



TANKOSLOJNI ZAVRŠNI SLOJEVI – HRN EN 13108-2





Habajući sloj (površinske karakteristike)

Bitumenizirani nosivi sloj

Tamponski sloj

Posteljica



BBTM – HRN EN 13108-2



- ▶ **BBTM - Béton Bitumineux Très Mince (French:
Very Thin Bituminous Concrete)**
- ▶ **Asfaltbeton za vrlo tanke habajuće slojeve**
 - čestice agregata općenito su diskontinuiranog sastava radi formiranja kontakta kamena s kamenom i postizanja otvorene površinske teksture
 - namijenjen za završne slojeve slojeve debljine od 20 mm do 30 mm



- ▶ Diskontinuirana granulometrijska krivulja, 0/8, 0/11
- ▶ 3 – 15% udio šupljina
- ▶ Vezivo: modificirani bitumen/cestograđevni bitumen
- ▶ Prosječna debљina sloja 20-30 mm
- ▶ Ugradnja:
 - ✓ Konvencionalna oprema za ugradnju
 - ✓ Vezivni sloj bitumenske emulzije 300-350 g/m²
 - ✓ Zbijanje čeličnim valjcima



► Granulometrijski sastav za BBTM

D	5 (5,6)		8		11 (11,2)		
Sito mm	5A	5B	8A	8B	11A	11B	11C
Prolazak kroz sito % (m/m)							
1,4 D ^a	100						
<i>D</i>	90 do 100						
Krupni po izboru	Maksimalna i minimalna vrijednost moraju se specificirati; raspon između maksimalne i minimalne vrijednosti odabire se između vrijednosti 10, 15 i 20						
2	25 do 35	15 do 25	25 do 35	15 do 25	25 do 35	15 do 25	25 do 35
Sitni po izboru	Maksimalna i minimalna vrijednost moraju se specificirati; raspon između maksimalne i minimalne vrijednosti odabire se između vrijednosti 4, 5, 6, 7, 8, 9, 10.						
0,063	7 do 9	4 do 6	7 do 9	4 do 6	7 do 9	4 do 6	10 do 12

^a Ako veličina sita izračunata kao 1,4 D nije cijeli broj u seriji ISO 565/R, uzima se slijedeća najbliža veličina sita



► Udio šupljina

► Gyratory (kružni zbijac)

Udio šupljina %	Kategorija V_g
10 do 17	$V_{g10 \text{ do } 17}$
12 do 19	$V_{g12 \text{ do } 19}$
18 do 25	$V_{g18 \text{ do } 25}$
20 do 25	$V_{g20 \text{ do } 25}$
Nema zahtjeva	V_{gNR}

► Marshall

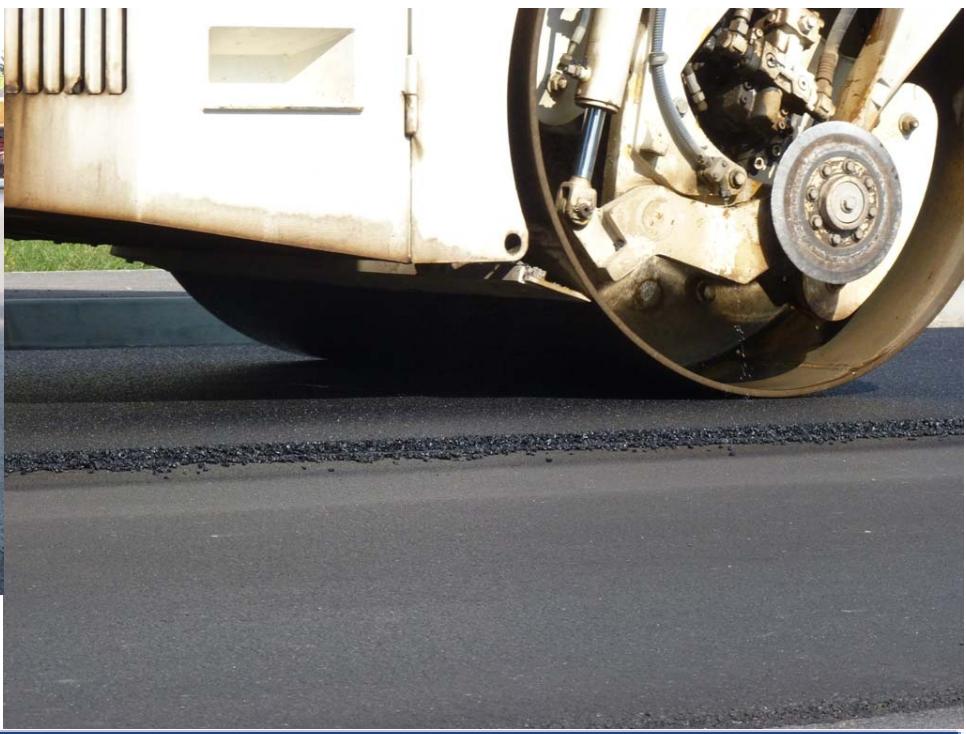
Udio šupljina %	Kategorija V_i ili V_v
3 do 6	$V_{i3 \text{ do } 6}$ ili $V_{v3 \text{ do } 6}$
7 do 10	$V_{i7 \text{ do } 10}$ ili $V_{v7 \text{ do } 10}$
11 do 15	$V_{i11 \text{ do } 15}$ ili $V_{v11 \text{ do } 15}$
Nema zahtjeva	V_{iNR} ili V_{vNR}



BBTM – ugradnja



► Ugradnja BBTM 8 u sloju debnjine 20 mm





BBTM 8 - makrotekstura



Zagreb – 11.10.2011.



BBTM 8 - makrotekstura





Makrotekstura klasičnog asfaltbetona sa kontinuiranom graničnom krivuljom





Površinska svojstva –
otpornost na klizanje

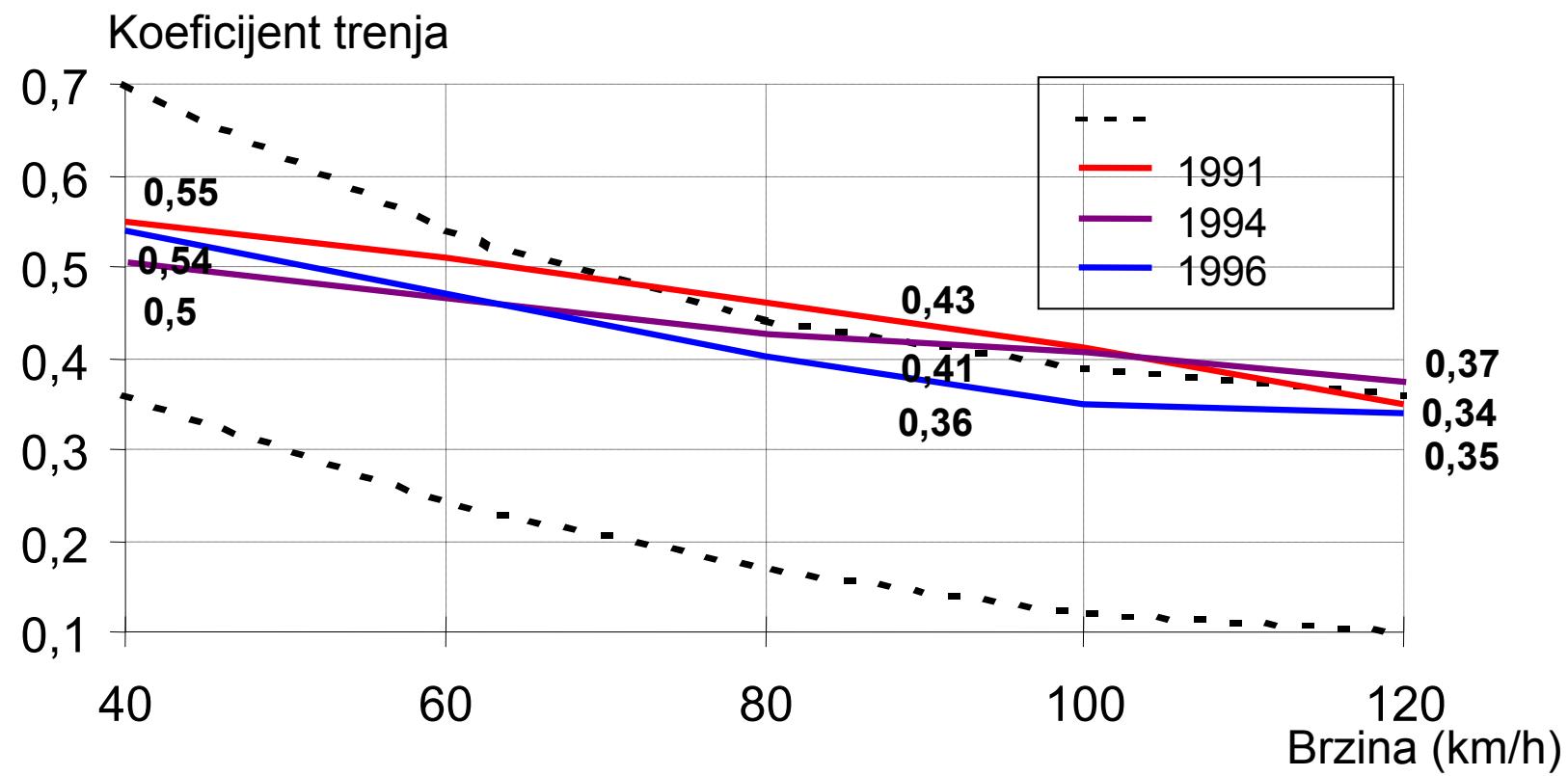


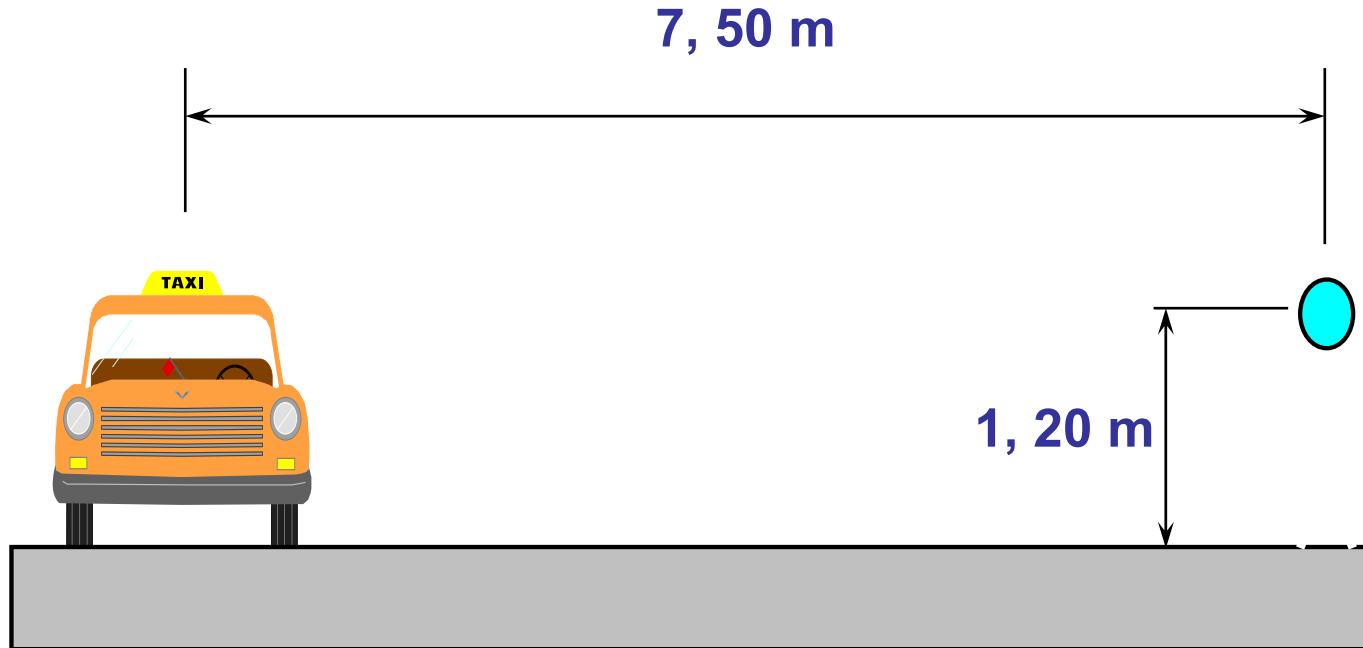
► **Uzdužni koeficijent trenja**
(standard NFP 98-220-2)

- **Uvjeti mjerena**
- ✓ Blokirani kotač (PIARC)
 - ✓ 1 mm vodenog filma
 - ✓ Brzina 40-120 km/h



► Završni sloj ugrađen 1987. godine

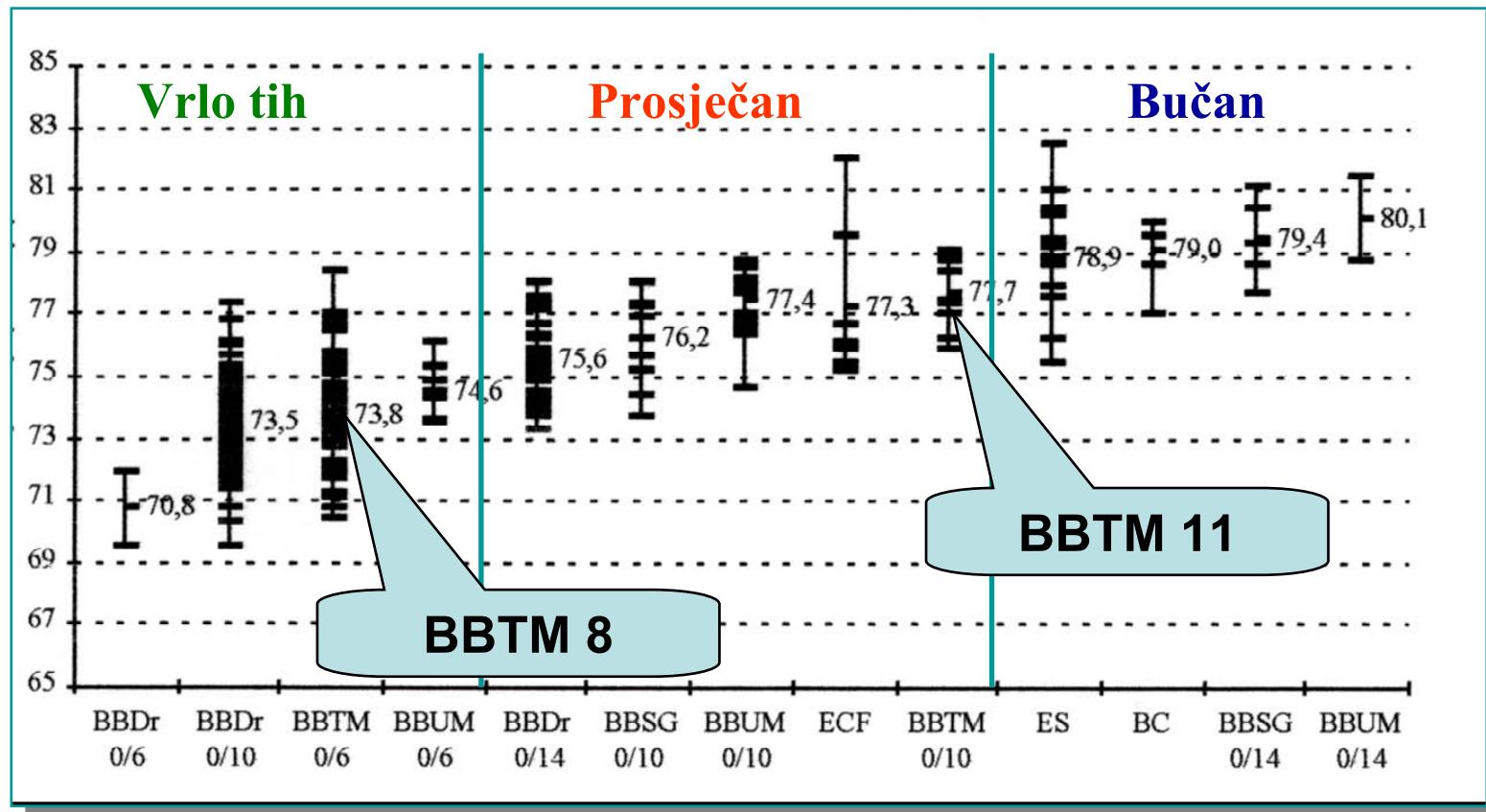




- ▶ **Standarizirana metoda S-31-119: Lamax=90 km/h**
 - ✓ Metoda prolaza vozila kraj mjernog mjesto



Baza podataka ispitivanja razine buke





ZAKLJUČAK



- ▶ Vrlo tanki asfaltni sloj osigurava vrlo dobру površinsku strukturu i ravnost, visoku i trajnu otpornost na klizanje, dobru otpornost na trajne deformacije, dobro dreniranje površine (odlična makro-tekstura), uz **niske troškove**
- ▶ Mogu se primjeniti za **sve razine prometa**
- ▶ **Otpornost na niske temperature** (visoki postotak šupljina) - korištenje polimerom modificiranog bitumena
- ▶ U tenderima treba propisati razinu makro-teksture i razinu i trajnost otpornosti na klizanje prema EN 13108-2
- ▶ Veličina zrna 0/8 i diskontinuirana krivulja rezultira **niskom razinom buke** uz izvrsna površinska svojstva



- ▶ U svrhu izrade ITT (početni tip ispitivanja) provedena su sljedeća laboratorijska ispitivanja
- ▶ **Dubina makroteksture**

- ▶ **BBTM 8 – 0,79 mm**

- ▶ **BBTM 11 – 1,1 mm**

Ramtech Ltd.
Testing, research and consulting in asphalt technology
Sachsova 6/VIII, 10000 Zagreb, Croatia

Test report:
I-182-2011

Date of test report:
July, 26th 2011.

Client:	Tebra d.o.o., Mihovljanska 70, 40000 Čakovec
Production of asphalt mixture:	Ramtech Ltd.
place of production:	Central laboratory
date of sampling:	May, 18th 2011.
Sampling:	Ramtech Ltd., Central laboratory
sample location:	/
original identification mark:	/
Type of asphalt mixture:	BBTM 8A PS(Tegra)-001/2011
Type of asphalt layer:	wearing course layer
produced from:	laboratory mixed asphalt
Laboratory test specimens:	HRN EN 12697-35 Laboratory mixing
method of production:	HRN EN 12397-33 Roller compactor
additional preparation:	
Date of testing :	May, 28 th 2011.
Type of bitumen:	PmB 45/80-65 Starfalt
Test conditions	temperature of testing: temperature of conditioning:
	23 °C 23 °C

Surface texture depth (HRN EN 13036- 1:laser) [mm]

Measurements made immediately after compaction	0,77	0,81	0,69	0,78	0,86
MTD	0,79				



- ▶ U svrhu izrade ITT (početni tip ispitivanja) provedena su sljedeća laboratorijska ispitivanja
- ▶ **SRT - otpornost na klizanje**
- ▶ **BBTM 8 – 65**
- ▶ **BBTM 11 – 68**

Ramtech Ltd.
Testing, research and consulting in asphalt technology
Sachsova 6/VIII, 10000 Zagreb, Croatia

Test report:
I-183-2011

Date of test report:
July, 26th 2011.

Client:	Tegra d.o.o., Mihovljanska 70, 40000 Čakovec
Production of asphalt mixture:	Ramtech Ltd.
producer:	
place of production:	Central laboratory
Sampling:	
date of sampling:	May, 18th 2011.
sample location:	Ramtech Ltd., Central laboratory
original identification mark:	/
Type of asphalt mixture:	BBTM 8A PS(Tegra)-001/2011
Type of asphalt layer:	wearing course layer
produced from:	laboratory mixed asphalt
Laboratory test specimens:	
method of production:	HRN EN 12697-35 Laboratory mixing
additional preparation:	HRN EN 12397-33 Roller compactor
Date of testing :	May, 28 th 2011.
Type of bitumen:	PmB 45/80-65 Starfalt
Test conditions	
temperature of testing:	23 °C
temperature of conditioning:	23 °C

Skid resistance (HRN EN 13036-4) [SRT]

Measurements made immediately after compaction	64	64	65	65	65
The mean value					65
Measured temperature					23 °C
Correction to measured value					0
PTV _{CORR}					65



► Otpornost na trajnu deformaciju

Ramtech Ltd.

Testing, research and consulting in asphalt technology

Test report date:
25th of July, 2011.

► BBTM 8

WTS_{air} = 0,049

PRD_{air} = 4,40

► BBTM 11

WTS_{air} = 0,04

PRD_{air} = 4,0

Client: Tegra d.o.o., Mihovljanska 70, 40000 Čakovec

Construction:

Initial Type Testing

Sample location:

Laboratory Specimen

Sample description:

Asphalt Wearing Course

Type of asphalt mixture:

BBTM 8A (PS Tegra 001/2011)

Date of sampling

5th of May, 2011.

Date of testing:

19th of May, 2011.

Wheel-tracking test report number:

WT-LU 410/2011

RESISTANCE OF ASPHALT LAYER TO PERMANENT DEFORMATION- SUMMARY OF LABORATORY TEST RESULTS

Identification of specimen in series	Original identification of specimen	Specimen thickness [mm]	Rut depth [mm]	Wheel-tracking slope [mm/10 ³ load cycles]	Proportional rut depth [%]	Test temperature [°C]	Additional notes
Specimen 1	Bituminous layer slab number 1	50,0	1,99	0,048	3,98	60,0	
Specimen 2	Bituminous layer slab number 2	50,0	2,41	0,050	4,82	60,0	

Mean wheel-tracking slope (WTS_{AIR}) : 0,049 [mm/10³ load cycles]

Mean rut depth (RD_{AIR}): 2,20 [mm]

Mean proportional rut depth (PRD_{AIR}): 4,40 [%]

Measuring by:

Matija Šafran

Evaluation:

Tested sample of asphalt layer has very good resistance to permanent deformation

Test report by:

Tomislav Šafran, dipl.ing.



► Ponašanje asfalta pri niskim temperaturama

- **BBTM 8**
-14,40 C° / 6,59 MPa

- **BBTM 11**
-31,5 C° / 4,7 MPa

Ramtech Ltd.

Testing, research and consulting in asphalt technology

Client:	Tegra d.o.o., Mihovljanska 70, 40000 Čakovec
Asphalt Mix Production	Producer: Tegra d.o.o., Mihovljanska 70, 40000 Čakovec
	Place of production: Asphalt Plant Ivanovec
Paving	Producer: Tegra d.o.o.
	Project: Initial Type Testing
	Type of asphalt layer: Asphalt Wearing Course
Sampling	Date: 15th of April 2011
	Place: Asphalt Plant
	Type of specimens: Raw materials
	Type of asphalt mixture: BBTM 8A
	Type of Bitumen: PrmB 45/80-65 Starfalt
Laboratory specimens	prepared from: Bituminous layer slab compacted in laboratory
	Compaction procedure: EN 12697-33:2008
	Mixing procedure: EN 12697-35:2008
	Date of testing: from 15th of April to 25th of May 2011.
	Test report serial number: 048

SUMMARY OF LABORATORY TEST RESULTS

Temperature that corresponds to maximum of thermal strength reserve [°C]	Maximum of thermal strength reserve [MPa]
-14,40	6,59



► Modul krutosti

► BBTM 8 – 4997 MPa

Ramtech Ltd.

Testing, research and consulting in asphalt technology
Sachsova 6/VIII, 10000 Zagreb, Croatia

Client:

Tegra d.o.o., Mihovljanska 70, 40000 Čakovec

Tested characteristic:

Determination of stiffness modulus

Relevant european standard:

EN 12697-26:2004 (Annex B: 4PB-PR)

Type of asphalt mixture:

BBTM 8A, bituminous wearing course, maximum grain size 8 mm

Mix design mark:

PS(Tegra)-001/2011

Method of asphalt mixture preparation:

EN 12697-35:2008

Method of specimen compaction:

EN 12697-33:2008

Test temperature:

20 °C

Test frequency:

8 Hz

Test report identification No.

MK-LU 019/2011

Date of test:
23rd of July, 2011.**STIFFNESS MODULUS - SUMMARY OF LABORATORY TEST RESULTS**

Mixture type and mix design mark	Stiffness modulus $ S'_m $ [MPa]
BBTM 8A (PS(Tegra)-001/2011)	4997

Laboratory measuring by:
Matija Šafran

Test report by:
Tomislav Šafran, dipl.ing.građ.