

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



CONTENT



Base courses in our Pavements



Application Potential



**Pozzolanic reactivity
Frattoni test**



Verification in the practice

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

BASE COURSES IN OUR PAVEMENTS

ASPHALT PAVEMENT

DIFFERENCE IN THE
BASE COURSE

FLEXIBLE

SEMI-RIGID

CEMENT CONCRETE PAVEMENT

RIGID

BASE COURSES IN OUR PAVEMENTS

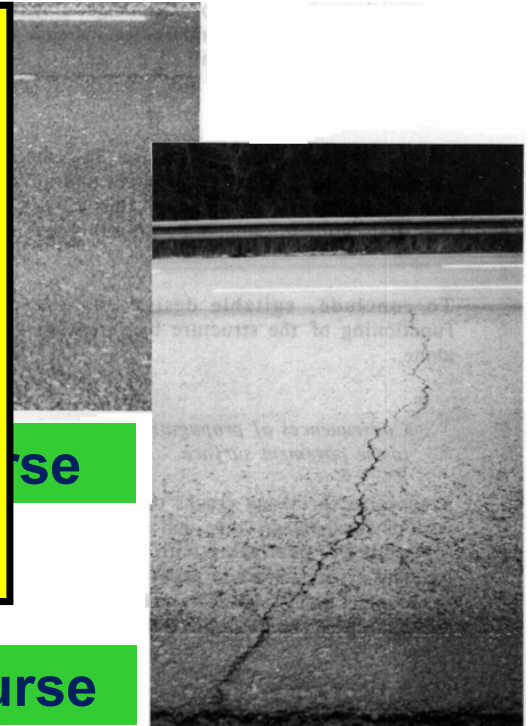
The semi-rigid pavements are in Slovakia very popular

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

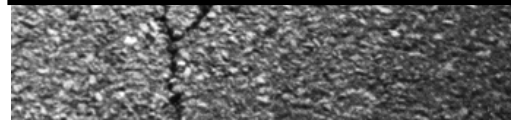
In the design phase, the maintenance costs are not taken into account ... (?)

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.



Duplicated crack in the wearing course



Branched crack

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

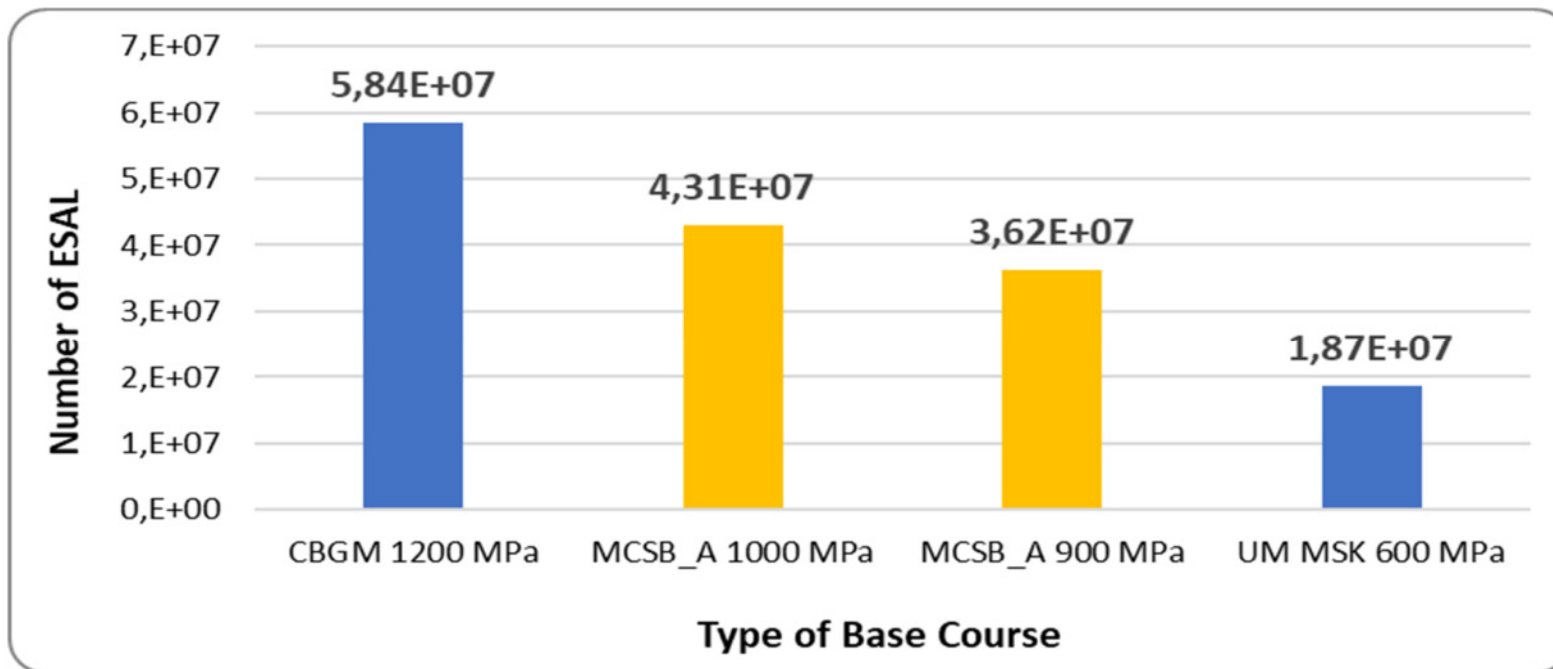
Layer	Thickness /mm/	Modulus of elasticity /MPa/	Poisson ratio	Bending strength /MPa/	Fatigue coefficients	
					a	b
AC11 surf	40	6000	0.3	3.2	0.97	0.105
AC16 bin	90	4600	0.3	2.8	0.95	0.11
AC22 base	70	4000	0.3	2.6	0.95	0.11
MCSB_A	170	1000	0.25	0.4	1.0	0.097
UM MSK		900				
CBGM		600				
UM SD	220	1200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

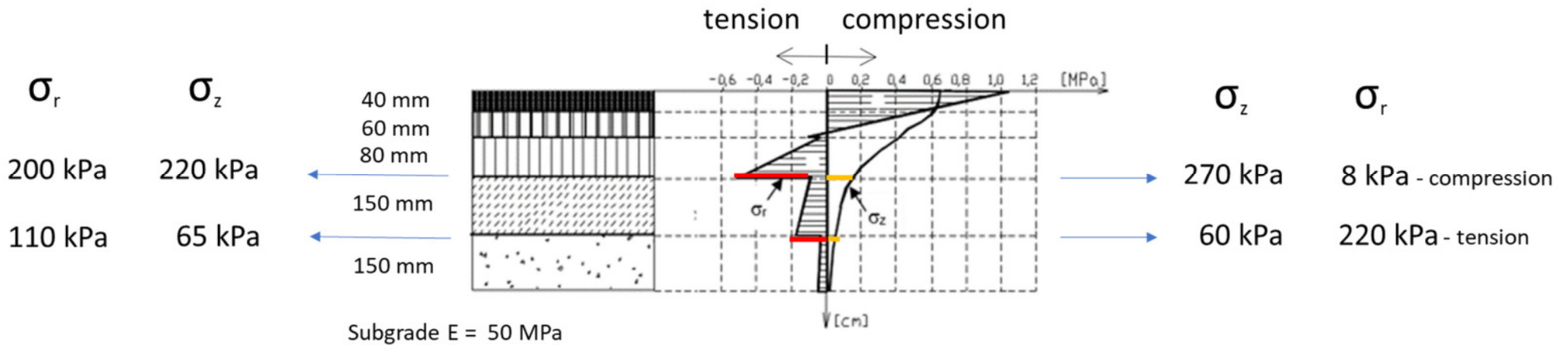
PARAMETERS FOR PAVEMENT DESIGN

Stress State in the Pavement

flexible

semirigid

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



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**

**MECHANICAL-
CHEMICAL
STRENGTHENED
BASE COURSE**

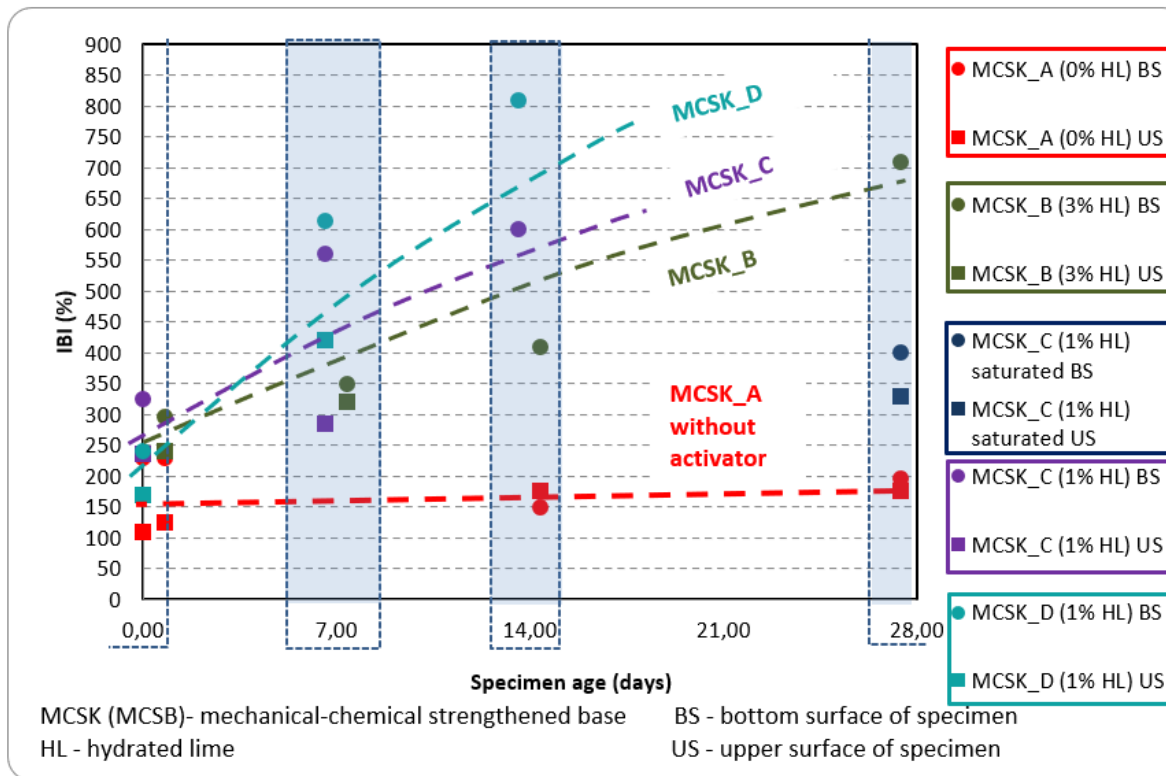
APPLICATION POTENTIAL FOR OUR ROADS

MECHANICAL-CHEMICAL STRENGTHENED BASE COURSE



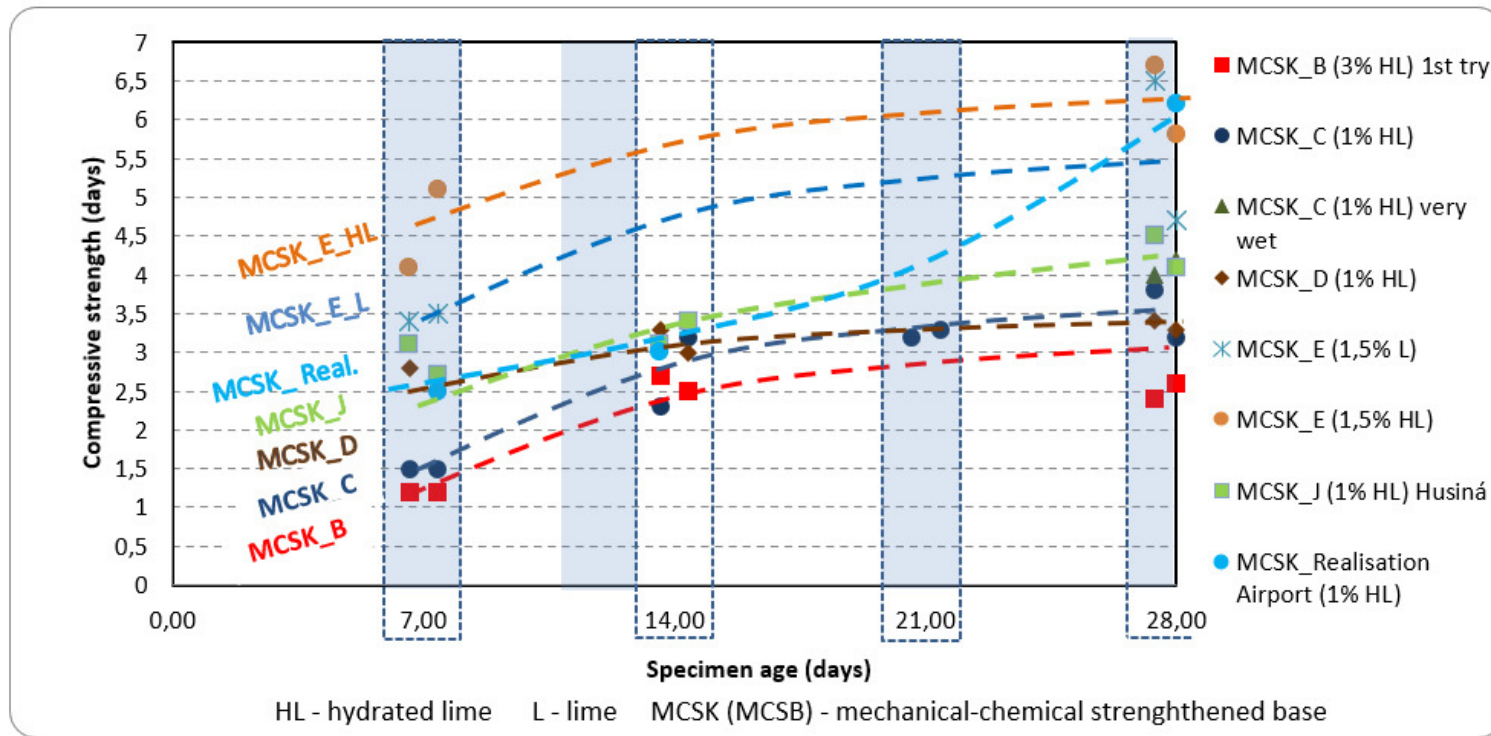
IBI (CBR)

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



COMPRESSIVE STRENGTH

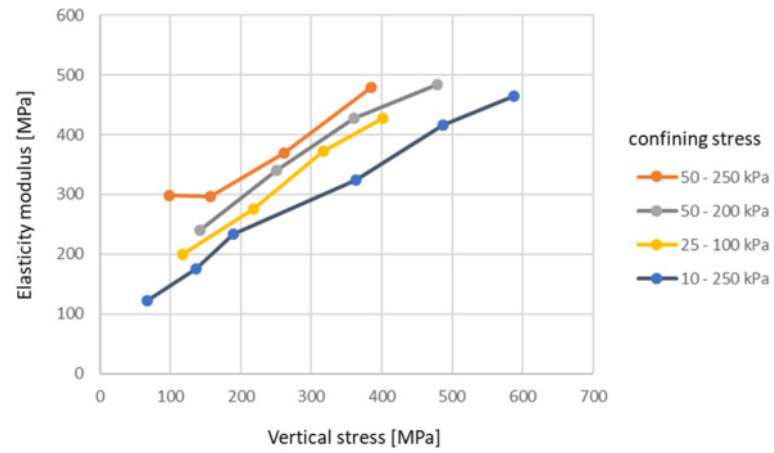
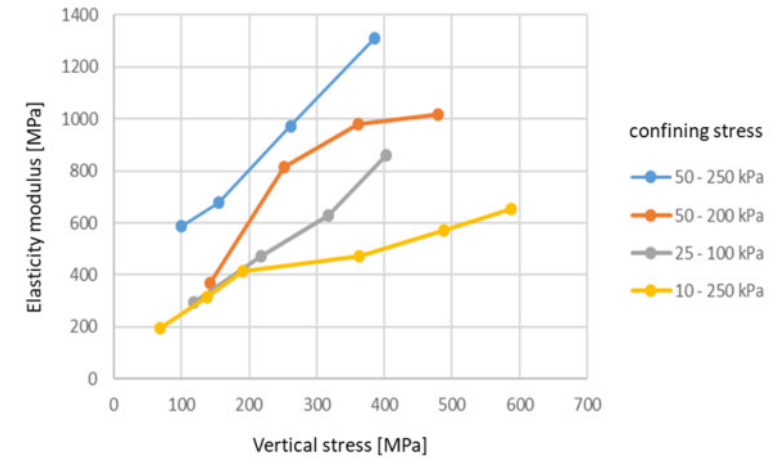
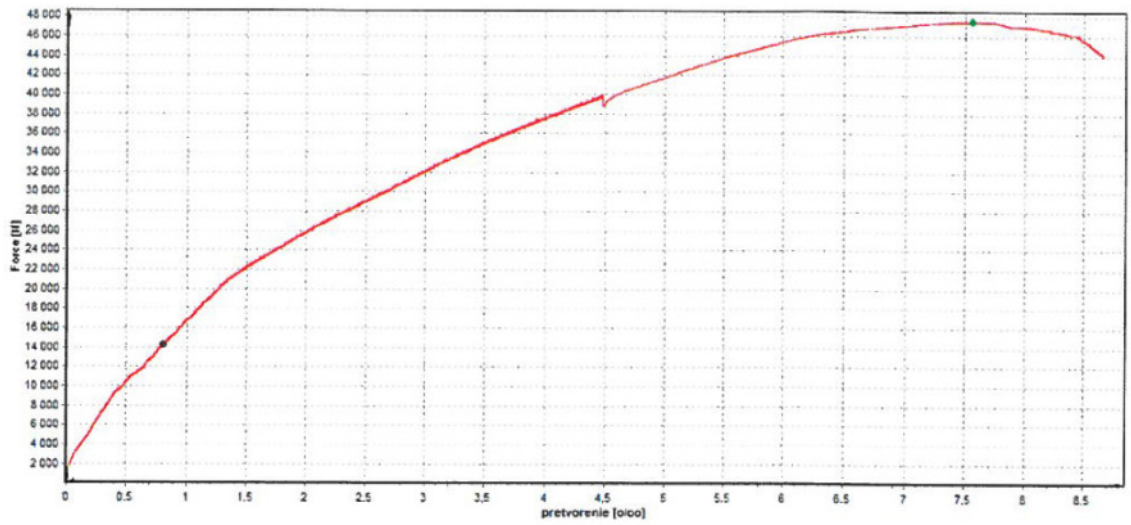
High IBI values → Compressive strength testing according to STN EN 13286-41 → Material tends to cemented types (CBGM)



MODULUS OF ELASTICITY

Design values → Necessary for pavement design

Different methods for testing of E modulus



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 $\text{Ca}(\text{OH})_2$ solution and converted to percent CaO binding efficiency of the pozzolan.

FRATTINI TEST



VERIFICATION IN THE PRACTICE



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VERIFICATION IN THE PRACTICE

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

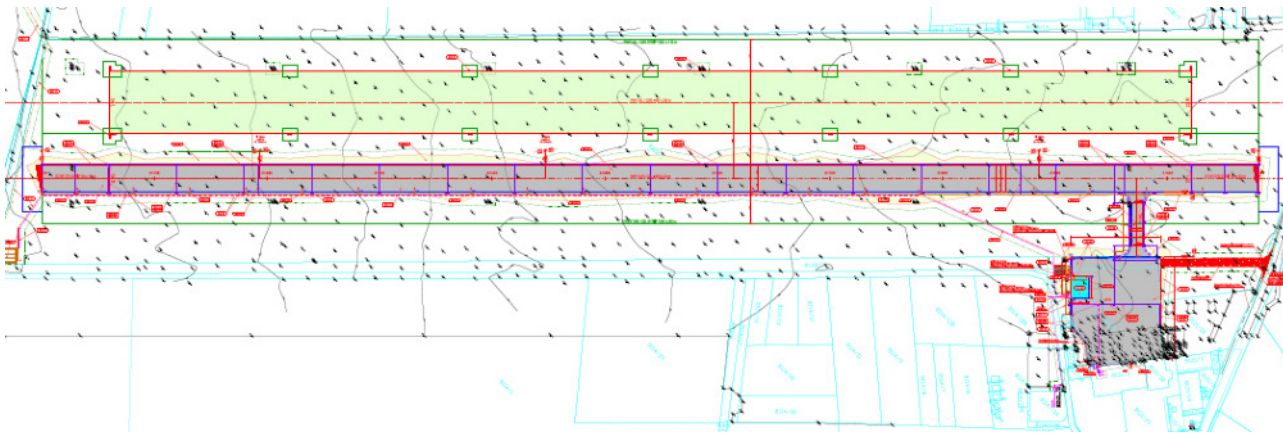
**The modernisation
included the construction
of paved movement areas**

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

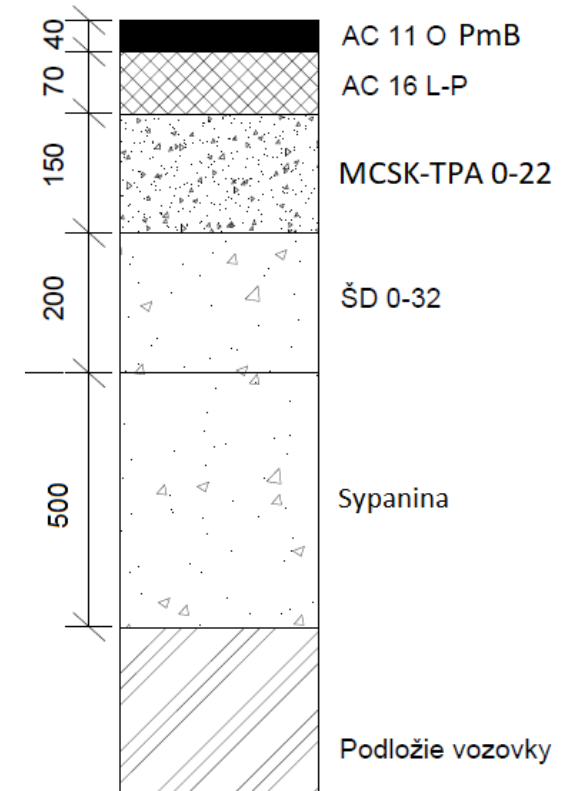


VERIFICATION IN THE PRACTICE

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



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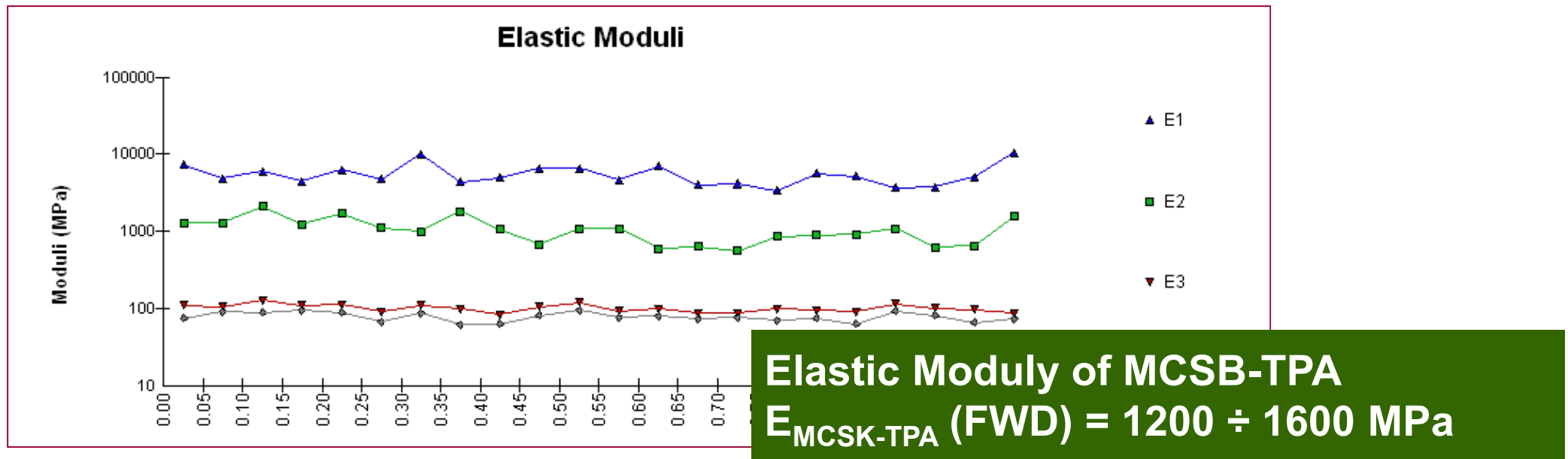
VERIFICATION IN THE PRACTICE

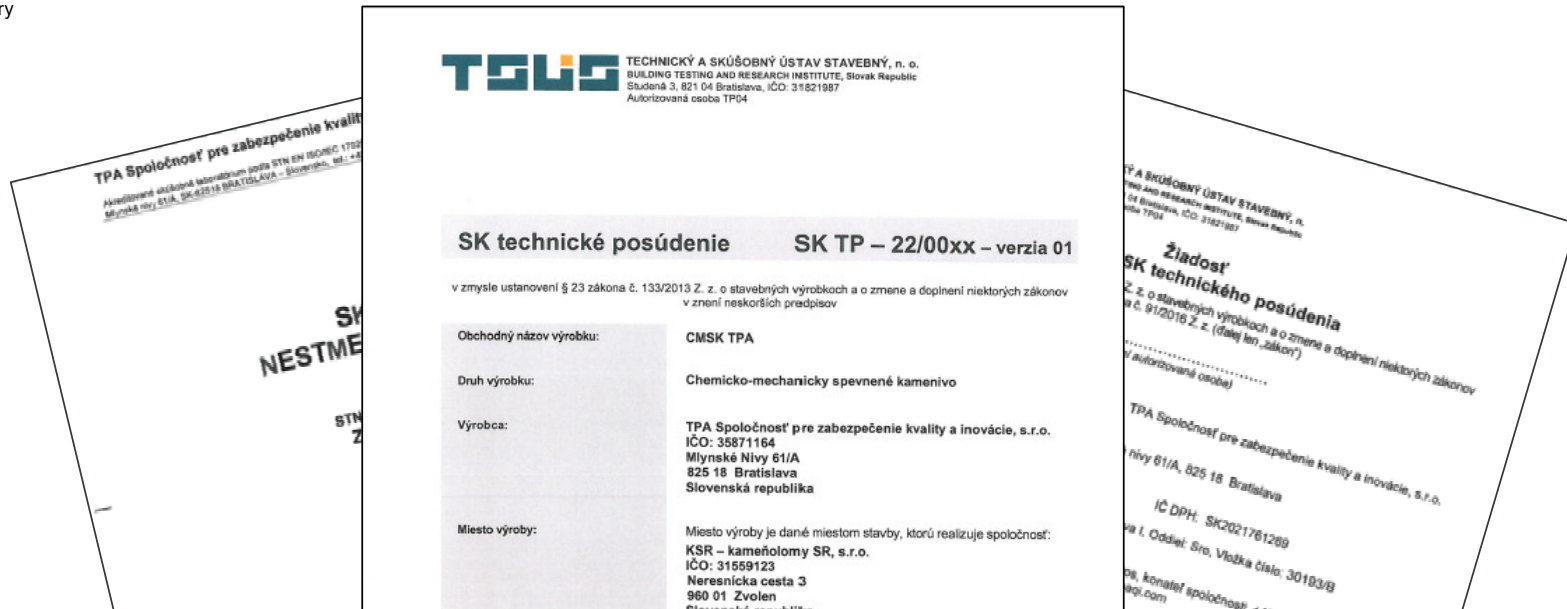
AIRPORT PRIEVIDZA - VERIFICATION AFTER IMPLEMENTATION FWD MEASUREMENT



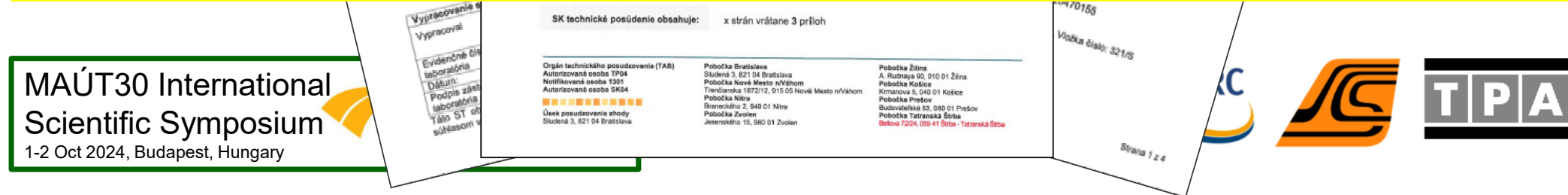
VERIFICATION IN THE PRACTICE

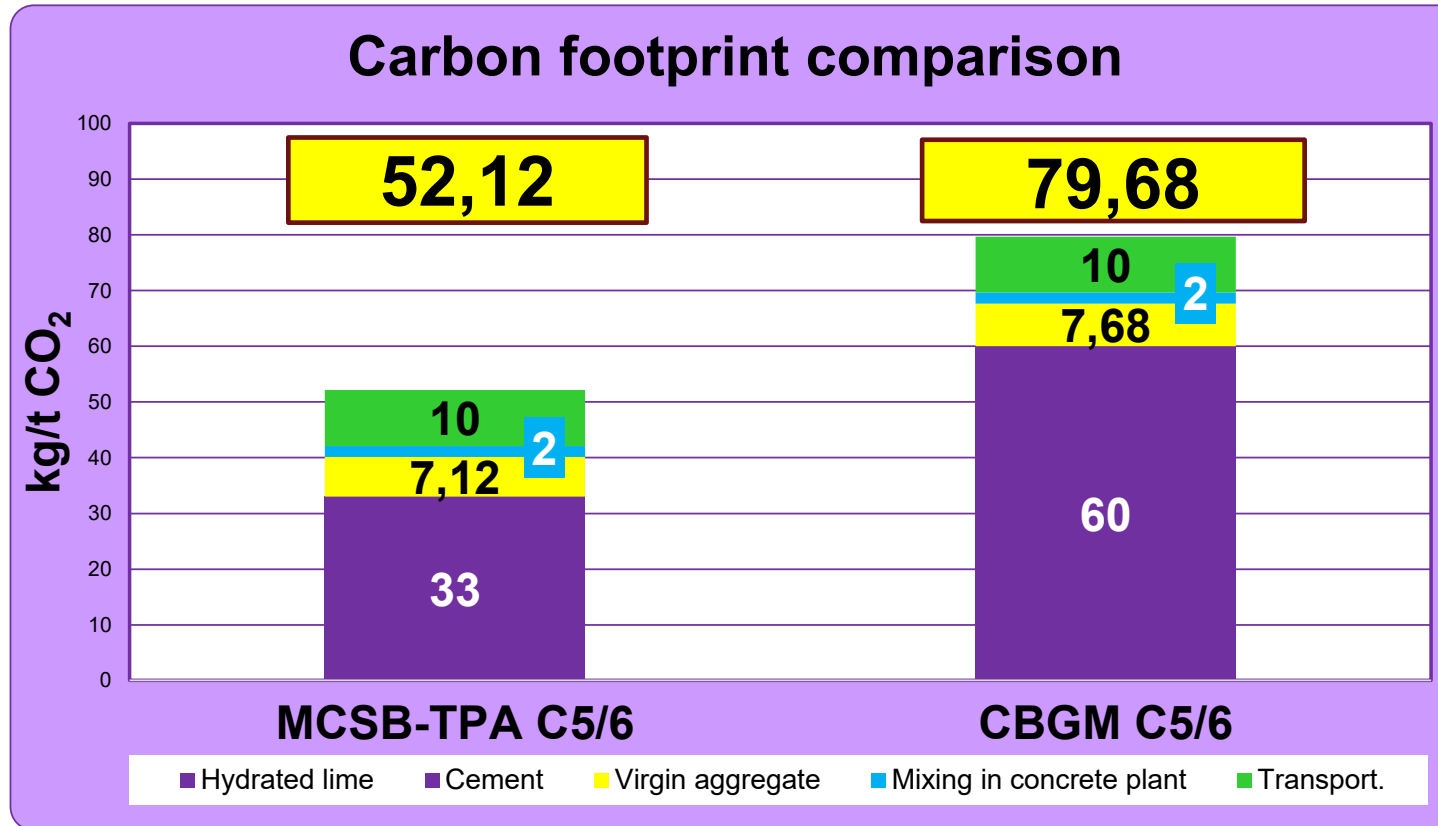
AIRPORT PRIEVIDZA - VERIFICATION AFTER IMPLEMENTATION FWD MEASUREMENT





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.





CONCLUSION

MECHANICAL-CHEMICAL STRENGTHENED BASE COURSE (MCSB-TPA) - A GREEN AND INNOVATIVE APPROACH TO A NEW GENERATION OF ASPHALT PAVEMENT CONSTRUCTION (IP00617)

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TPA **STRABAG**

The strength of base course is achieved partly by mechanical skeleton of the structure and partly by natural bonding of selected aggregate and bond activator.

By the term: "Mechanically-chemically bonded base layer" we mean a new type of base layer that is based on an unbound construction method, but has slightly higher mechanical parameters, such as elastic modulus, compared to the well-known (so-called) mineral concrete. The higher elastic modulus is achieved by activating the natural bonding ability of certain types of rock. In our case, the binding force is very low, which is an important advantage and also our goal. In the end we have a layer whose cohesion is partly based on the cohesion between the stone framework and the bond between fine material. Hence the name: "Mechanically - chemically bonded". The MCSB-TPA was developed in TPA Slovakia as part of an R&D project.

WHY THE NEW GENERATION OF ASPHALT PAVEMENTS? – BASE COURSES IN OUR ROADS

Asphalt pavements are divided into flexible and semi-rigid structures due to the base layers. In the case of unbound base courses, we are talking about the flexible asphalt pavement; in case of bound base courses, we are talking about the semi-rigid asphalt pavement.

The higher mechanical efficiency of hydraulically bound base courses compared to unbound base courses is a reason of their major use in heavy trafficked pavements. The use of an unbound base course limits the performance of a pavement. A gap between the performance of the pavement with an unbound and hydraulic bound base layer can be eliminated using the "MCSB" layer.

IDEA	LABORATORY	PRACTICE

From the results of the material tests in the laboratory and field tests made on the construction of real site, the hypotheses on the possibility of designing the material for pavement base course, which design parameters (modulus of elasticity) are between the mechanically strengthened aggregate (MSR) and the cement bound granular mixture layer (CBGM), were confirmed.

In addition, it is also possible to fine-tune the mechanical parameters of the base layer according to the designer's intention and the type of aggregate, which is locally available through experimental design of the composition of the mixture in the laboratory.

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



LOW COST PAVEMENT SYSTEMS

2024TRXXEN

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Thank you for your attention!

