



Hrvatsko Asfaltno Društvo



Croatian Asphalt Association

*Najnovija iskustva s
vlaknima modificiranim asfaltom*

*Latest Experiences with
Fiber Modified Asphalt Pavements*

Frank Hauber J. Rettenmaier & Söhne (Germany)

Međunarodni seminar ASFALJNI KOLNICI 2019

International seminar ASPHALT PAVEMENTS 2019

Latest Experiences with Fiber Modified Asphalt Pavements

SMA Binder Course

Noise Reducing Asphalt Pavements - SMA plus

Asphalt Pavements for Regional Roads – AC Duopave



Seminar on Asphalt Pavements - Opatija 2019



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Latest Experiences with Fiber Modified Asphalt Pavements

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Challenges

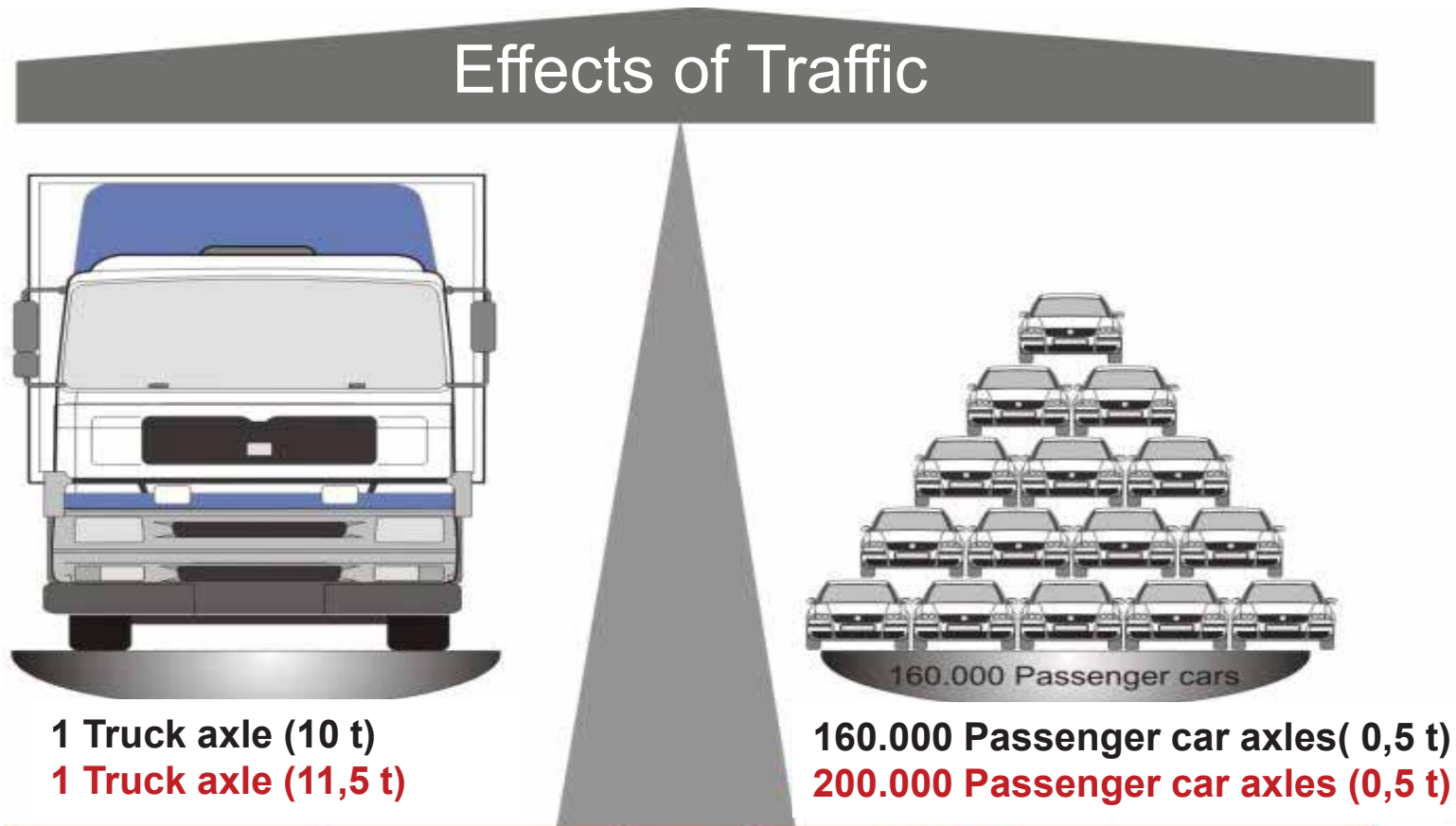


Challenges for Binder Courses

- High trafficked areas
- Increasing number of traffic jams
- Increasing number of truck traffic
- Higher axle loads
- Different types of surface pavements



Heavy Load Traffic



is equivalent to



German Road Specifications

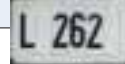
Autobahn



Federal road



Regional road



District road



Municipal road

Bk100

Bk32

Bk10

Bk3.2

Bk1.8

Bk1.0

Bk0.3

Load

Road design according to load classes

Based on RStO 12 - Guidelines for the standardization of pavement structures of traffic areas, Edition 2012



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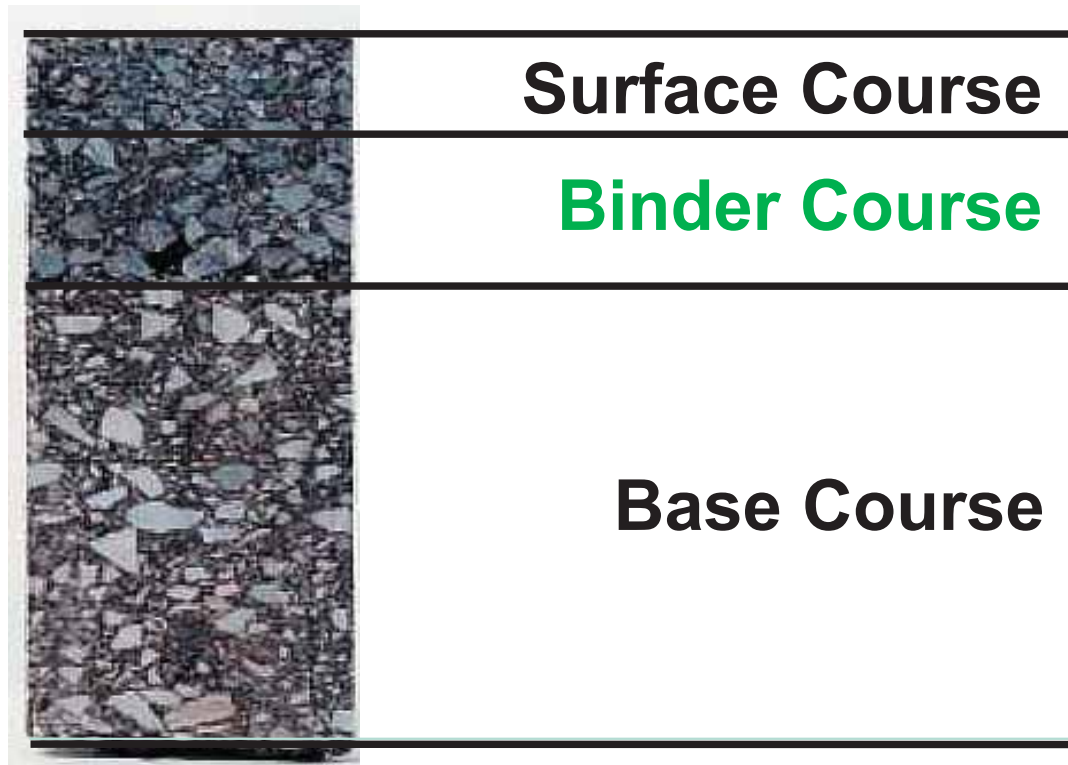


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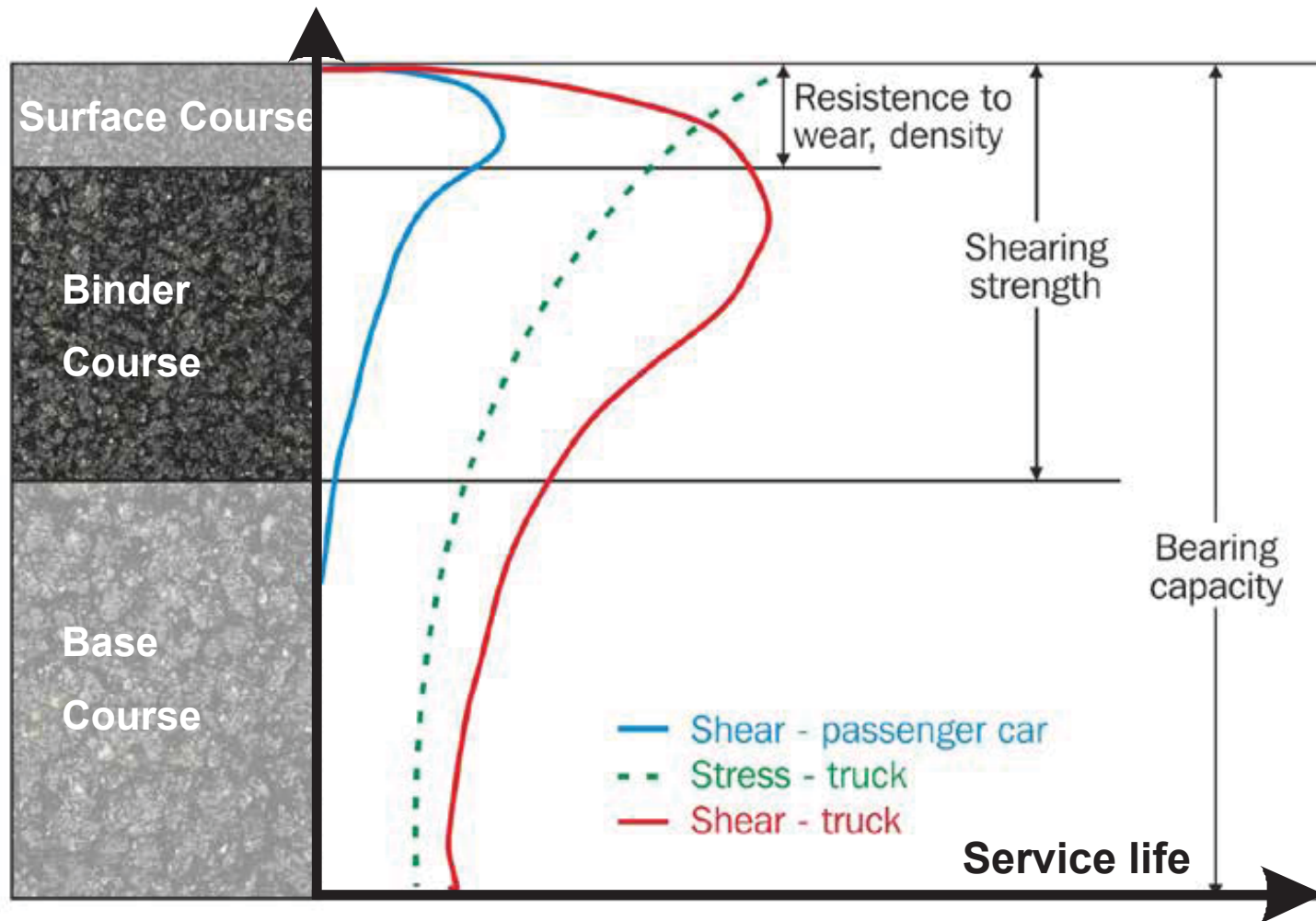


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German Road Specifications



German Road Specifications



German Specifications



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



German Specifications



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



Expectations of the Administration



- **Reliable**
- **Functional**
- **Durable**
- **Sustainable**
- **Economical**



Standard Binder Course

AC B C

Asphalt Concrete Binder Course



Room for Improvement



Room for Improvement



Requirements to an alternative Concept

- **Deformation resistance**
- **Impermeable to water**
- **Easy to apply and to handle**
- **Process reliable**
- **Possible use of a maximum amount of RAP**
- **Longer life time**
- **Lower life-cycle costs**



The Concept Solution



SMA B C

Stone Mastic Asphalt Binder Courses



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SMA Binder Course

SMA B C
Stone Mastic Asphalt Binder Courses



Performance and cost effectiveness
at its best.

Versatility
Stability
Durability

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SMA Binder Courses

Recommendations for SMA B C

SMA B C		SMA 22 B C	SMA 16 B C
Materials			
Aggregates (production size)			
Ratio crushed aggregate surface		$C_{crushed}; C_{ch}; C_{verl}$	$C_{crushed}; C_{ch}; C_{verl}$
Resistance to crushing		SZ_{12} / LA_{12}	SZ_{12} / LA_{12}
Minimum part of fine aggregates 0/2 with $E_c \geq 35$	%	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	$B_m \geq 4.8$	$B_m \geq 5.2$
Stabilizing additive (cellulose fibers)	% by weight	≥ 0.2	≥ 0.2

Asphalt Mixture

Minimum void content Marshall-Specimen	Vol.-%	$V_{min} \geq 3.0$	$V_{min} \geq 3.0$
Maximum void content Marshall-Specimen	Vol.-%	$V_{max} \geq 4.0$	$V_{max} \geq 4.0$
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	%	$PRD_m \geq 5.0$	$PRD_m \geq 5.0$

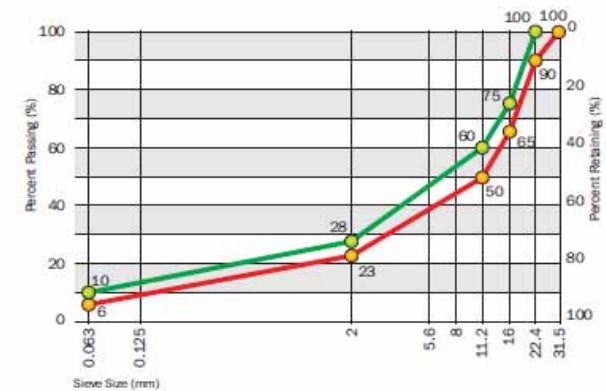
(...) in exceptions

Characteristics of Layer

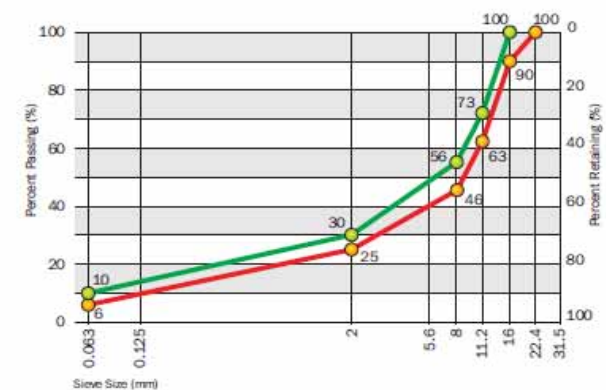
Paving thickness	cm	9.5 - 12.0	6.0 - 9.5
Degree of compaction	%	≥ 98.0	≥ 98.0
Void content	Vol.-%	1.5 - 5.5	1.5 - 5.5

Recommendations for SMA B C

SMA 22 B C



SMA 16 B C



Publication 2008

news&info



SMA for Asphalt Binder Courses

Kerstin Gärtner, Klaus Graf and Marco Schünemann

So far asphalt binder courses have been designed according to the specifications of ZTV Asphalt-StB 01 with a particularly high deformation resistance being the main focal point. The resistance was achieved by using highly viscous bitumen and a relatively small bitumen content. This led to a failure of the asphalt binder course caused by stripping and finally to collateral damage in the asphalt surface course. The concept of the recently designed stone mastic asphalt binder course is based on lessons learned and features a high bitumen content, low air voids, good

Association]). As these binder courses are susceptible to water ingress the regulations set forth that high shoulders should be sealed with hot bitumen. When renewing the road surface these binder courses often showed considerably damages due to water ingress. Large sections had to be replaced which lead to subsequent cost increases. An alternative binder course mixture based on the SMA principle was developed for these reasons. Binder courses with this design were laid in North and South Germany as early as in the 80ies and 90ies and proved to be very stable. Recently, more and more noise reducing wearing courses have been laid featuring a higher void content. Consequently, a greater amount of water reached the base consisting of asphalt binder. Even if the base is



FGSV Working Group

Forschungsgesellschaft
für Straßen- und
Verkehrswesen e.V.



**German Road and Transportation
Research Association**

Working Group 7.3.3 Innovations



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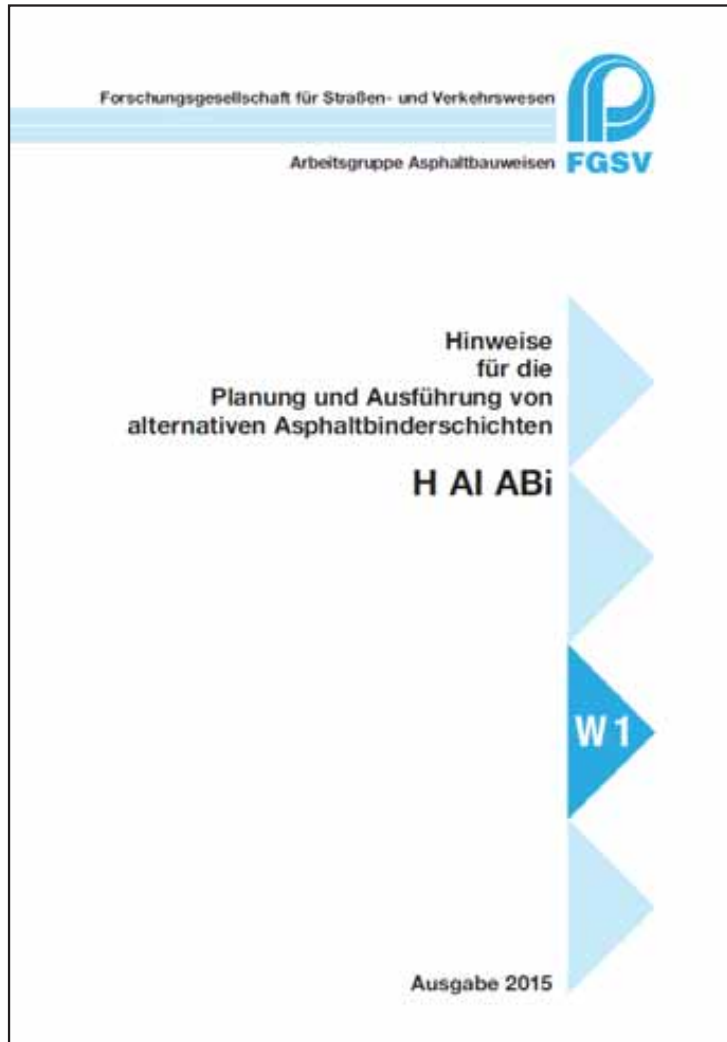


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Specification in Germany



Instructions for the design and construction of alternative asphalt binder courses

Edition 2015



Increasing Number of Projects



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Increasing Number of Projects



SMA Binder Courses

- Deformation resistant
- Impermeable to water
- Easy to apply and to handle
- Use of up to 30 % RAP possible
- Process reliable
- Longer life time
- Lower life-cycle costs



Latest Experiences with Fiber Modified Asphalt Pavements

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Asphalt Pavements for Regional Roads – AC Duopave



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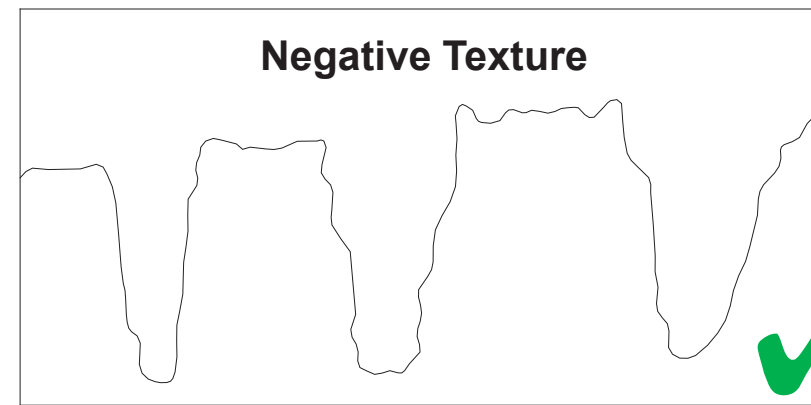
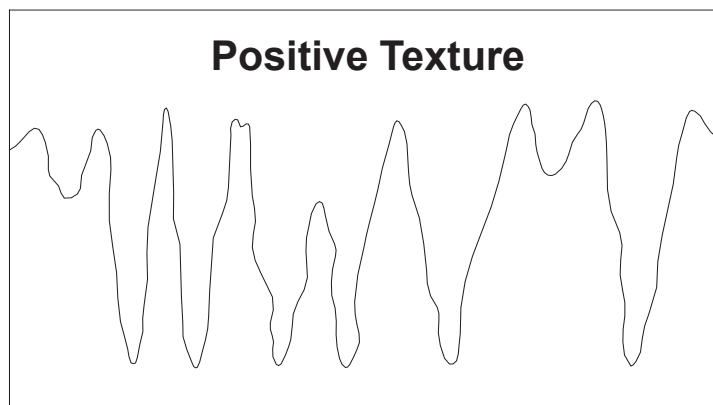
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Traffic Noise



Noise Level – The Influencing Factors

- **Maximum aggregate size fraction**
- **Gradation curve**
- **Void content**
- **Evenness**
- **Roughness**
- **Surface treatment (gritting)**



Noise Reduced Areas



Noise barriers



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Noise Reduced Areas



Enclosures



Noise Reduced Areas



Texture



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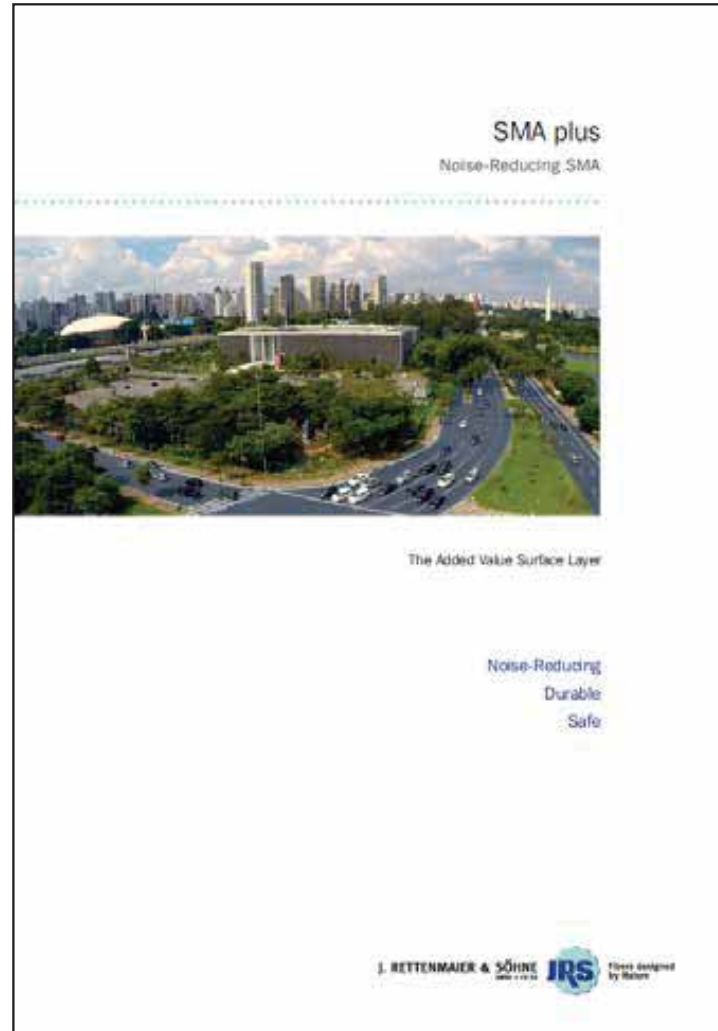
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SMA plus

Noise Reducing SMA



SMA plus

Noise Reducing SMA

Recommendations for SMA plus

SMA plus		SMA plus 8	SMA plus 5
Materials			
Aggregates (production size)			
Ratio crushed aggregate surface		$C_{\text{crushed}} / C_{\text{total}} / C_{\text{total}}$	$C_{\text{crushed}} / C_{\text{total}} / C_{\text{total}}$
Resistance to crushing		SZ_{10} / LA_{10}	SZ_{10} / LA_{10}
Resistance to polishing		PSV _{min. value} (51)	PSV _{min. value} (51)
Minimum part of fine aggregates 0/2 with E_{10} 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	85 - 100
Passing sieve	0.063 mm	% by weight	20 - 30
Passing sieve	0.063 mm	% by weight	6 - 8
Passing sieve	0.063 mm	% by weight	7 - 10

Binder

Binder, type and grade			
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* (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

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
Void filled with bitumen	%	is to be specified	is to be specified
Proportional rut depth	%	is to be specified	is to be specified

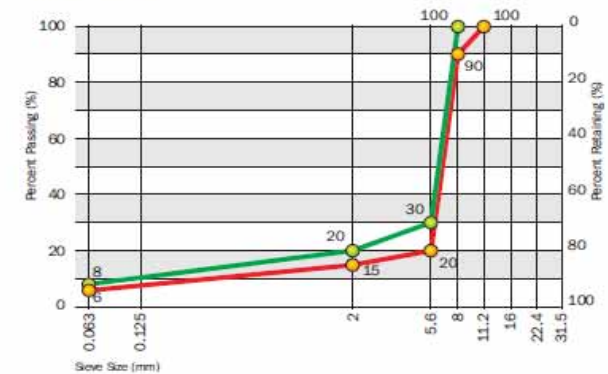
Characteristics of Layer

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

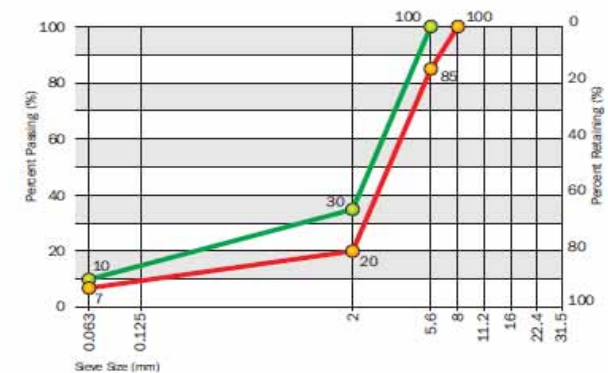
* factor α considers the density of the aggregate mixture

Recommendations for SMA plus

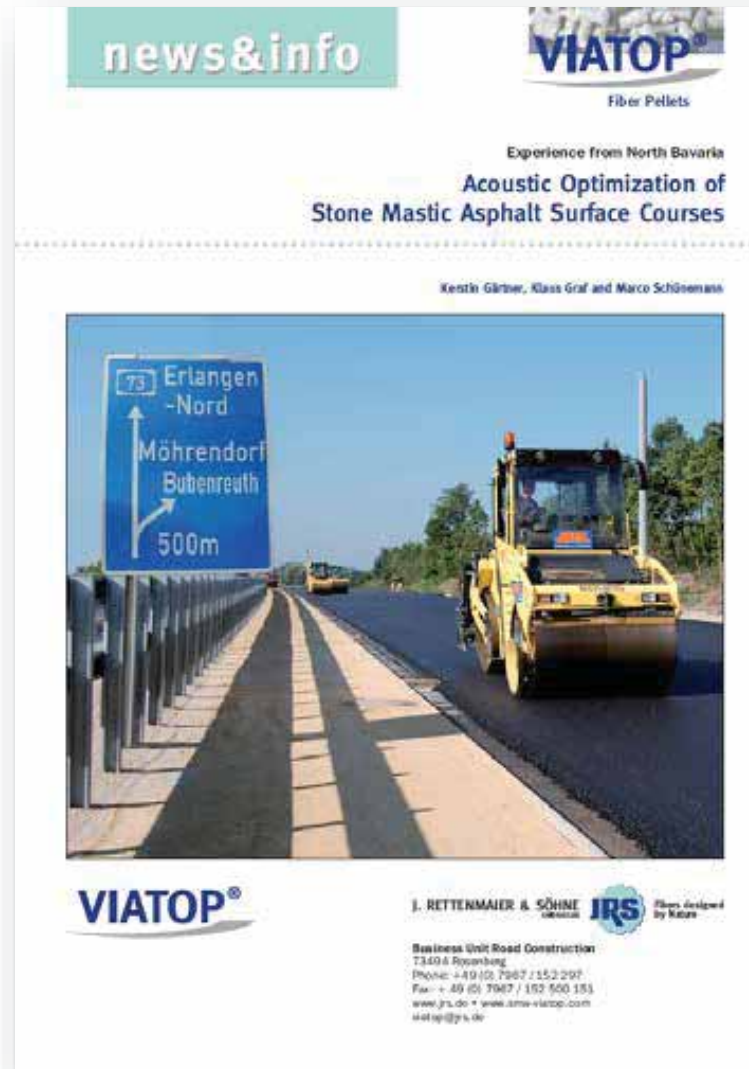
SMA plus 8



SMA plus 5



Publications



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since
1997



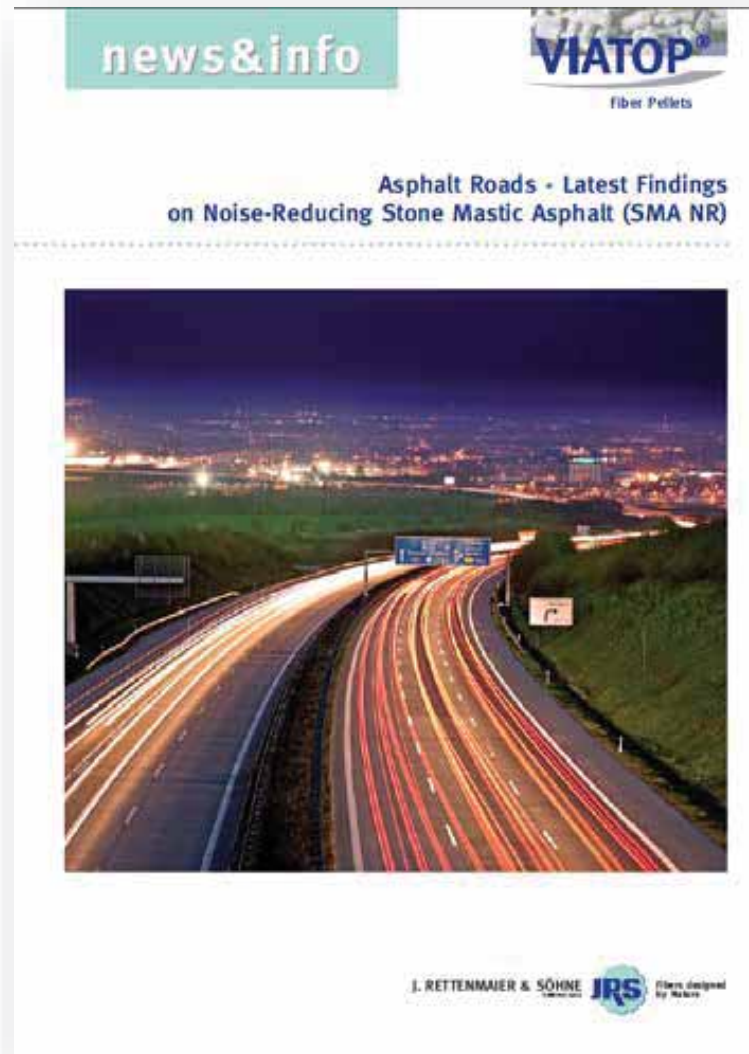
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Publications



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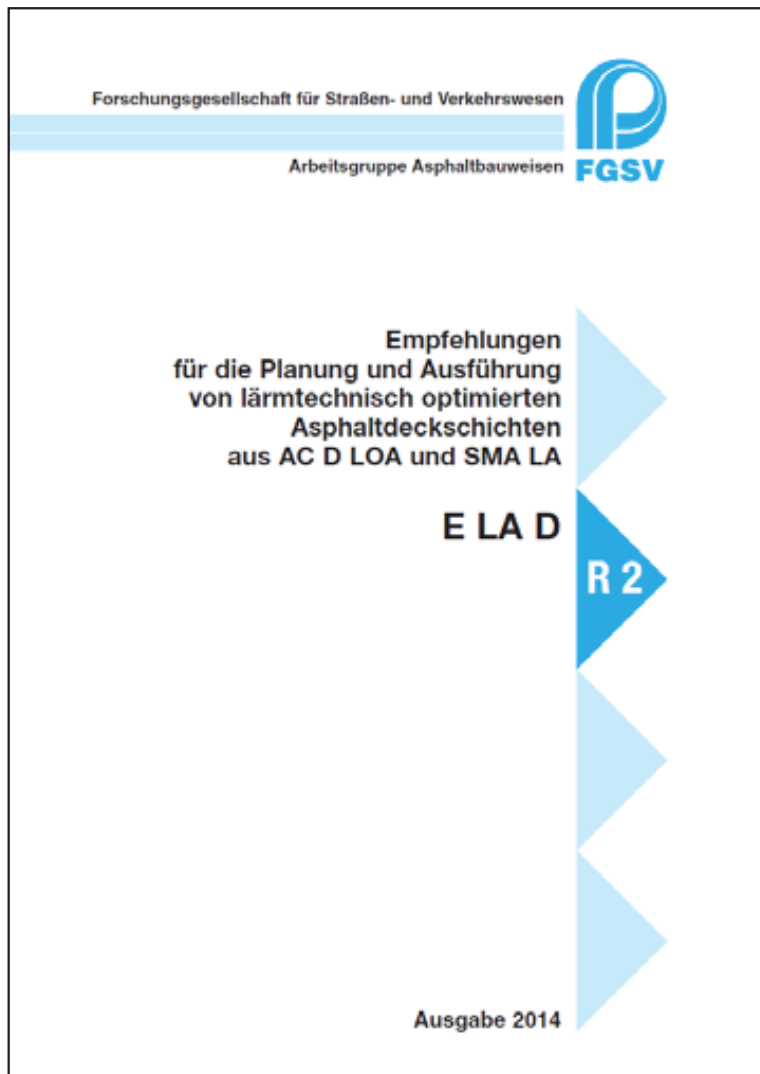


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SMA plus Specifications



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

Edition 2014



Recommendations

	Maximum Speed in km/h		
	$30 < v_{\max} \leq 50$	$50 < v_{\max} < 80$	$v_{\max} \geq 80$
Dominating traffic noise emission	Vehicle power train Trucks up to 50 km/h Cars up to 30 km/h	Contact tyre / road	
Recommended SMA mix	SMA plus 5	SMA plus 5	
		SMA plus 8	SMA plus 8

Source: E LA D, FGSV 2014



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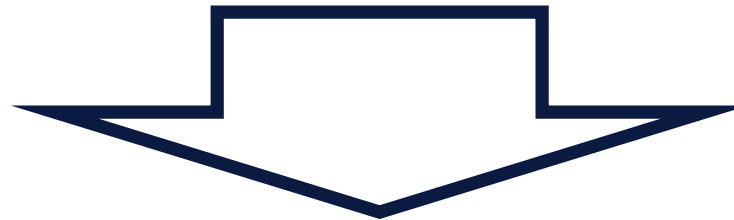
AC Duopave

ONCE UPON A TIME ...



OSTALBKREIS

Approach in 2008
**SMA Binder at District Ostalb -
Test Section ?**



Idea

**Adaption of the SMA Binder concept
for District Roads !**



AC Duopave

AC DUOPAVE

**Combination layer
surface / base course
„Two in One“**



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Das Pellet.



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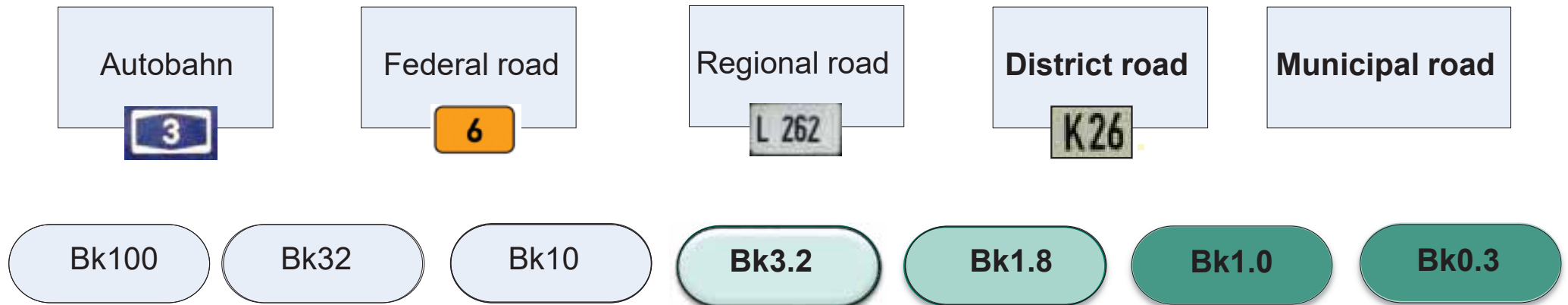
German Road Network



- Autobahn
- Federal Road
- Regional Road
- **District Road**
- **Municipal Road**



German Road Classification



Load

Road design according to load classes

Based on RStO 12 - Guidelines for the standardization of pavement structures of traffic areas, Edition 2012



AC Duopave for Municipal- / District- and partially for Regional Roads



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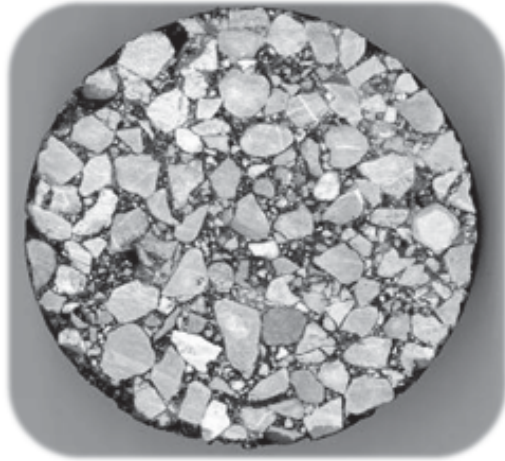


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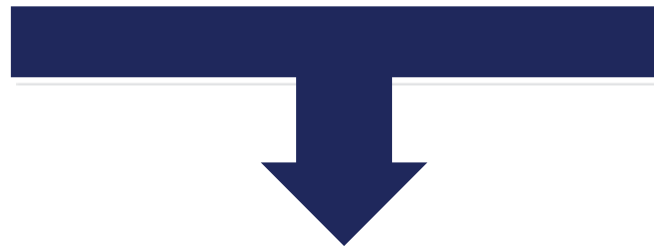
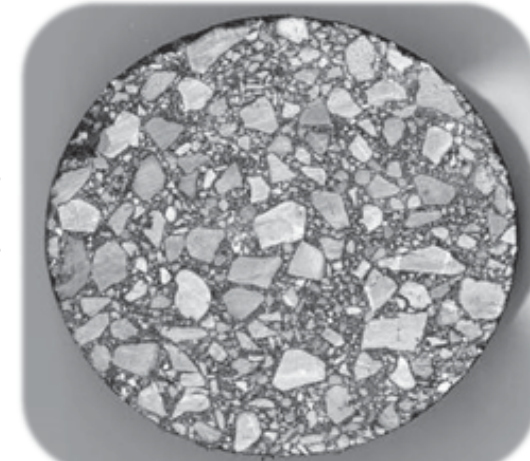
AC Duopave

Combination layer - surface / base course

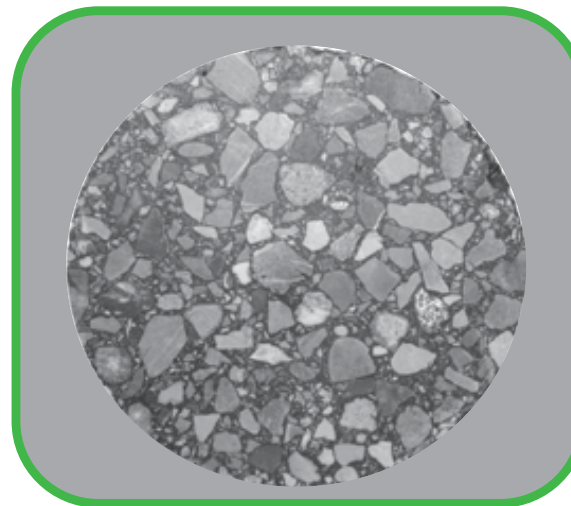
SMA



AC



AC Duopave



Aggregate fractions
11.2/16 mm
8/11.2 mm
5.6/8 mm
2/5.6 mm

Sand 0.063/2 mm
Filler \leq 0.063 mm
Bitumen
VIATOP®



First Trial Section

Combination layer surface / base course (two in one)

AC Duopave 16

June 17th, 2008

District Road 3321 Rosenberg - Unterknausen



First Trial Section



AC Duopave 16

Layer thickness 6 cm

June 2008

Germany - District Ostalb



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District Road – Höningen

Before maintenance



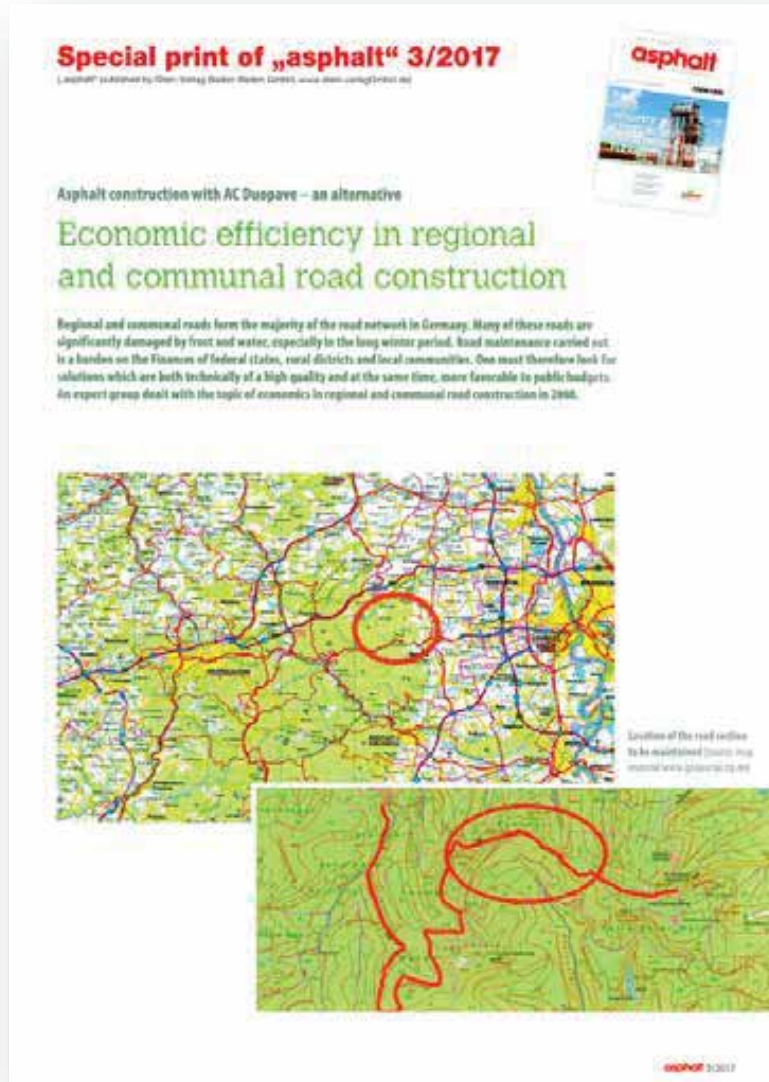
After maintenance



AC Duopave 16
Length 1,800 m



Publication



Economic efficiency in regional and communal road construction

March 2017



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since 1997



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AC Duopave – Advantages

- ✓ Paving in variable layer thickness possible



AC Duopave – Advantages

- ✓ High resistance to permanent deformation and wear



AC Duopave – Advantages

- ✓ Improved road safety due to convincing skid resistance properties



AC Duopave – Advantages

- ✓ Easy to pave and to compact



AC Duopave – Advantages

- ✓ Perfect type of mixture for low traffic regional and municipal roads



AC Duopave – Advantages

- ✓ **AC Duopave 16 (one layer – surface/base course) compared to conventional paving in two steps (two layers – surface + base course) is the more economic solution !**



AC Duopave – Recommendations



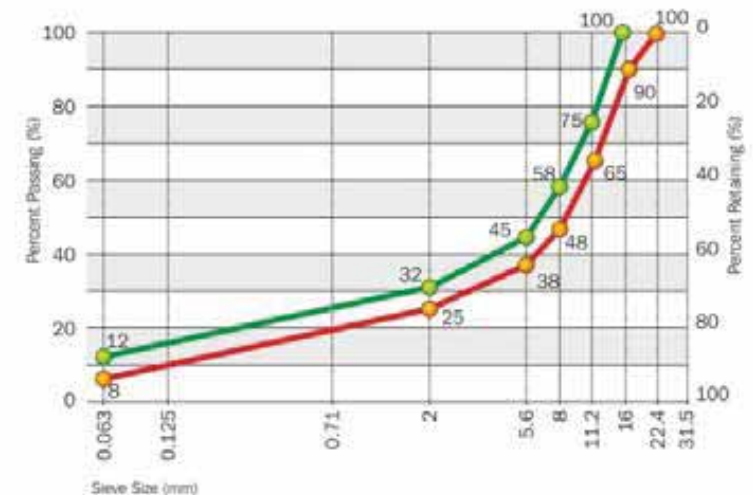
AC Duopave – Recommendations

Recommendations for AC Duopave

AC Duopave		AC Duopave 16	
Materials			
Aggregates (production size)			
Ratio crushed aggregate surface		$C_{min} \geq C_{max} \geq C_{nom}$	
Resistance to crushing		$5Z_{cr} / LA_{cr}$	
Resistance to polishing		PSV _{min} (48)	
Minimum part of fine aggregates 0/2 with E _c 35	%	50	
Composition of Asphalt Mixture			
Aggregate mixture			
Passing sieve	22.4 mm	% by weight	100
Passing sieve	16 mm	% by weight	90 - 100
Passing sieve	11.2 mm	% by weight	65 - 75
Passing sieve	8 mm	% by weight	48 - 58
Passing sieve	5.6 mm	% by weight	38 - 45
Passing sieve	2 mm	% by weight	25 - 32
Passing sieve	0.063 mm	% by weight	7 - 11
Binder			
Binder, type and grade			
Minimum binder content	% by weight	50/70	
Stabilizing additive (cellulose fibers)	% by weight	8 - 5.2	
		≥ 0.2	
Asphalt Mixture			
Minimum void content Marshall-Specimen	Vol-%	V _{min} 2.5	
Maximum void content Marshall-Specimen	Vol-%	V _{max} 3.0	
Characteristics of Layer			
Paving thickness	cm	4.0 - 8.0	
Degree of compaction	%	98.0	
Void content	Vol-%	5.0	
Gritting material		1.0 - 2.0 kg / m ² aggregates 2/5 mm (dedusted or lightly bitumenized)	

Recommendations for AC Duopave

AC Duopave 16



AC Duopave



Trial Section in Slovenia



AC Duopave 16
300 m test section
Company Trgograd



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Specification and Trial Section in Hungary



„Combined Wearing-Base Course Asphalt
Mix AC 16 for Pavement Construction on
Low-Volume Roads. Requirements“



From 2013 in Poland

**Jednowarstwowa nawierzchnia
asfaltowa**

SMA 16 JENA

Poradnik dla zarządców i wykonawców
dróg samorządowych



RETENMAIER Polska **IRS** Wiązka przewa
z natury

AC Duopave 16 = SMA 16 JENA
(in Poland)



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Hvala lijepa!

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Official Agent



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