GREEN AND INNOVATIVE APPROACH TO A NEW GENERATION OF ASPHALT PAVEMENT CONSTRUCTION

MECHANICAL – CHEMICAL STRENGTHENED BASE COURSE

TPA - Society for Quality Assurance and Innovation (member of STRABAG concern)
Slovak Road Association

Zsolt Boros

MAÚT30 International Scientific Symposium
1-2 Oct 2024, Budapest, Hungary

BASECO$_2$URSE

CONTENT

Base courses in our Pavements

Application Potential

Pozzolanic reactivity
Frattini test

Verification in the practice

BASE COURSES IN OUR PAVEMENTS

ASPHALT PAVEMENT

DIFFERENCE IN THE BASE COURSE

FLEXIBLE

SEMI-RIGID

CEMENT CONCRETE PAVEMENT

RIGID

BASE COURSES IN OUR PAVEMENTS

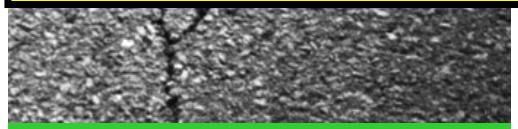
The semi-rigid pavements are in Slovakia very popular

Thanks to the high mechanical efficiency of a semi-rigid pavement construction, it results as a winner of optimization process of pavement design
- it is the most economical alternative

In the design phase, the maintenance costs are not taken into account ... (?)

BASE COURSES IN OUR PAVEMENTS

The influence of neglected reflective cracks on the traffic comfort of the road is comparable to the state of degraded joints of cement concrete pavements.



Branched crack

Duplicated crack in the wearing course

BASE COURSES IN OUR PAVEMENTS

MOTIVATION

Development of an unbound base layer with the maximum possible load-bearing capacity (modulus of elasticity) by optimizing the composition and looking for further possibilities.

BASE COURSES IN OUR PAVEMENTS

PARAMETERS FOR PAVEMENT DESIGN

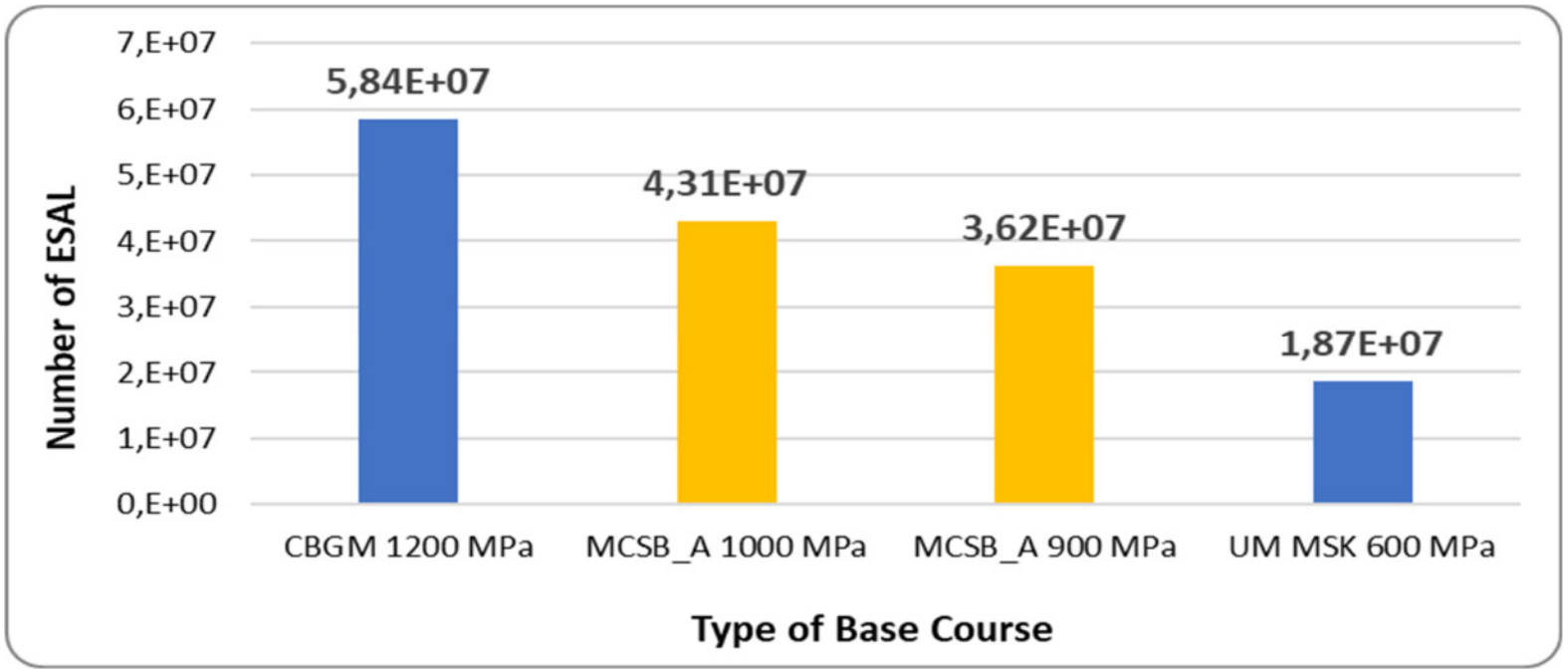
Layer	Thickness /mm/	Modulus of elasticity /MPa/	Poisson ratio	Bending strength /MPa/	Fatigue coefficients	
					a	b
AC11 surf	40	6000	0.3	3.2	0.97	0.105
AC16 bin	90	4600	0.3	2.8	0.95	0.11
AC22 base	70	4000	0.3	2.6	0.95	0.11
MCSB_A	170	1000 900	0.25	0.4	1.0	0.097
UM MSK		600	0.25	0.1	-	-
CBGM		1200	0.25	0.5	1.0	0.095
UM SD	220	350	0.30	0.07	-	-
Subgrade	infinity	90	0.35	-	-	-

Design values of elasticity modulus

Sensitivity analysis of pavement life

BASE COURSES IN OUR PAVEMENTS

PARAMETERS FOR PAVEMENT DESIGN



Design values of elasticity modulus

Sensitivity analysis of pavement life

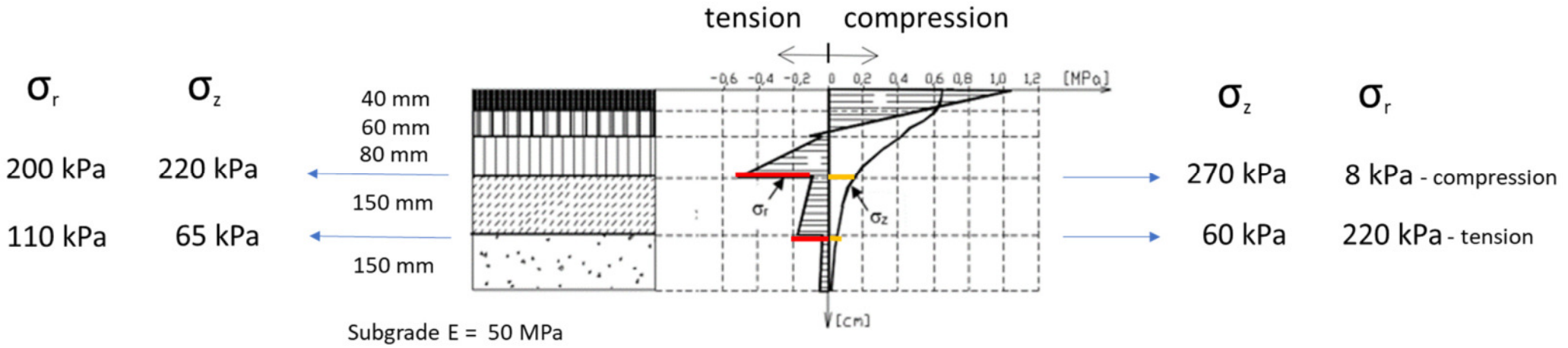
BASE COURSES IN OUR PAVEMENTS

PARAMETERS FOR PAVEMENT DESIGN

Stress State in the Pavement

flexible semirigid

Axle load 100 kN, 1 contact area, contact pressure 0,65 MPa, summer conditions



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APPLICATION POTENTIAL FOR OUR ROADS

APPLICATION POTENTIAL FOR OUR ROADS

MCSB-TPA

GREEN ANSWER TO THE PROBLEMS OF REFLECTIVE CRACKING OF SEMI-RIGID PAVEMENT CONSTRUCTIONS

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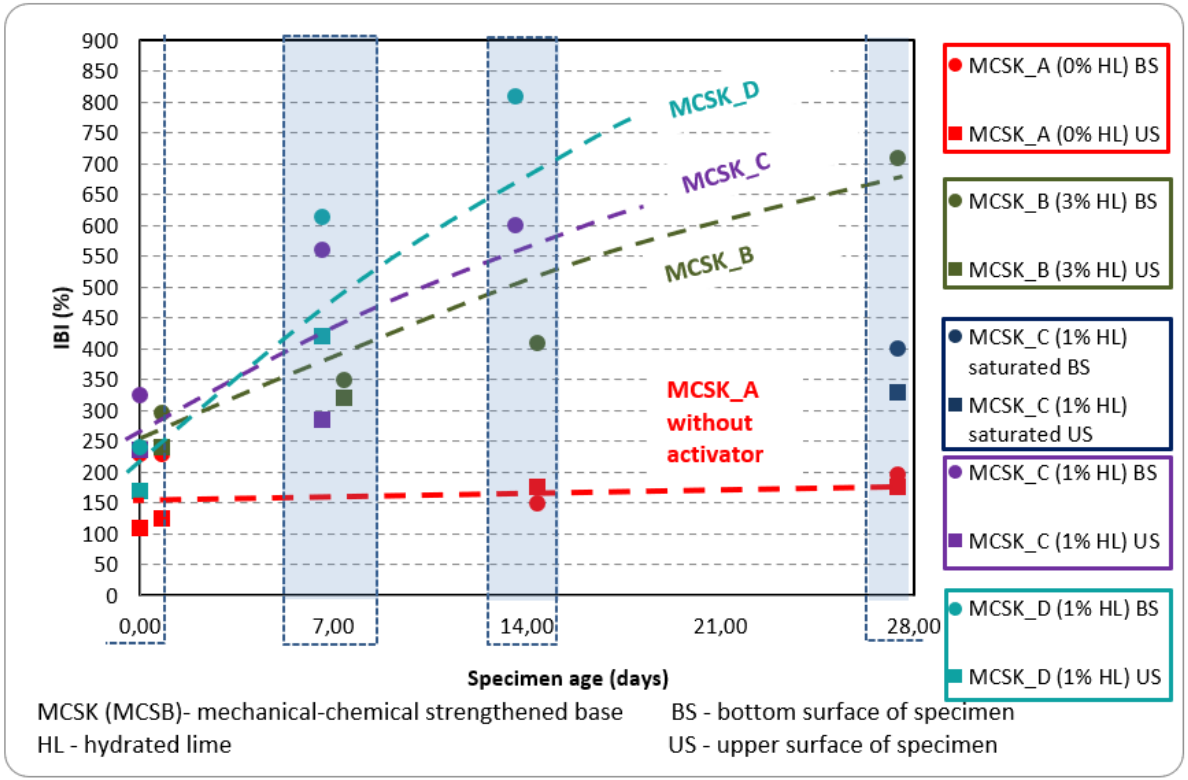
APPLICATION POTENTIAL FOR OUR ROADS

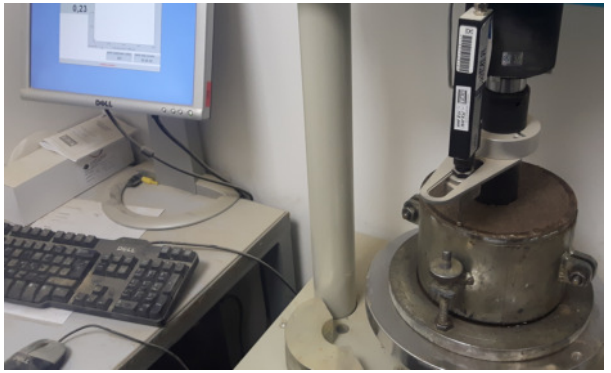
MECHANICAL-CHEMICAL STRENGTHENED BASE COURSE

IBI (CBR)

Required test for unbonded base course mix according to TKP 5
Minimum value for „MSK“: IBI ≥ 100%

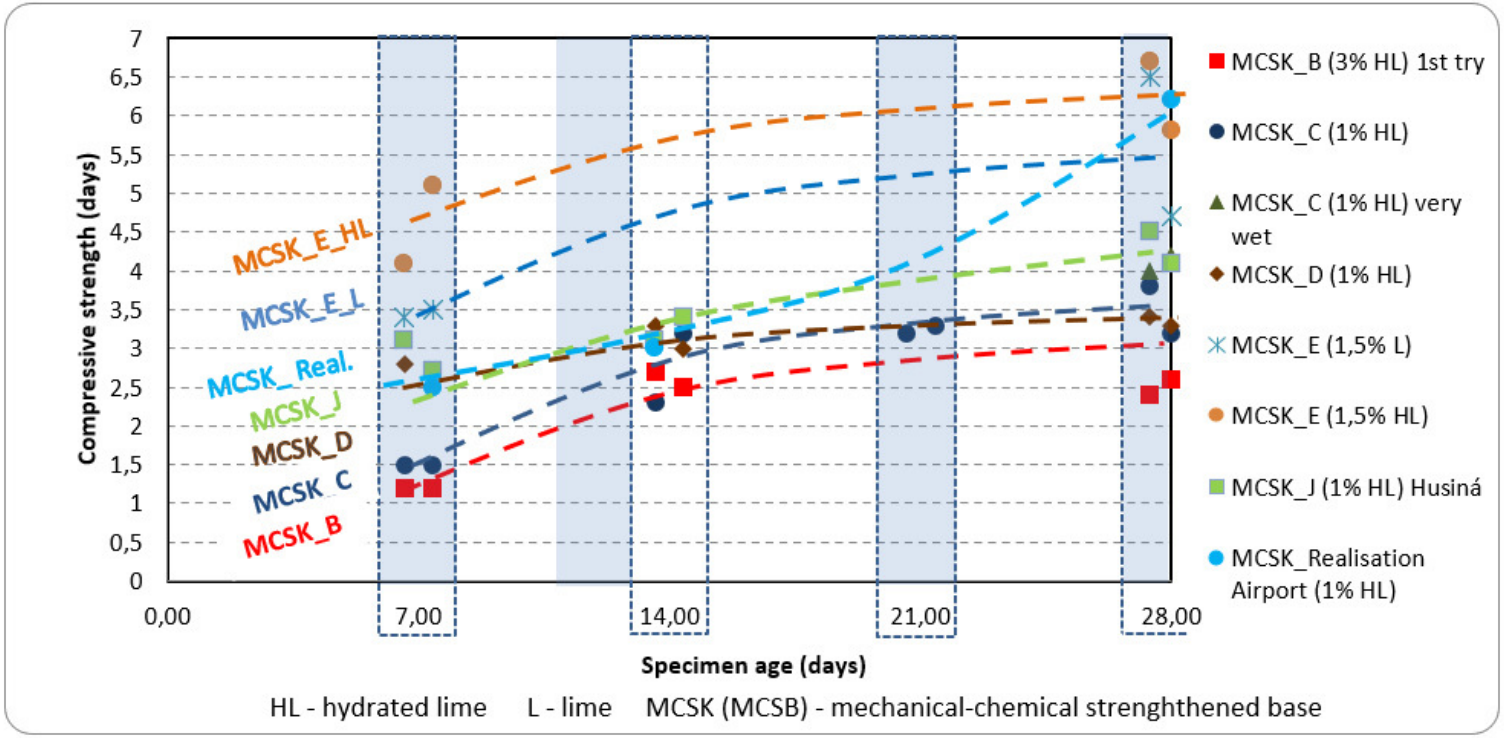


MCSK (MCSB)- mechanical-chemical strengthened base
HL - hydrated lime
BS - bottom surface of specimen
US - upper surface of specimen



COMPRESSIVE STRENGTH

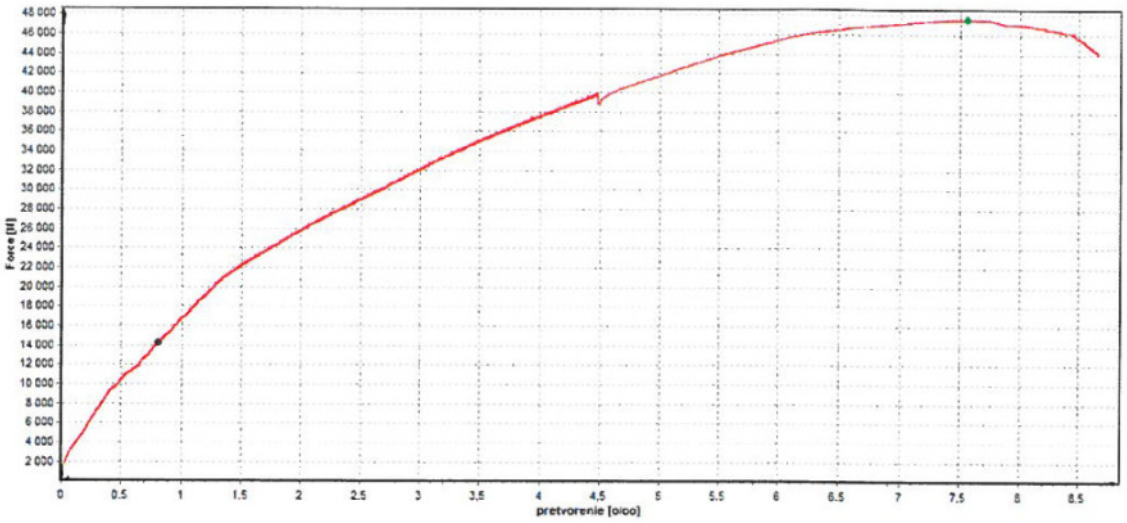
High IBI values→ Compressive strength testing according to STN EN 13286-41 → Material tends to cemented types (CBGM)

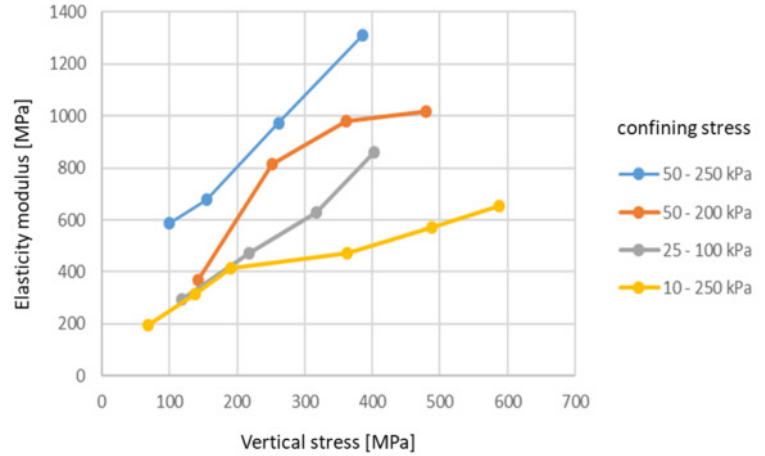


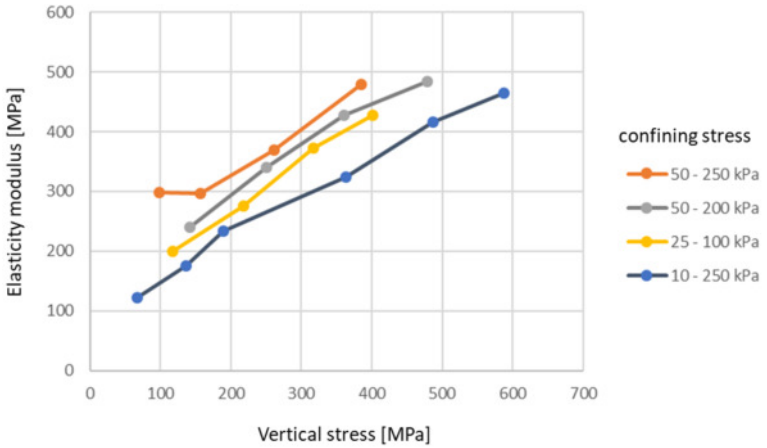
MODULUS OF ELASTICITY

Design values → Necessary for pavement design

Different methods for testing of E modulus







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POZZOLANIC REACTIVITY

FRATTINI TEST

Direct method for determining the pozzolanicity of a material

The pozzolanic reactivity is expressed as the concentration of CaO captured by 1 gram of pozzolan in a supersaturated $Ca(OH)_2$ solution and converted to percent CaO binding efficiency of the pozzolan.

FRATTINI TEST

VERIFICATION IN THE PRACTICE

VERIFICATION IN THE PRACTICE

Modernisation: 2018
Contractor: STRABAG
Legth of Runway: 1 081 m

The modernisation included the construction of paved movement areas

RWY - 26 t. m2
TWY - 600 m2
APN – 6,5 t. m2

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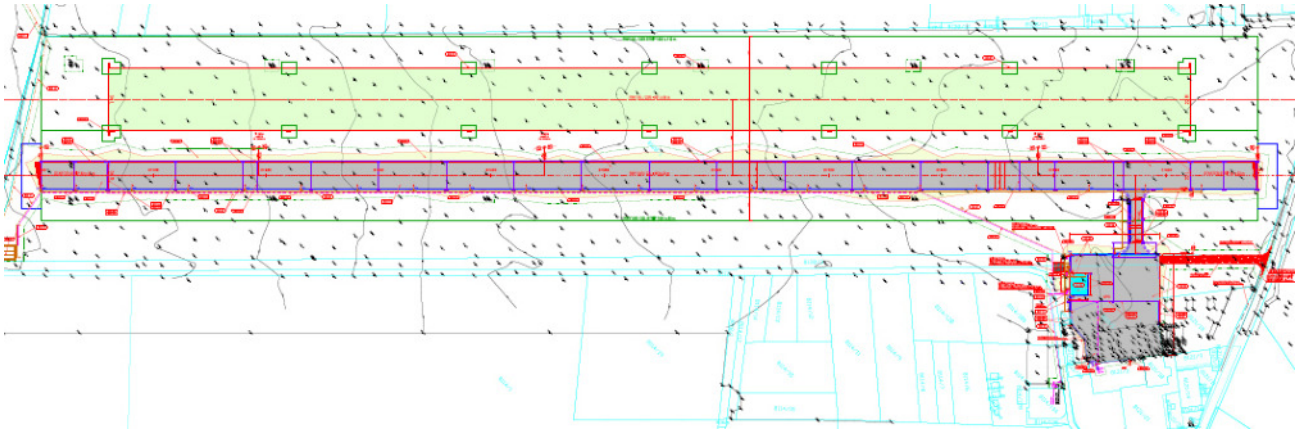
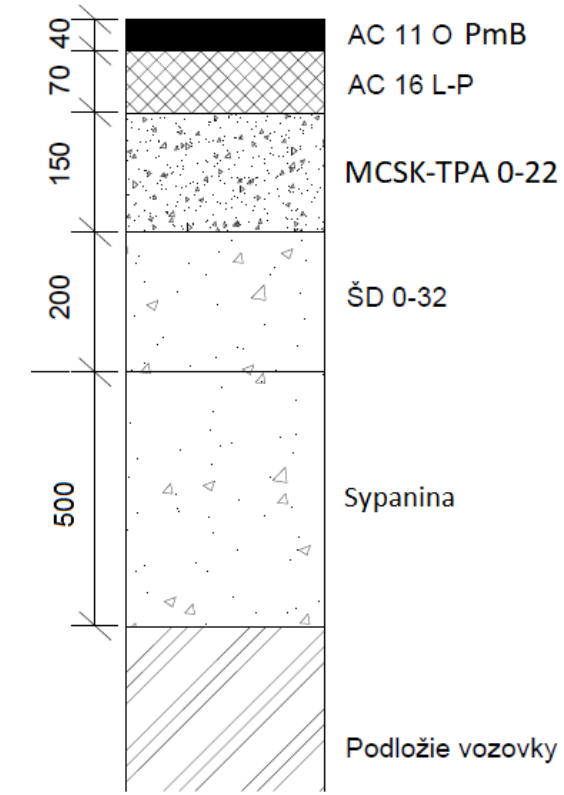
VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA





Volume of built-in MCSB-TPA: **approx. 4 700 m³**
approx. 10 700 t

VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - TRANSPORT TO THE CONSTRUCTION SITE

VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - LAYING

VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - LAYING

VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - LAYING

VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - COMMISSIONING

VERIFICATION IN THE PRACTICE

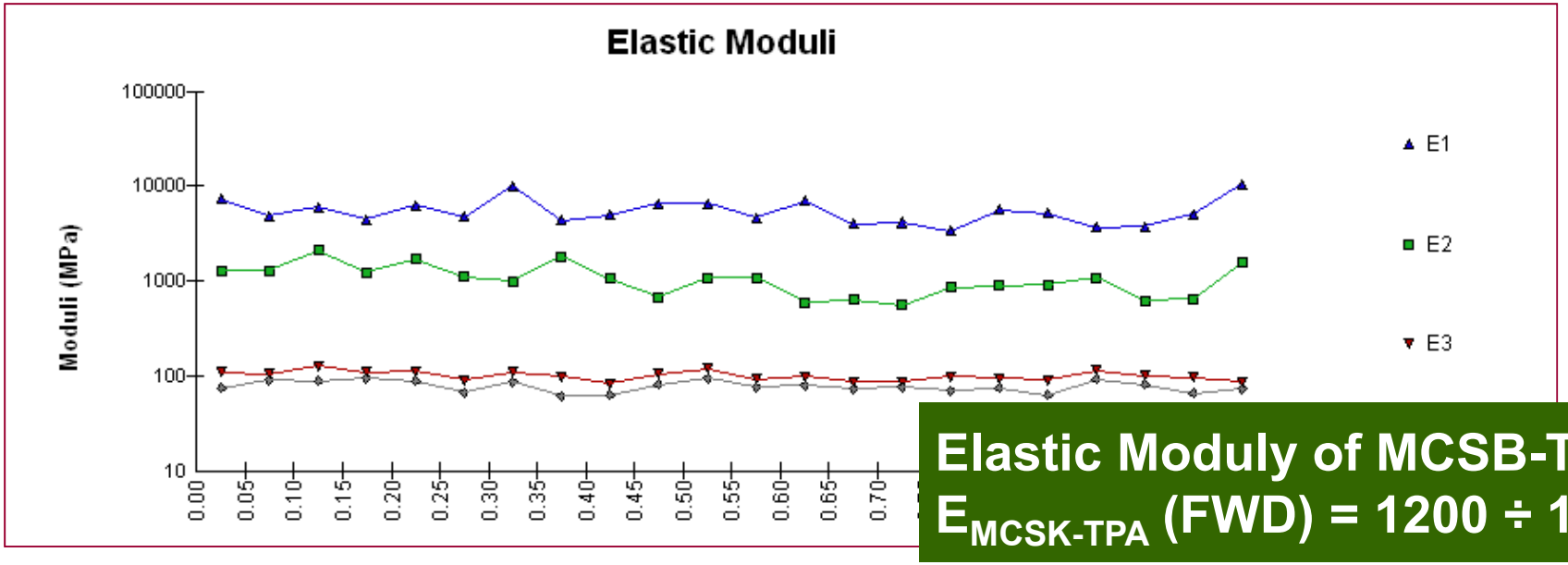
AIRPORT PRIEVIDZA - VERIFICATION AFTER IMPLEMENTATION

FWD MEASUREMENT

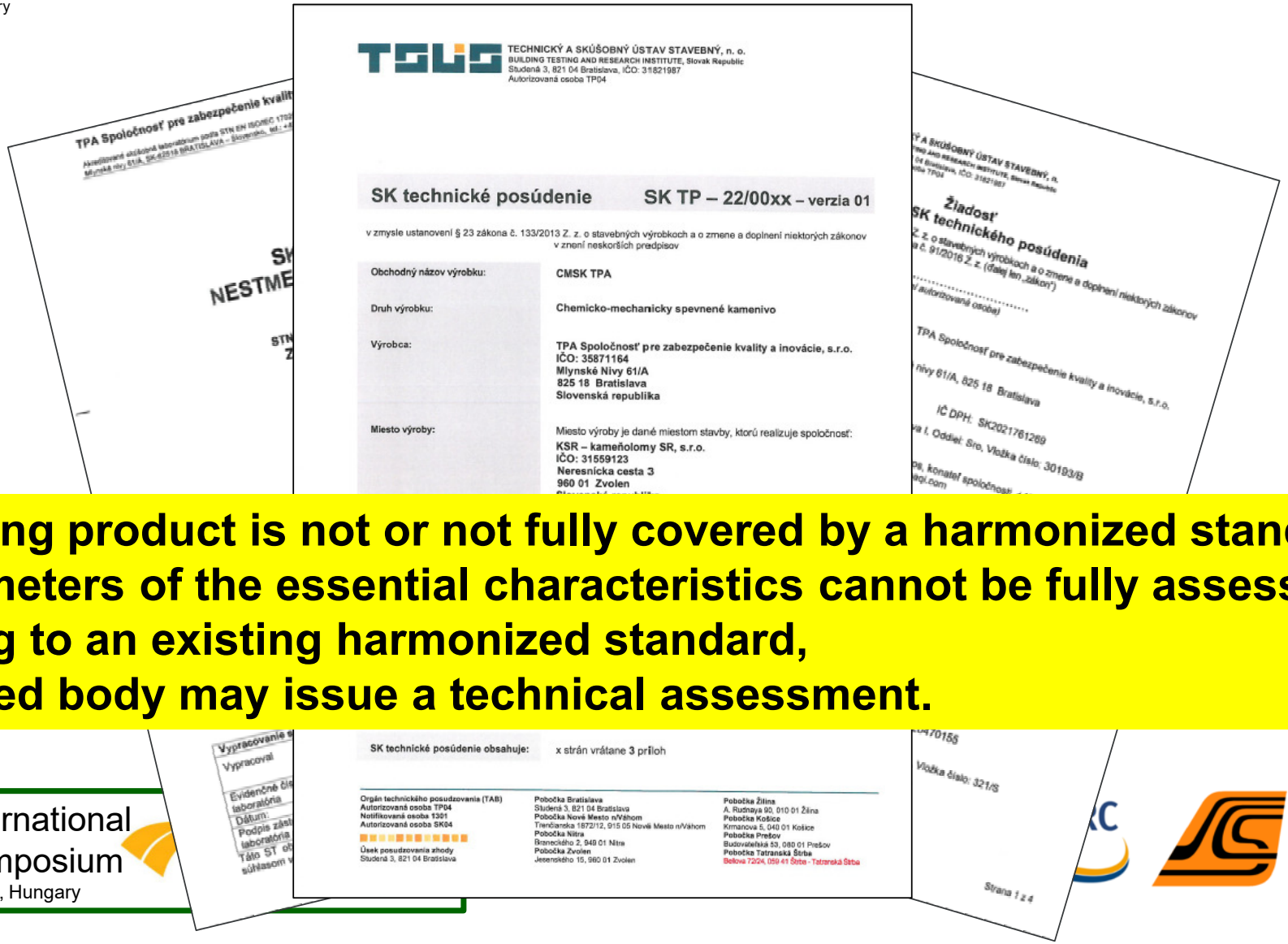
VERIFICATION IN THE PRACTICE

AIRPORT PRIEVIDZA - VERIFICATION AFTER IMPLEMENTATION

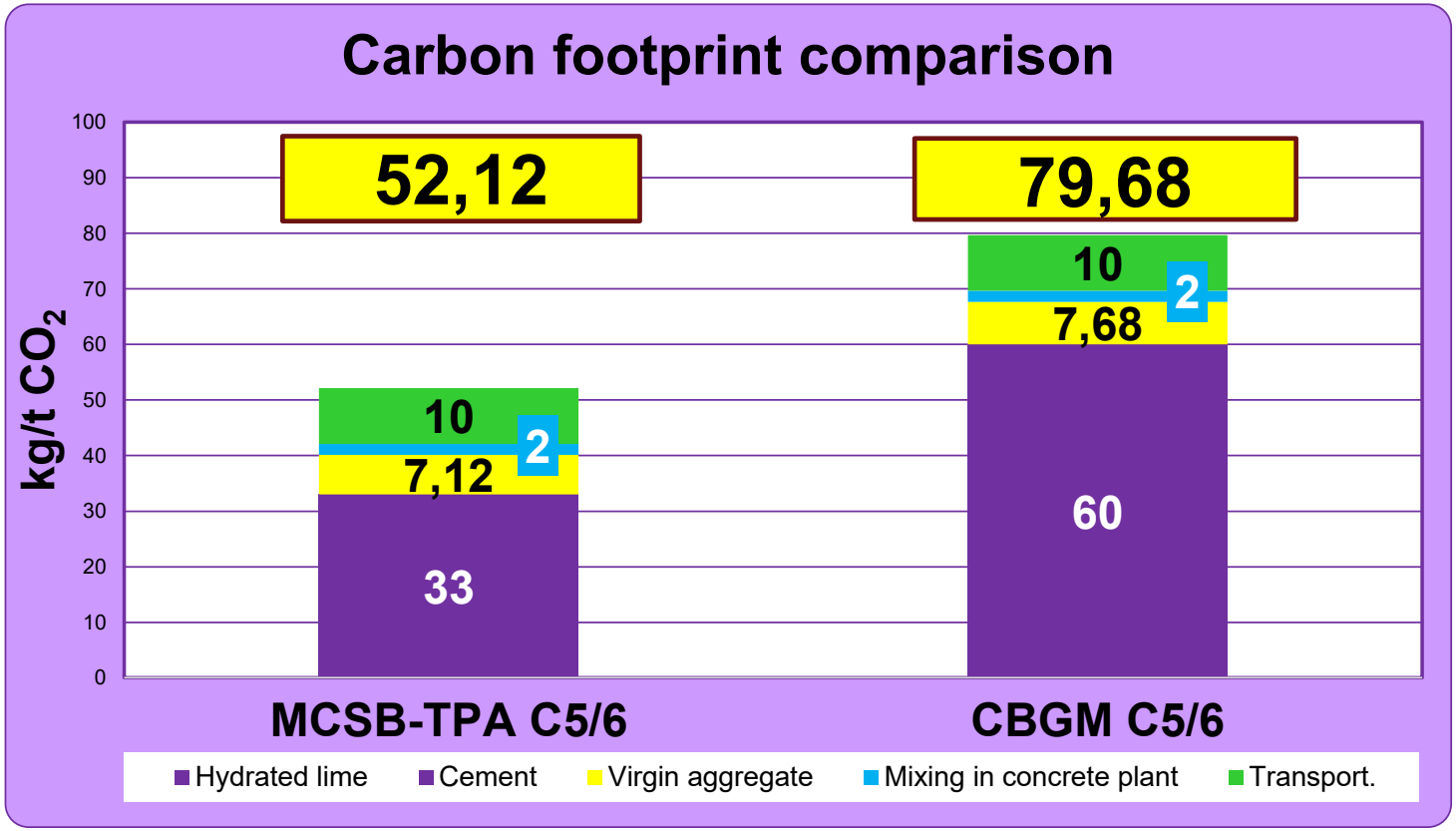
FWD MEASUREMENT



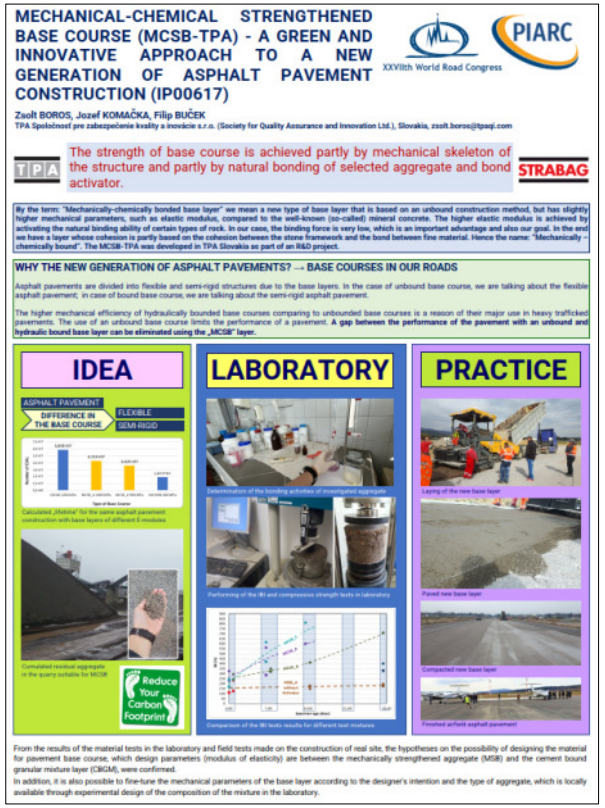
Elastic Moduly of MCSB-TPA
$E_{MCSK\text{-}TPA}$ (FWD) = 1200 ÷ 1600 MPa



**If a building product is not or not fully covered by a harmonized standard, or the parameters of the essential characteristics cannot be fully assessed according to an existing harmonized standard,
the notified body may issue a technical assessment.**


Carbon footprint comparison
kg/t CO_2
100
90
80
70
60
50
40
30
20
10
0
52,12
79,68
10
2
7,12
33
10
2
7,68
60
MCSB-TPA C5/6
CBGM C5/6
Hydrated lime
Cement
Virgin aggregate
Mixing in concrete plant
Transport.

CONCLUSION



SUCCESSFUL RESEARCH PROJECT

Promising hypotheses based on theory (silicate chemistry)

Confirmation of hypotheses in TPA laboratories

Practical verification - excellent results

2018 – Base Course – airfields in PRIEVIDZA

MAIN ADVANTAGE: USE OF THE RESIDUAL 0/4 CARBONATED FRACTION FROM THE QUARRY

AUTHORS/ ACKNOWLEDGEMENTS

This technical report has been prepared by the Technical Committee 4.1 Pavements of the World Road Association (PIARC).

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Salome NAICKER (SOUTH AFRICA), Mario JAIR (ARGENTINA) were responsible for the quality control of this technical report.

The Technical Committee was chaired by Margo BRIESSINCK (Belgium). Gina AHLSTROM (USA), Aïda BERGAOUI SRIHA (Tunisia) and Horacio DELGADO ALAMILLA (Mexico) were respectively the English, French, and Spanish-speaking secretaries.

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