SPENS Final seminar
27 – 28 August 2009

WP3 Improvement of Pavement Structures

Task 3.1 Long-Term Performance of Reinforced Pavements

Presentation by
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Objectives

The main objectives are:

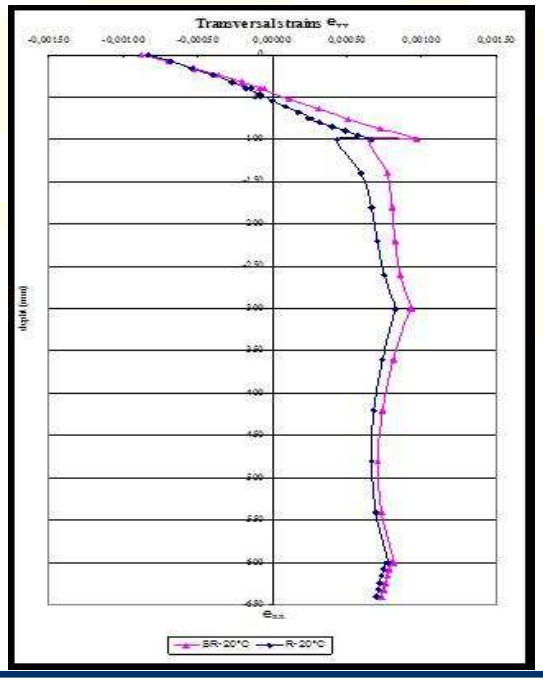
- To establish the efficiency of reinforcement in flexible pavements
- Modelling of reinforced pavement structure
- Methodology for evaluation of reinforced pavement performance

Modelling

Demand: a user-friendly pavement design methodology

➡ a multi-layer linear elastic model

➡ Reinforcement defined as an Equivalent layer (REFLEX approach - Kolisoja et al 2002)



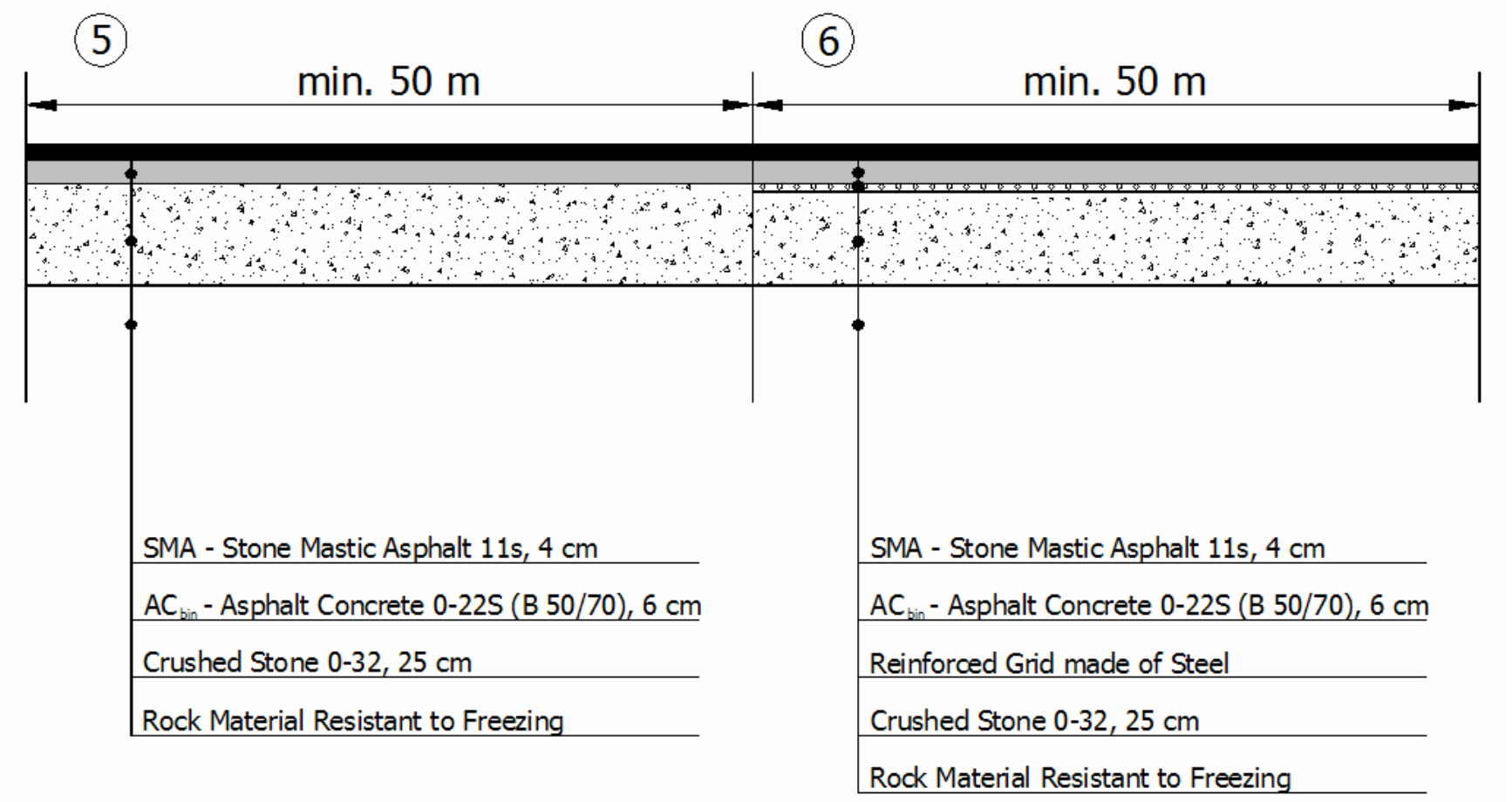
Verification?

Validation?

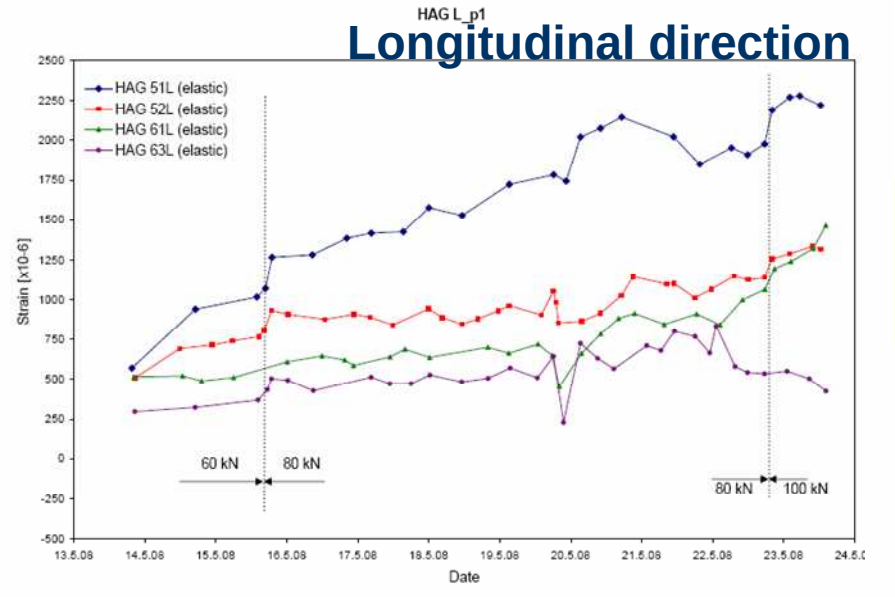
Accelerated Loading Test

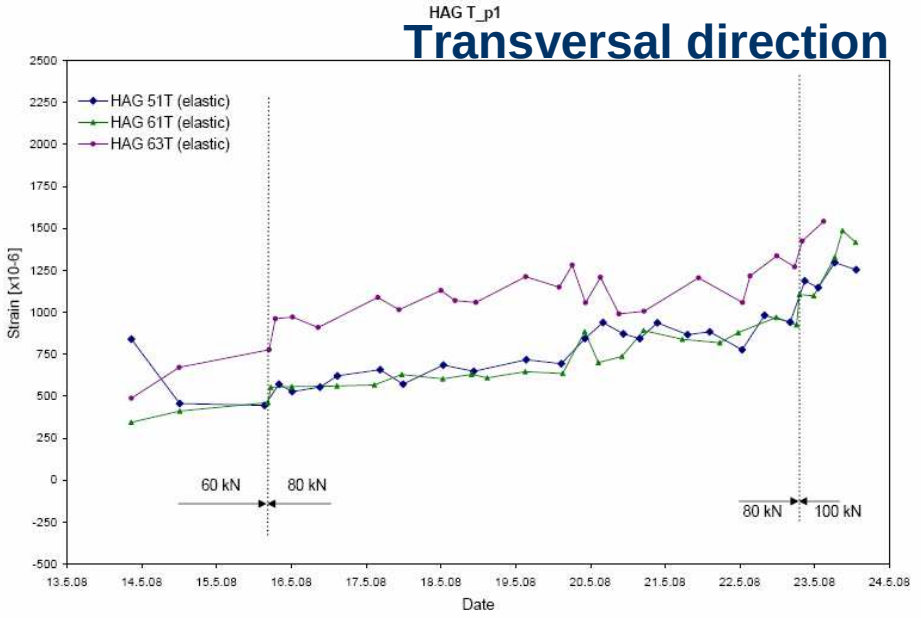
Test site

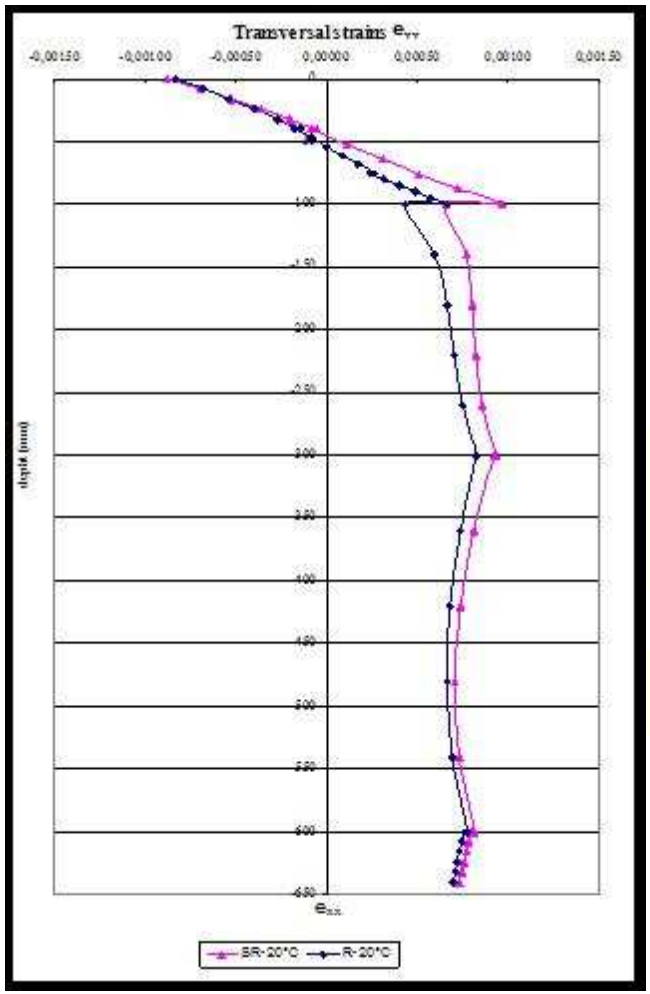
Structure of test sections



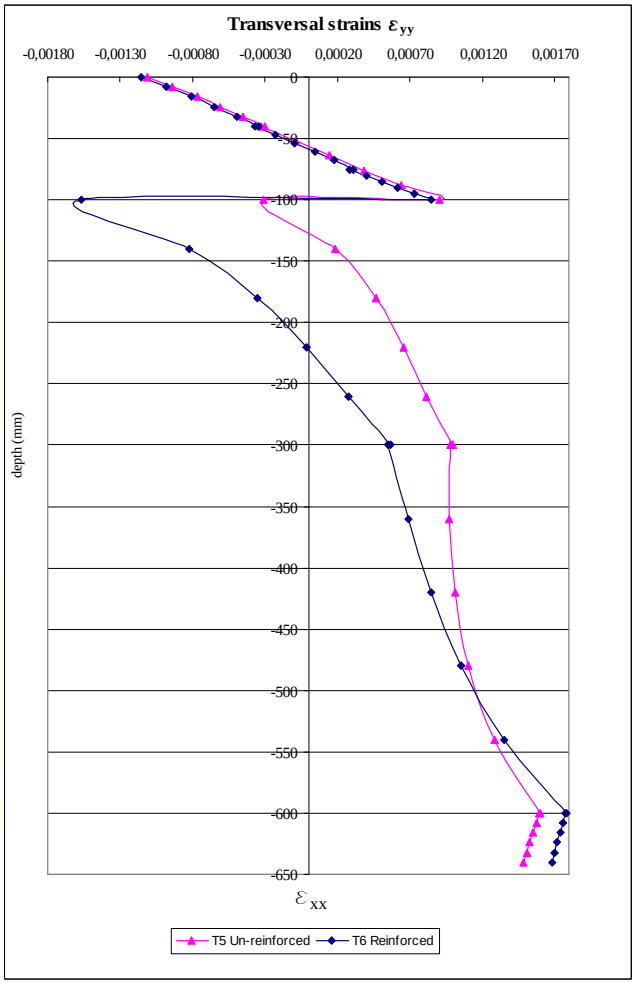
Response measurements by horizontal strain gauges





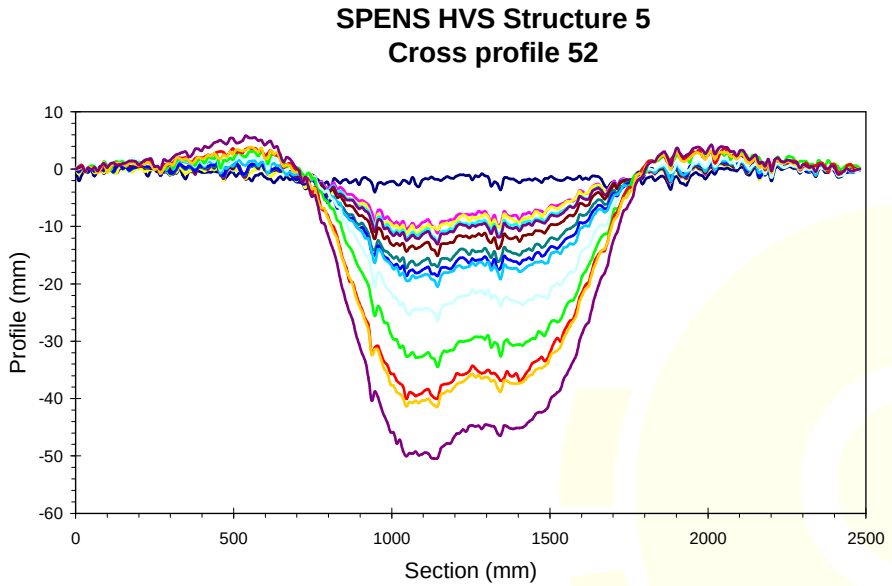


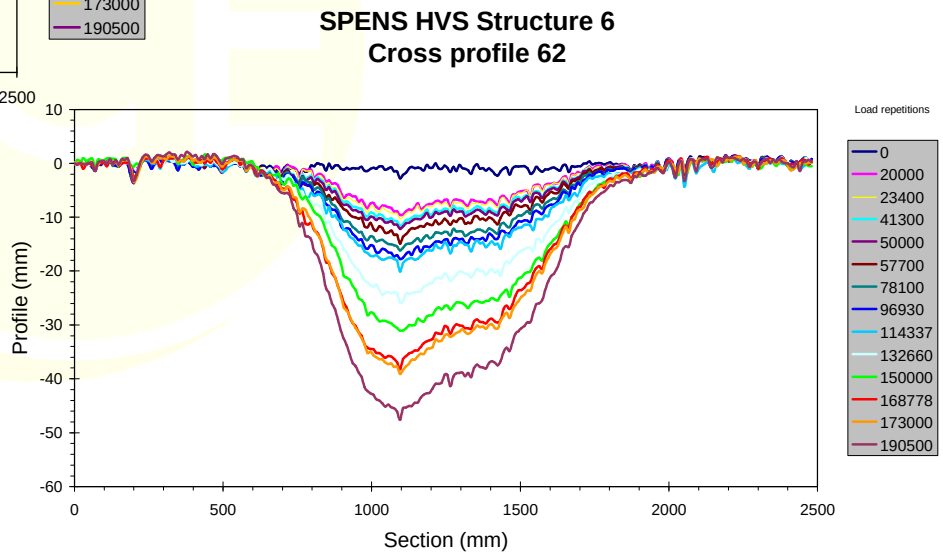
With friction



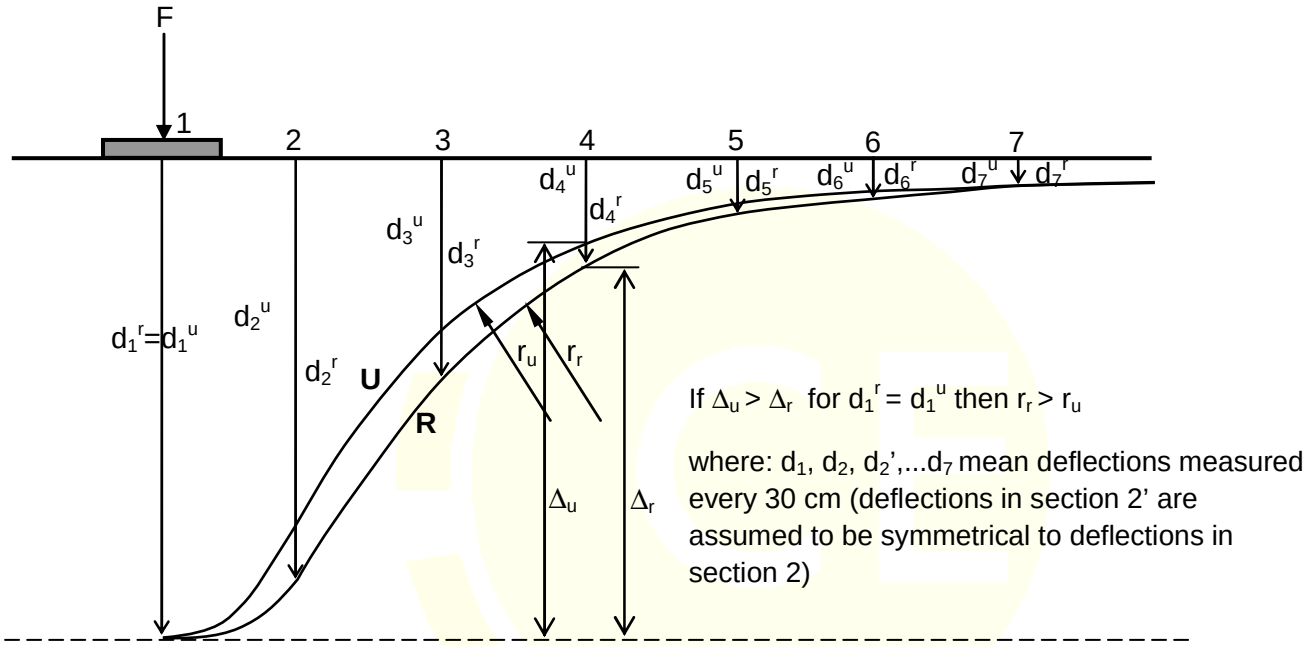
Without friction

ALT: Rut development



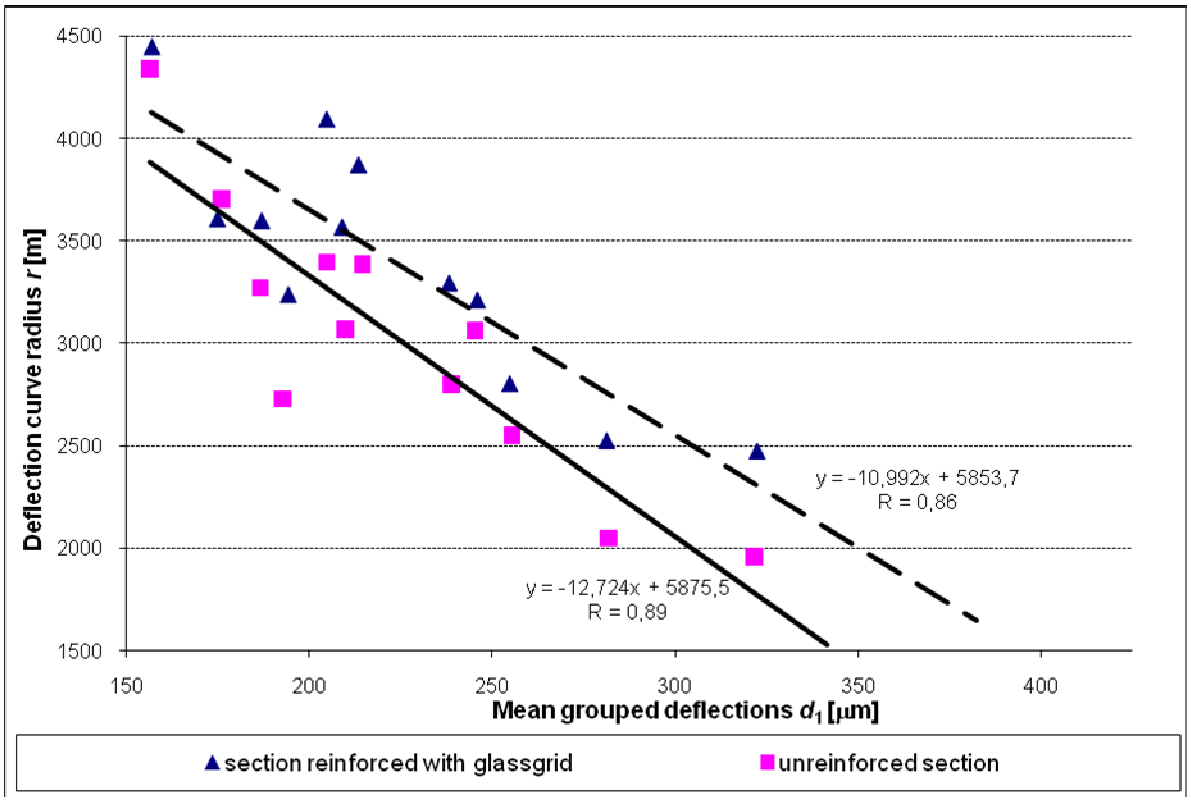


Field test: Falling Weight Deflectometer



Schematic curvatures of deflection curves in FWD test
for reinforced pavement (curve R) and unreinforced (curve U)

FWD



Deflection curve radius between geophone 2 and 2' and deflection d1 under load plate

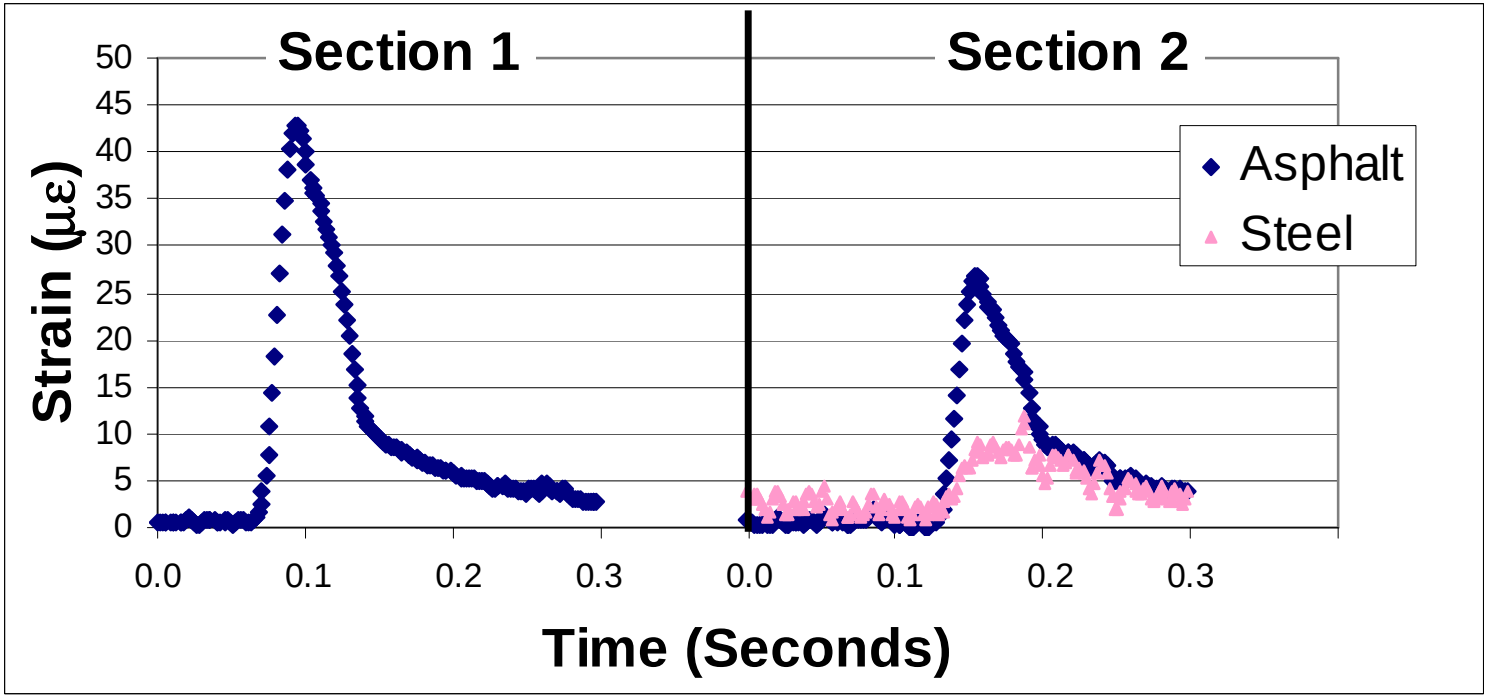
Road section	Arc section radius of the deflection curve			
	Arc 2' – 2 ↓	Arc 2 – 4 ↑	Arc 4 – 6 ↑	Arc 5 – 7 ↑
Reinforced, m	3106	9032	12292	13328
Unreinforced, m	2695	7354	10299	11581
Difference, %	15	23	19	15

Arc section radiuses of the deflection curve for deflection under load plate d1 = 250 mm.

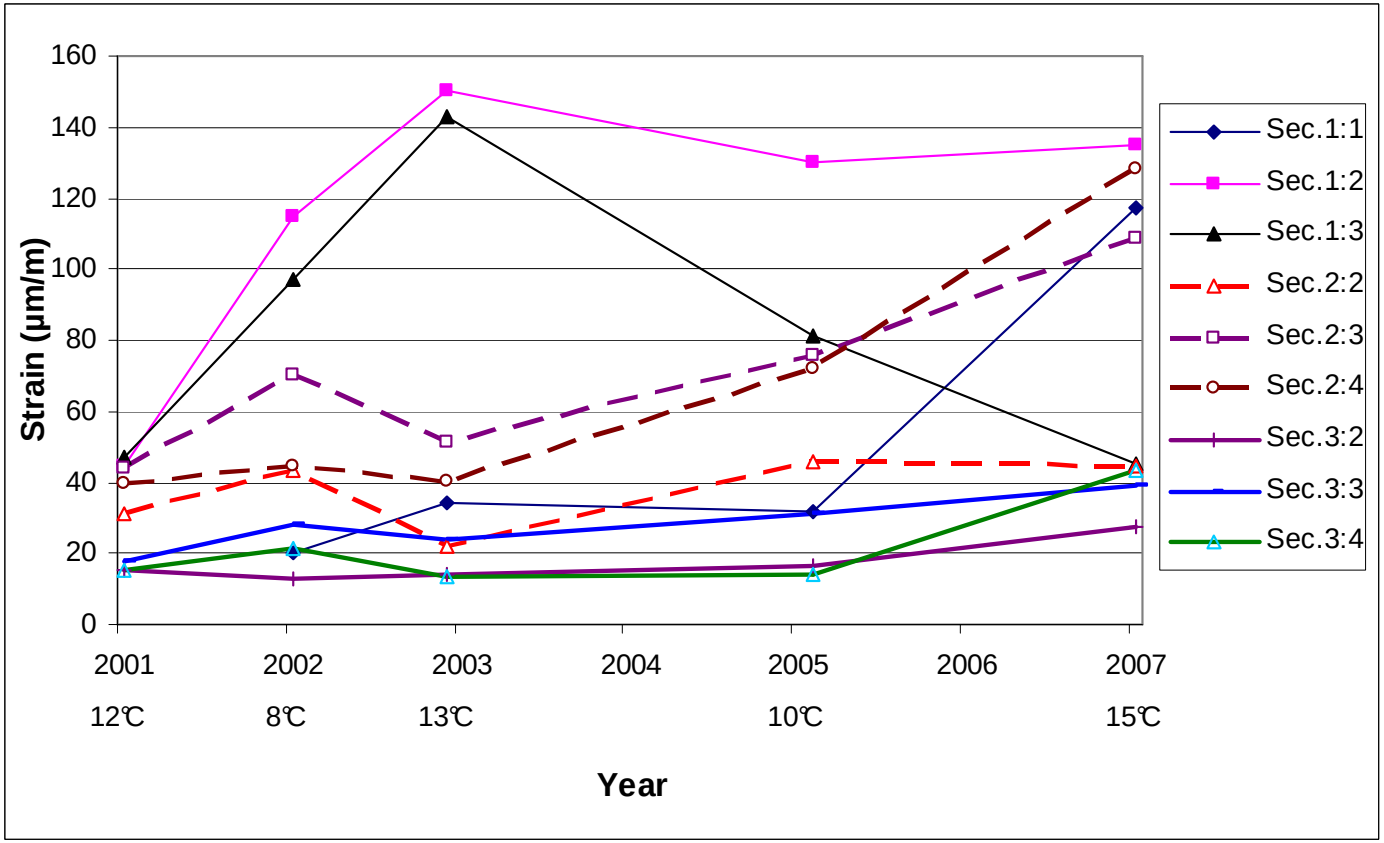
Field test: Strain measurements

Steel reinforced test sections

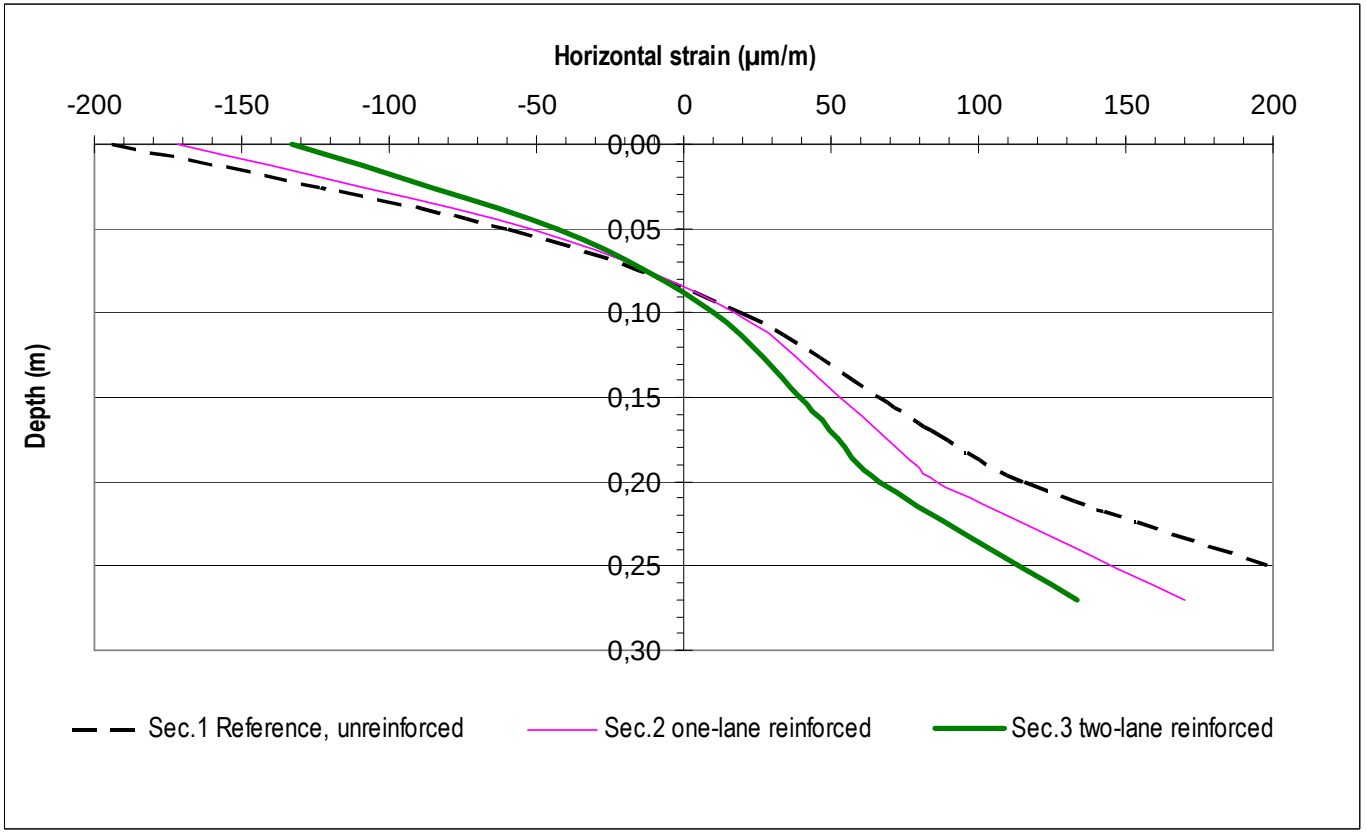
Field test: Load Transfer efficiency



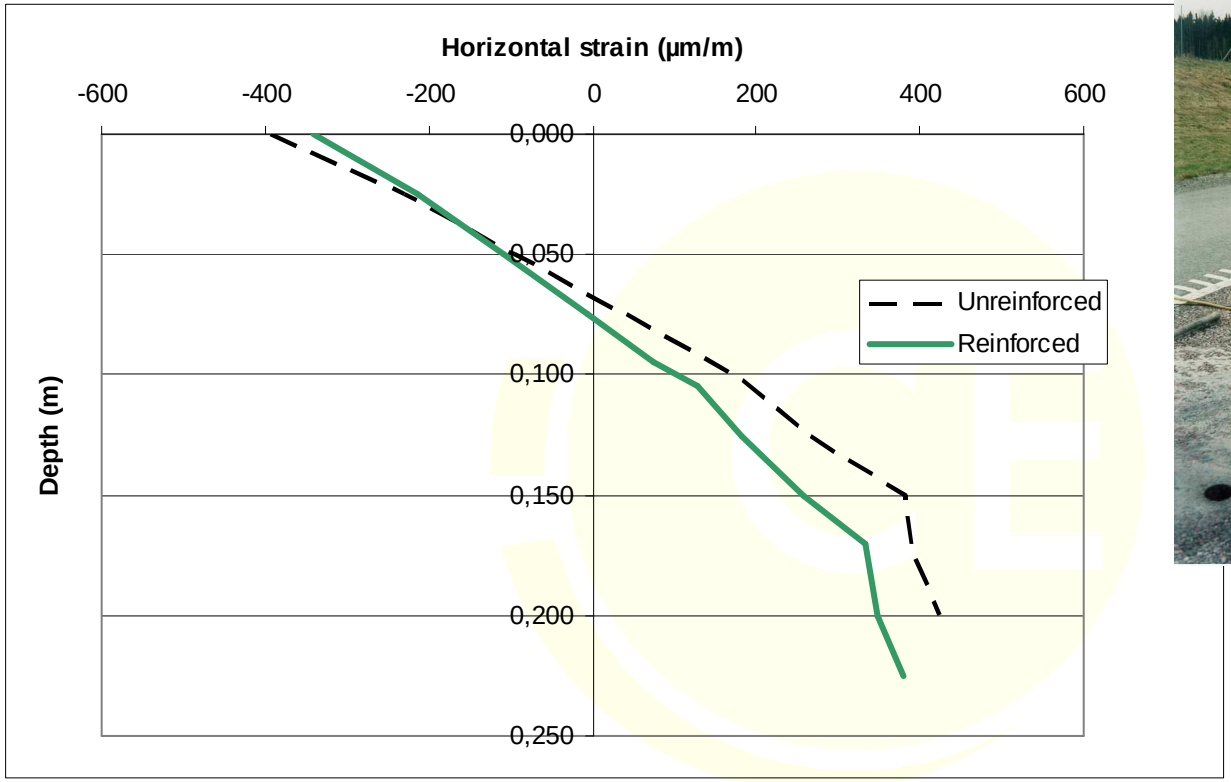
Field test: measured strains



Field test: FWD - BISAR



Calculated strains of the reference test sections using backcalculated moduli with BISAR programme

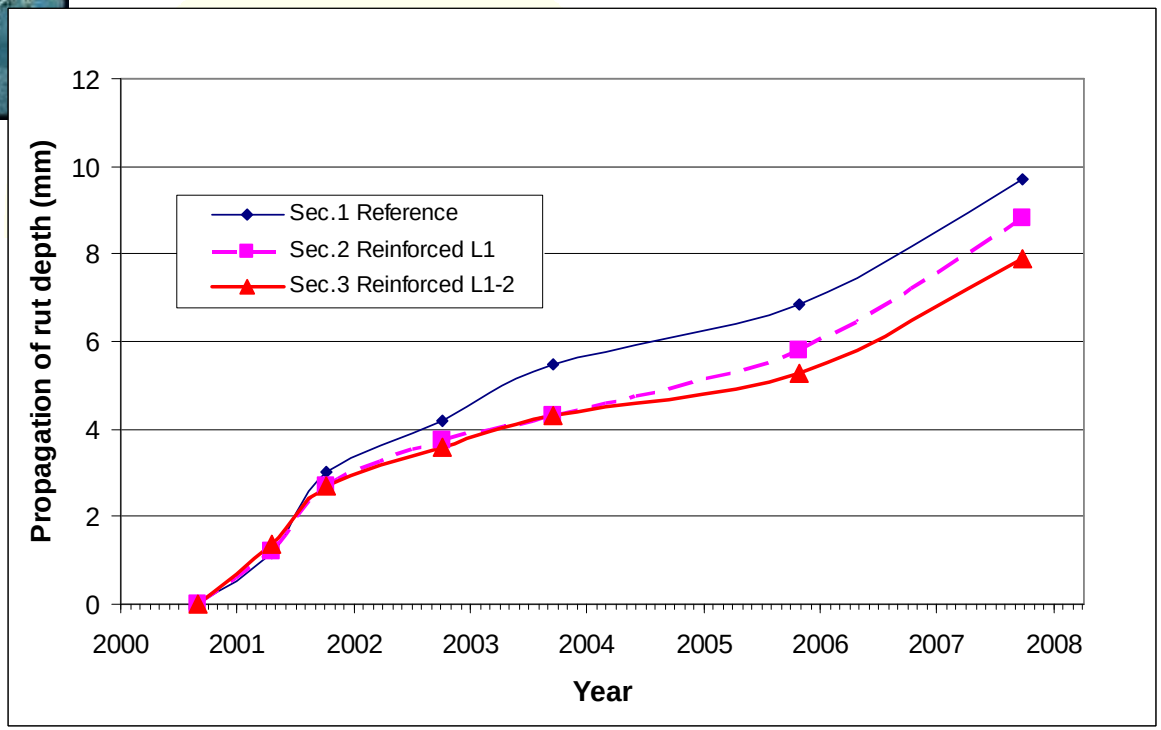


Calculated strains using measured moduli of bituminous layers and calculated modulus of EL with PMS Objekt programme

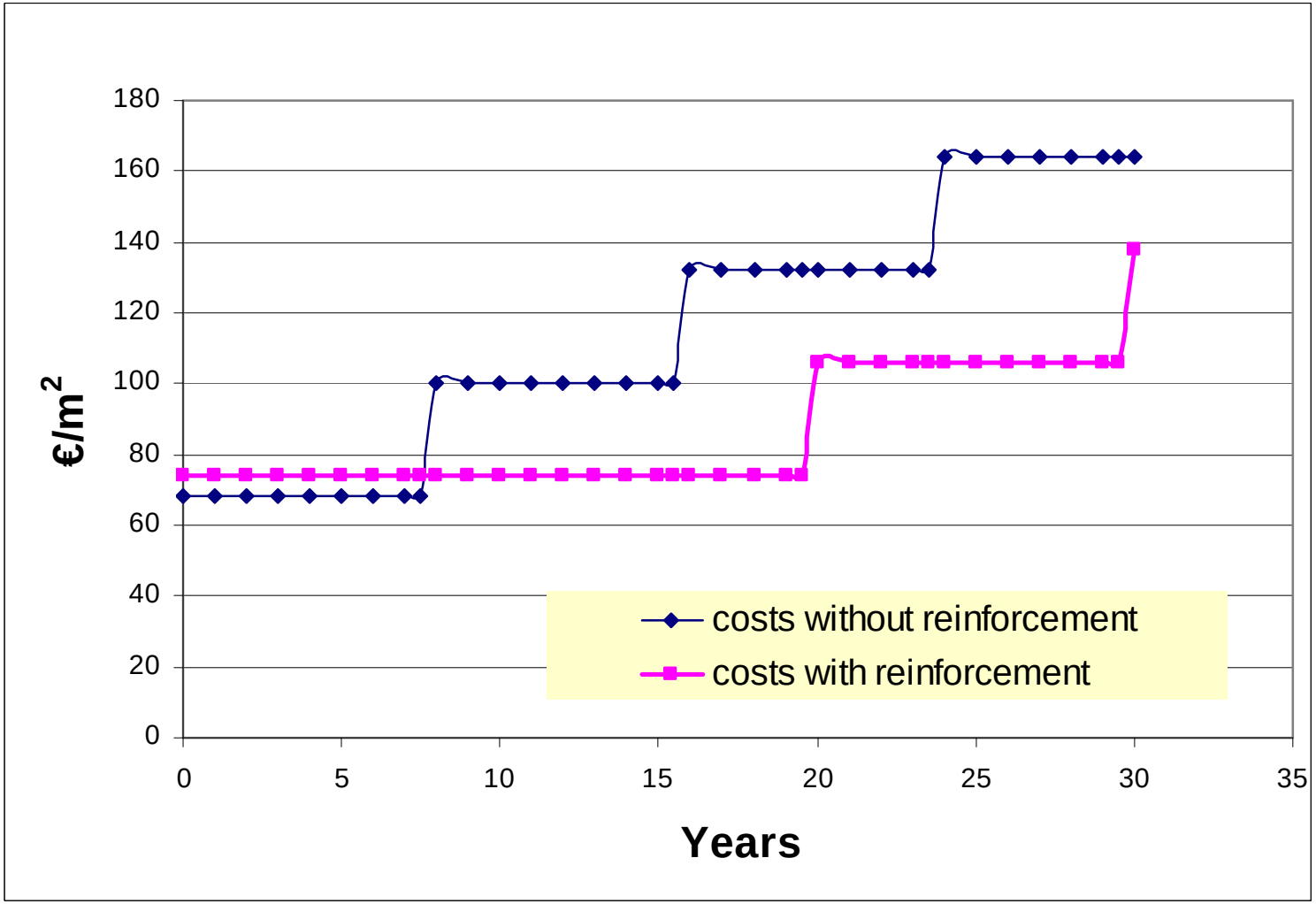
Determined strains and ranking of the structures by different methods

Structures	Strain at the bottom of the bituminous layer					
	Measured		Calculated, FWD measurements		Caculated, REFLEX approach	
	Strain, µs	% of reference	Strain, µs	% of reference	Strain, µs	% of reference
Reference (Sec.1)	126	100%	69	100%	383	100%
Reinforced (Sec.2)	94	74%	53	77%	257	67%
Reinforced (Sec.3)	37	29%	40	58%		
Decrease of strain in average		52%		67%		67%

Filed test: Rutting



Economical evaluation



Conclusions

- Reinforced structure has prolonged the service life of pavement with at least 20 %

- Less maintenance frequency

- Less costs

Deliverable D9

LONG-TERM PERFORMANCE OF REINFORCED PAVEMENTS

(including guidelines)


Thank you