



HPCM as a surface pavement Concept and properties

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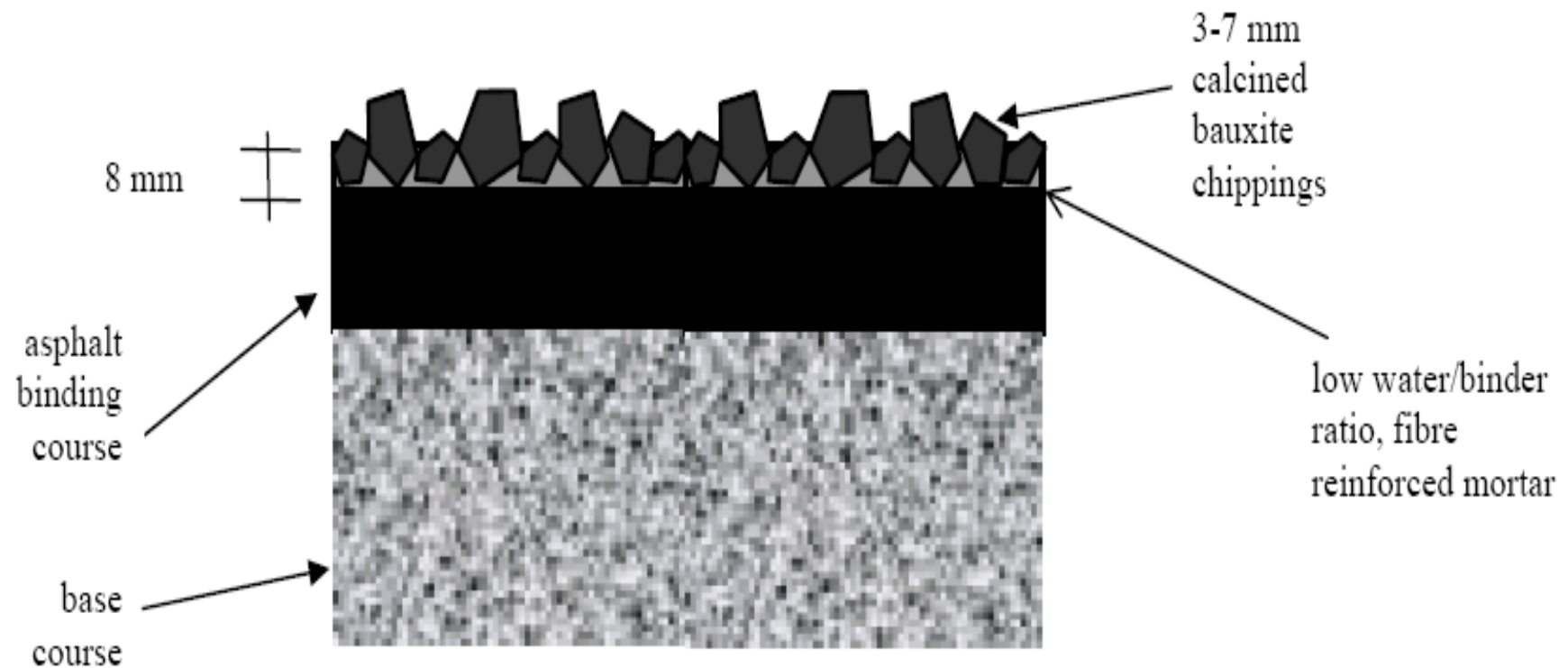
Coordinator of the HPCM sub-project

LCPC Nantes - France

Summary

- Design of HPCM complex
- Plain mortar tests
- Cracking tests
- Surface resistance tests
- Miscellaneous
- Conclusion

Design of HPCM complex



Design of HPCM complex (cont.)

- « Ultra-ultra » thin white topping
- Main idea: best available mineral materials in minimum quantities



Design of HPCM complex (cont.)

<i>Components</i>	<i>Kg/m³</i>
Siliceous coarse sand 0.2/1	429
Siliceous fine sand 0.08/0.315	429
CEM I Portland cement	985
Silica fume	197
Superplasticizer (dry powder)	4.40
Retarder	4.95
Water	207
w/c	0.21
Slump (cm)	21

Plain mortar tests

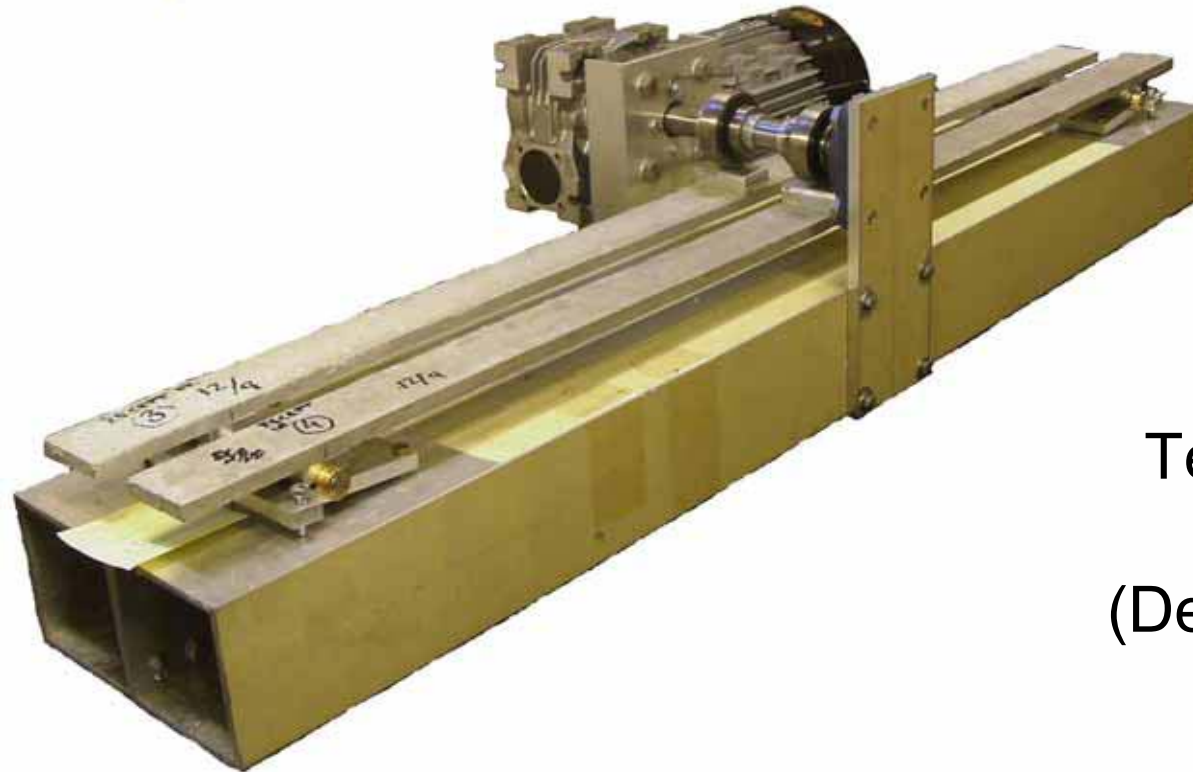
Dimensions of specimens (cm)	Type of test	Mean value (MPa)
Prisms 4x4x16	Flexural	28.5
Prisms 4x4x16	Compressive	164
Cubes 10x10x10	Compressive	148
Cylinders Ø11x22	E-modulus	43 000
Cylinders Ø11x22	Compressive	129

(with 4% PVA fibres)

Plain mortar tests (cont.)

- Flexural fatigue behavior
 - tests on mortar reinforced with 2 % of either steel or PVA fibres
 - imposed deflection = 3 times the real one (under traffic loading)
 - 25 10^6 cycles
 - good behavior (decrease of E-modulus, but no failure)

Plain mortar tests (cont.)



Tests at
DBT
(Denmark)

Plain mortar tests (cont.)

- Cracking motors:
 - high shrinkage
 - autogenous: $650 \cdot 10^{-6}$ at 250 days
 - total shrinkage at 50% R.H.: $800 \cdot 10^{-6}$ at 250 days
 - high coefficient of thermal expansion ($17.6 \cdot 10^{-6} \text{ K}^{-1}$)
- => limited risk of buckling by hot weather, but need of fibres to control cracking

Cracking tests

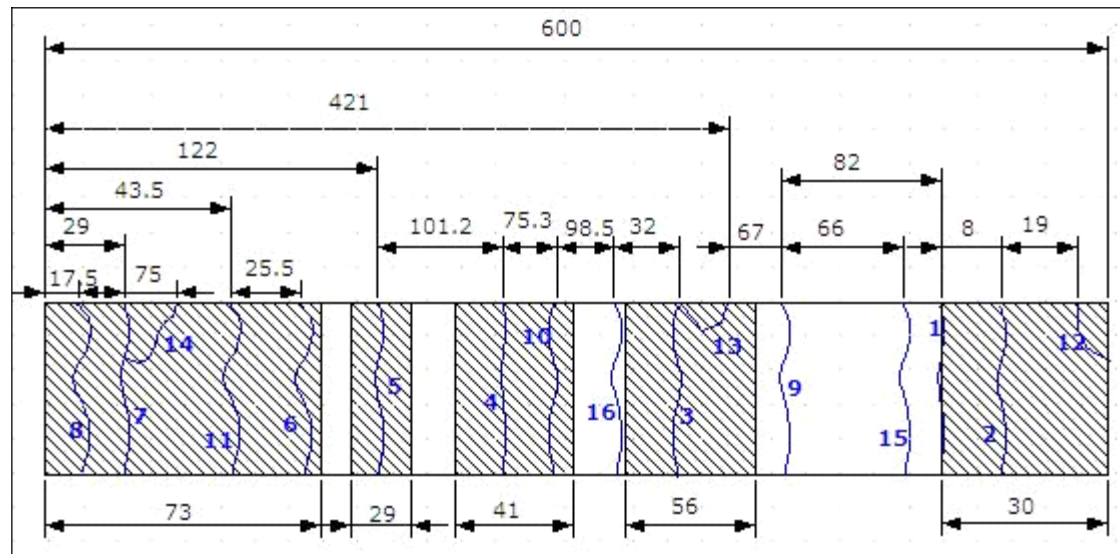
- Aim: to design the fibre reinforcement
- Two types of fibres
 - steel
 - PVA (Poly Vinyl Alcohol)
- Dosage: from 1 to 5 % in volume

Cracking tests (cont.)

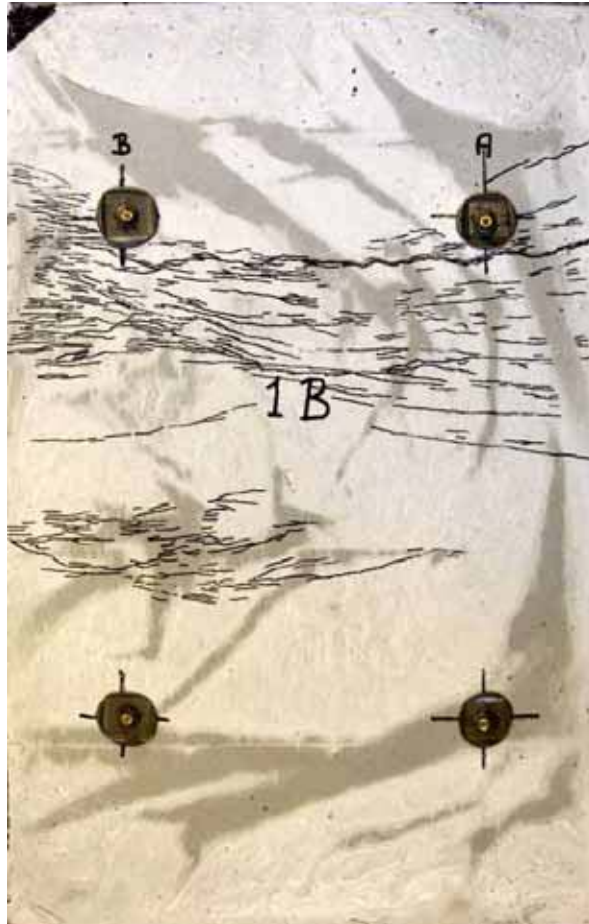


Tests at
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Cracking tests (cont.)



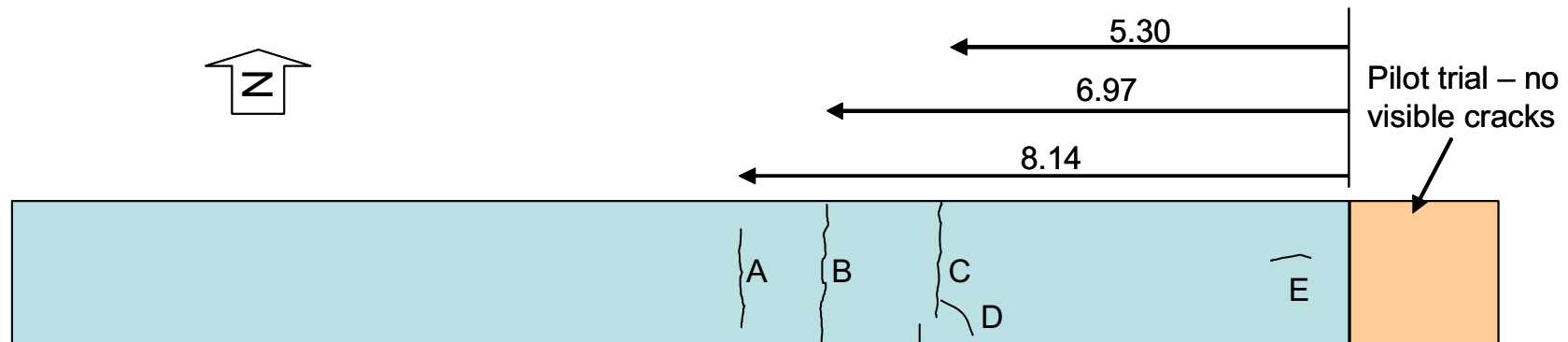
Results for plain mortar (no fibres)



Tests at
DBT
(Denmark)



Tests at RTA (Australia)



Cracking tests (cont.)

- Scale-1 test performed with 4 % of PVA fibres => cracking
- Better behavior with steel fibres
- With 3 % of SF, no visible cracks are likely to appear
- Stiff (asphalt) base course necessary

Surface resistance tests

- Rutting tests
- ASTM abrasion test
- Tribometer test
- Freeze/thaw test
- «Total test»: acid attack + freeze/thaw + shocks

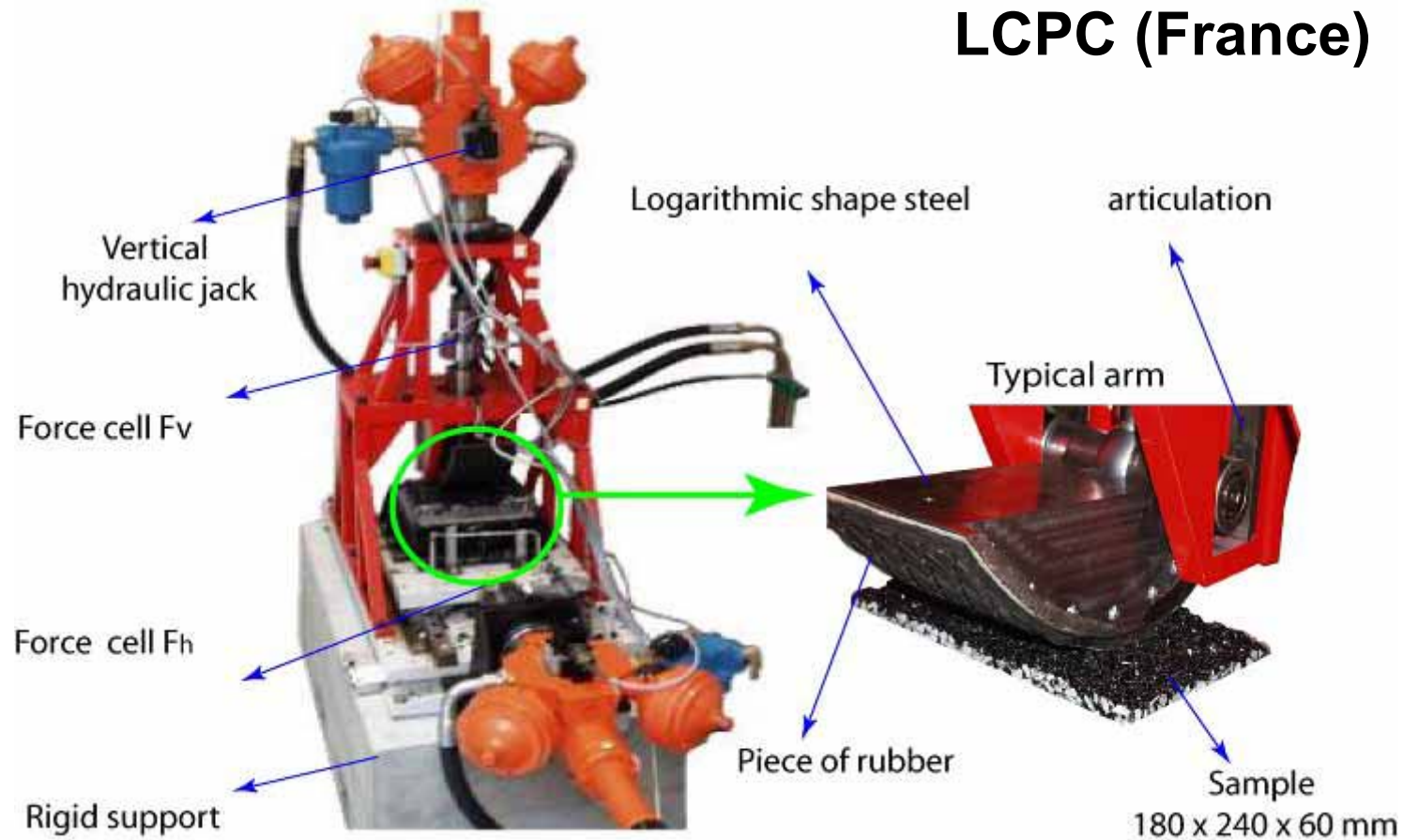


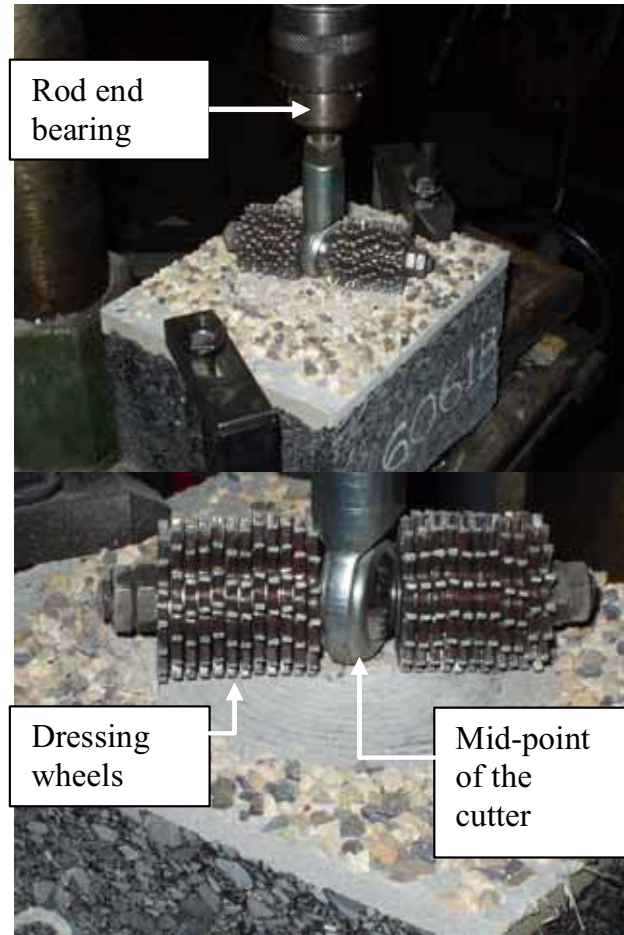
**The rutting
tester**

**LCPC
(France)**



The « Tribometer » test LCPC (France)





**Abrasion
test
FHWA
TFHRC
(USA)**

Surface resistance tests (cont.)

- Results:
 - excellent behavior under freeze/thaw
 - calcined bauxite => polishing not expected
 - limited loss of chippings likely to appear under traffic ($\approx 10\%$?) depending on the level of embedment
 - no influence on skid resistance

Miscellaneous

- Noise generation
 - studied through texture assessment and numerical simulation
 - result: comparable to exposed-aggregate concrete of same texture
- Behavior under fatigue loading



PTF test at TRL (UK)

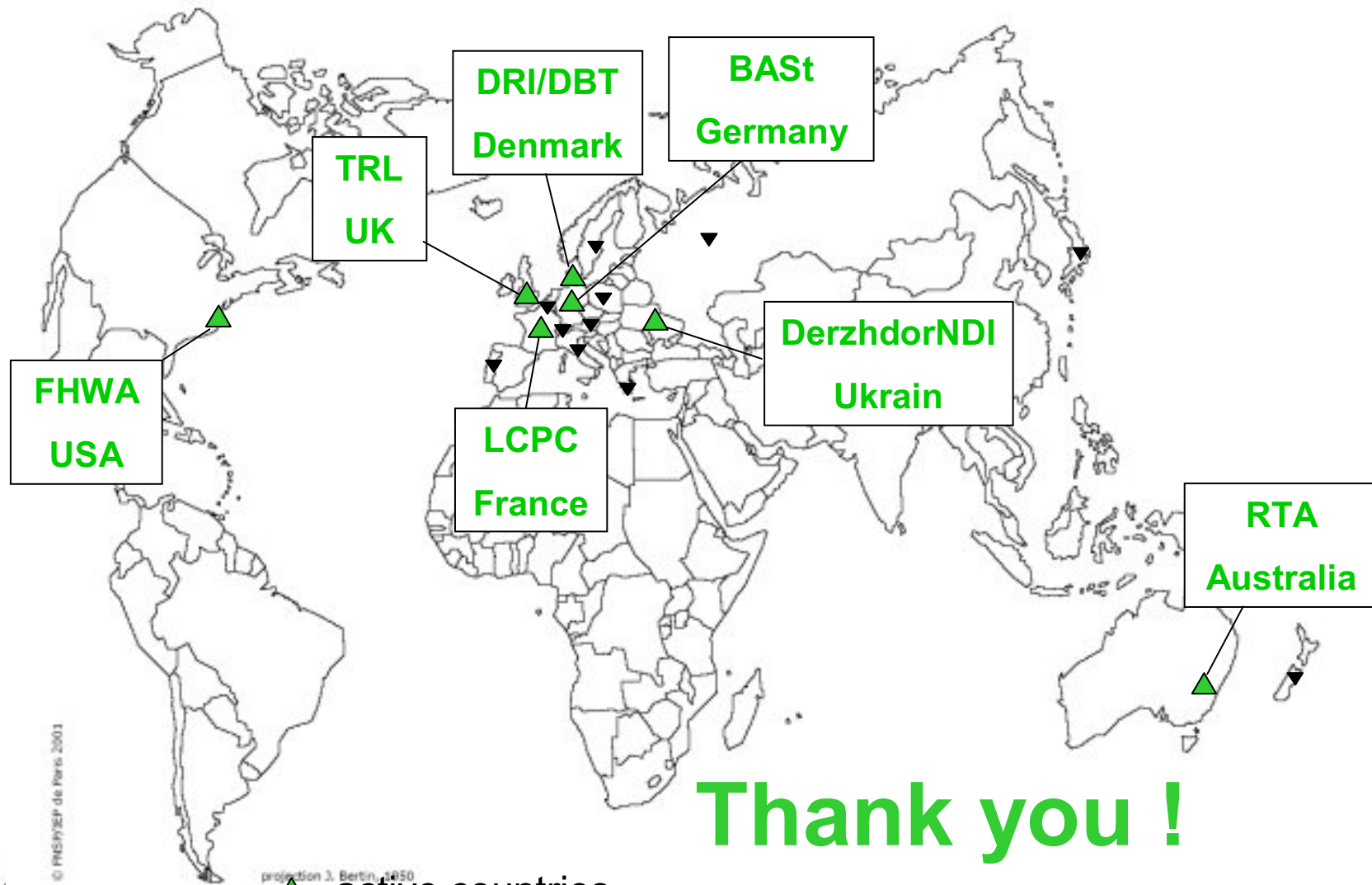


Miscellaneous (cont.)

- PTF Test
 - 1 M standard axle at 20°C
 - 0.5 M at 35°C
 - low rutting (1.5 mm instead of 8 mm for standard SMA)
 - delamination of asphalt at the edges => need for a stiff, low rutting asphalt

Conclusion

- New material developed in an international collaborative project
- Encouraging results
- Need for further research (laying technique, machinery for industrial application)
- Next step: LLP phase III with trafficked test sections



Thank you !

- ▲ active countries
- ▼ other involved countries