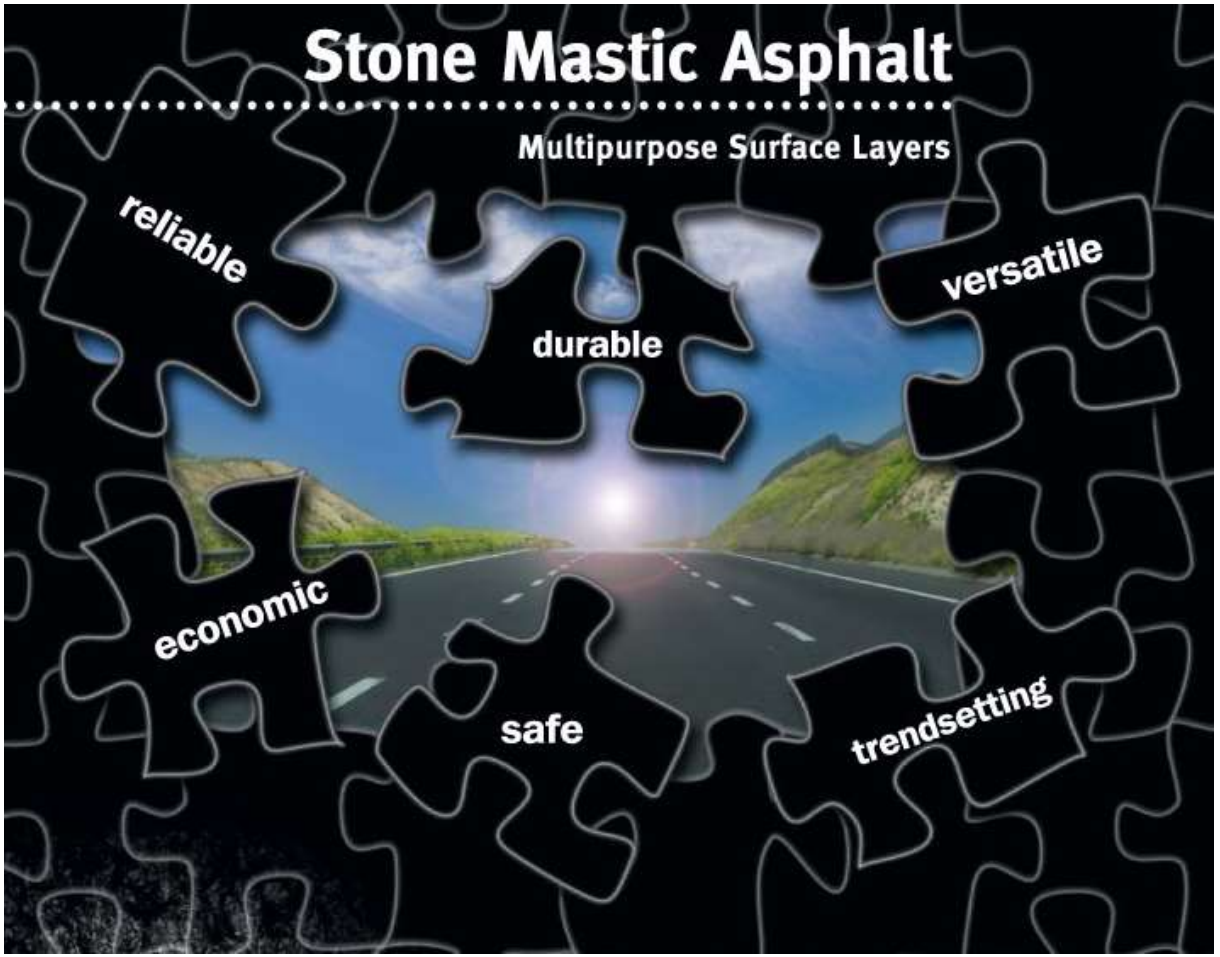
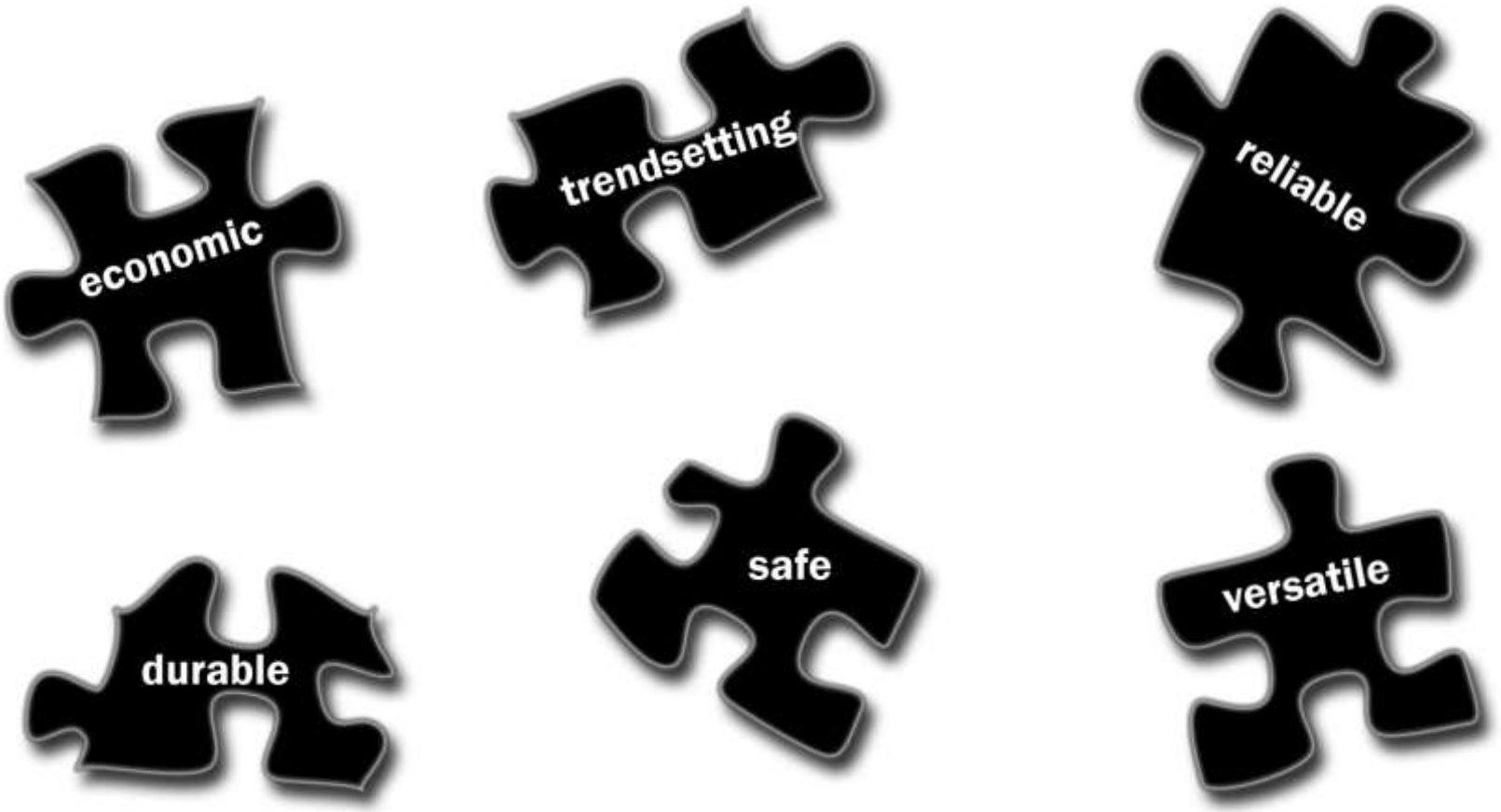
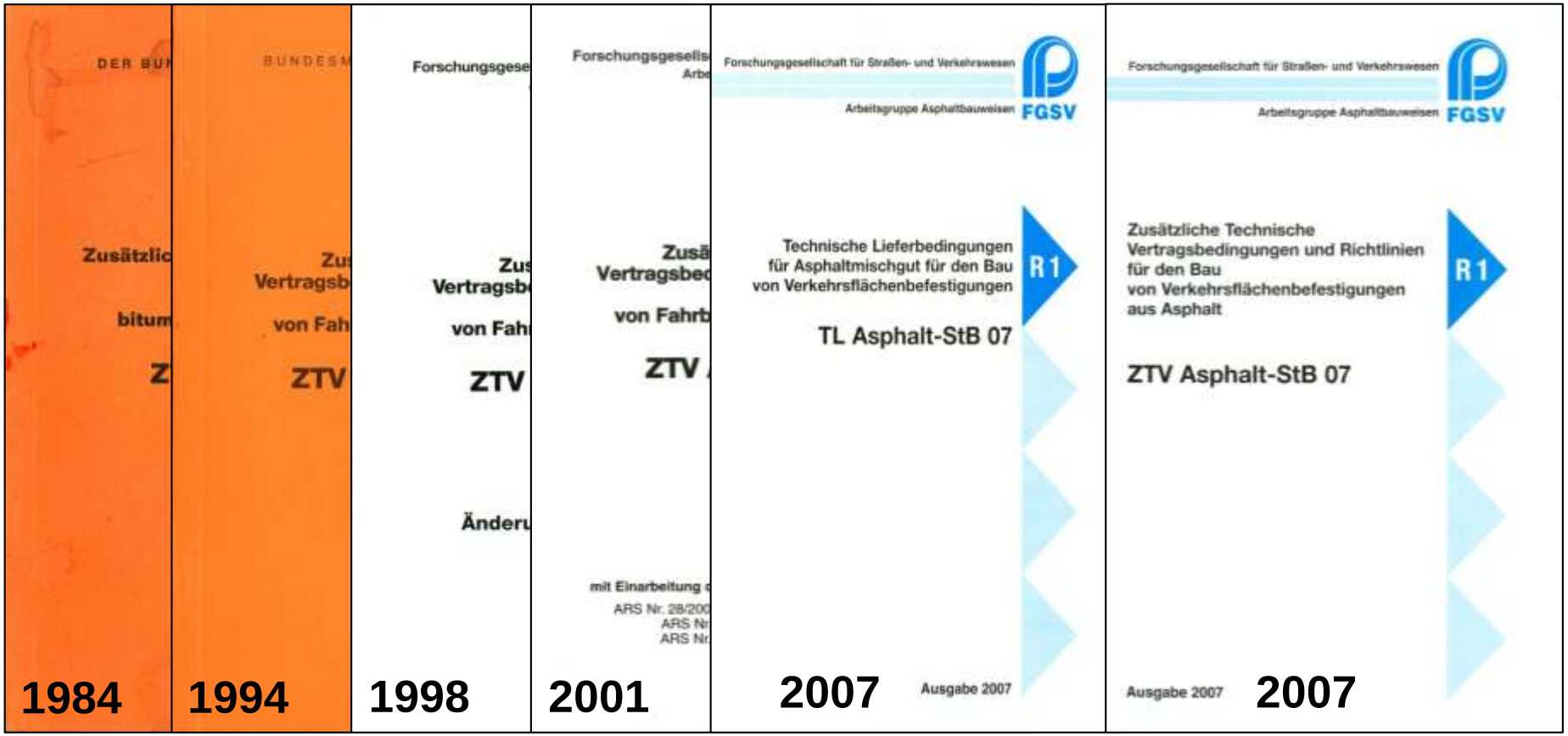
Stone Mastic Asphalt - SMA



Stone Mastic Asphalt - SMA



Specifications in Germany



Specifications in Germany

ZTV Asphalt-StB 07/13, German Additional Technical Conditions of Contract and Directives for the Construction of Road Asphalt Pavements, updated according to „ARS 11/2012“ published by the Federal Ministry of Transport, Building and Urban Development

Specifications in Germany

TL Asphalt-StB 07/13, German Technical Conditions of Delivery for Asphalt Mixtures for the Construction of Road Pavements, updated according to „ARS 11/2012“ published by the Federal Ministry of Transport, Building and Urban Development

Specifications in Germany

SMA		SMA 11 S	SMA 8 S	SMA 5 S[1]
Materials				
Aggregates (production size)				
Ratio crushed aggregate surface		$C_{100/0}$; $C_{95/1}$; $C_{90/1}$	$C_{100/0}$; $C_{95/1}$; $C_{90/1}$	$C_{100/0}$; $C_{95/1}$; $C_{90/1}$
Resistance to crushing		Sz_{18} / LA_{20}	SZ_{18} / LA_{20}	SZ_{18} / LA_{20}
Resistance to polishing		$PSV_{specified}$ (51)	$PSV_{specified}$ (51)	$PSV_{specified}$ (48)
Minimum part of fine aggregates with 0/2 E_{cs} 35	%	100	100	100
Shape Index (SI)		20		
Flakiness Index (FI)		20		
Aggregate product size		G_F 85; G_C 90/10; G_C 90/15		
Resistance to frost		F_1		

[1] Source: Extract of ZTV BEA-StB 09, German Additional Technical Conditions of Contract and Directives for the constructional maintenance of Road Asphalt Pavements

Composition of Asphalt Mixture				
Aggregate mixture				
Passing sieve 16 mm	% by weight	100		
Passing sieve 11.2 mm	% by weight	90 – 100	100	
Passing sieve 8 mm	% by weight	50 – 65	90 – 100	100
Passing sieve 5.6 mm	% by weight	35 – 45	35 – 55	90 – 100
Passing sieve 2 mm	% by weight	20 – 30	20 – 30	30 – 40
Passing sieve 0.063 mm	% by weight	8 – 12	8 – 12	7 – 12

Specifications in Germany

Binder				
Binder, type and grade		25/55-55 50/70	25/55-55 50/70	45/80-50 50/70 25/55-55
Minimum binder content (factor α)[2]		B_{min} 6.7	B_{min} 7.3	B_{min} 7.4
Stabilizing additive (cellulose fibers)	% by weight	0.3	0.3	0.3

Asphalt Mixture				
Minimum void content Marshall-Specimen		V_{min} 2.5	V_{min} 2.5	V_{min} 2.0
Maximum void content Marshall-Specimen		V_{max} 3.0	V_{max} 3.0	V_{max} 3.0
Voids filled with bitumen	%	is to be specified	is to be specified	is to be specified
Proportional rut depth	%	is to be specified	is to be specified	—

[2] Factor α considers the density of the aggregate mixture

Source: Extract of TL Asphalt-StB 07/13, German Technical Conditions of Delivery for Asphalt Mixtures for the Construction of Road Pavements, updated according to "ARS 11/2012" published by the Federal Ministry of Transport, Building and Urban Development

Characteristics of Layer				
Paving thickness	cm	3.5 - 4.0	3.5 - 4.0	1.5 - 2.0
Paving amount	kg/m²	85 - 100	85 - 100	30 - 50
Degree of compaction	%	≥ 98.0		≥ 96.0
Void content	Vol.-%	≤ 5.0		≤ 6.0
Gritting material		0.5 – 1.0 kg/m² aggregates 1/3 mm (dedusted or lightly bitumenized)		

Source: Extract of ZTV Asphalt-StB 07/13, German Additional Technical Conditions of Contract and Directives for the Construction of Road Asphalt Pavements, updated according to "ARS 11/2012" published by the Federal Ministry of Transport, Building and Urban Development

Aggregate Requirements

SMA		SMA 11 S	SMA 8 S	SMA 5 S[1]
Materials				
Aggregates (production size)				
Ratio crushed aggregate surface		$C_{100/0}$; $C_{95/1}$; $C_{90/1}$	$C_{100/0}$; $C_{95/1}$; $C_{90/1}$	$C_{100/0}$; $C_{95/1}$; $C_{90/1}$
Resistance to crushing		Sz_{18} / LA_{20}	SZ_{18} / LA_{20}	SZ_{18} / LA_{20}
Resistance to polishing		$PSV_{specified}$ (51)	$PSV_{specified}$ (51)	$PSV_{specified}$ (48)
Minimum part of fine aggregates with 0/2 E_{cs} 35	%	100	100	100
Shape Index (SI)		20		
Flakiness Index (FI)		20		
Aggregate product size		G_F 85; G_C 90/10; G_C 90/15		
Resistance to frost		F_1		

[1] Source: Extract of ZTV BEA-StB 09, German Additional Technical Conditions of Contract and Directives for the constructional maintenance of Road Asphalt Pavements

Aggregate Requirements

Properties	Requirements	Main Influence on
Crushed Surface	$C_{100/0}$ (100% crushed surface)	Void content Stability
Hardness	LA $\leq$ 20	No particle sizes' destruction during compaction
Resistance to Polishing	PSV $\geq$ 51	Roughness Skid resistance
Shape Index	3:1 (min. 80%)	Void content Degree of filling Compaction degree Stability
Fines	E_{CS} 35	Void content Stability
Filler	Limestone	Void content
Oversize/Undersize	See separate chart	Void content Stability

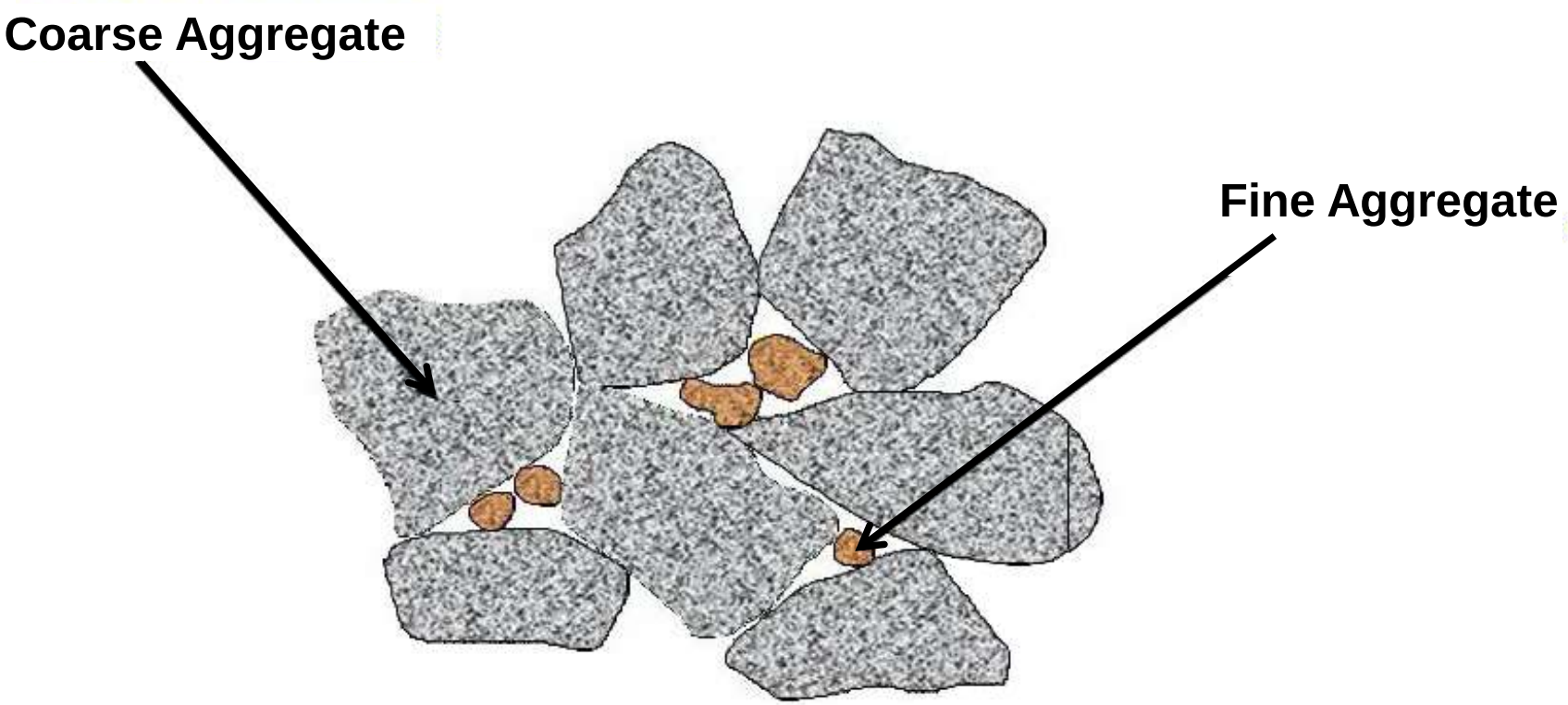
Aggregate Requirements

Fraction	Category	Oversize	Undersize
8.0 / 11.2 mm	G_C 90/10	10 %	10 %
5.6 / 8.0 mm	G_C 90/10	10 %	10 %
2.0 / 5.6 mm	G_C 90/10	10 %	10 %
0.0 / 2.0 mm	G_F 85	15 %	
1.0 / 3.0 mm*	G_C 90/10	10 %	10 %

*** Gritting material for early life skid resistance**

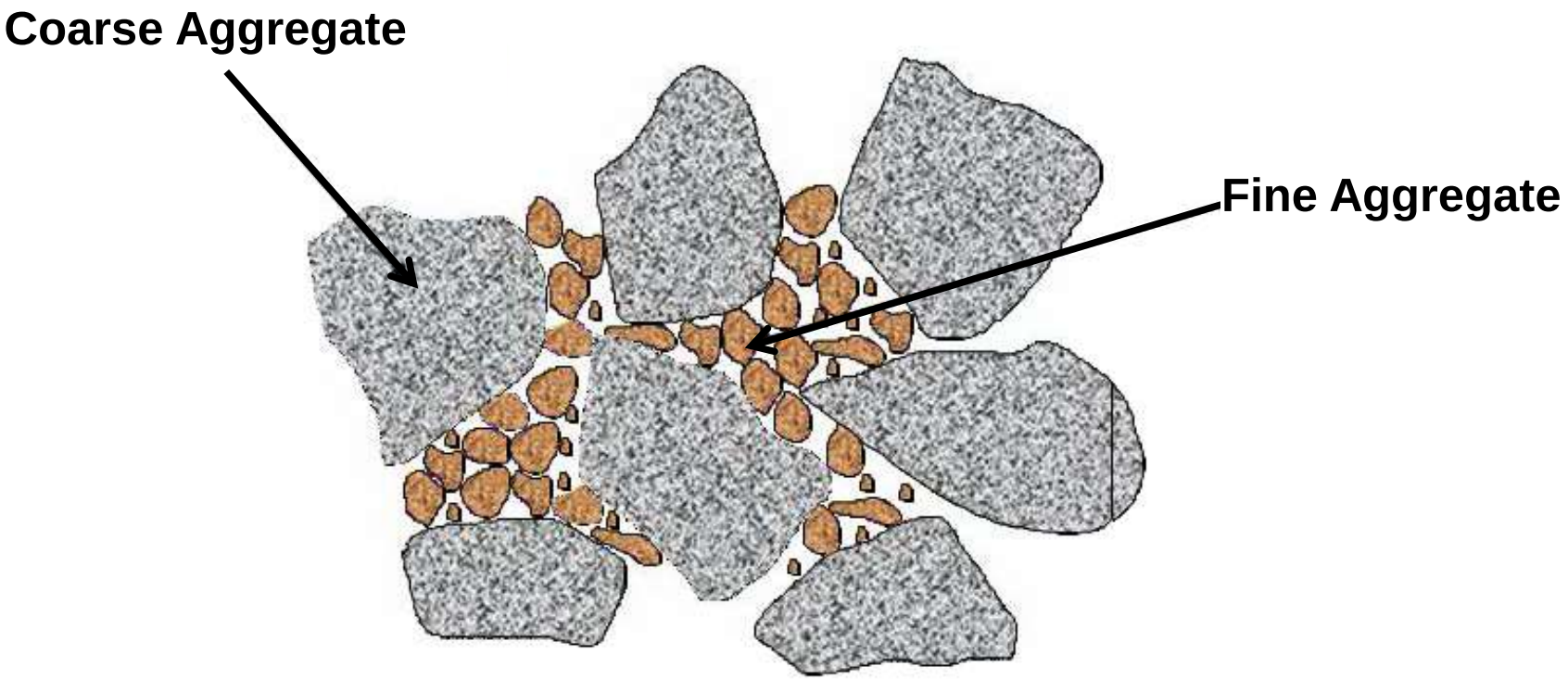
Aggregate Requirements

Good Coarse Aggregate Skeleton



Aggregate Requirements

Bad Coarse Aggregate Skeleton



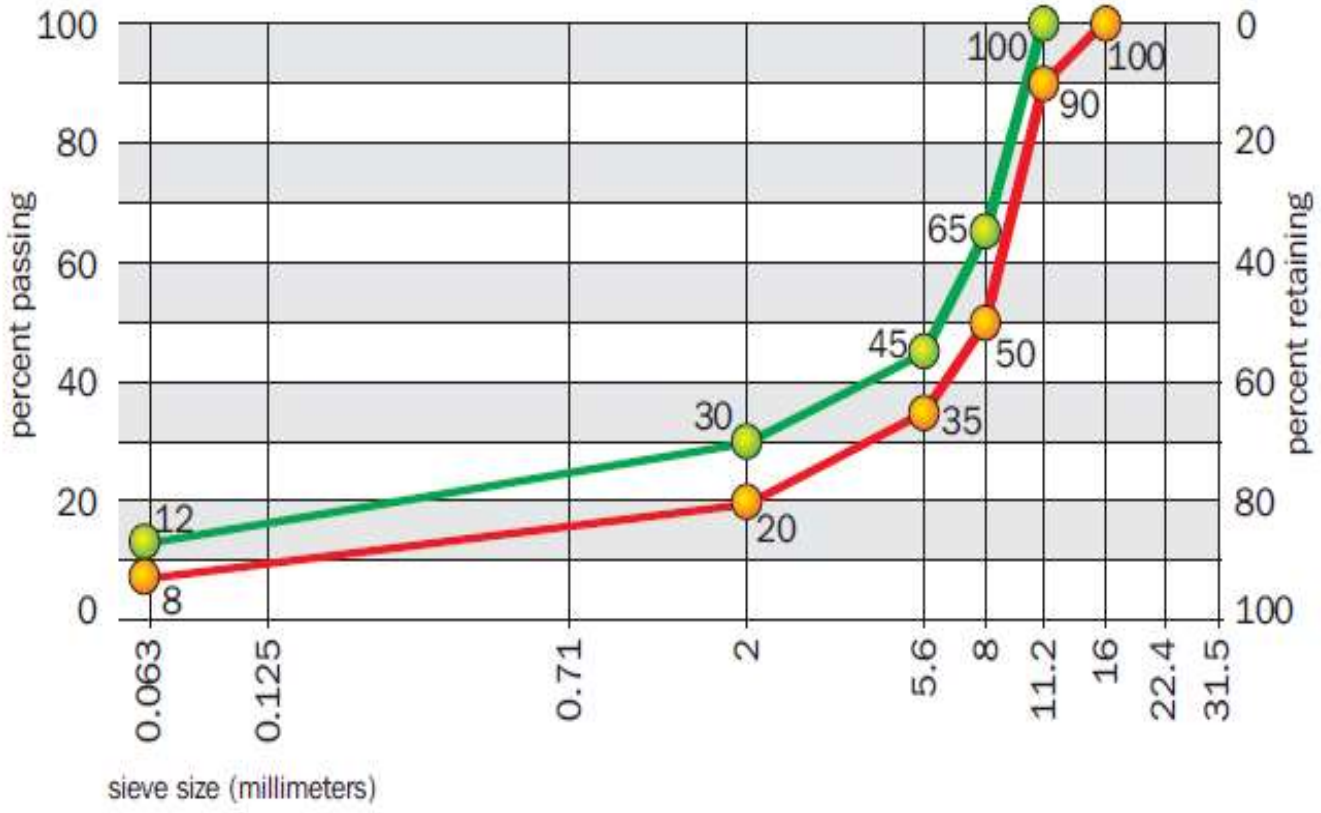
Specifications in Germany

SMA		SMA 11 S	SMA 8 S	SMA 5 S[1]
Composition of Asphalt Mixture				
Aggregate mixture				
Passing sieve 16 mm	% by weight	100		
Passing sieve 11.2 mm	% by weight	90 – 100	100	
Passing sieve 8 mm	% by weight	50 – 65	90 – 100	100
Passing sieve 5.6 mm	% by weight	35 – 45	35 – 55	90 – 100
Passing sieve 2 mm	% by weight	20 – 30	20 – 30	30 – 40
Passing sieve 0.063 mm	% by weight	8 – 12	8 – 12	7 – 12

[1] Source: Extract of ZTV BEA-StB 09, German Additional Technical Conditions of Contract and Directives for the constructional maintenance of Road Asphalt Pavements

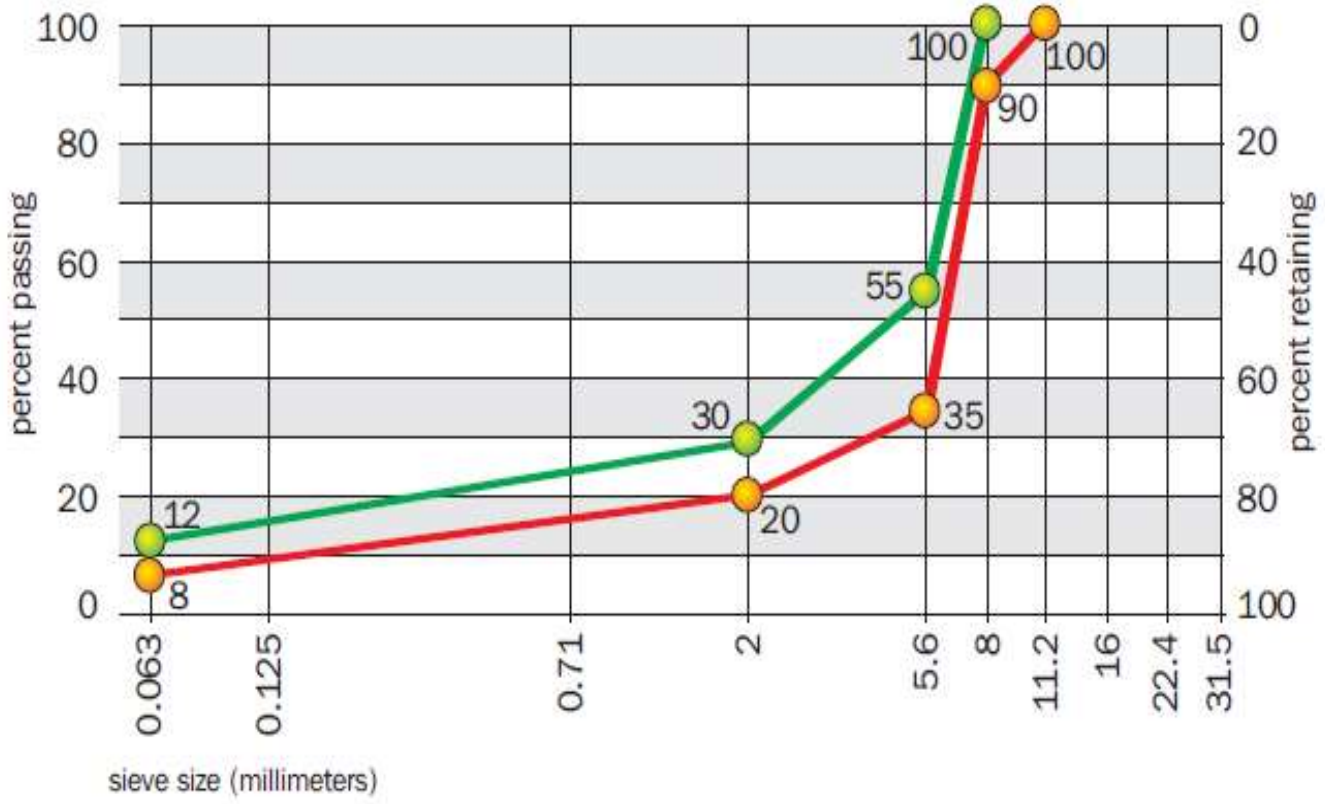
Specifications in Germany

SMA 11 S



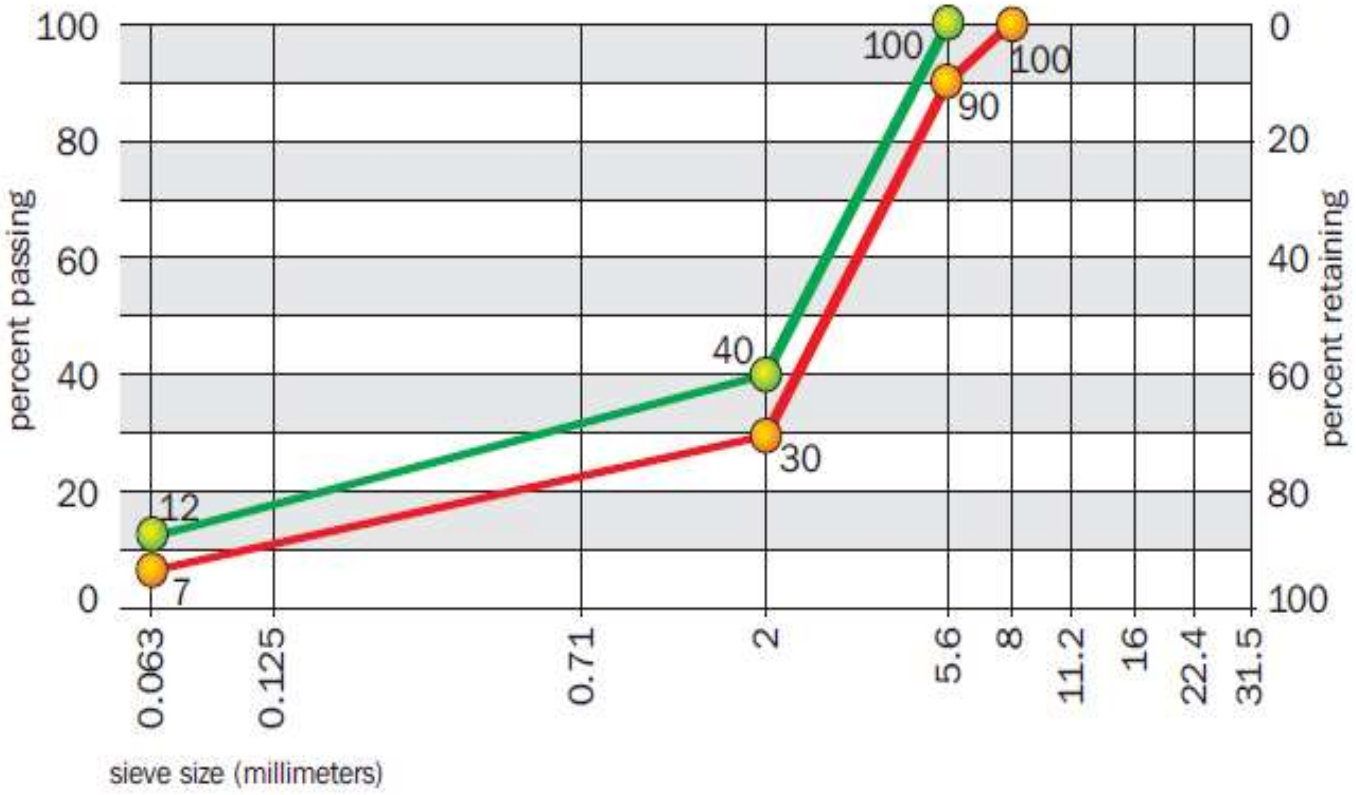
Specifications in Germany

SMA 8 S



Specifications in Germany

SMA 5 S



Specifications in Germany

SMA		SMA 11 S	SMA 8 S	SMA 5 S[1]
Binder				
Binder, type and grade		25/55-55 50/70	25/55-55 50/70	45/80-50 50/70 25/55-55
Minimum binder content (factor α)[2]		B_{min} 6.7	B_{min} 7.3	B_{min} 7.4
Stabilizing additive (cellulose fibers)	% by weight	0.3	0.3	0.3

[2] Factor α considers the density of the aggregate mixture
Source: Extract of TL Asphalt-StB 07/13, German Technical Conditions of Delivery for Asphalt Mixtures for the Construction of Road Pavements, updated according to "ARS 11/2012" published by the Federal Ministry of Transport, Building and Urban Development

Characteristics of Layer				
Paving thickness	cm	3.5 - 4.0	3.5 - 4.0	1.5 - 2.0
Paving amount	kg/m²	85 - 100	85 - 100	30 - 50
Degree of compaction	%	≥ 98.0		≥ 96.0
Void content	Vol.-%	≤ 5.0		≤ 6.0
Gritting material		0.5 – 1.0 kg/m² aggregates 1/3 mm (dedusted or lightly bitumenized)		

Source: Extract of ZTV Asphalt-StB 07/13, German Additional Technical Conditions of Contract and Directives for the Construction of Road Asphalt Pavements, updated according to "ARS 11/2012" published by the Federal Ministry of Transport, Building and Urban Development

Specifications in Germany

SMA		SMA 11 S	SMA 8 S	SMA 5 S[1]
Materials				
Aggregates (production size)				
Ratio crushed aggregate surface		$C_{100/-}$; $C_{90/1}$; $C_{90/3}$	$C_{100/-}$; $C_{90/1}$; $C_{90/3}$	$C_{100/-}$; $C_{90/1}$; $C_{90/3}$
Resistance to crushing		$SZ_{8/}$ / LA_{30}	$SZ_{8/}$ / LA_{30}	$SZ_{8/}$ / LA_{30}
Resistance to polishing		$PSV_{aver.}$ (51)	$PSV_{aver.}$ (51)	$PSV_{aver.}$ (48)
Minimum part of fine aggregates with 0/2 E_{cs} 35	%	100	100	100
Shape Index (SI)		20		
Flakiness Index (FI)		20		
Aggregate product size		G_c 85; G_c 90/10; G_c 90/15		
Resistance to frost		F_1		

[1] Source: Extract of ZTV BEA-StB 09, German Additional Technical Conditions of Contract and Directives for the constructional maintenance of Road Asphalt Pavements

Composition of Asphalt Mixture				
Aggregate mixture				
Passing sieve 16 mm	% by weight	100		
Passing sieve 11.2 mm	% by weight	90 – 100	100	
Passing sieve 8 mm	% by weight	50 – 65	90 – 100	100
Passing sieve 5.6 mm	% by weight	35 – 45	35 – 55	90 – 100
Passing sieve 2 mm	% by weight	20 – 30	20 – 30	30 – 40
Passing sieve 0.063 mm	% by weight	8 – 12	8 – 12	7 – 12
Binder				
Binder, type and grade		25/55-55 50/70	25/55-55 50/70	45/80-50 50/70 25/55-55
Minimum binder content (factor α)[1]		B_{min} 6.7	B_{min} 7.3	B_{min} 7.4
Stabilizing additive (cellulose fibers)	% by weight	0.3	0.3	0.3
Asphalt Mixture				
Minimum void content Marshall-Specimen		V_{min} 2.5	V_{min} 2.5	V_{min} 2.0
Maximum void content Marshall-Specimen		V_{max} 3.0	V_{max} 3.0	V_{max} 3.0
Voids filled with bitumen	%	is to be specified	is to be specified	is to be specified
Proportional rut depth	%	is to be specified	is to be specified	—

[1] Factor α considers the density of the aggregate mixture

Source: Extract of TL Asphalt-StB 07/13, German Technical Conditions of Delivery for Asphalt Mixtures for the Construction of Road Pavements, updated according to "ARS 11/2012" published by the Federal Ministry of Transport, Building and Urban Development

Paving and Compaction - Gritting

Chippings 1 to 3 mm

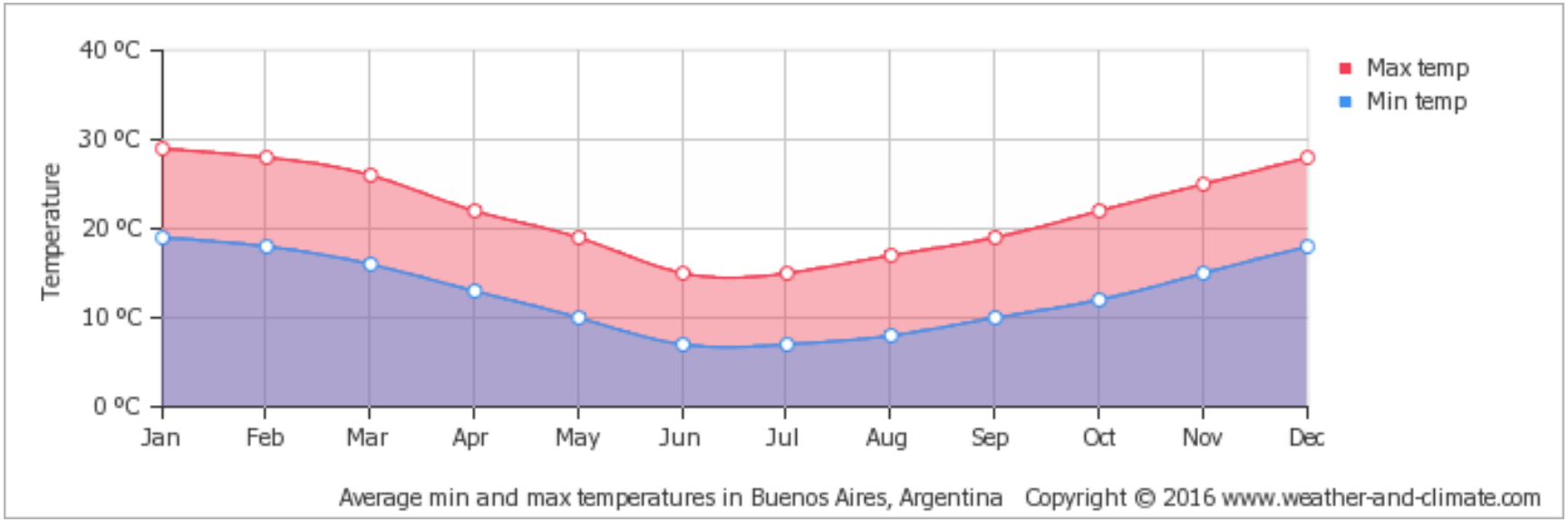
0.5 – 1.0 kg/m²

Applications

Applications

Argentina

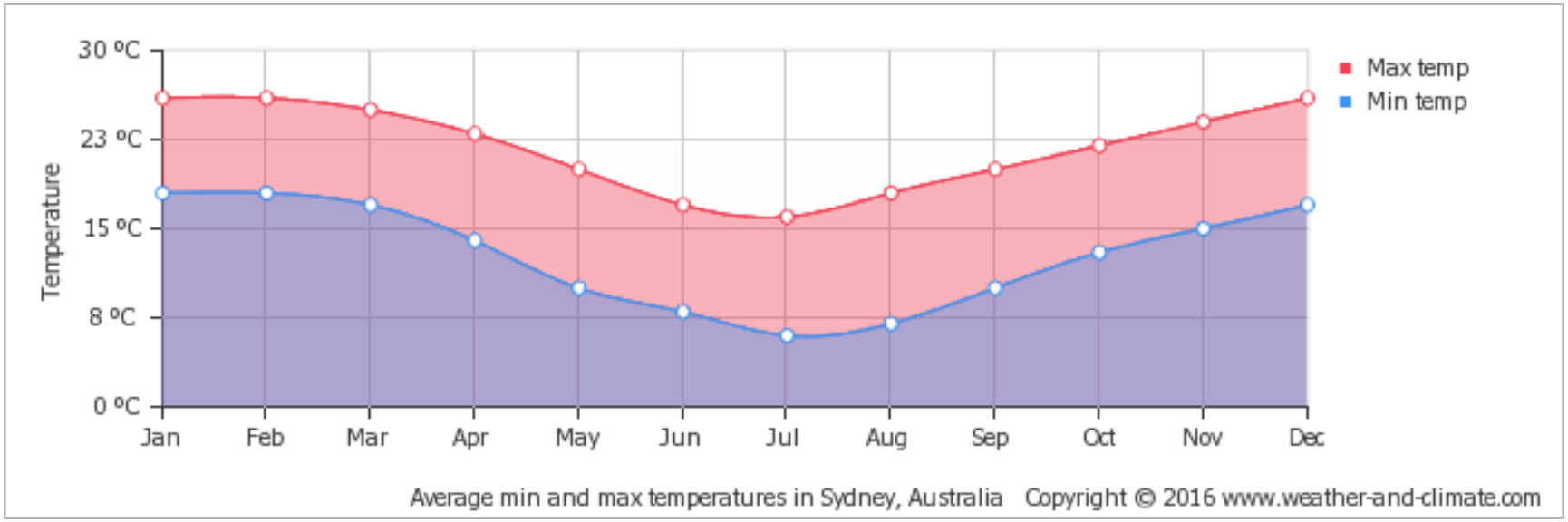
Argentina



Applications

Australia

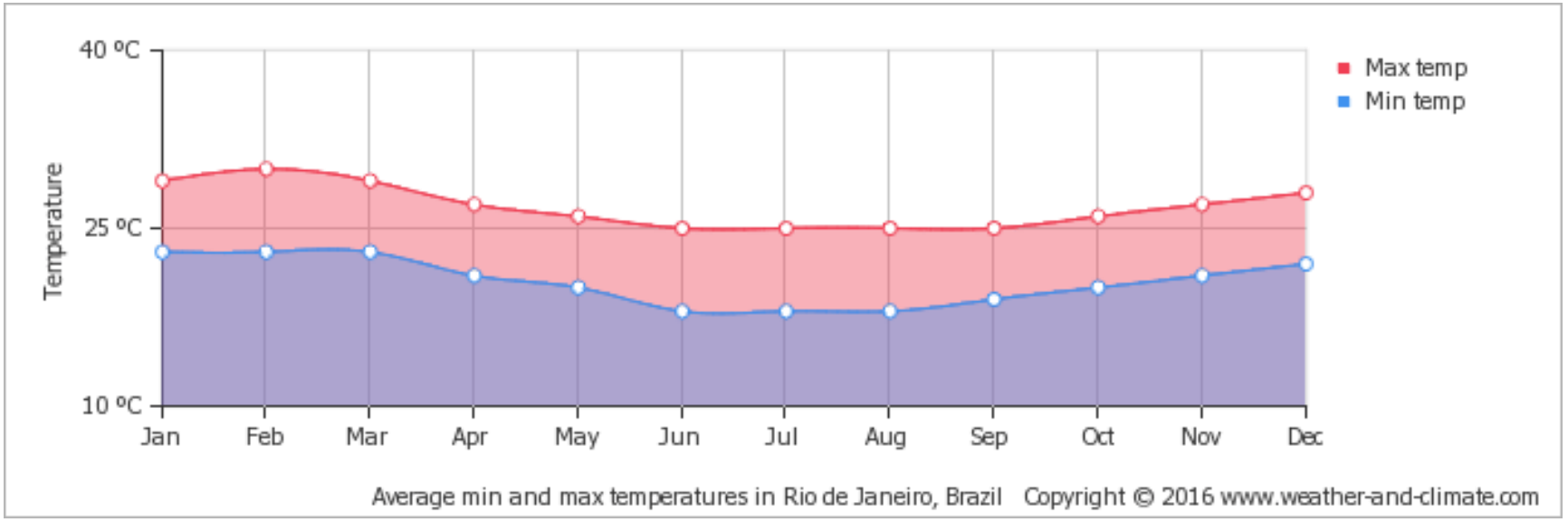
Australia



Applications

Applications

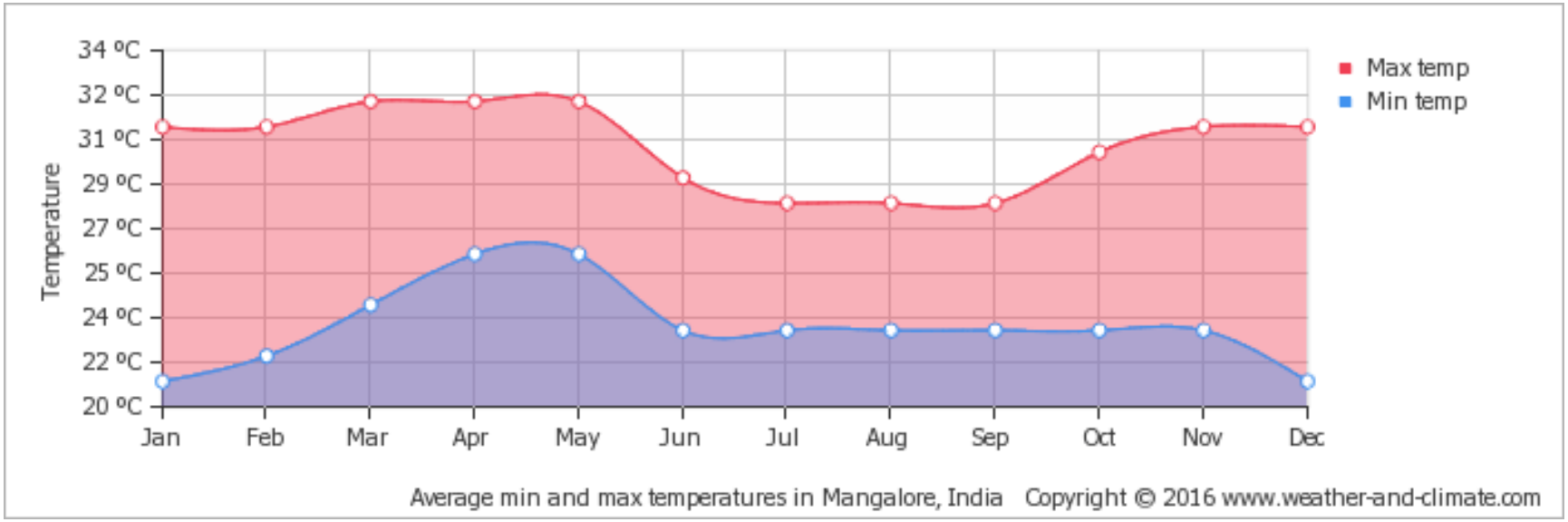
Brazil



Applications

Applications

India

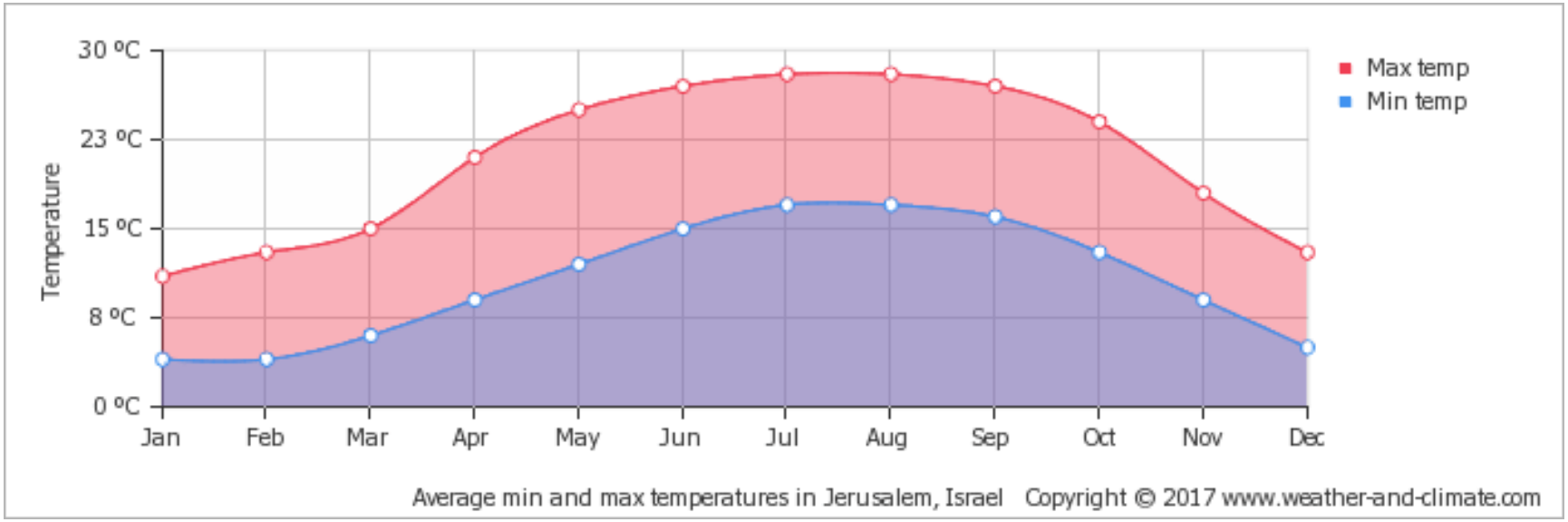


Applications

Applications

Israel

Israel



Applications

Applications

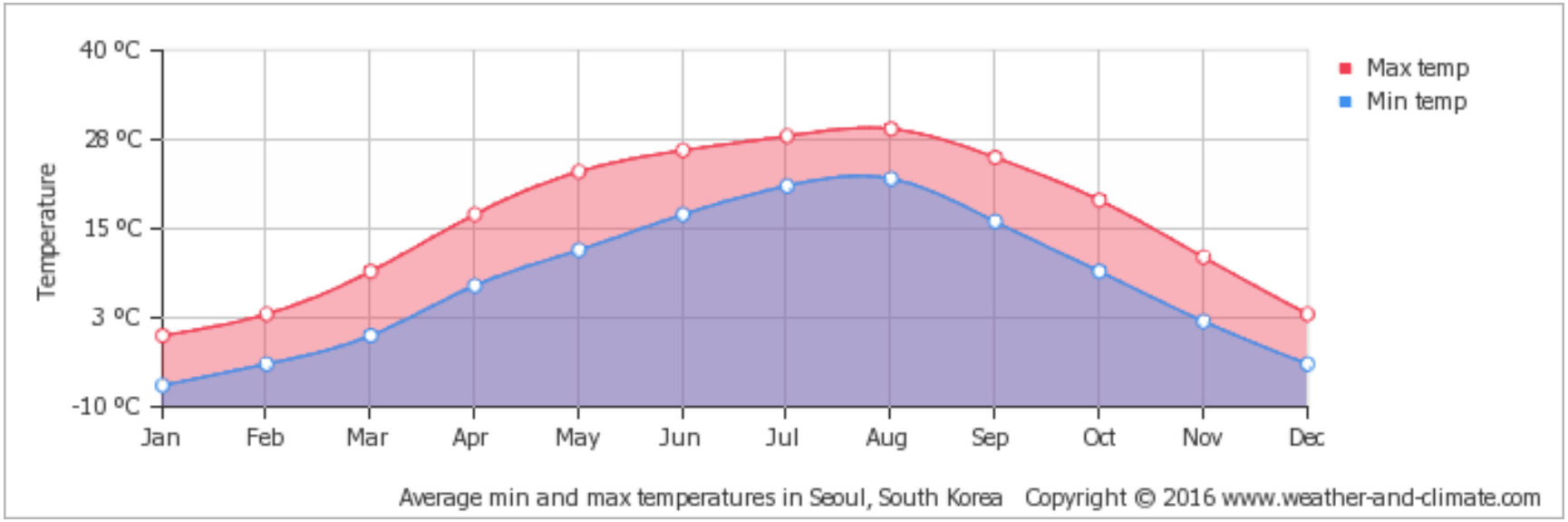
Applications

For road construction engineers, connections between two islands separated by saltwater have always been a big challenge. Careful and sophisticated planning is essential, as is choosing the best material to ensure that this connection is long lasting and safe.

In Korea, the engineers who designed the Seohae Grand Bridge which connects the island of Pyongtaek (Gyeonggi-do) with Dangjin (Chungcheongnam-do) at mainland South Korea, conducted extensive studies, and finally decided to use SMA with **VIATOP®** as the best solution for the surface layer for this important connection.

Today, after 16 years in service they have received confirmation that their decision was the correct one, as the surface layer of SMA with **VIATOP ®** is still there, and still offers an excellent performance.

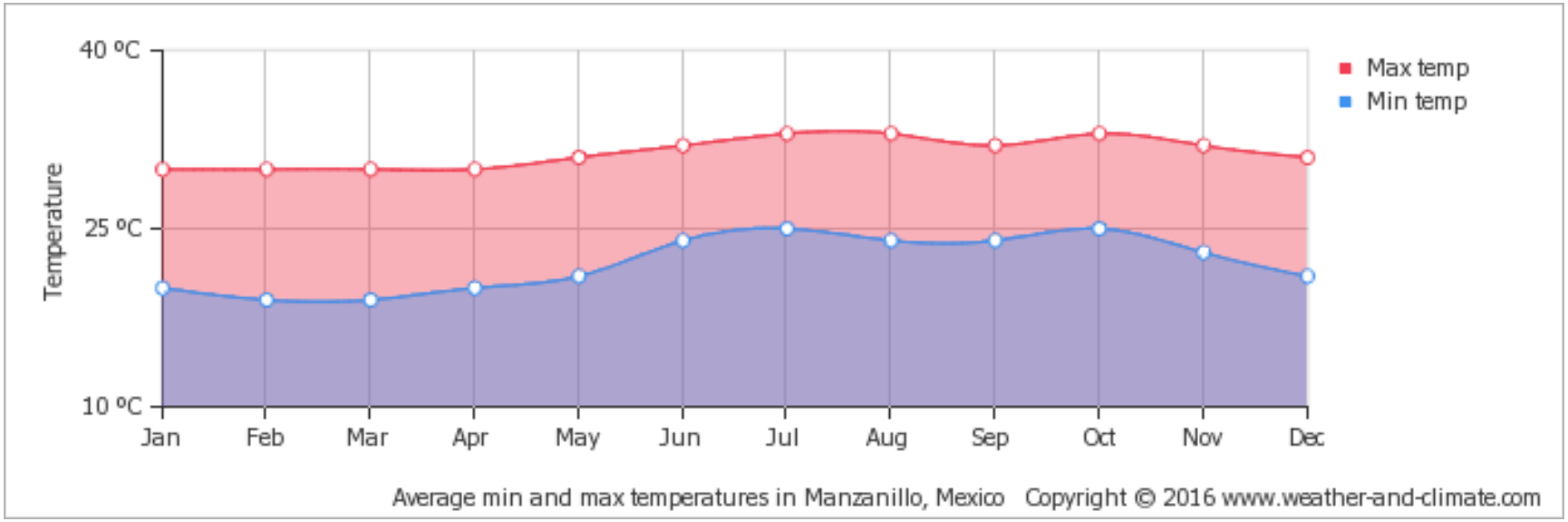
Korea


40 °C
28 °C
15 °C
3 °C
-10 °C
Temperature
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Max temp
Min temp
Average min and max temperatures in Seoul, South Korea
Copyright © 2016 www.weather-and-climate.com

Applications

Applications

Mexico



Applications

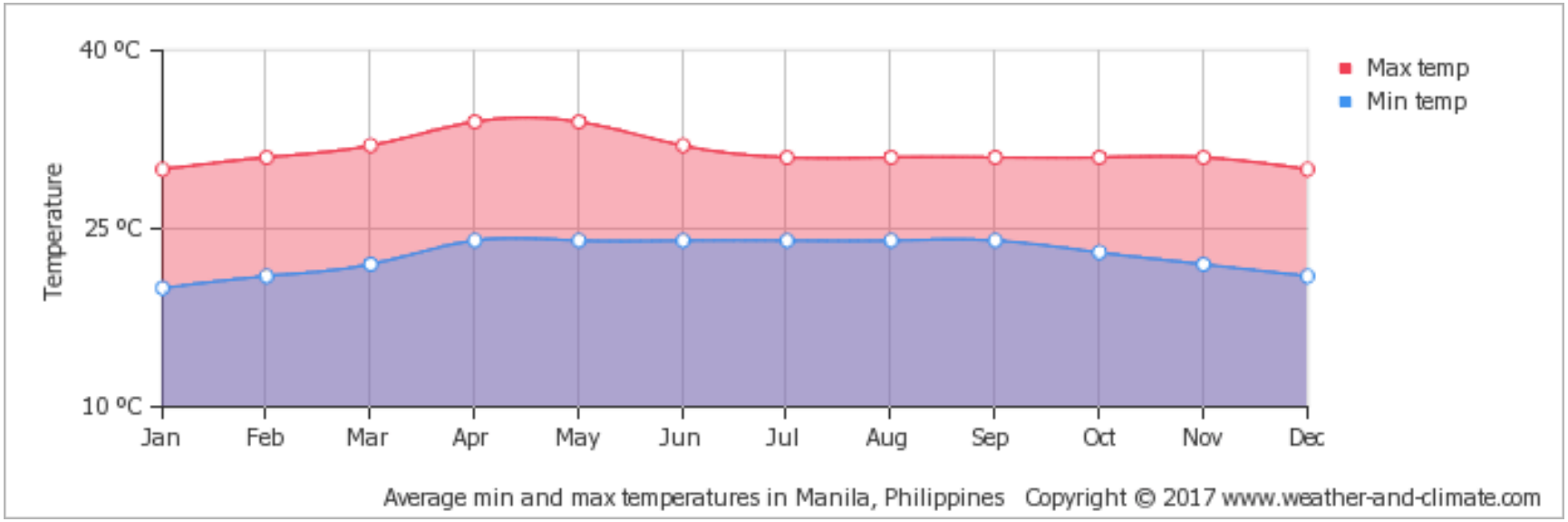
Philippines

Applications

Applications

Applications

Philippines

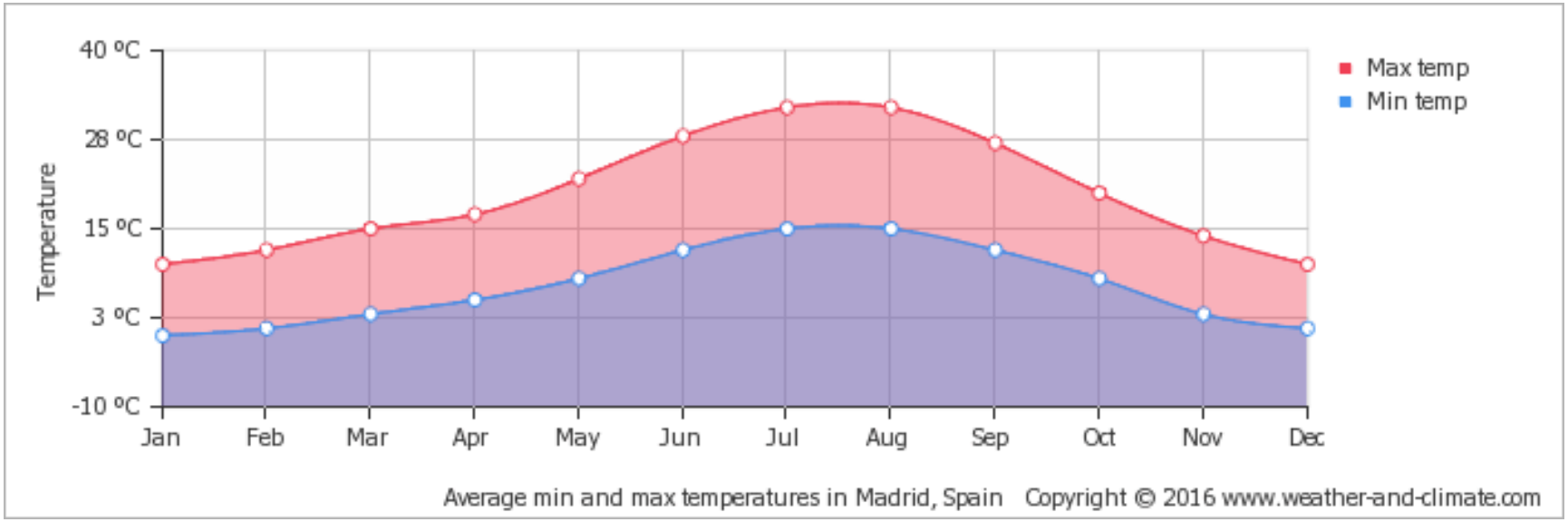


Applications

Applications

Applications

Spain



Spain

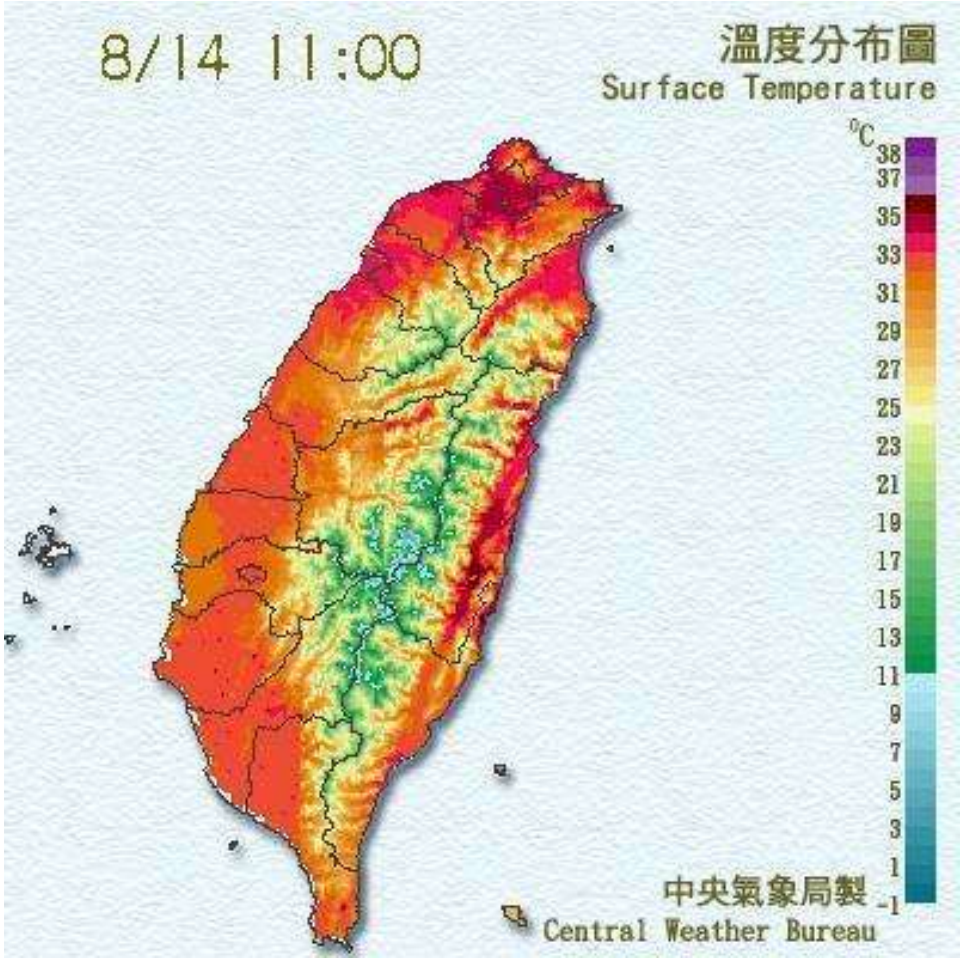
Spain has two basic climatic areas:

- The coasts (both Mediterranean and Atlantic): average minimum temperatures around 10 ºC, and average maximum temperatures around 30-35 ºC
- The inside with a mild continental climate with cold winters: average minimum temperatures around -5 ºC, and average maximum temperatures around 40 ºC (this is the case of Madrid)

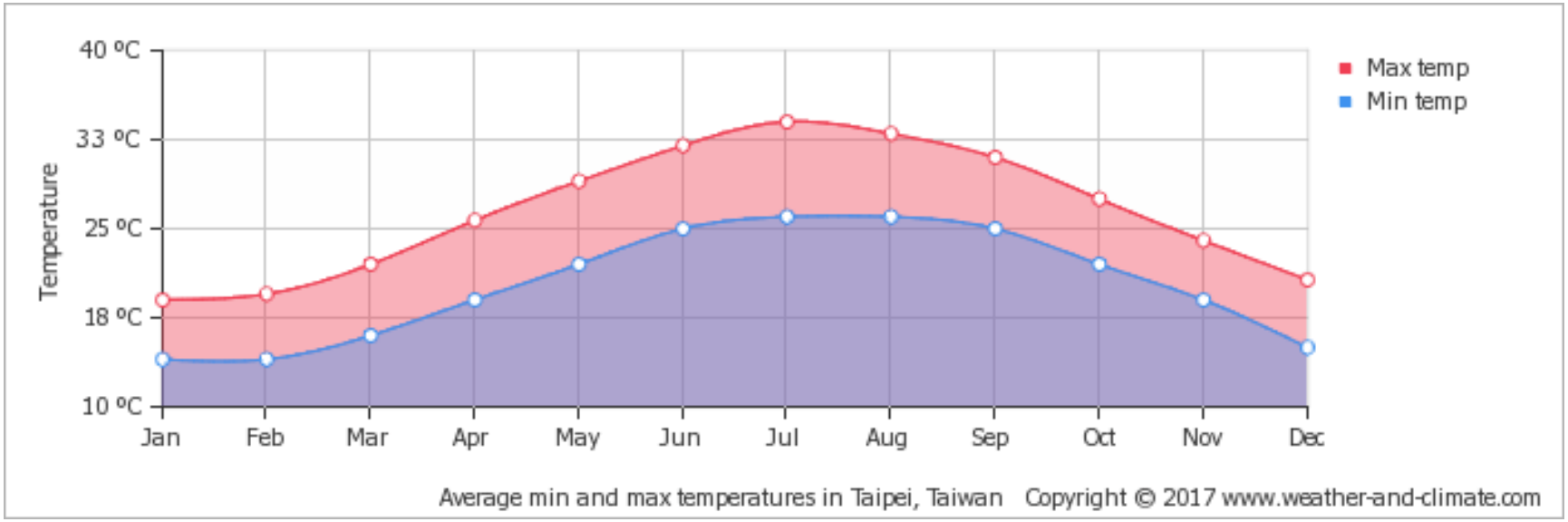
Applications

Applications

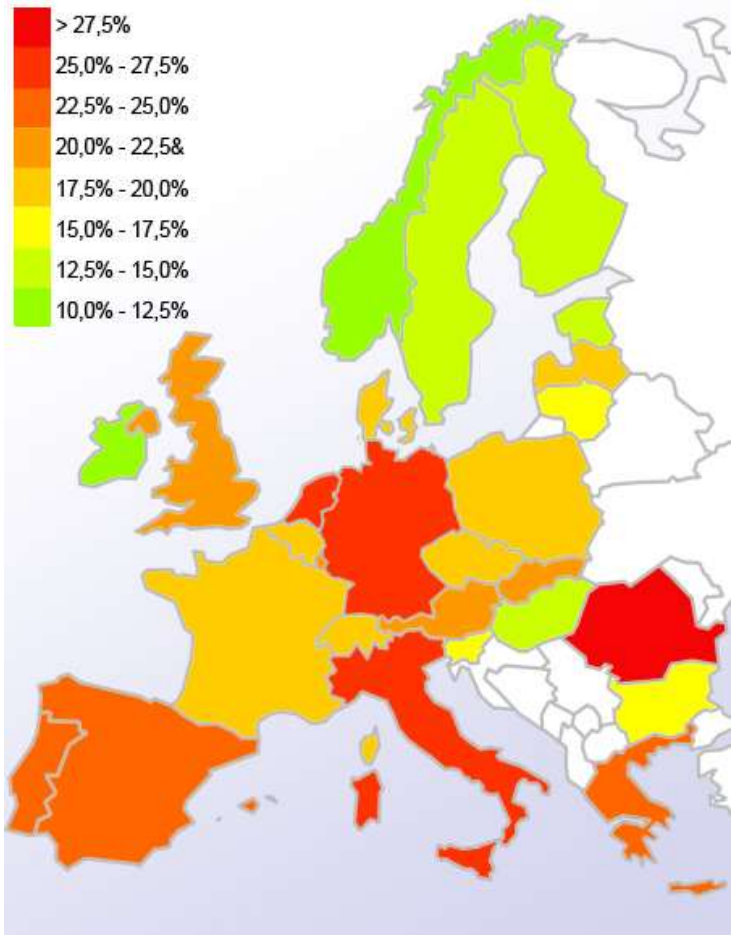
Taiwan


8/14 11:00
溫度分布圖
Surface Temperature
°C
38
37
35
33
31
29
27
25
23
21
19
17
15
13
11
9
7
5
3
1
-1
中央氣象局製
Central Weather Bureau

Taiwan



Noise



Percentage of population suffering from noise

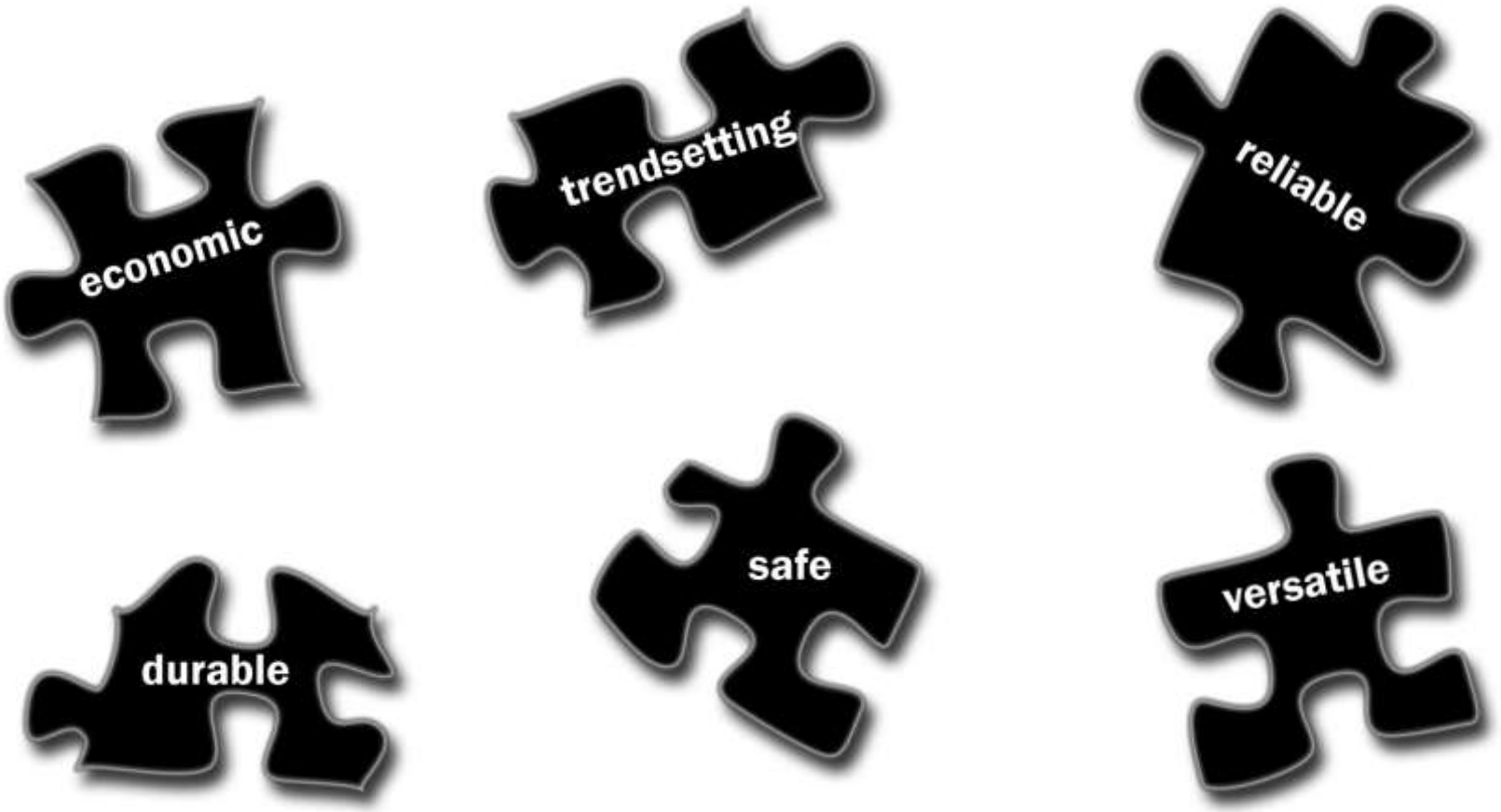
Source: Eurostat

Combining PA and SMA

PA **SMA plus** **SMA**

- **Process reliable**
- **Easy to apply and to handle**
- **Simple drainage system**
- **Longer life time (x -> 20 years)**
- **Lower life-cycle costs**
- **Noise reduction**

Noise Reducing SMA



Requirements 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	100
Passing sieve 5.6 mm	% by weight	20 - 30	85 - 100
Passing sieve 2 mm	% by weight	15 - 20	20 - 30
Passing sieve 0.063 mm	% by weight	6 - 8	7 - 10

Requirements for SMA plus

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

[1] factor α considers the density of the aggregate mixture

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
Eveness (4 m section of measurements)	mm	≤ 3	≤ 3

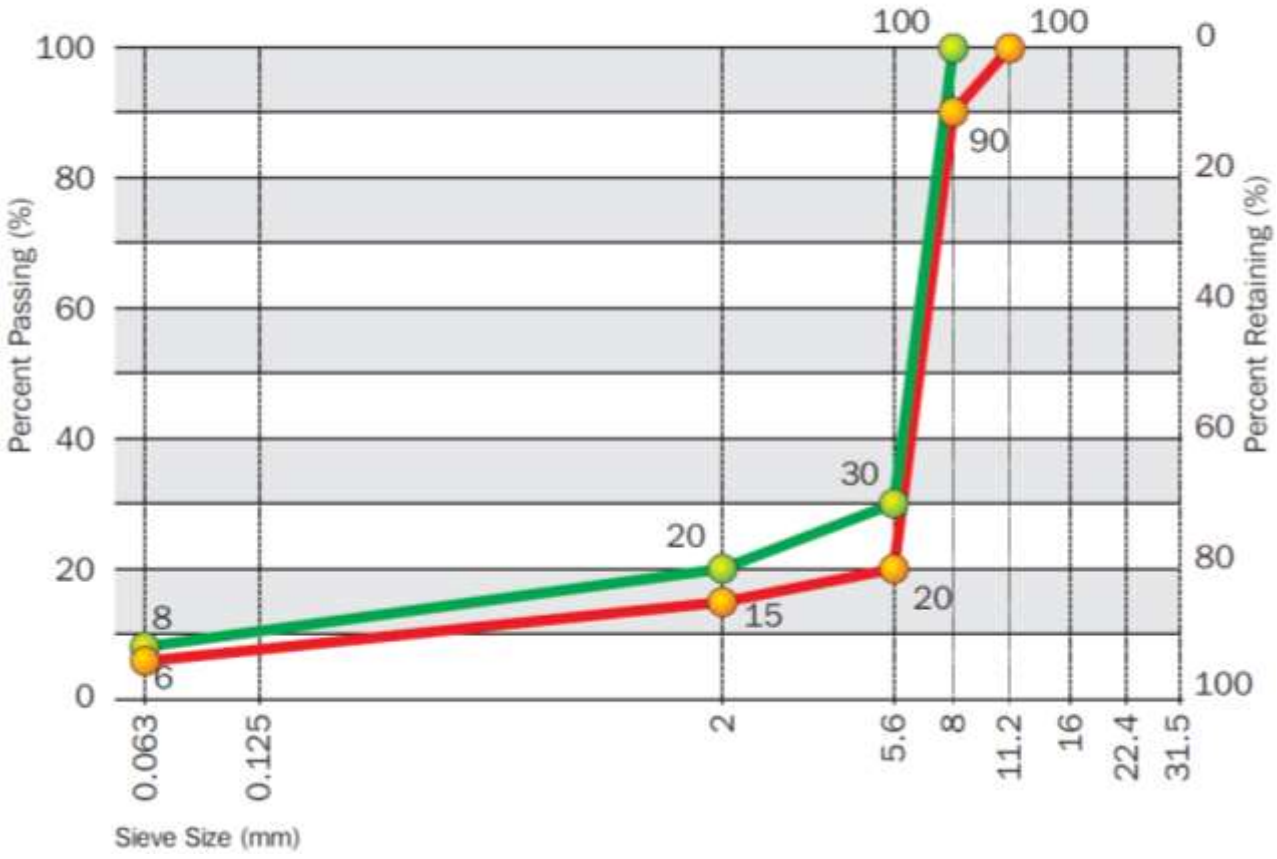
VIATOP® Das Pellet.

Source: Extract of E LA D, FGSV 2014

J. RETTENMAIER & SÖHNE GMBH + CO KG JRS Fibers designed by Nature

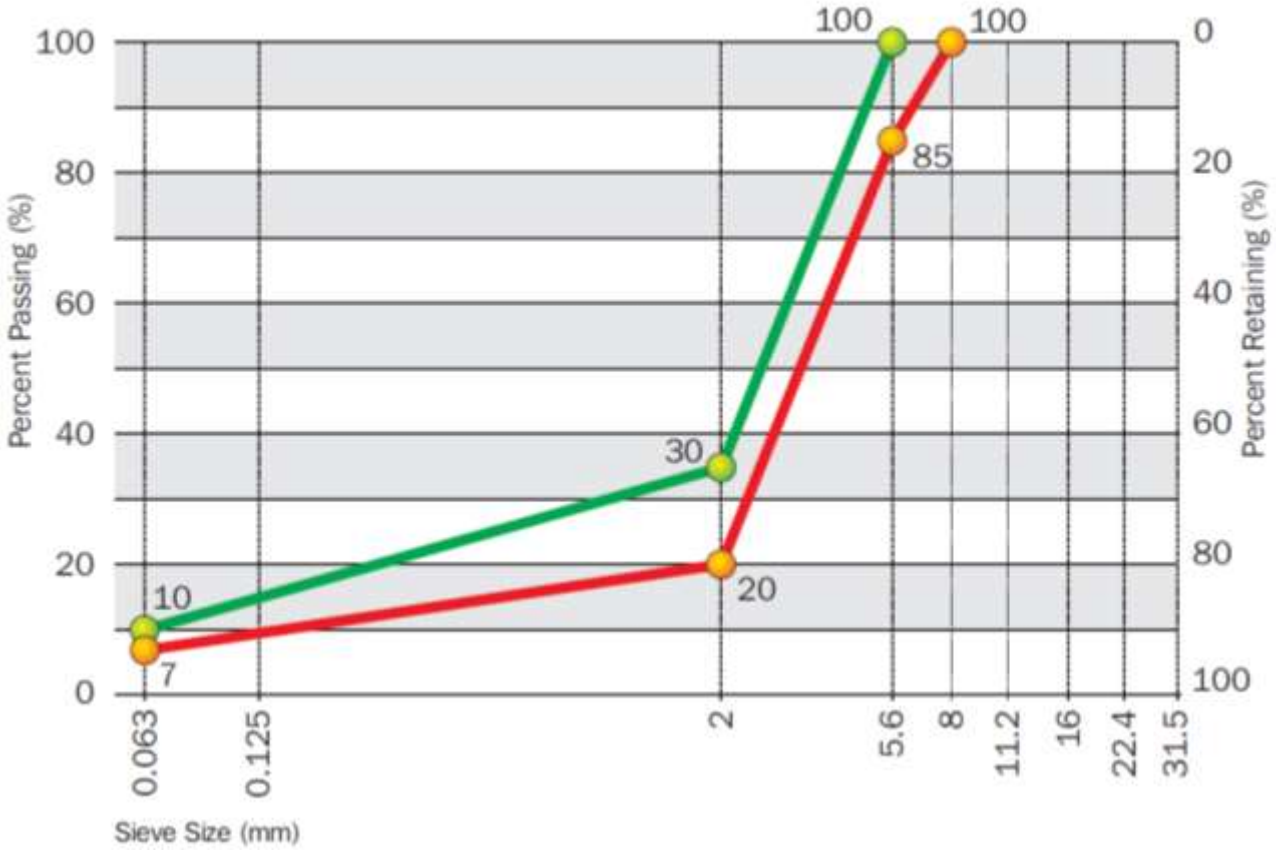
Requirements for SMA plus

SMA plus 8



Requirements for SMA plus

SMA plus 5



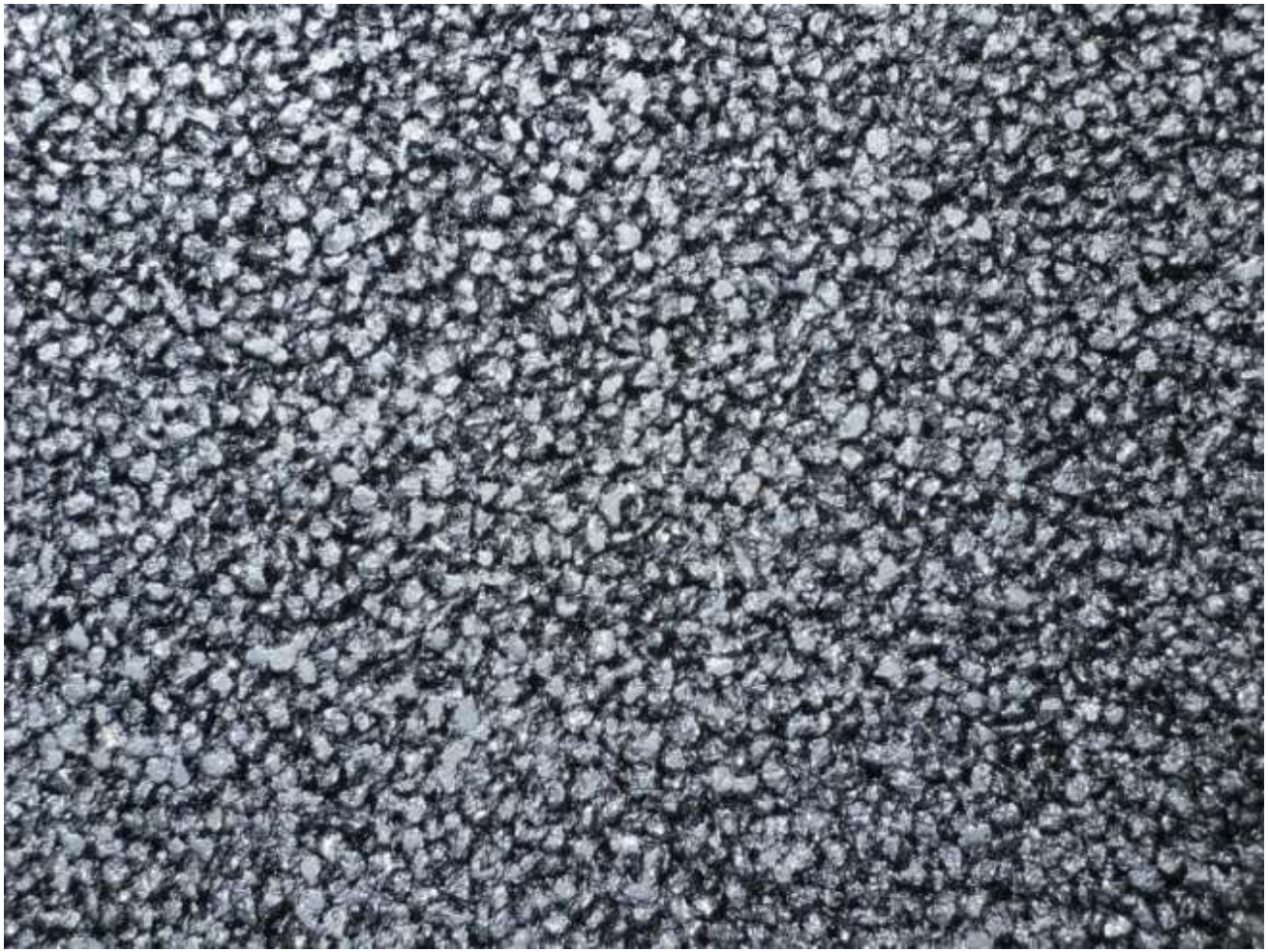
Applications

Applications

Applications

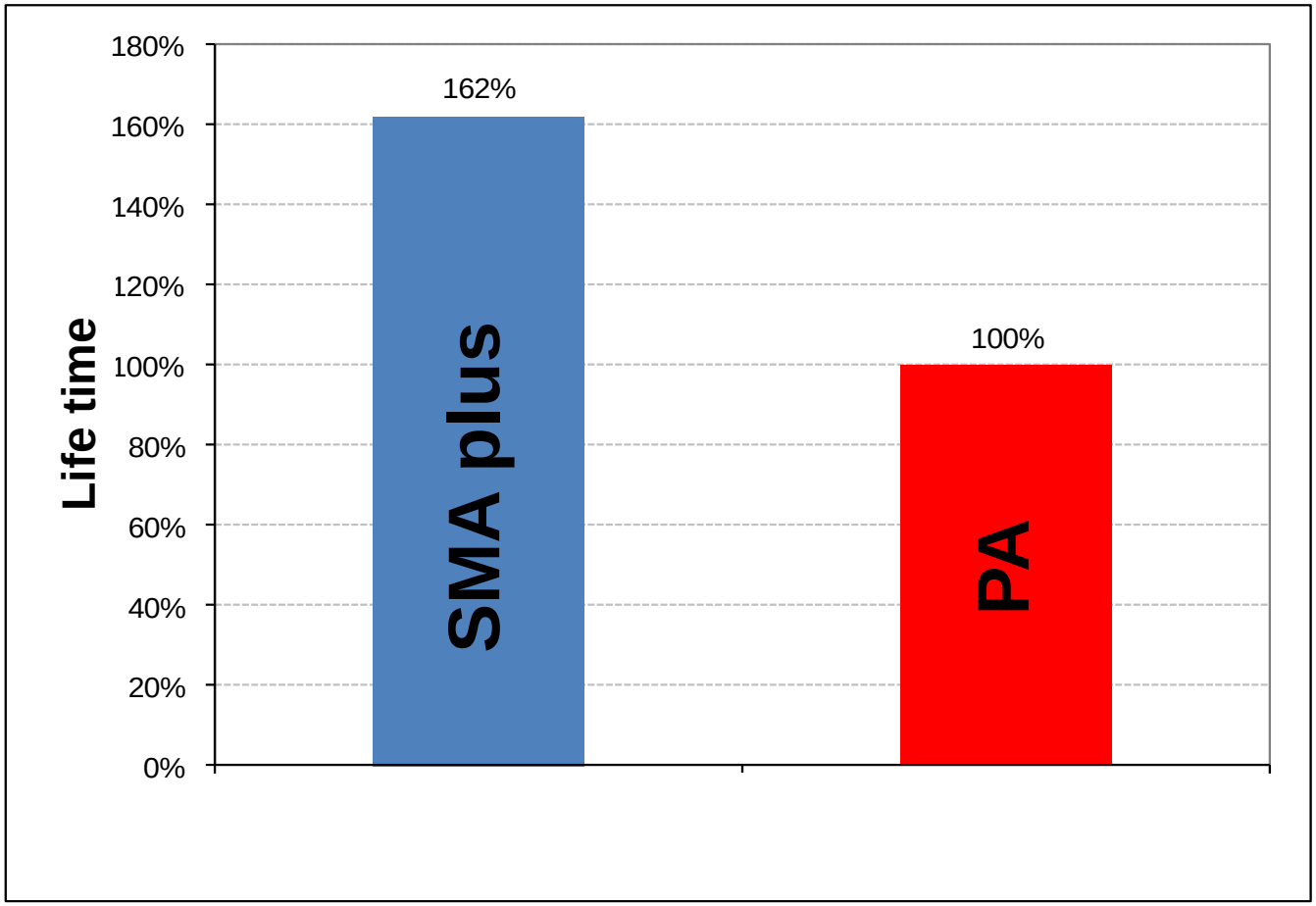
Applications

Applications



Noise Reducing Asphalt Pavements

	PA 8	SMA plus 8
Special requirements for aggregates	Yes PSV (min. 53) SI 3:1 min. 92%	**No** **PSV (min. 51)** **SI 3:1 min. 80%**
Binder	40/100-65 A	**40/100-65 A**
Bindercontent	≥ 6.5%	**≥ 6.6%**
Fibers	≥ 0.5 % by weight	**≥ 0.3 % by weight**
Evenness binder course	≤ 3 mm	**≤ 4 mm**
Binder course	AC 22 B S, AC 16 B S AC 16 B S - Typ SMA	**AC 16 B S** **SMA 16 B C**
Tack coat	2,000 g/m²	**350 – 500 g/m²**
Layer thickness	4.5 – 5.5 cm	**2.5 – 3.5 cm**
Initial costs incl. tack coat	€ 15.00 / m²	**€ 6.50 / m²**
Life time	8 – 10 years	**14 – 16 years**


Life time
180%
160%
140%
120%
100%
80%
60%
40%
20%
0%
162%
100%
SMA plus
PA

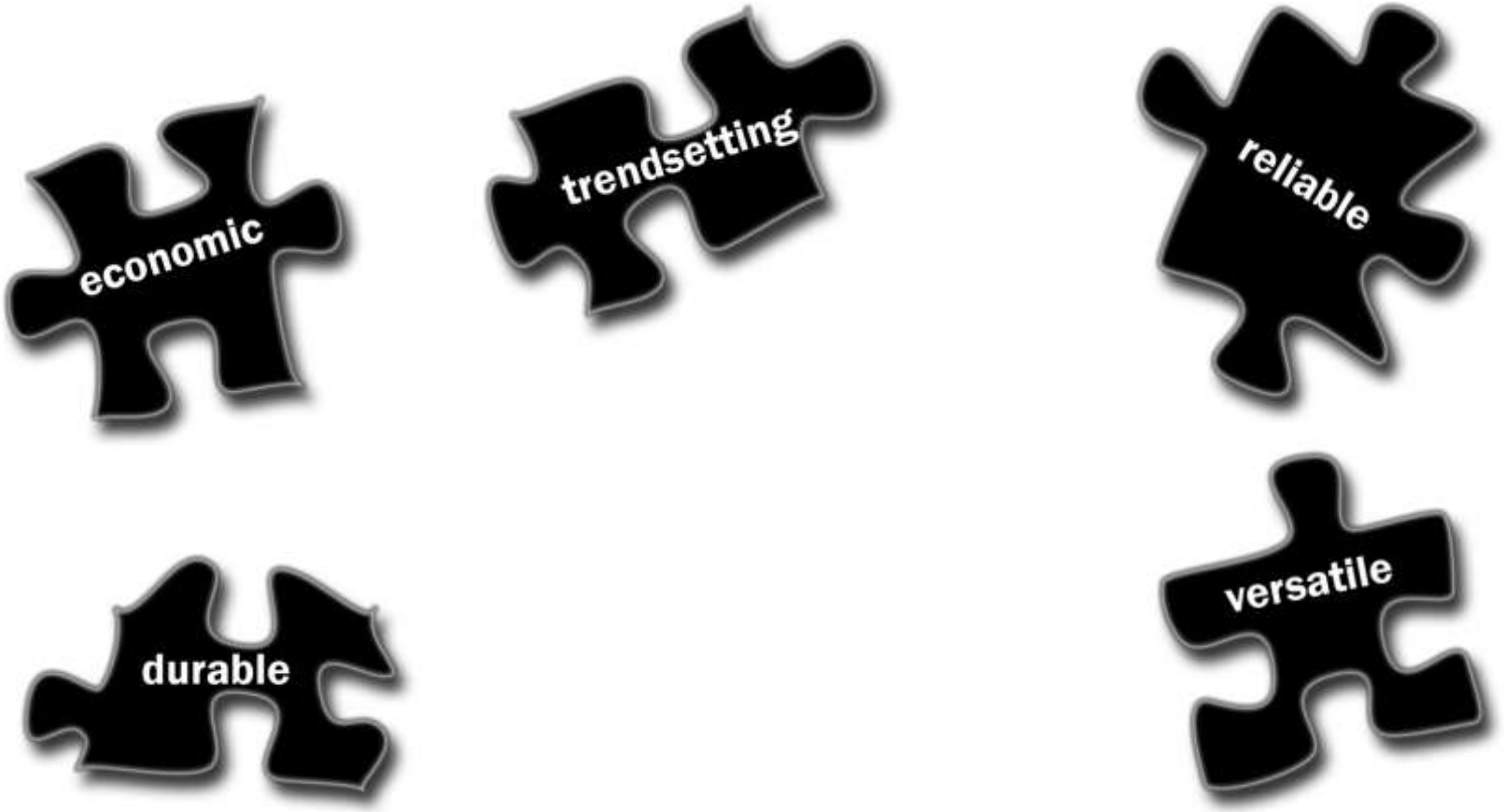
Applications

Applications

Applications

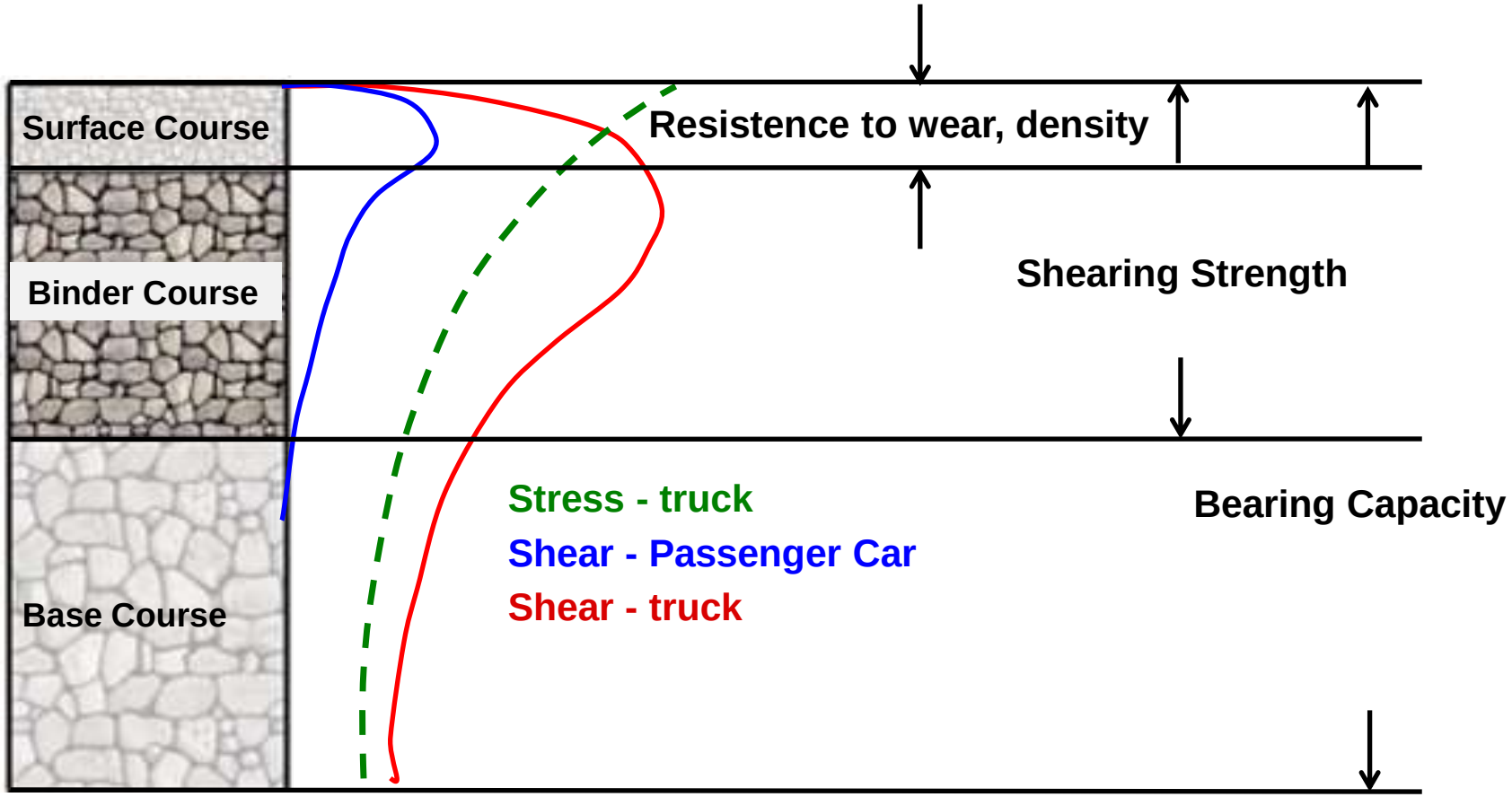
Applications

SMA Binder Course



Current Situation in Germany

Distribution Of Loads

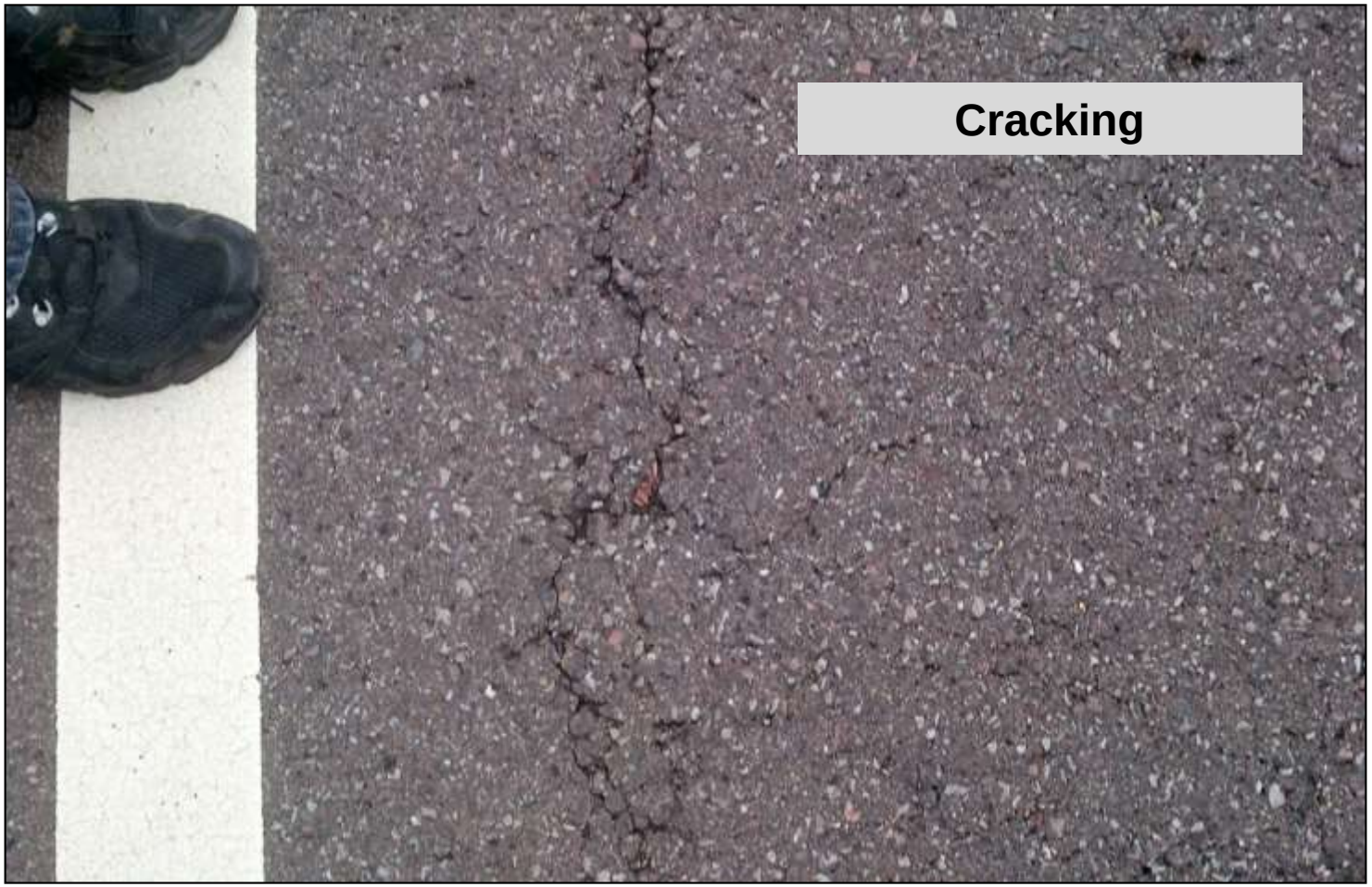


Disadvantages

Disadvantages

Disadvantages

Disadvantages



Requirements 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} 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	100
Passing sieve 16 mm	% by weight	65 - 75	90 - 100
Passing sieve 11.2 mm	% by weight	50 - 60	63 - 73
Passing sieve 8 mm	% by weight	-	46 - 56
Passing sieve 2 mm	% by weight	23 - 28	25 - 30
Passing sieve 0.063 mm	% by weight	6 - 10	6 - 10

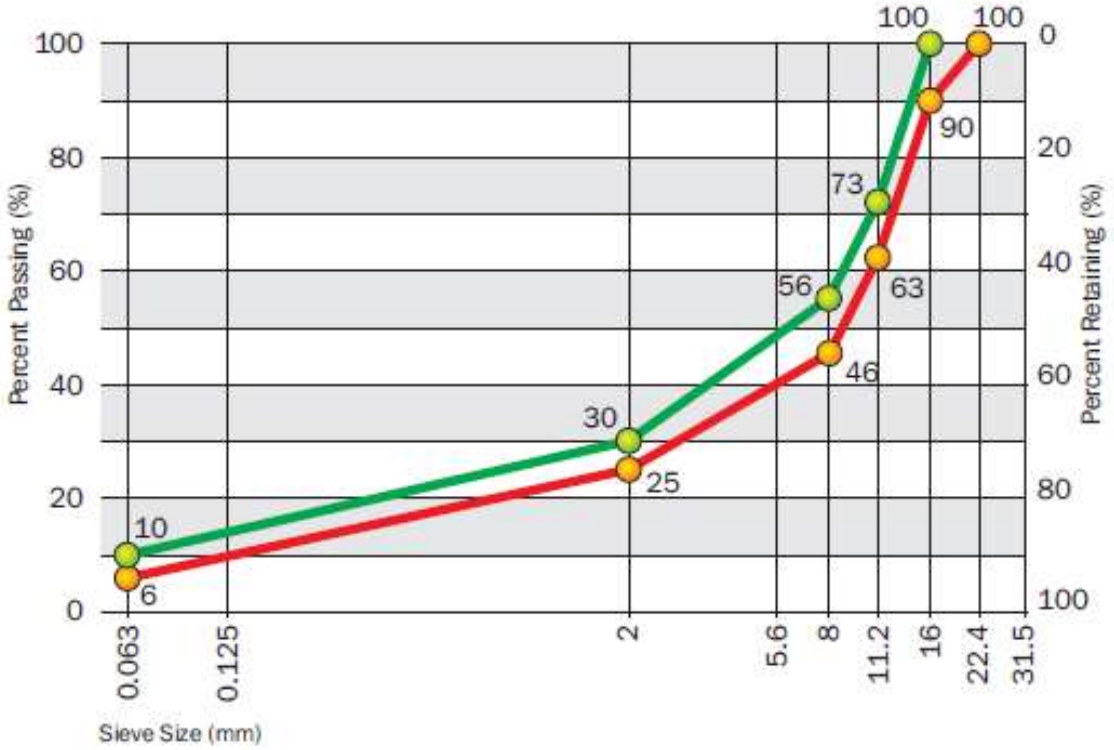
Requirements for SMA B C

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

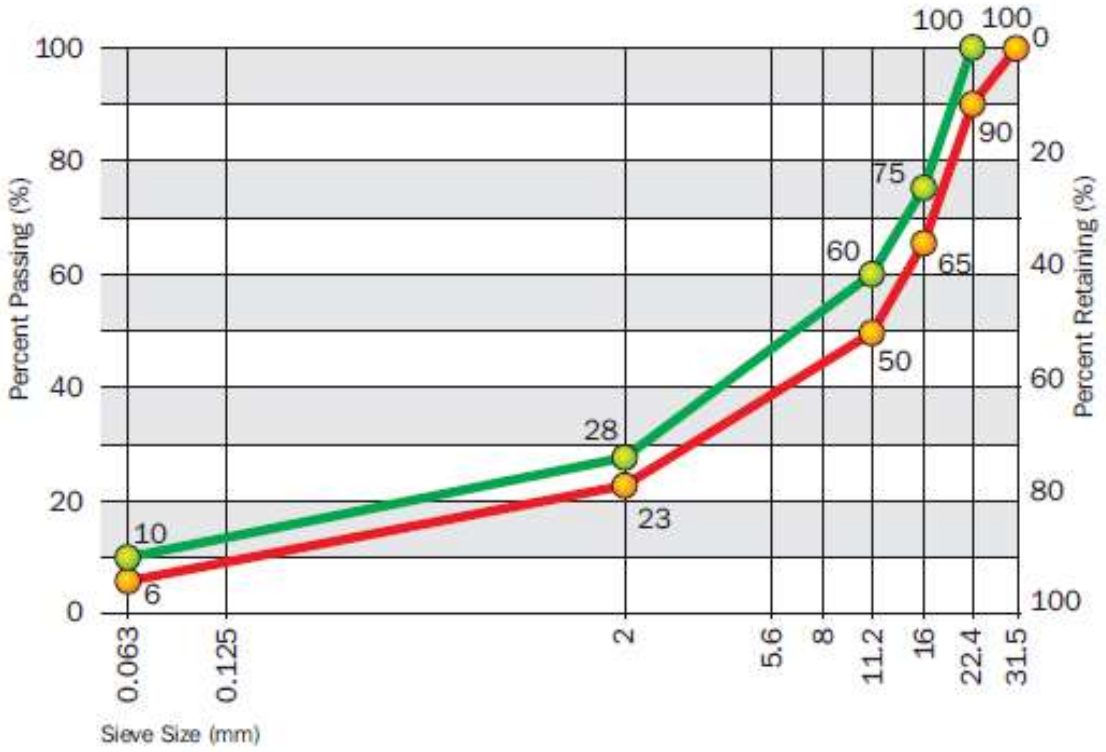
Requirements for SMA B C

SMA 16 B C



Requirements for SMA B C

SMA 22 B C



Characteristics of Layer
Asphalt Binder Courses SMA B C

SMA B C		SMA 22 B C	SMA 16 B C
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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SMA
Do it right
or just don´t do it!