# Fatigue properties and Self-healing of bituminous pavement materials

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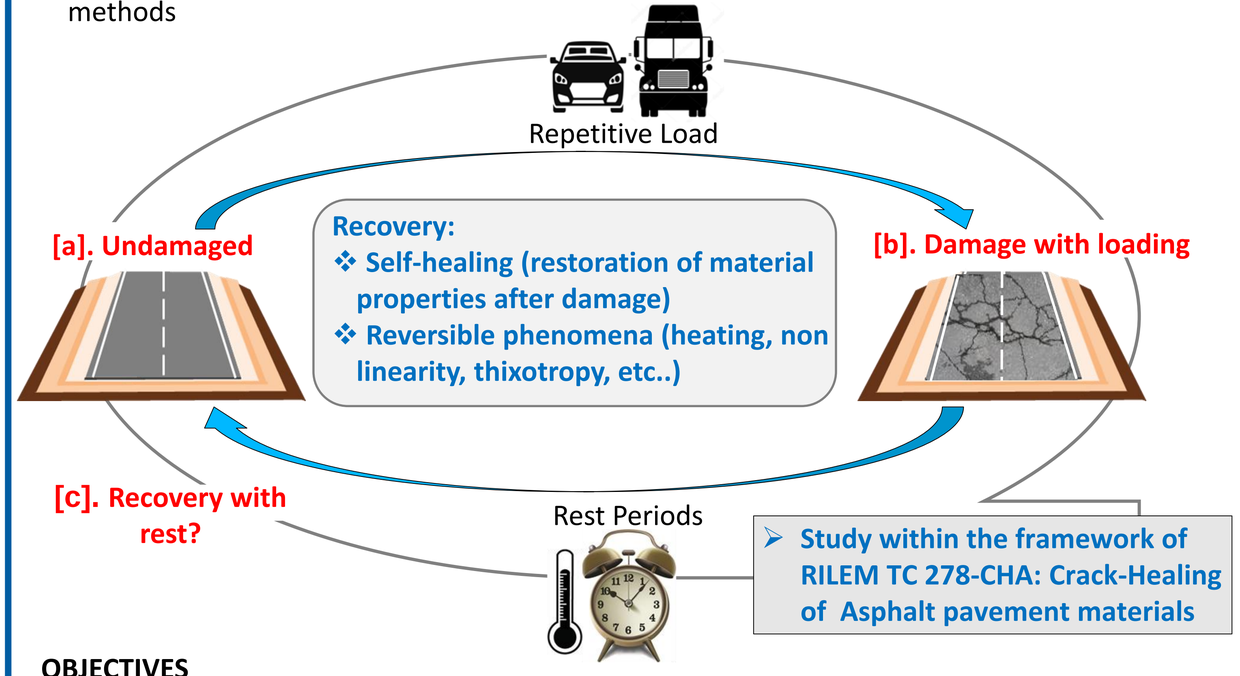
## Context and objectives

- Fatigue and self-healing of road materials are key aspects of pavement durability
- Both phenomena are open subjects of research, in order to develop proper characterization methods



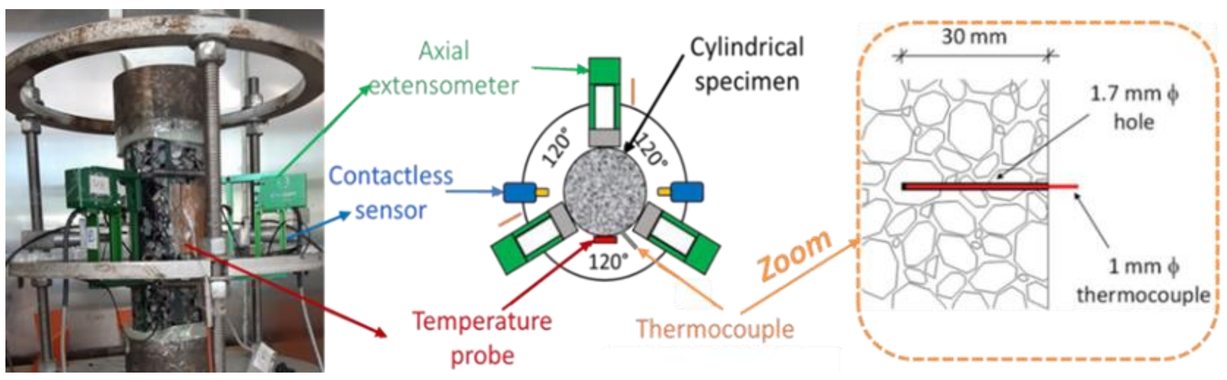

➢ Study within the framework of RILEM TC 278-CHA: Crack-Healing of Asphalt pavement materials

**OBJECTIVES**

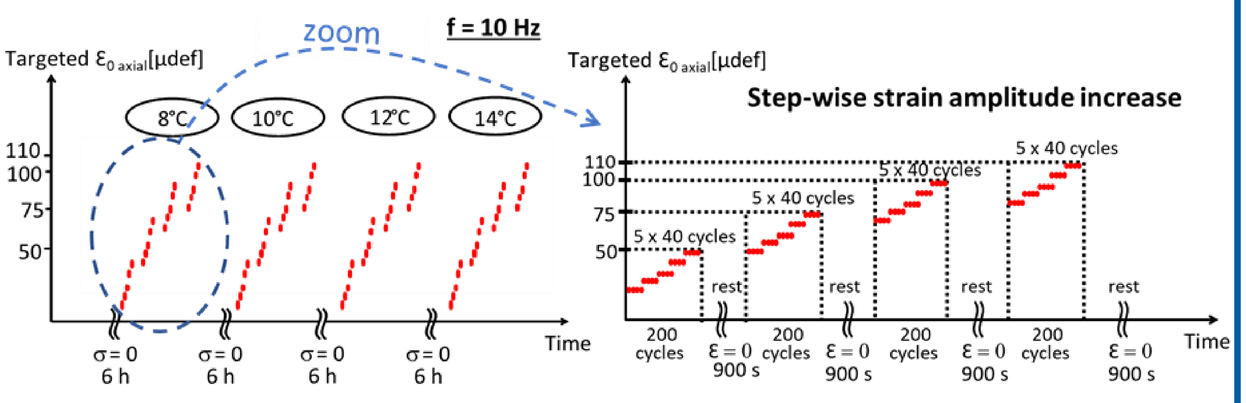
Development of laboratory test procedure proposed by ENTPE to evaluate damage and recovery of bituminous materials:

- Evaluating repeatability of test procedure within RILEM framework
- Improving test procedure (rest periods up to 48 h)
- Studying evolution of 3D properties (complex Poisson's ratio) during load and rest periods

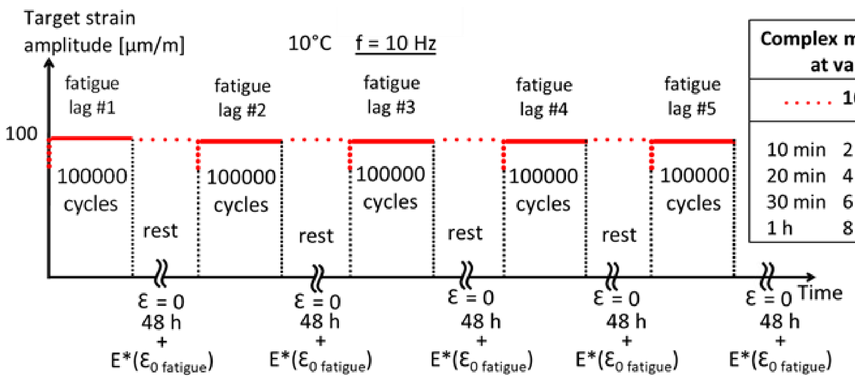
## Experimental equipment, procedure and materials




❖ 1st step: Complex modulus tests at varying strain amplitude and temperature → Effects of strain amplitude (non-linearity) and temperature on $|E^*|$, $\varphi_E$, $|\nu^*|$, $\varphi_\nu$




❖ 2nd step: Fatigue tests with rest periods → Effects of cyclic loading and rest on $|E^*|$,$\varphi_E$,$|\nu^*|$, $\varphi_\nu$




| Complex modulus test during rest were performed at varying strain amplitudes (step-wise) | | | | | |
|---|---|---|---|---|---|
| ..... 100 cycles at fixed intervals during rest | | | | | |
| 10 min | 2 h | 10 h | 18 h | 28 h | 44 h |
| 20 min | 4 h | 12 h | 20 h | 32 h | 48 h |
| 30 min | 6 h | 14 h | 22 h | 36 h | |
| 1 h | 8 h | 16 h | 24 h | 40 h | |

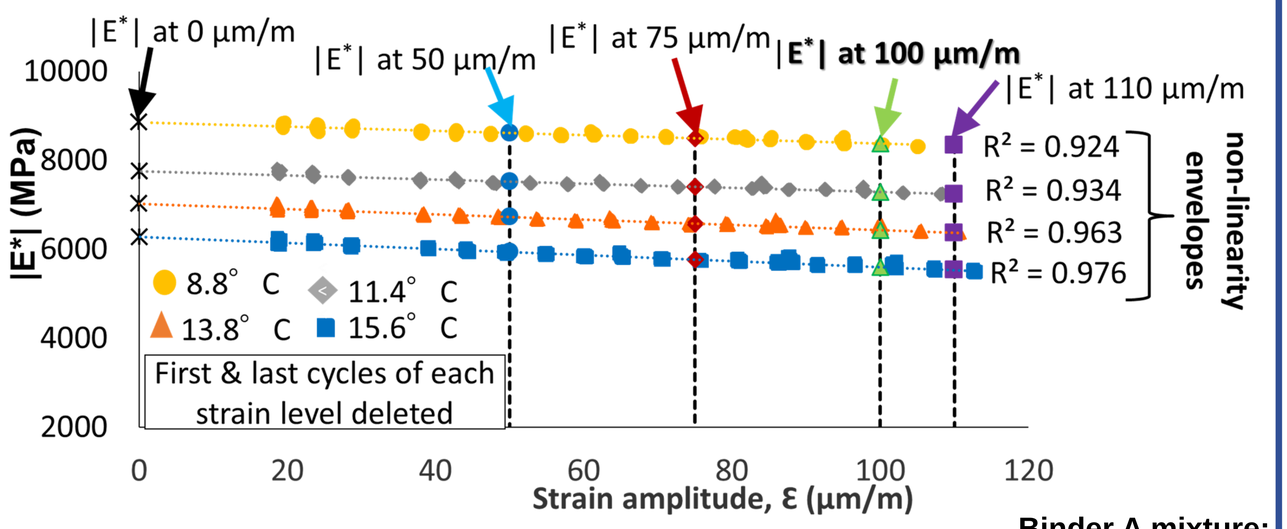
❖ Materials tested

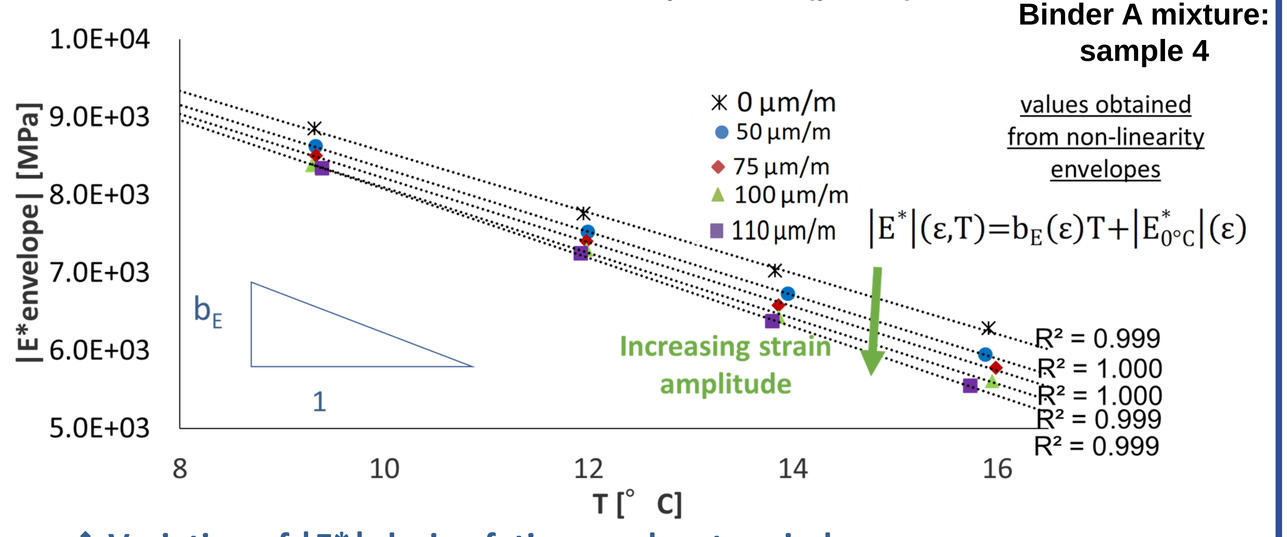
3 mixtures with 3 different binders and same grain size distribution (8 samples for each mixture, provided by Univ. Gustave Eiffel).

| Base binder | A | B | C (Modified) |
|---|---|---|---|
| Binder pen. (1/10 mm) | 49 | 80 | N/A |
| Binder content | 6.6 % | 6.6 % | 6.6 % |

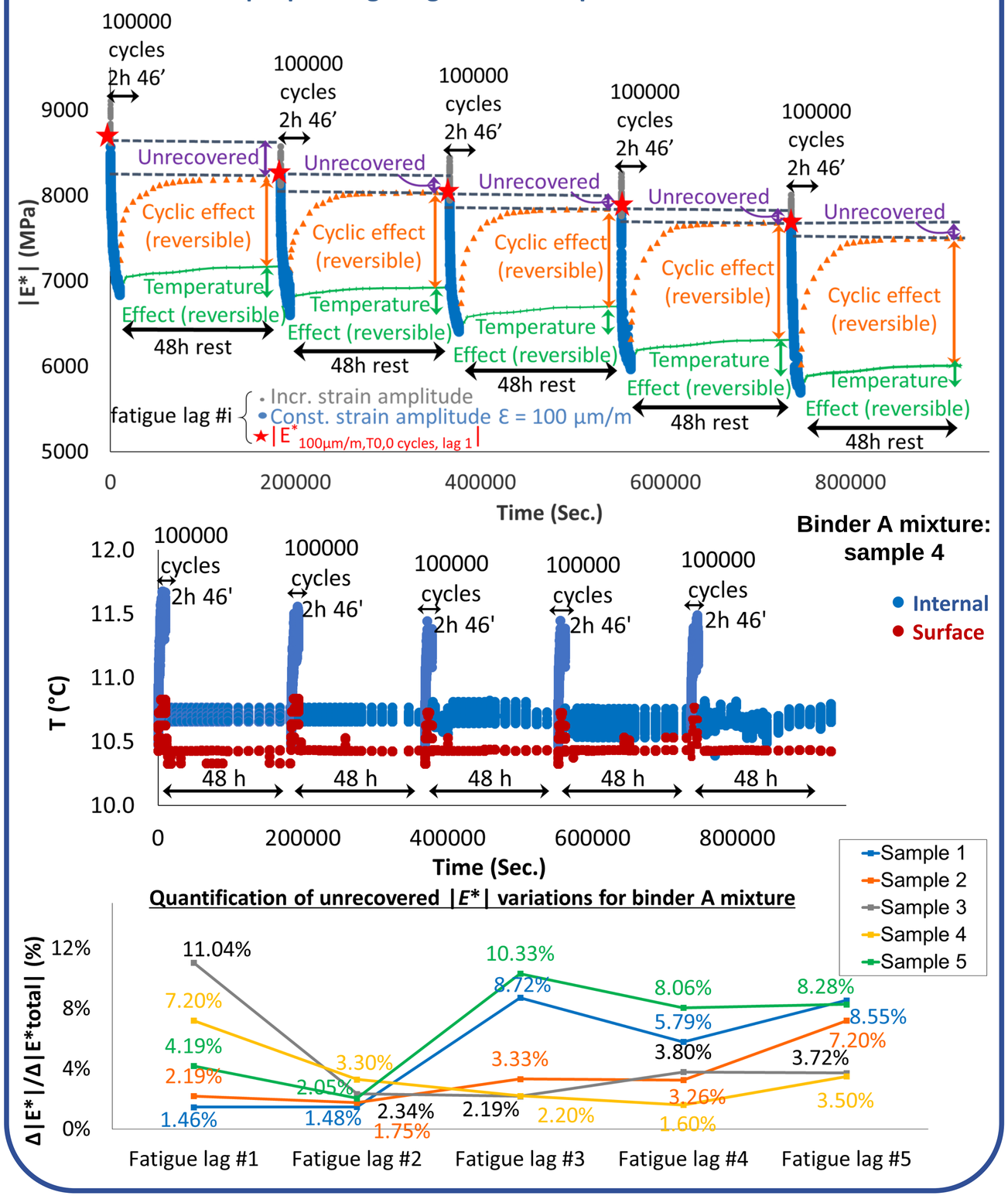
## Examples of results obtained

❖ Variation of |E*| with strain amplitude and temperature (undamaged conditions)




❖ Variation of |E*| during fatigue and rest periods.




## Partial conclusions and ongoing work

- Isolation and estimation of reversible and irreversible variations of material properties during fatigue and rest
- About 90% (or more) of total variations observed during each fatigue tests are completely reversible (not permanent damage)
- Ongoing analysis on norm and phase angle of complex modulus and complex Poisson's ratio.