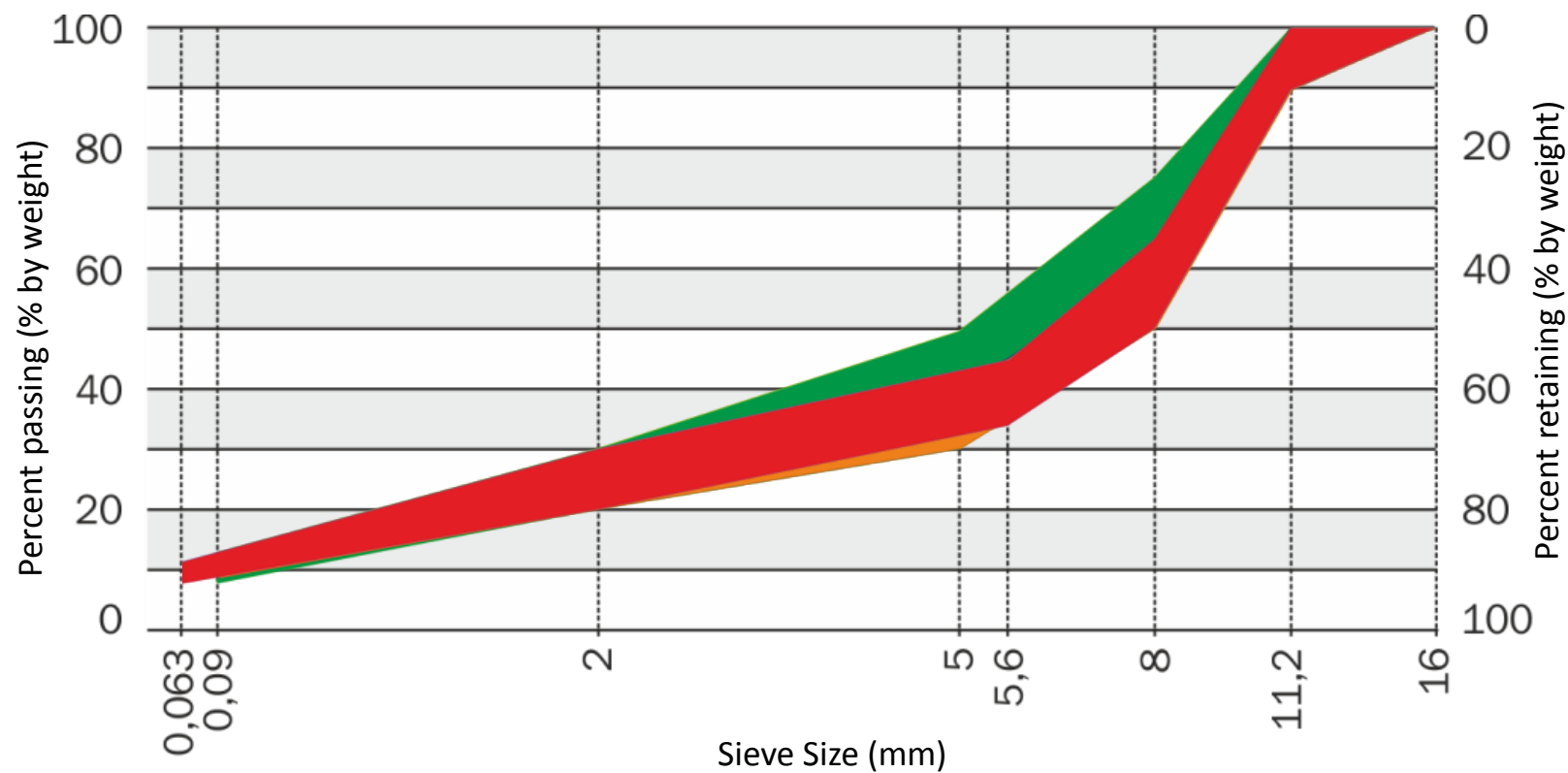
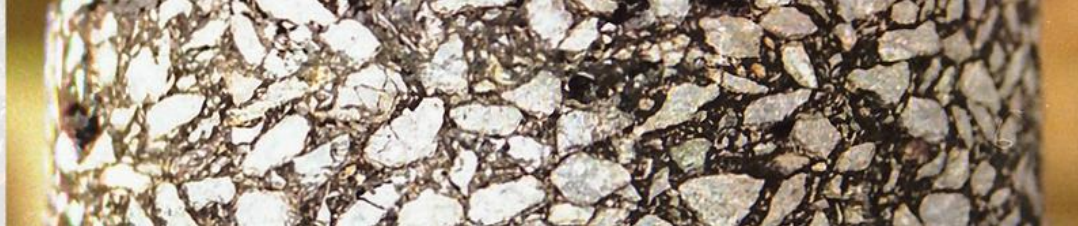
TL Asphalt-StB 07/13

SMA 0/11 S
SMA 11 S



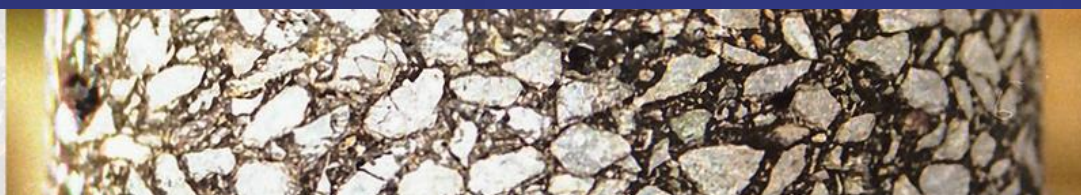
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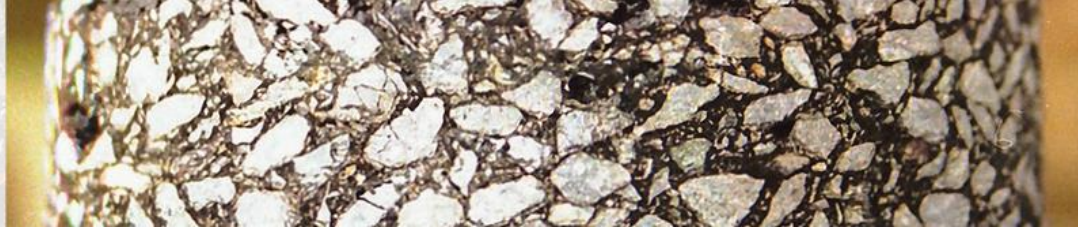


- | | | |
|---|--|---|
| ■ ZTV bit – StB 84 | ■ ZTV Asphalt-StB 94/98 | ■ TL Asphalt-StB 07 |
| ■ ZTV Asphalt-StB 94 | ■ ZTV Asphalt-StB 2001 | ■ TL Asphalt-StB 07/13 |

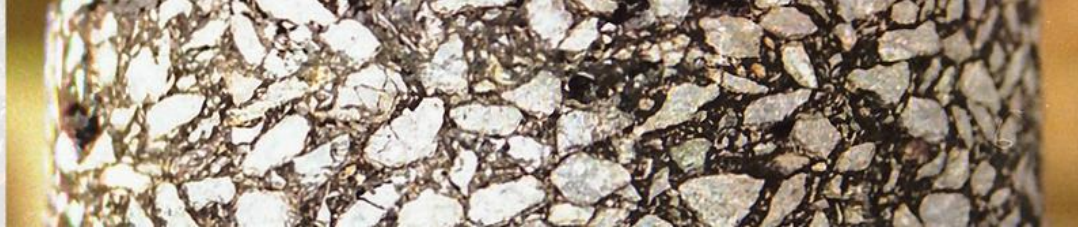
SMA 0/11 S
SMA 11 S



SMA 0/11 S SMA 11 S		ZTV bit - StB 84	ZTV Asphalt - StB 94	ZTV Asphalt - StB 94/98	ZTV Asphalt - StB 01	TL / ZTV Asphalt - StB 07	TL / ZTV Asphalt - StB 07/13
Minerals							
Aggregates (production size)		High quality chippings, high quality crushed sand and/or natural sand, mineral dust	High quality chippings, high quality crushed sand, natural sand, mineral dust	High quality chippings, high quality crushed sand, mineral dust	High quality chippings, high quality crushed sand, mineral dust		
Ratio crushed aggregate surface					C _{100/0} ; C _{90/1}	C _{100/0} ; C _{95/1} ; C _{90/1}	C _{100/0} ; C _{95/1} ; C _{90/1}
Resistance to crushing		SZ ₁₈	SZ ₁₈	SZ ₁₈	SZ ₁₈	SZ ₁₈ / LA ₂₀	SZ ₁₈ / LA ₂₀
Resistance to polishing				PSV ≥ 50	PSV ≥ 50	PSV _{specified} (51)	PSV _{specified} (51)
Minimum part of fine aggregates with 0/2 mit E _{CS} 35	%					100	100
Shape Index (SI)						SI ₂₀	SI ₂₀
Flakiness Index (FI)						FI ₂₀	FI ₂₀
Aggregate product size						G _F 85; G _C 90/10; G _C 90/15	G _F 85; G _C 90/10; G _C 90/15
Resistance to frost						F ₁	F ₁



SMA 0/11 S SMA 11 S		ZTV bit - StB 84	ZTV Asphalt - StB 94	ZTV Asphalt - StB 94/98	ZTV Asphalt - StB 01	TL / ZTV Asphalt - StB 07	TL / ZTV Asphalt - StB 07/13
Composition of Asphalt Mixture							
Aggregate mixture							
Passing sieve 16 mm	% by weight	100	100	100	100	100	100
Passing sieve 11.2 mm	% by weight	90 – 100	90 – 100	90 – 100	90 – 100	90 – 100	90 – 100
Passing sieve 8 mm	% by weight	50 – 75	50 – 75	50 – 60	50 – 60	50 – 65	50 – 65
Passing sieve 5.6 mm	% by weight					35 – 45	35 – 45
Passing sieve 5 mm	% by weight	30 – 50	30 – 50	30 – 40	30 – 40		
Passing sieve 2 mm	% by weight	20 – 30	20 – 30	20 – 25	20 – 27	20 – 30	20 – 30
Passing sieve 0.09 mm	% by weight	8 – 13	8 – 13	9 – 13	9 – 13		
Passing sieve 0.063 mm	% by weight					8 – 12	8 – 12
Crushed sand - natural sand - ratio		≥ 1:1	≥ 1:1	1:0	1:0		



SMA 0/11 S SMA 11 S		ZTV bit - StB 84	ZTV Asphalt - StB 94	ZTV Asphalt - StB 94/98	ZTV Asphalt - StB 01	TL / ZTV Asphalt - StB 07	TL / ZTV Asphalt - StB 07/13
Binder							
Binder, type and grade		B 65	B 65	B 65 (PmB 45)	50/70 (PmB 45) ← 25/55-55; 50/70	25/55-55; 50/70	25/55-55; 50/70
Binder content	% by weight	6.0 - 7.5	6.5 - 7.5	≥ 6.5	≥ 6.5	B _{min} 6.6	B _{min} 6.7
Stabilizing additive (cellulose fibers)	% by weight	0.3 - 1.5	0,3 - 1.5	0.3 - 1.5	0.3 - 1.5	0.3 - 1.5	0.3 – 1.5



Stabilizing additive

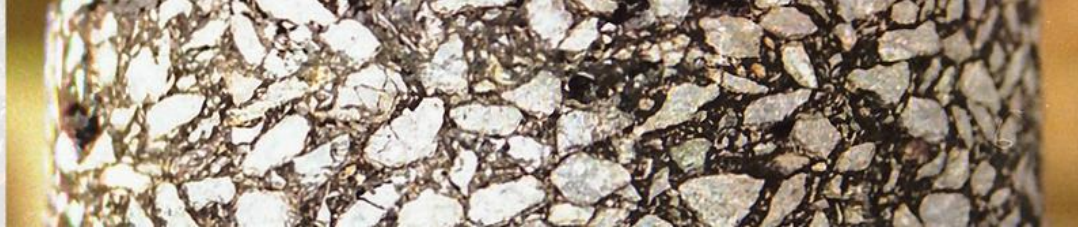


Drainage inhibitor

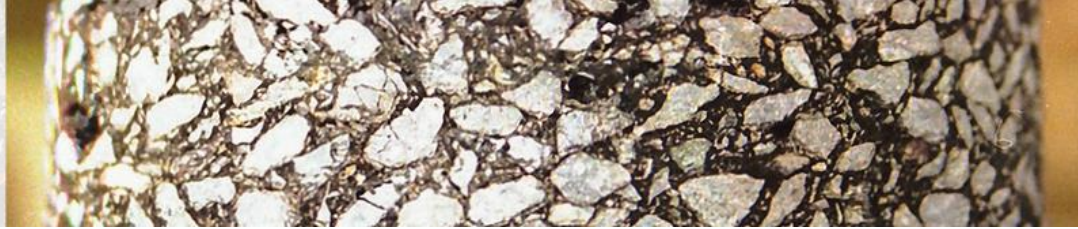


Durability enhancer

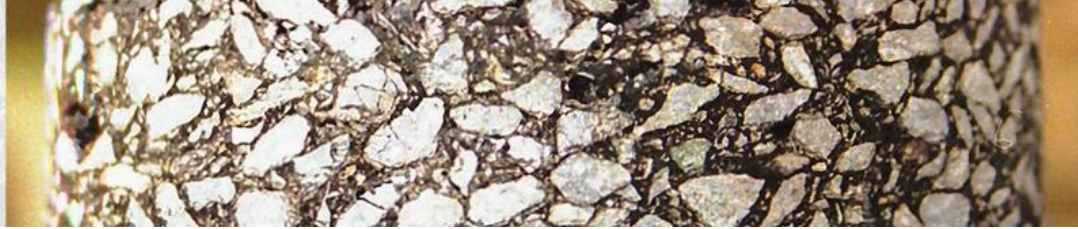




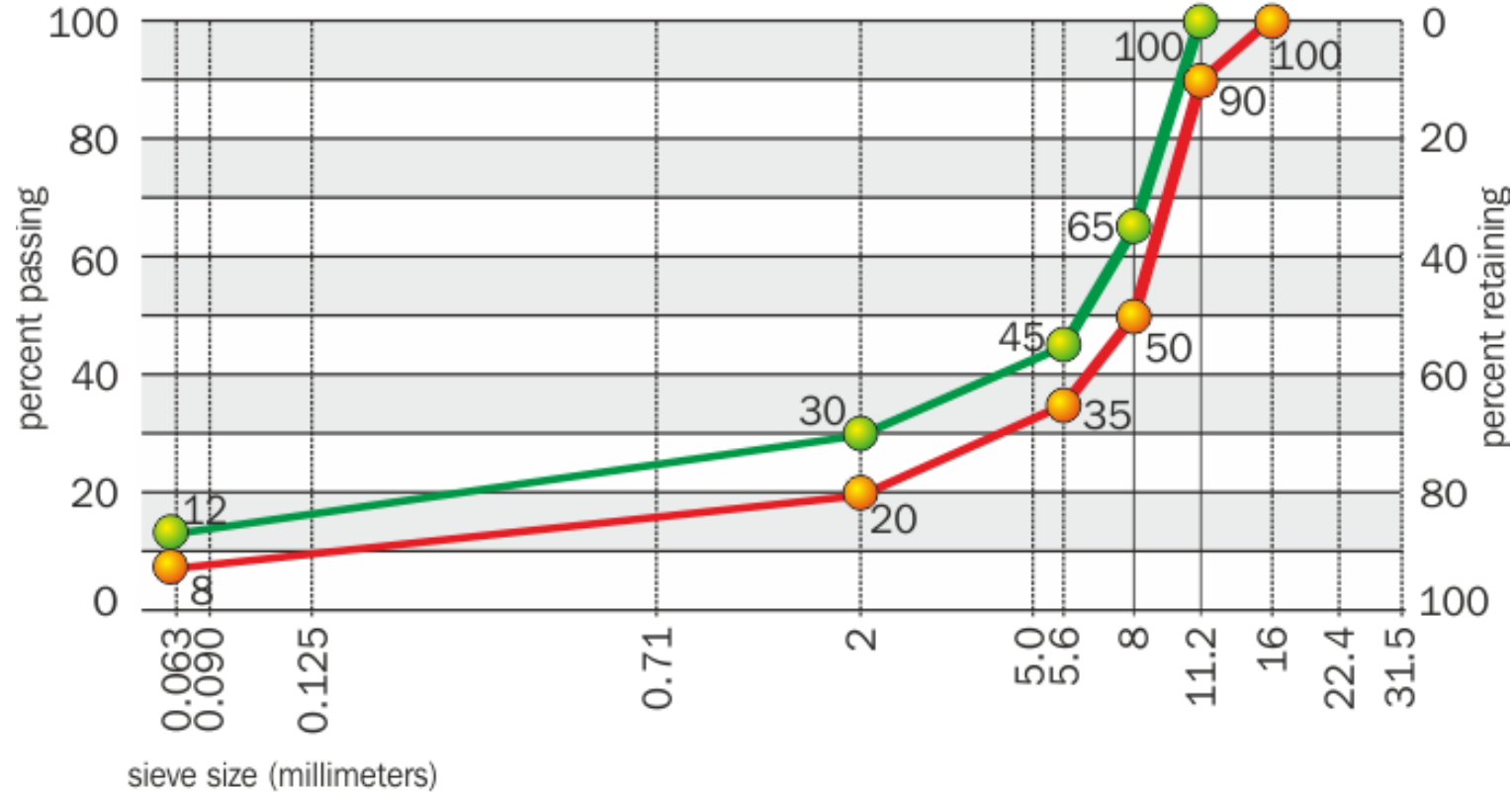
SMA 0/11 S SMA 11 S		ZTV bit - StB 84	ZTV Asphalt - StB 94	ZTV Asphalt - StB 94/98	ZTV Asphalt - StB 01	TL / ZTV Asphalt - StB 07	TL / ZTV Asphalt - StB 07/13
Asphalt Mixture							
Compaction temperature Marshall-Specimen	°C	135 ± 5	135 ± 5	135 ± 5	135 ± 5		
Minimum void content Marshall-Specimen	% by volume	2.0	2.0	3.0	3.0	V _{min} 2.5	V _{min} 2.5
Maximum void content Marshall-Specimen	% by volume	4.0	4.0	4.0	4.0	V _{max} 3.0	V _{max} 3.0
Voids filled with bitumen (VFB)	%					is to be specified	is to be specified
Proportional rut depth	%					is to be specified	is to be specified



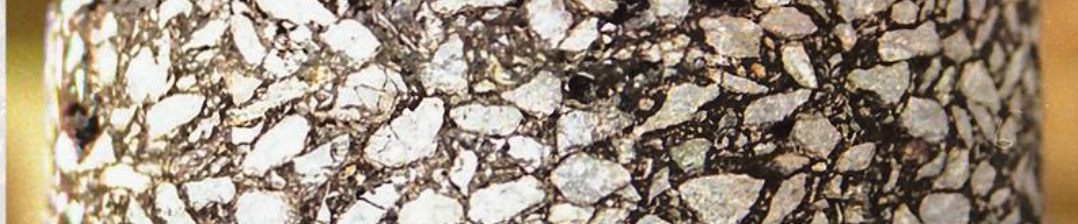
SMA 0/11 S SMA 11 S		ZTV bit - StB 84	ZTV Asphalt - StB 94	ZTV Asphalt - StB 94/98	ZTV Asphalt - StB 01	TL / ZTV Asphalt - StB 07	TL / ZTV Asphalt - StB 07/13
Characteristics of Layer							
Paving thickness	cm	2.5 – 5.0	2.5 – 5.0	3.5 – 4.0	3.5 – 4.0	3.5 – 4.0	3.5 – 4.0
Paving amount	kg/m ²	60 – 125	60 – 125	85 – 100	85 – 100	85 – 100	85 – 100
Degree of compaction	%	≥ 97	≥ 97	≥ 97	≥ 97	≥ 97	≥ 98
Void content	% by volume	≤ 6.0	≤ 6.0	≤ 6.0	≤ 6.0	≤ 5.0	≤ 5.0
Gritting material				0.5 – 1.0 kg/m ² raw or lightly bitumenized high-quality sand / chippings 1/3 mm 1.0 – 2.0 kg/m ² raw or lightly bitumenized high-quality chippings 2/5 mm	0.5 – 1.0 kg/m ² raw or lightly bitumenized crushed aggregates (C _{90/1}) 1/3 mm 1.0 – 2.0 kg/m ² raw or lightly bitumenized crushed aggregates (C _{90/1}) 2/5 mm	0.5 – 1.0 kg/m ² raw or lightly bitumenized crushed aggregates 1/3 mm 1.0 – 2.0 kg/m ² raw or lightly bitumenized crushed aggregates 2/5 mm	0.5 – 1.0 kg/m ² raw or lightly bitumenized crushed aggregates 1/3 mm 1.0 – 2.0 kg/m ² raw or lightly bitumenized crushed aggregates 2/5 mm



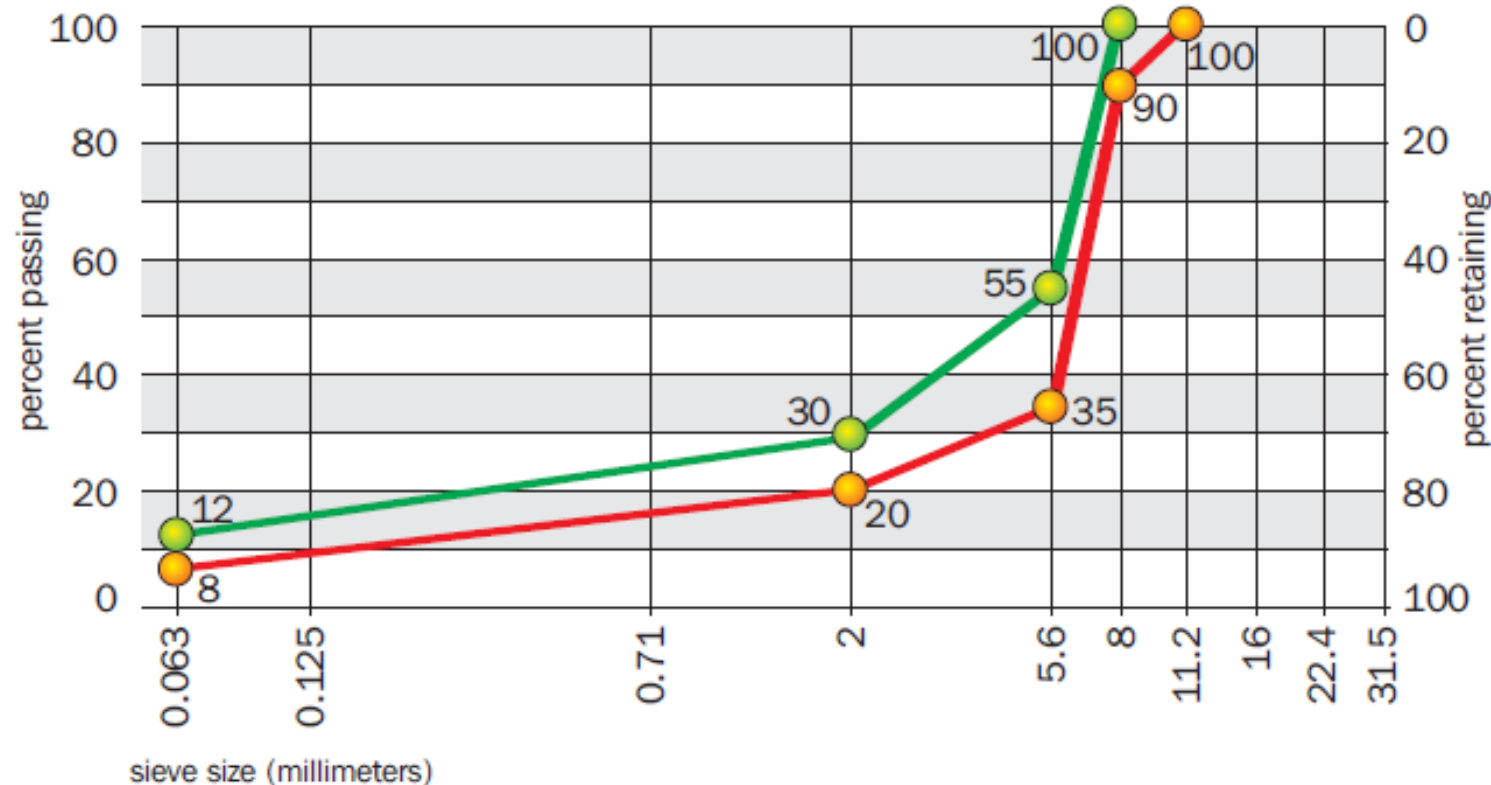
Stone Mastic Asphalt 11 S



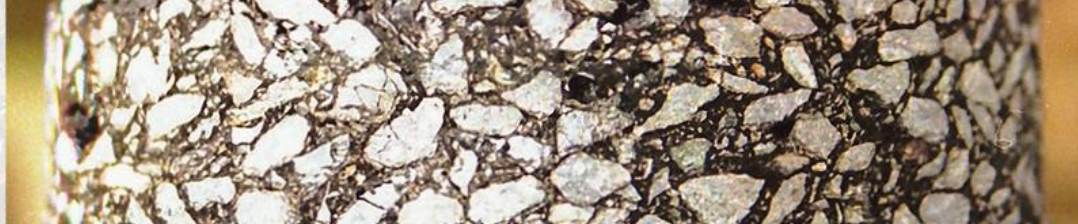
TL Asphalt-StB 2007/2013



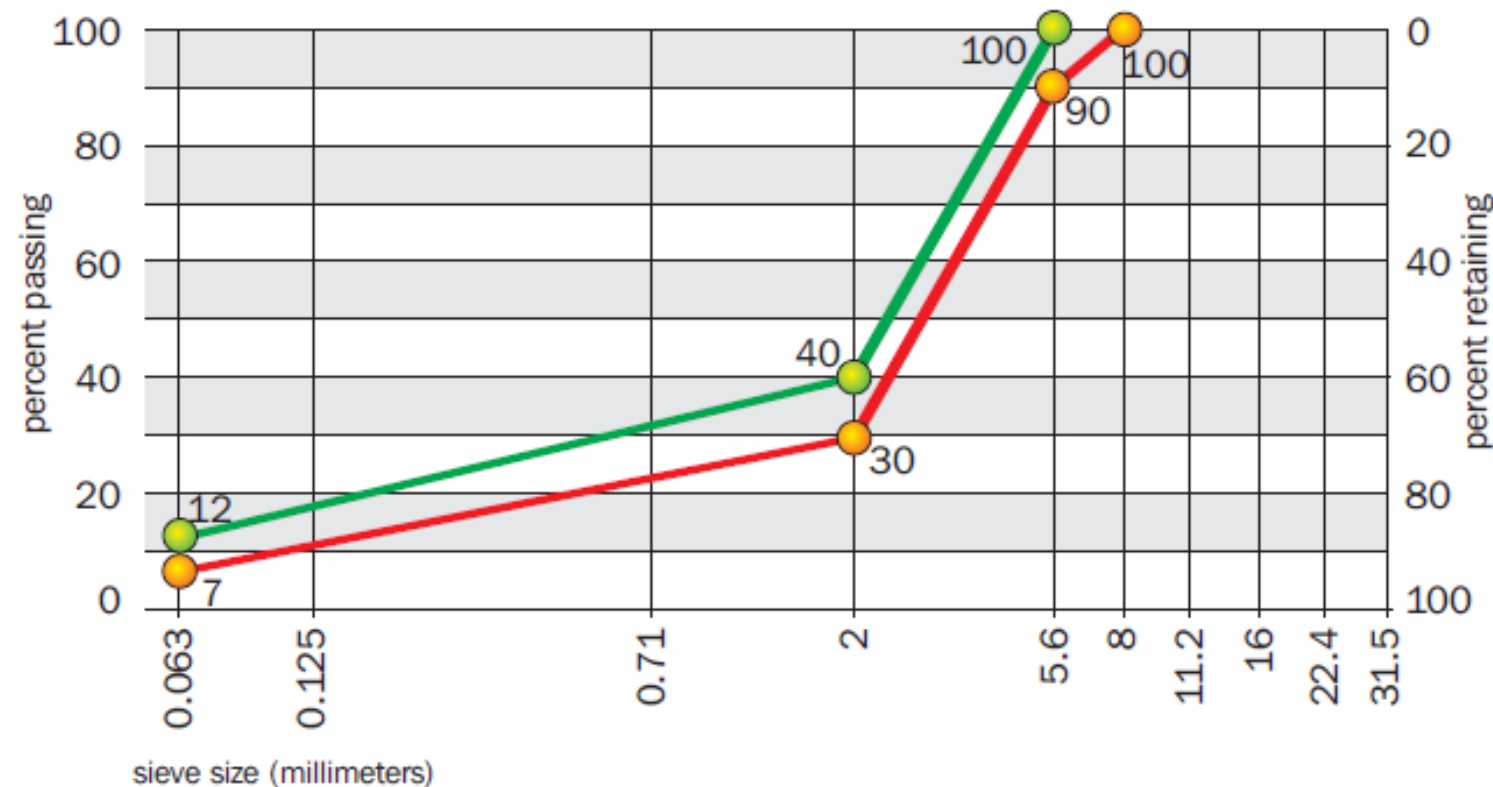
Stone Mastic Asphalt 8 S



TL Asphalt-StB 2007/2013

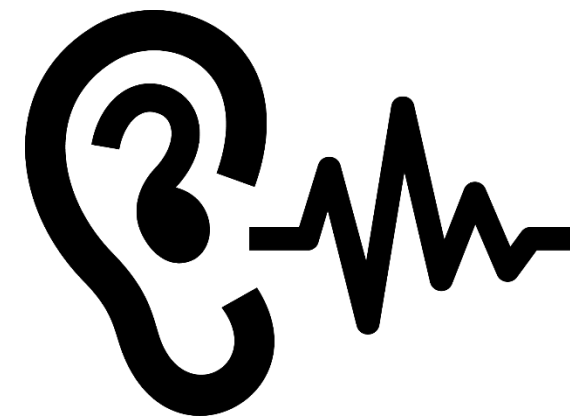
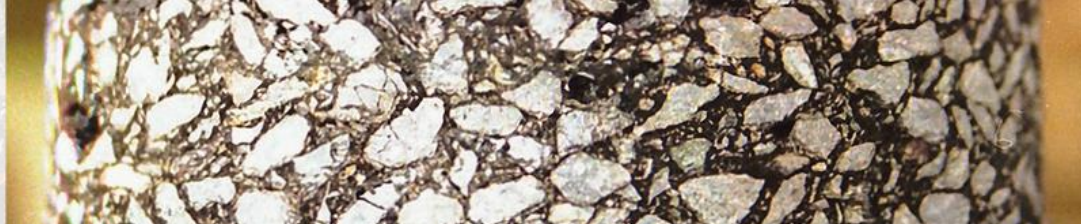


Stone Mastic Asphalt 5 S



TL Asphalt-StB 2007/2013

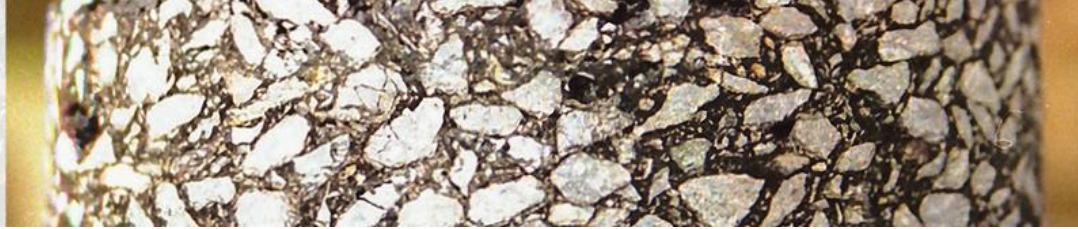
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Arbeitsgruppe Asphaltbauweisen

Empfehlungen
für die Planung und Ausführung
von lärmtechnisch optimierten
Asphaltdeckschichten
aus AC D LOA und SMA LA

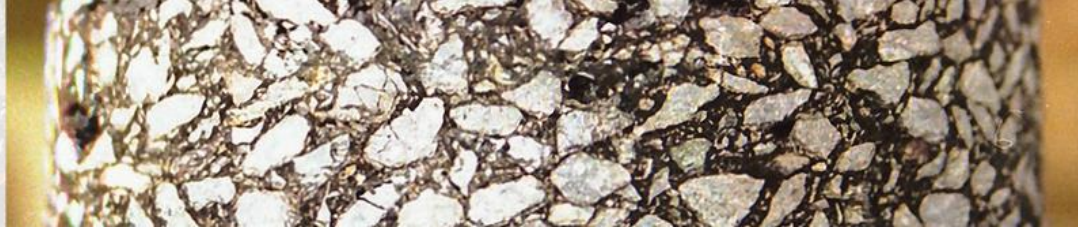
E LA D

R 2

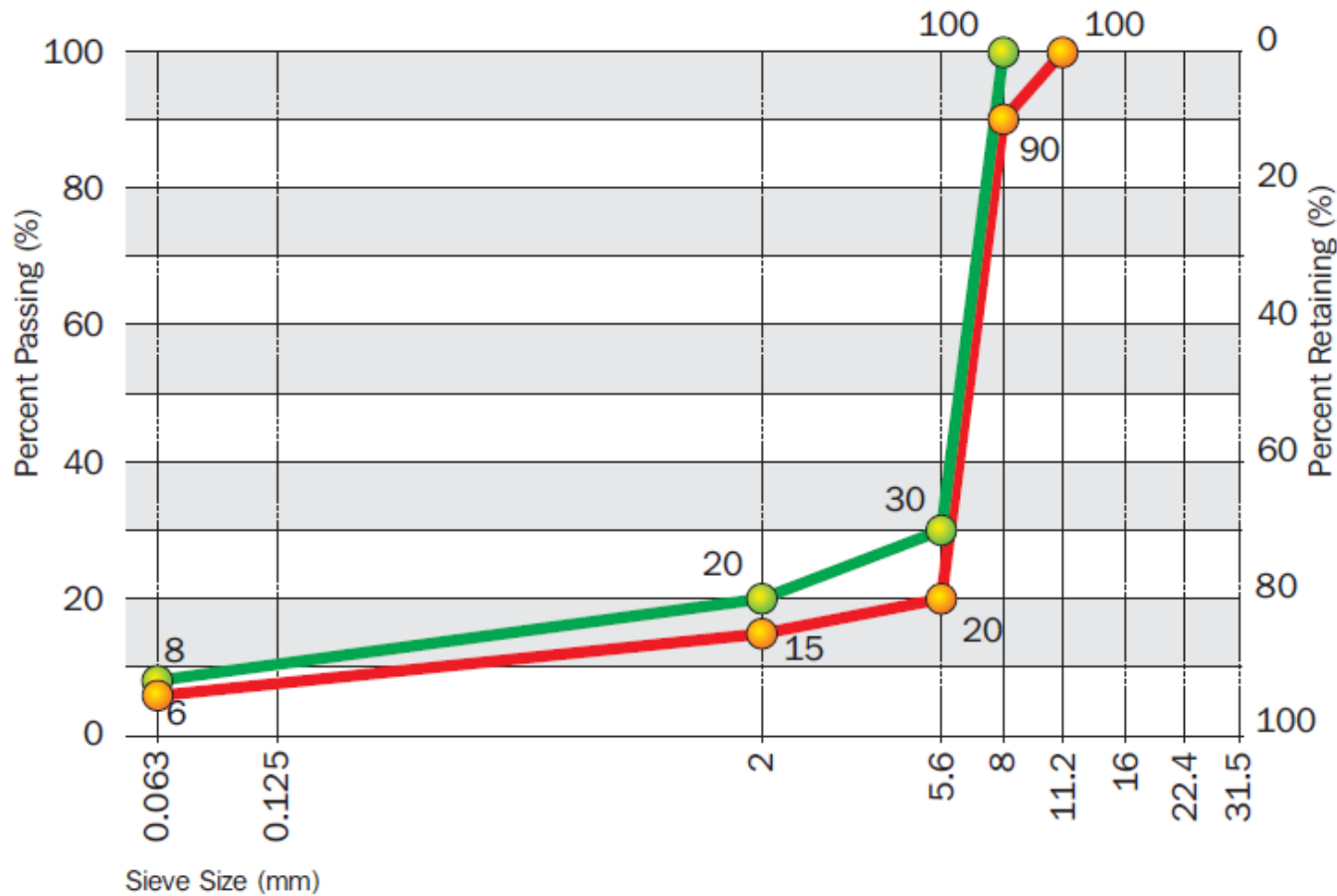
Ausgabe 2014

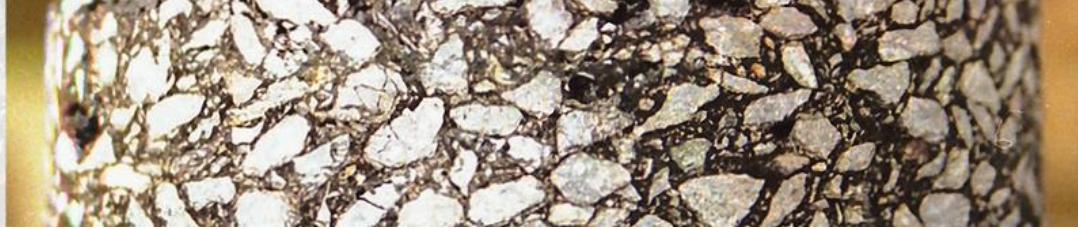
Recommendations for the Planning and Implementation of Noise-optimized Asphalt Surface Courses

Edition 2014

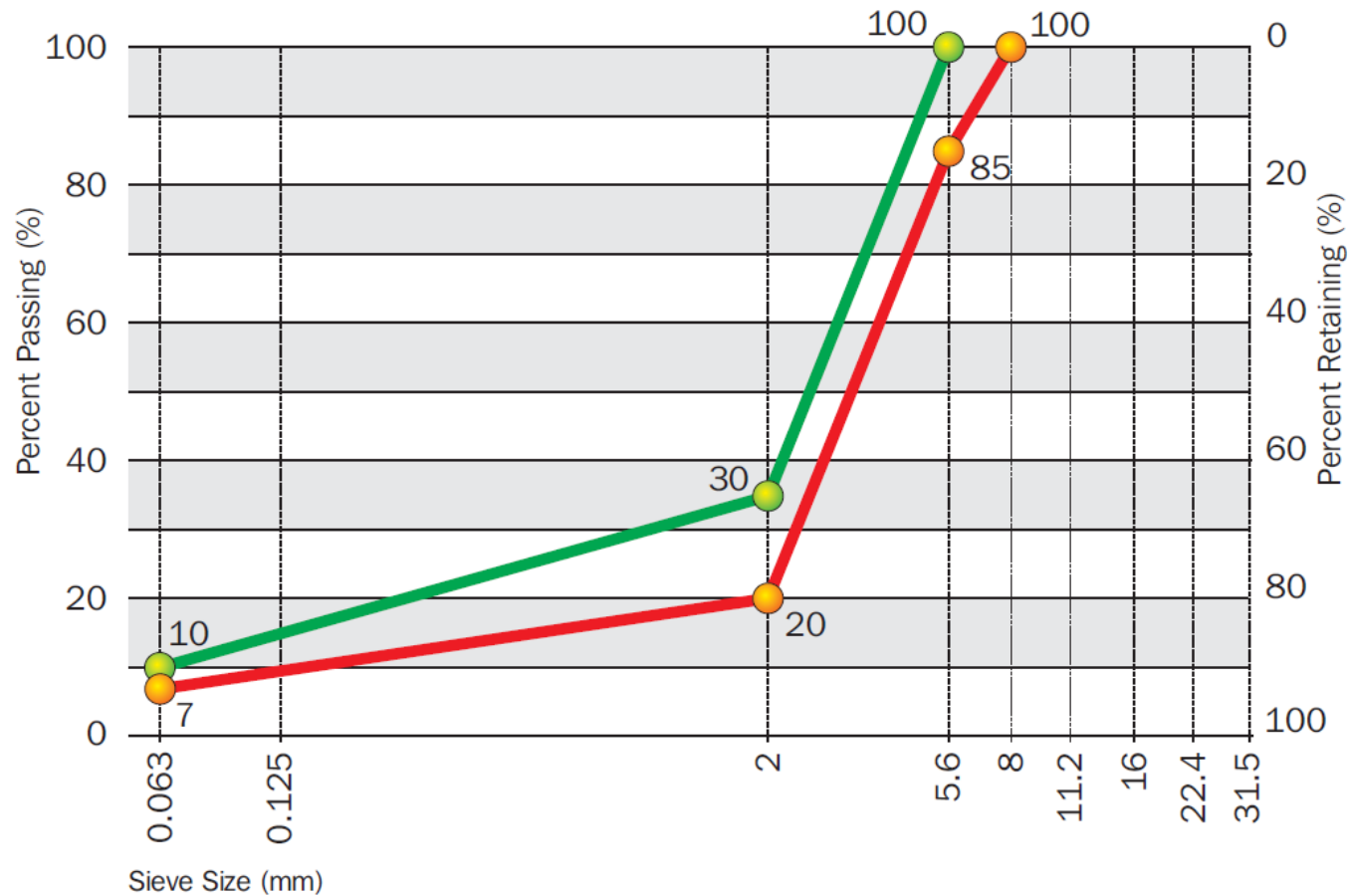


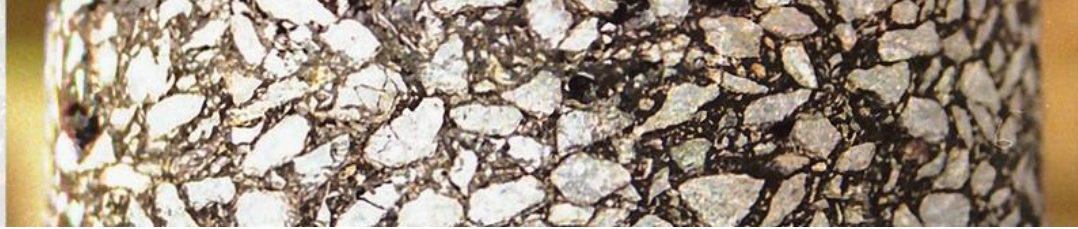
SMA plus 8





SMA plus 5



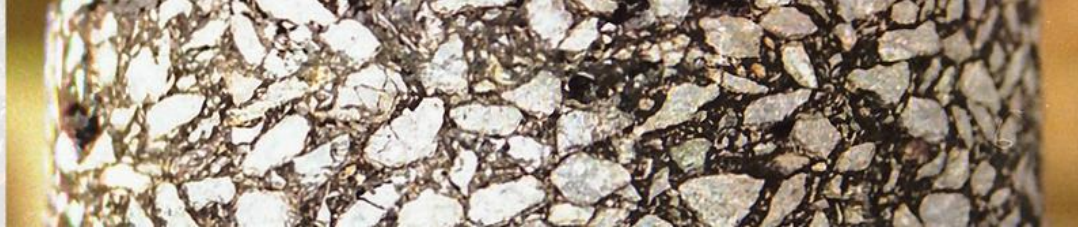


Recommendations for SMA plus

SMA plus		SMA plus 8	SMA plus 5
Materials			
Aggregates (production size)			
Ratio crushed aggregate surface		$C_{100/0}; C_{95/1}; C_{90/1}$	$C_{100/0}; C_{95/1}; C_{90/1}$
Resistance to crushing		SZ_{18} / LA_{20}	SZ_{18} / LA_{20}
Resistance to polishing		PSV _{specified} (51)	PSV _{specified} (51)
Minimum part of fine aggregates 0/2 with E_{cs} 35		100	100

Composition of Asphalt Mixture			
Aggregate mixture			
Passing sieve	11.2 mm	% by weight	100
Passing sieve	8 mm	% by weight	90 - 100
Passing sieve	5.6 mm	% by weight	20 - 30
Passing sieve	2 mm	% by weight	15 - 20
Passing sieve	0.063 mm	% by weight	6 - 8

Binder			
Binder, type and grade		40/100-65 45/80-50 (25/55-55)	40/100-65 45/80-50 (25/55-55)
Minimum binder content ¹ (factor α)	% by weight	B_{min} 6.6	B_{min} 7.0
Binder volume	Vol.-%	is to be specified	is to be specified
Stabilizing additive (cellulose fibers)	% by weight	≥ 0.3	≥ 0.15

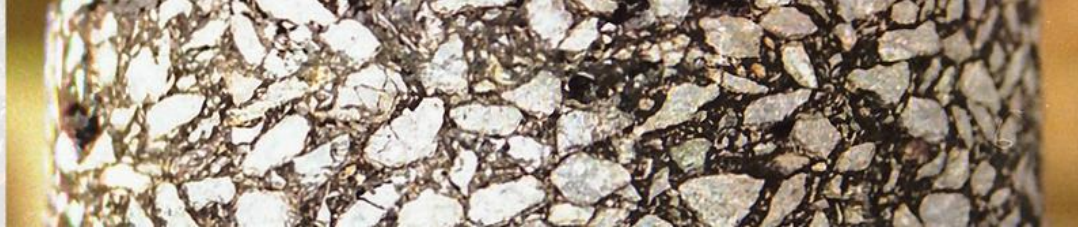


Recommendations for SMA plus

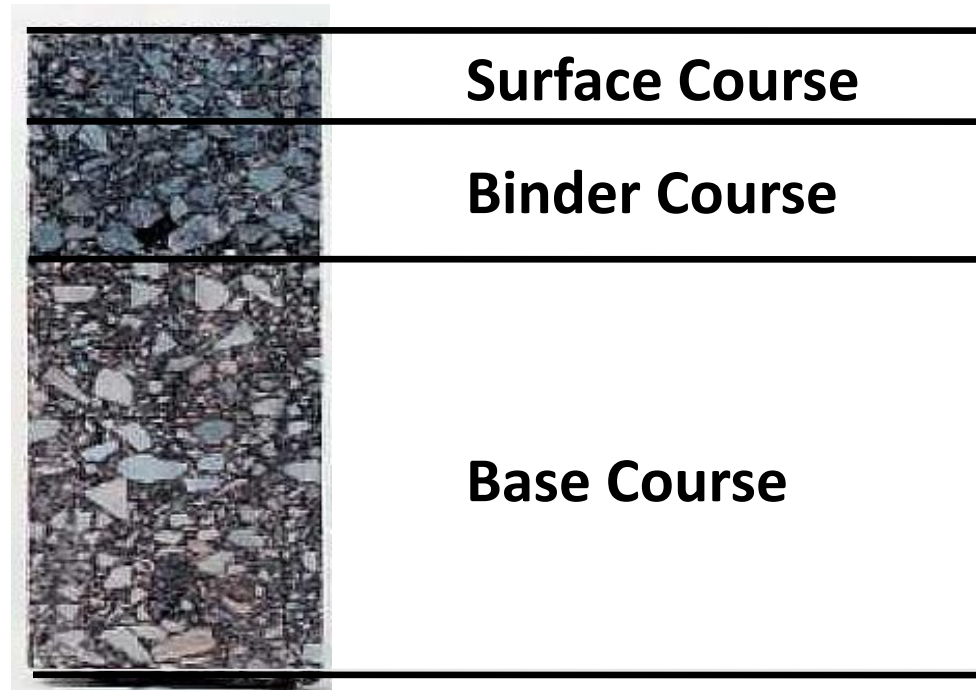
SMA plus		SMA plus 8	SMA plus 5
Asphalt Mixture			
Minimum void content Marshall-Specimen	Vol.-%	$V_{min} 9.0$	$V_{min} 9.0$
Maximum void content Marshall-Specimen	Vol.-%	$V_{max} 11.0$	$V_{max} 11.0$
Voids filled with bitumen	%	is to be specified	is to be specified
Proportional rut depth	%	is to be specified	is to be specified

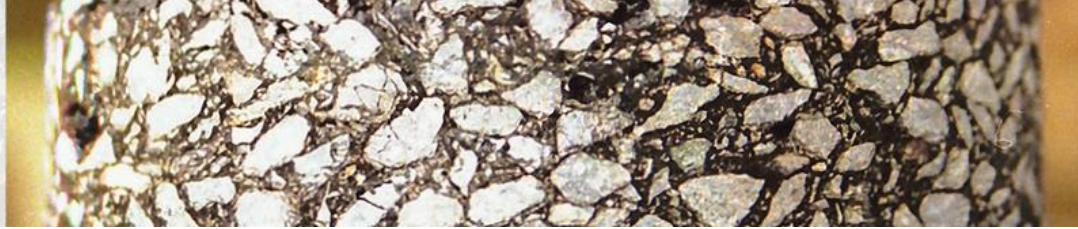
Characteristics of Layer			
Paving thickness	cm	2.5 - 4.0	2.0 - 3.0
Degree of compaction	%	≥ 97.0	≥ 97.0
Void content	Vol.-%	9.0 - 14.0	9.0 - 14.0
Evenness (4 m section of measurements)	mm	≤ 3	≤ 3

¹ factor α considers the density of the aggregate mixture



Layer construction in Germany





Forschungsgesellschaft für Straßen- und Verkehrswesen



Arbeitsgruppe Asphaltbauweisen

Hinweise
für die
Planung und Ausführung von
alternativen Asphaltbinderschichten

H AI ABi

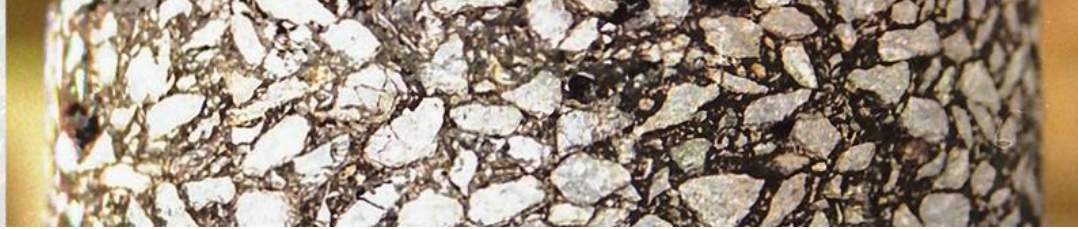
W 1

Ausgabe 2015

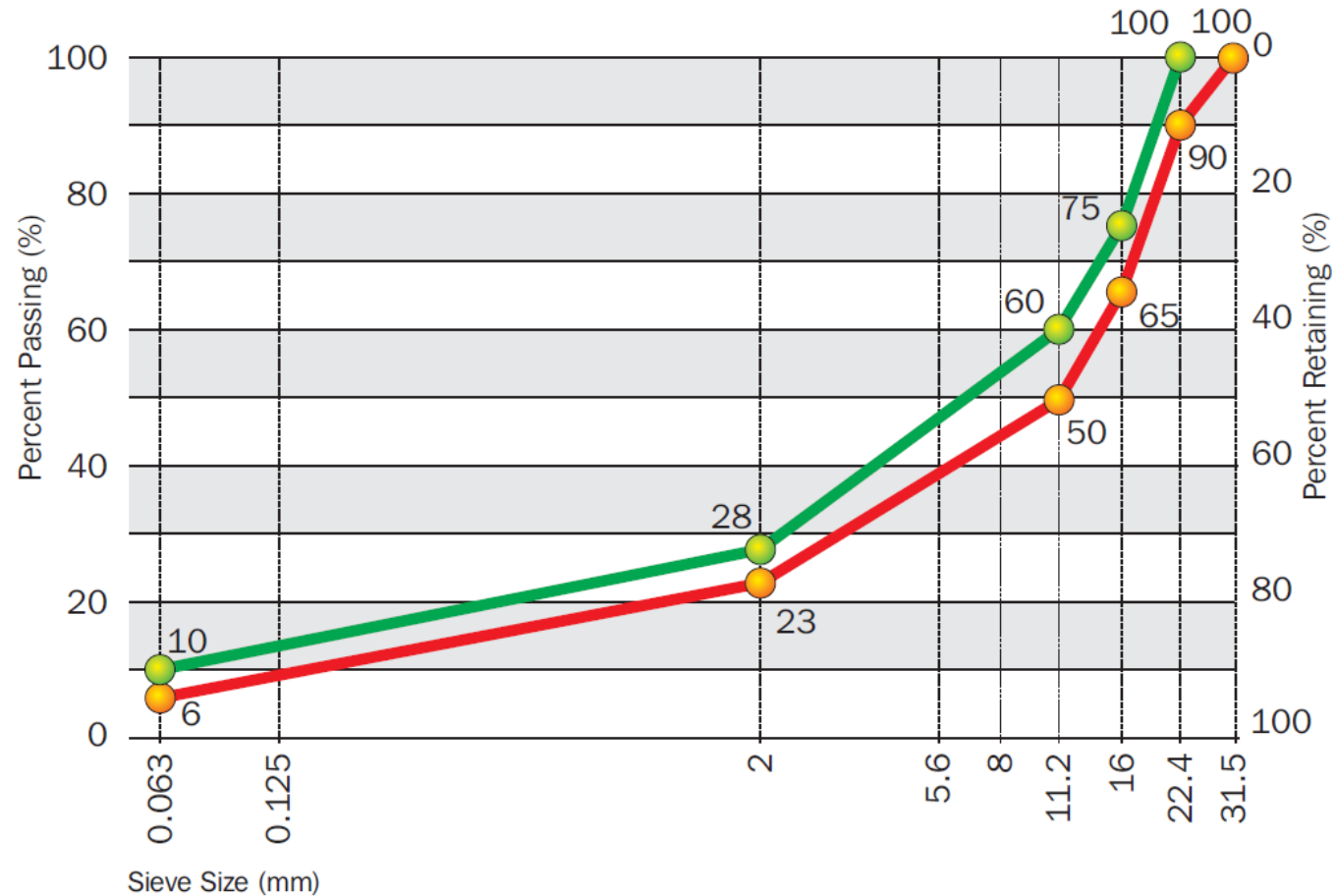
Instructions for the design and construction of alternative asphalt binder courses

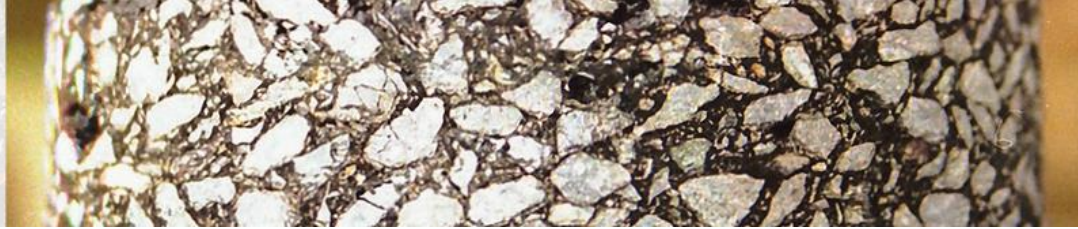
Edition 2015



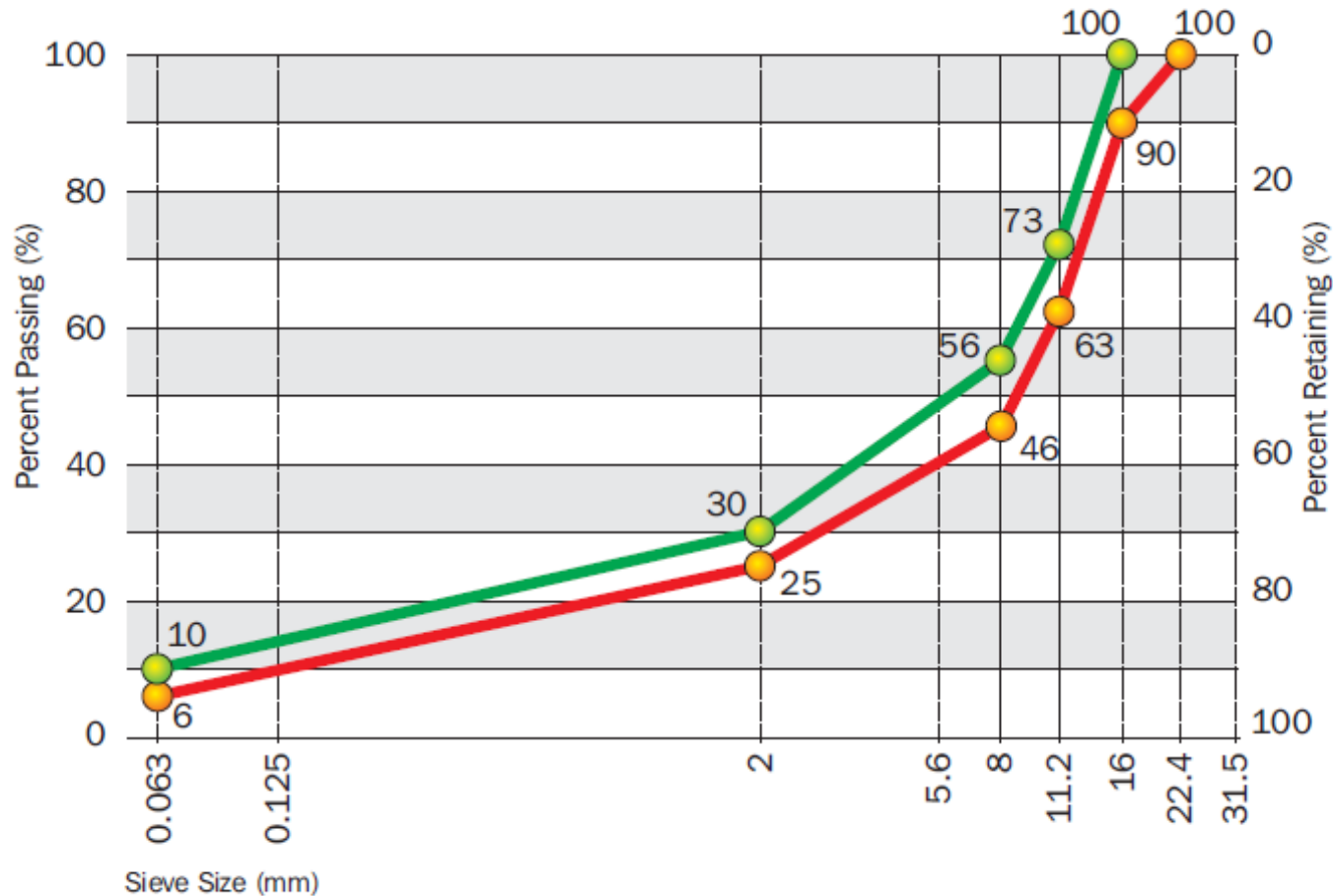


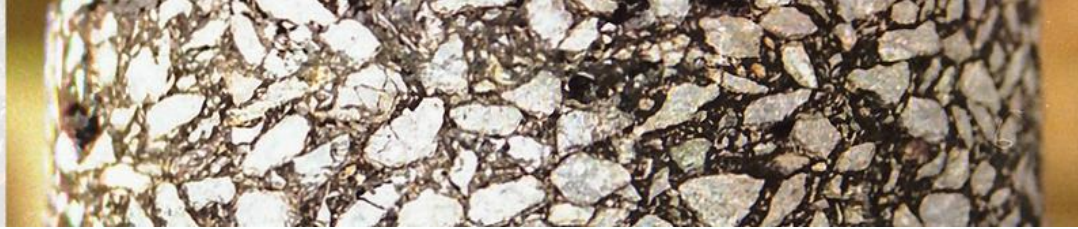
SMA 22 B C





SMA 16 B C



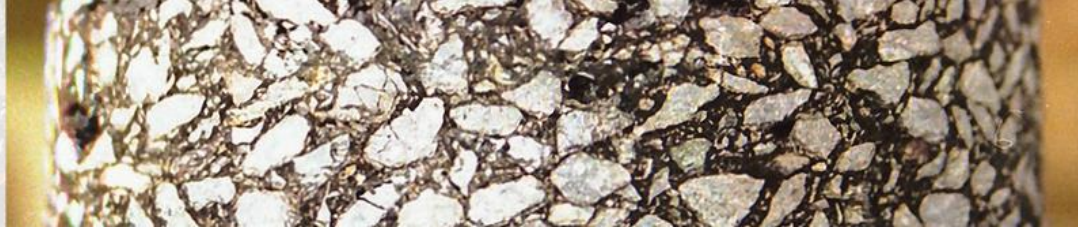


Recommendations for SMA B C

SMA B C		SMA 22 B C	SMA 16 B C
Materials			
Aggregates (production size)			
Ratio crushed aggregate surface		$C_{100/0}; C_{95/1}; C_{90/1}$	$C_{100/0}; C_{95/1}; C_{90/1}$
Resistance to crushing		SZ_{18} / LA_{20}	SZ_{18} / LA_{20}
Minimum part of fine aggregates 0/2 with $E_{cs} \geq 35$	%	100	100

Composition of Asphalt Mixture			
Aggregate mixture			
Passing sieve	31.5 mm	% by weight	100
Passing sieve	22.4 mm	% by weight	90 - 100
Passing sieve	16 mm	% by weight	65 - 75
Passing sieve	11.2 mm	% by weight	50 - 60
Passing sieve	8 mm	% by weight	-
Passing sieve	2 mm	% by weight	23 - 28
Passing sieve	0.063 mm	% by weight	6 - 10

Binder			
Binder, type and grade		10/40-65 (25/55-55)	10/40-65 (25/55-55)
Minimum binder content	% by weight	$B_{min} \geq 4.8$	$B_{min} \geq 5.2$
Stabilizing additive (cellulose fibers)	% by weight	≥ 0.2	≥ 0.2



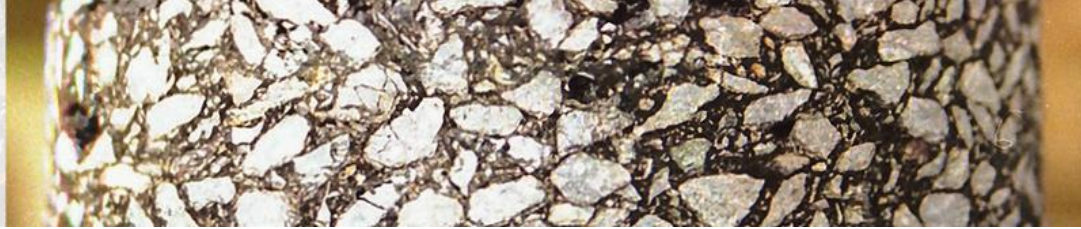
Recommendations for SMA B C

SMA B C		SMA 22 B C	SMA 16 B C
Asphalt Mixture			
Minimum void content Marshall-Specimen	Vol.-%	$V_{min} 3.0$	$V_{min} 3.0$
Maximum void content Marshall-Specimen	Vol.-%	$V_{max} 4.0$	$V_{max} 4.0$
Binder volume	Vol.-%	is to be specified	is to be specified
Voids filled with bitumen	%	is to be specified	is to be specified
Proportional rut depth	%	$PRD_{Air} 5.0$	$PRD_{Air} 5.0$

(...) in exceptions

Characteristics of Layer			
Paving thickness	cm	9.5 - 12.0	6.0 - 9.5
Degree of compaction	%	≥ 98.0	≥ 98.0
Void content	Vol.-%	1.5 - 5.5	1.5 - 5.5

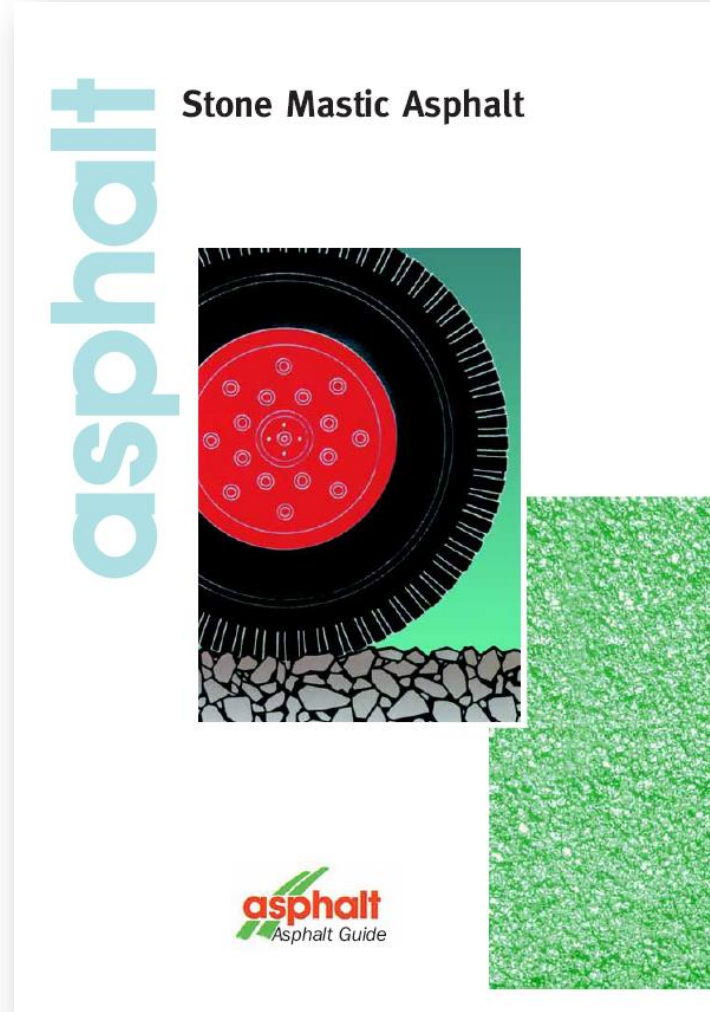
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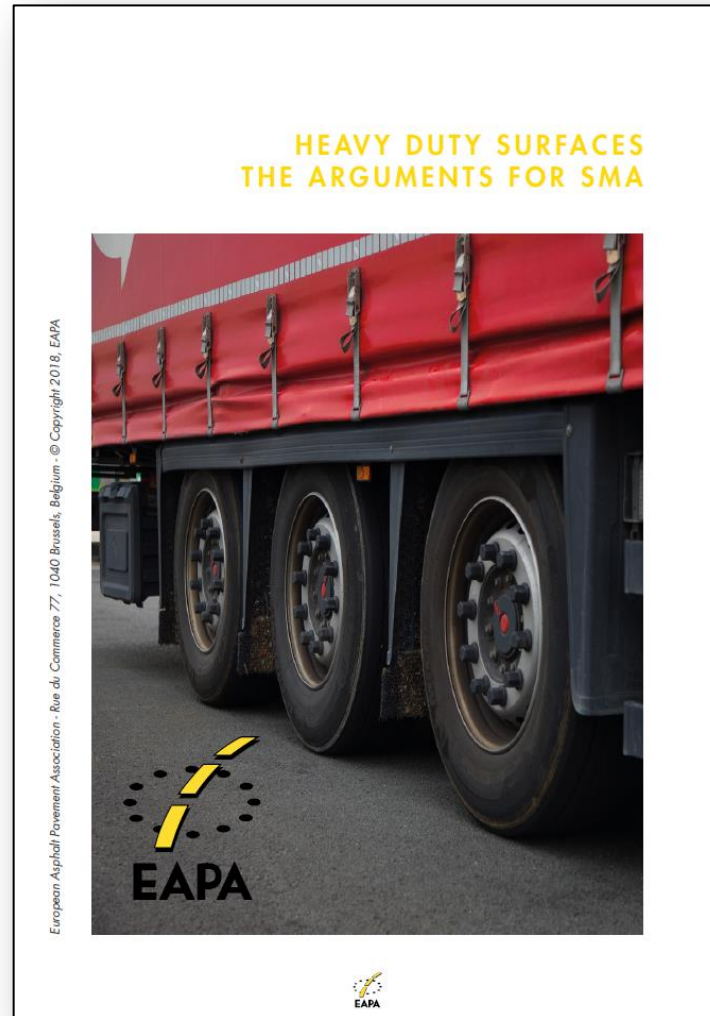
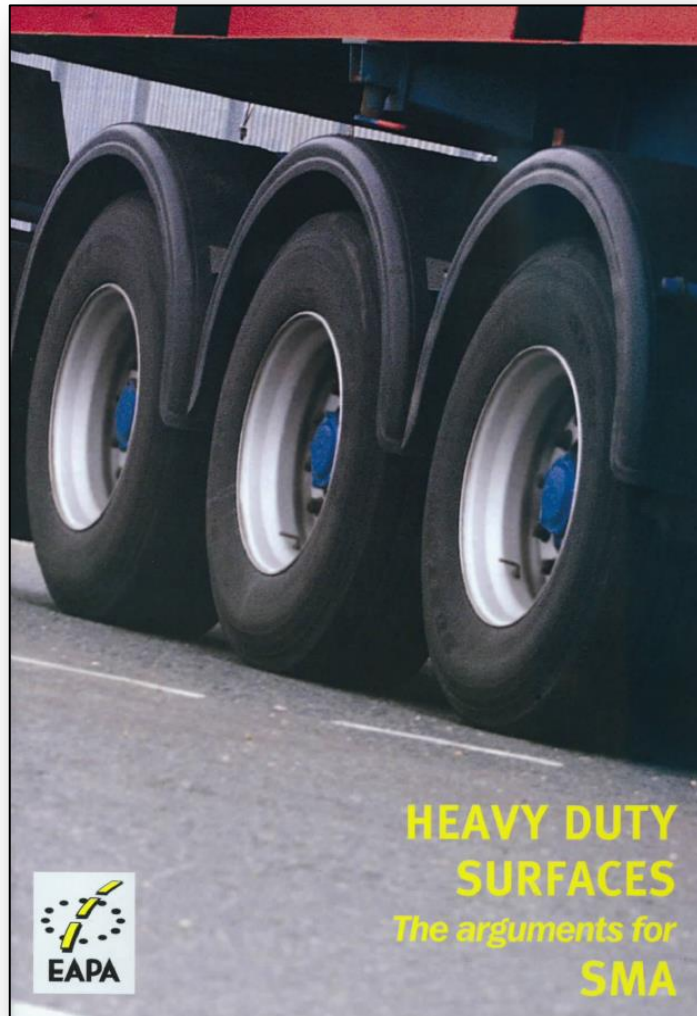
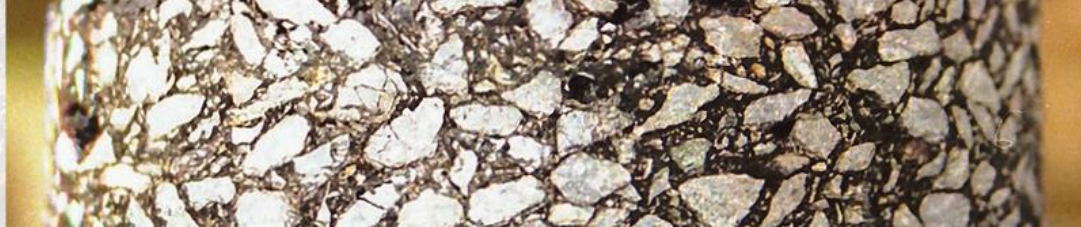


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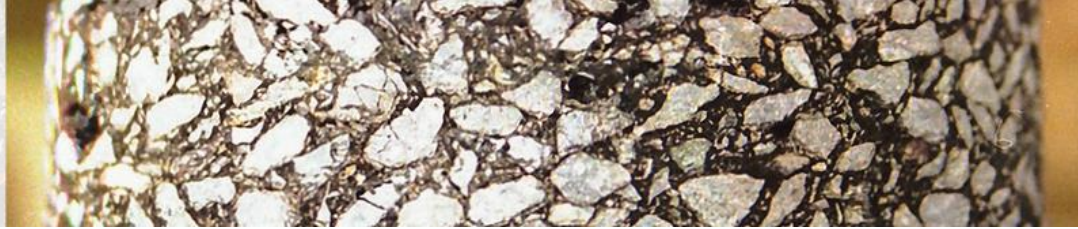
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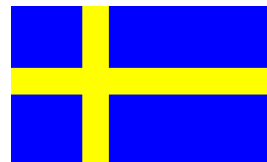
1980's



UK



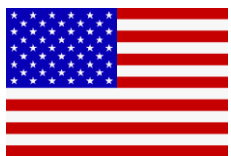
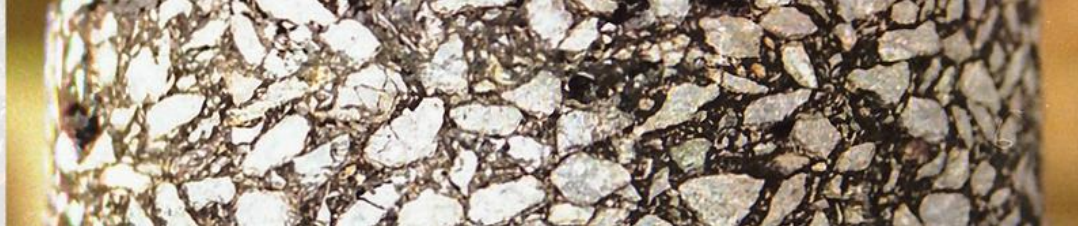
The Netherlands



Sweden



Finland



USA



Ireland



México



Korea

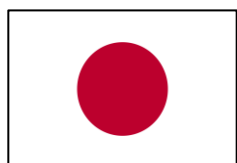


New Zealand



Slovak Republic

1990's



Japan



China



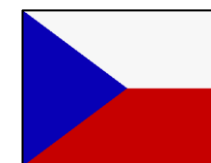
Australia



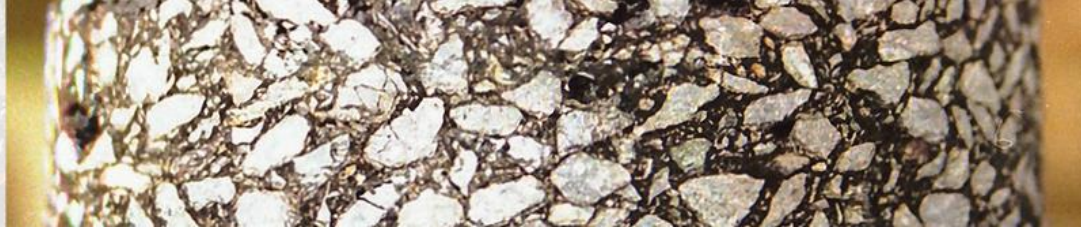
Argentina



Israel



Czech Republic



Brazil



Turkey



Chile



Guatemala

2000s



Russia



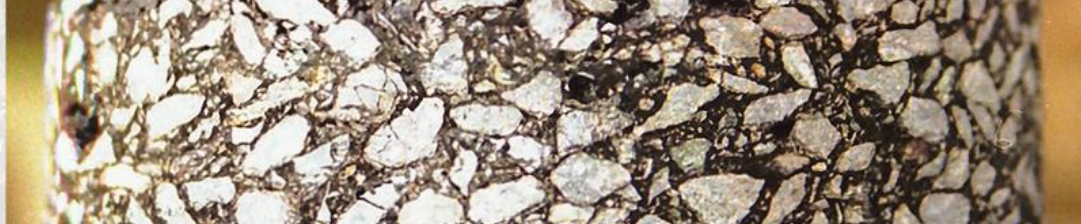
The Philippines



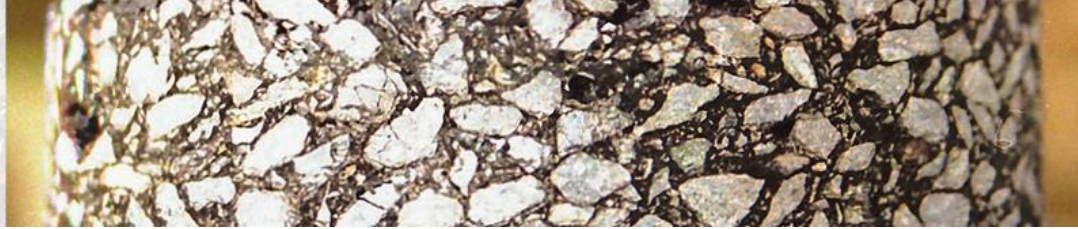
India



Tanzania

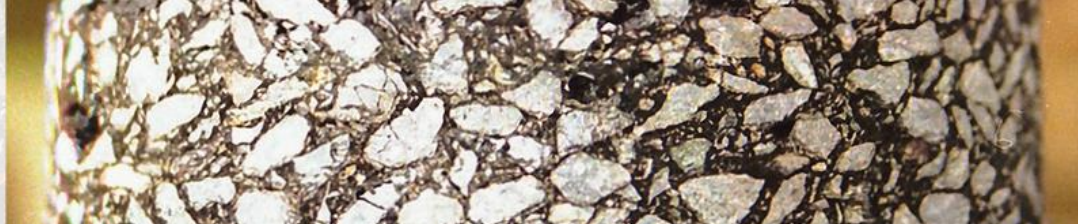


Seohae Grand Bridge in South Korea



Kaohsiung International Airport (SMA runway) - Taiwan

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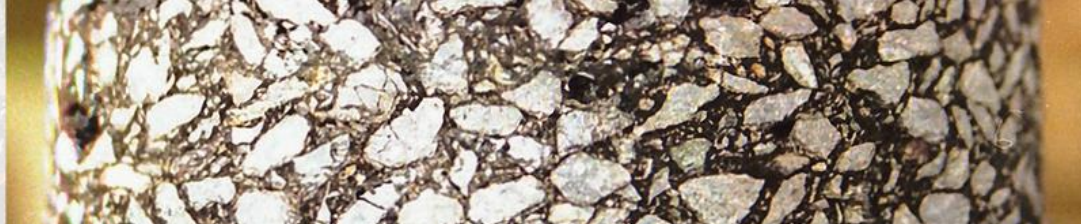
Lihpao racing Park (SMA racing track) - Taiwan

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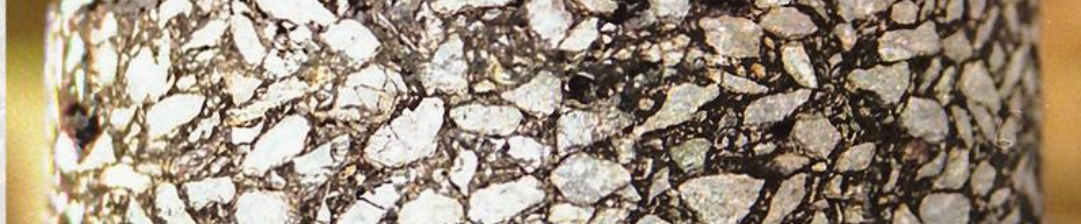
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China

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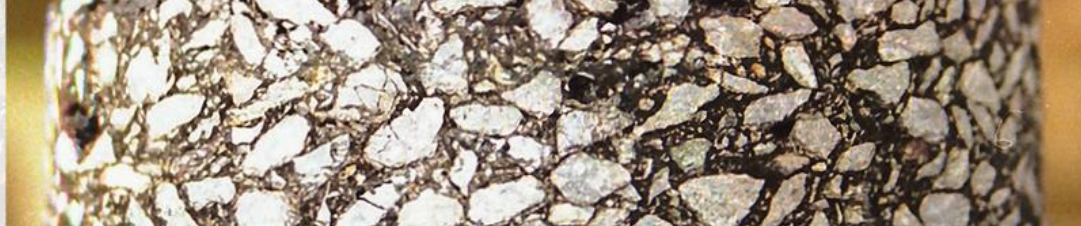
China

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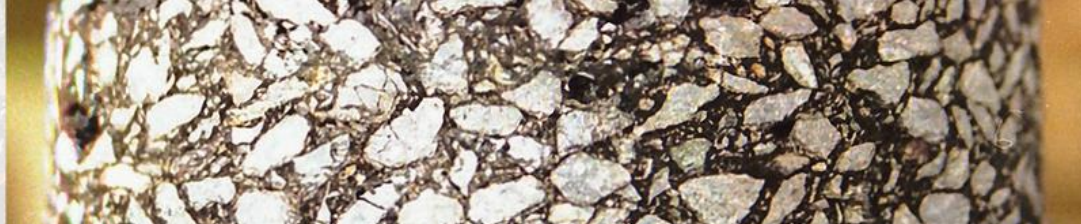
China

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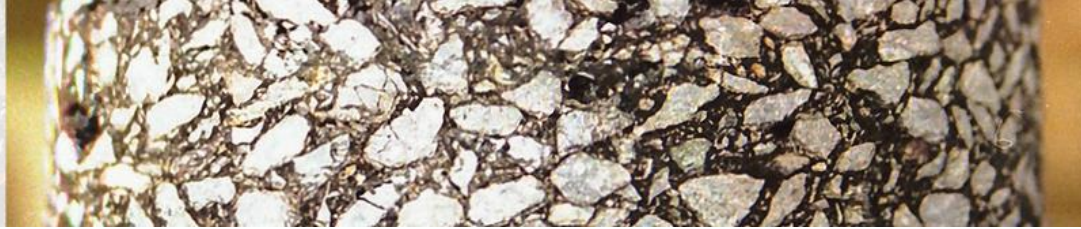


China

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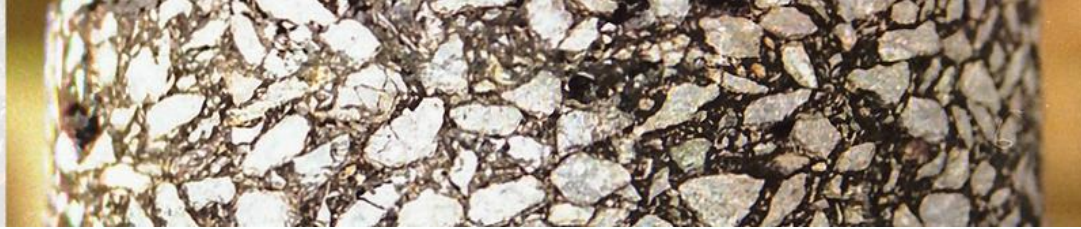


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Holland – Europe's Biggest Aqueduct

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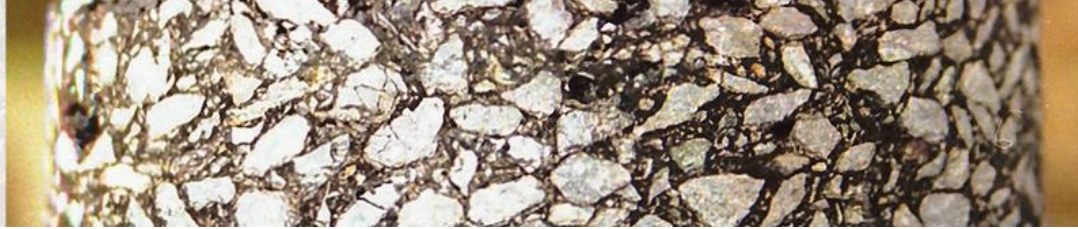
Australia – Sydney Harbor Tunnel

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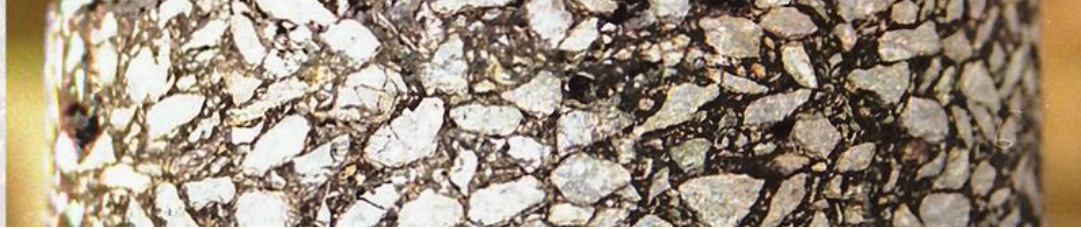
Spain – Almost every airport – taxiways and runways

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Stone Matrix Asphalt

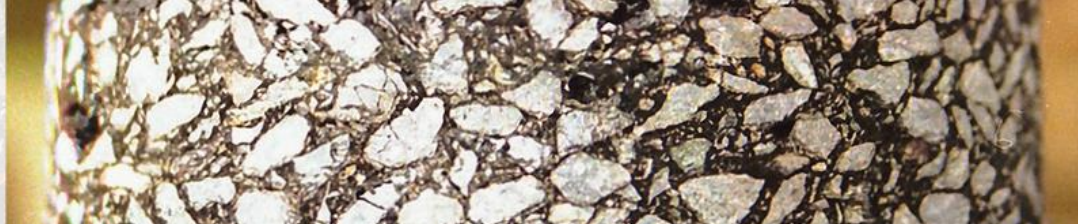


Spain – Barcelona – Container Terminal

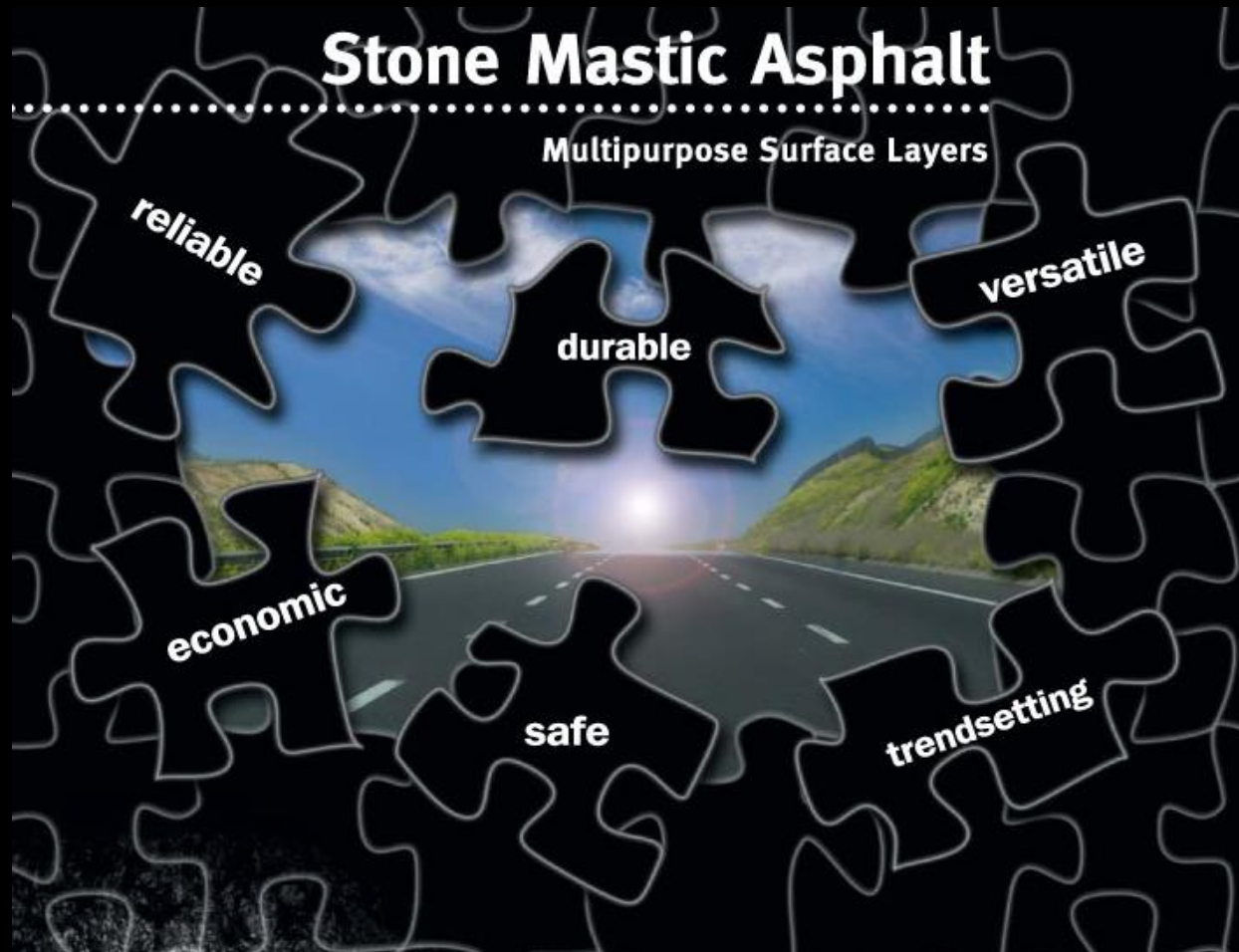
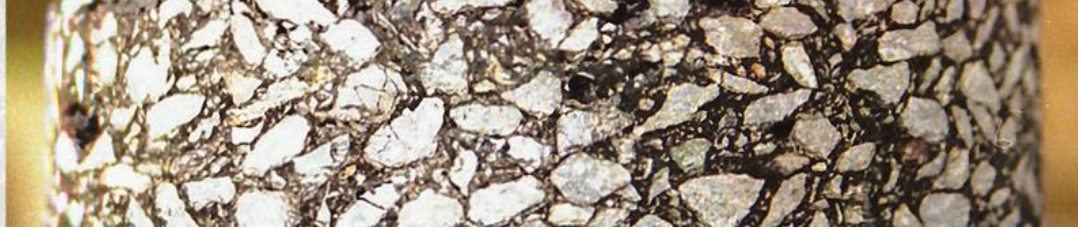
J. RETTENMAIER & SÖHNE
GMBH + CO KG

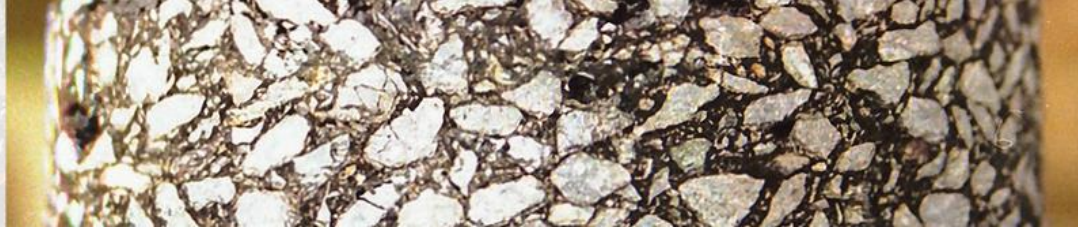


Fibers designed
by Nature



Mexico DF - Formula 1 Racecourse Hermanos Rodriguez





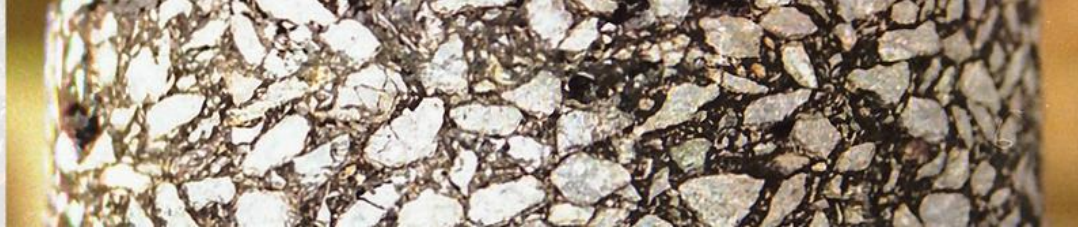
Long-Life Asphalt Pavements – Technical version

June 2007

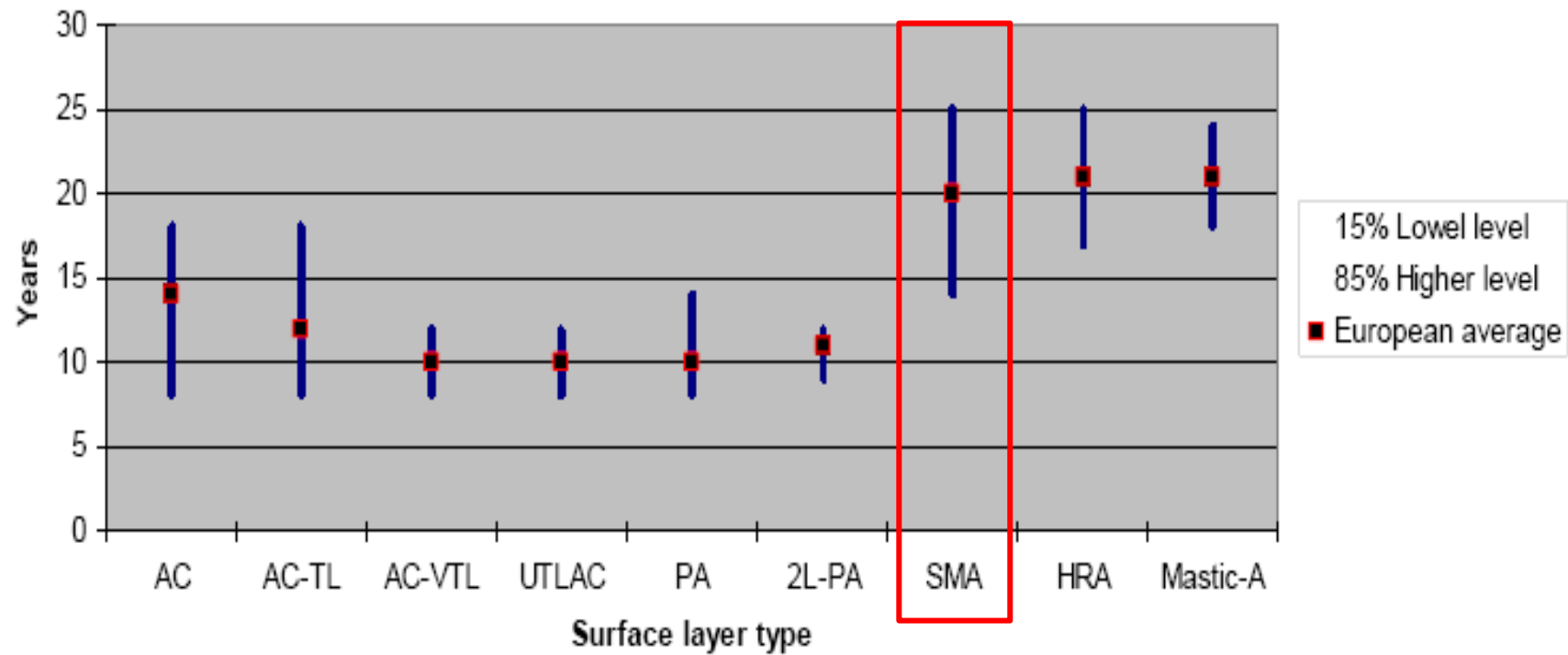
Long-Life Asphalt Pavements

Technical version

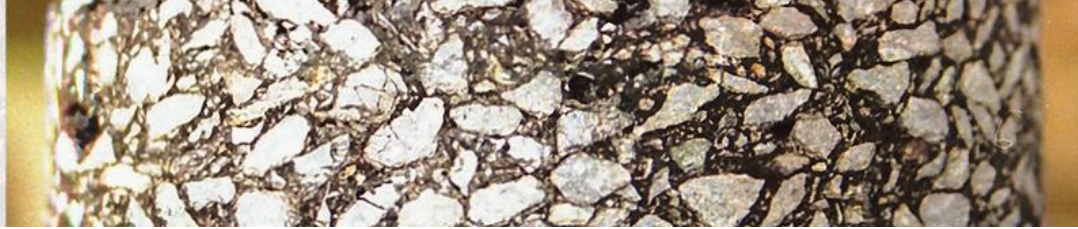




Major roads / Motorways / Heavily trafficked roads



1ST INTERNATIONAL CONFERENCE ON
Stone Matrix Asphalt



7th E&E CONGRESS
EURASPHALT & EUROBITUME

ASPHALT 4.0 FOR FUTURE MOBILITY

MADRID 12-14 May 2020
Palacio Municipal de Congresos de Madrid

#eecongress2020

SMA

Past – Present – Future