# CRACKING RISK OF RECYCLED CONCRETE AGGEGATES AT EARLY AGE UNDER RESTRAINED DEFORMATION

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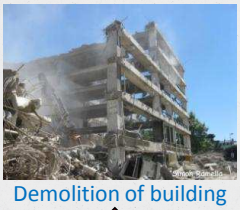
## BACKGROUND

The main issue of recycling is primarily to environmental consideration: The reuse of recycled aggregates from demolition can limit the extraction of raw materials, thus participating in the preservation of natural resources, and reduce the amount of waste.



Demolition of building

+ years

Recycling yard → **Crushing** → Recycled concrete aggregates

Characterization of recycled aggregates

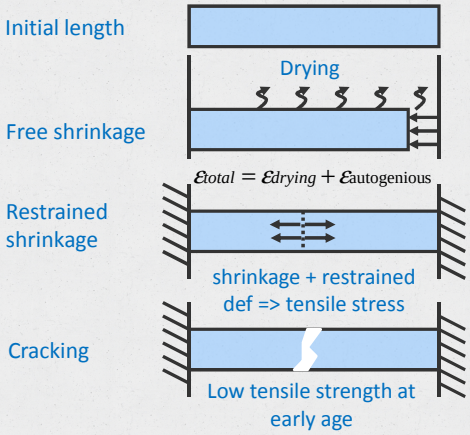
**Investigation of early age behaviour and cracking sensitivity of recycled concrete aggregates**

**Porous** **Absorption**


Properties in the hardened state ← **+ days** ← Rheological performance at early age

**Influence of increasing RCA proportion ?**

### Cracking by restrained shrinkage

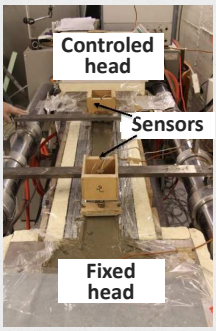



## EXPERIMENTAL PROCEDURES

### Temperature-Stress Testing Machine (TSTM) device

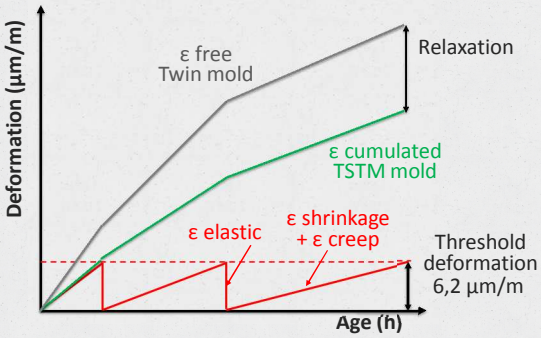
TSTM mold

Twin mold => free shrinkage




TSTM device of ULB

(Darquennes, 2008 ; Staquet, Delsaute, 2012)




$$\varepsilon_{TSTM} = (S_1 + S_2) \times \frac{1000}{750}$$

$$\varepsilon_{TSTM} = \varepsilon_{elas} + \varepsilon_{creep} + \varepsilon_{ther} + \varepsilon_{sh}$$

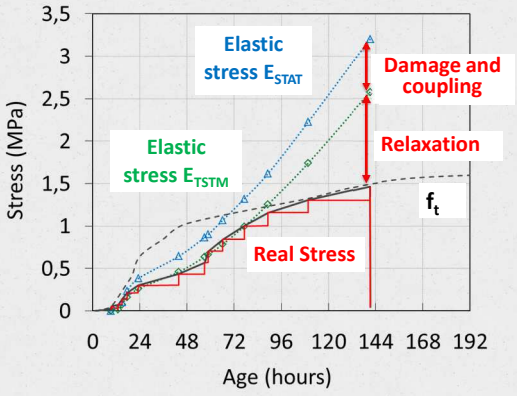
$$\varepsilon_{free} = (S_3 + S_4) \times \frac{1000}{750}$$

$$\varepsilon_{free} = \varepsilon_{ther} + \varepsilon_{sh}$$

### Mechanical characterization

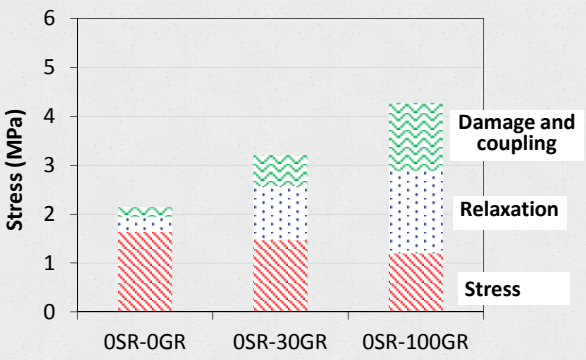
Two static Young's modulus of concrete are characterized : the first one is determined during each load cycle in the TSTM mold noted $E_{TSTM}$ and the second is assessed from cyclic compression test on cylindrical samples, noted $E_{STAT}$.

## RESULTS AND DISCUSSIONS




- Evolution of tensile strength $f_t$
- Elastic stress :
  - Free deformation of the twin mold x $E_{TSTM}$
  - Free deformation of the twin mold x $E_{STAT}$
- Evolution of the real stress(TSTM)

-The same calculation is applied to the tree mixtures : 0% recycled Gravel (RG), 30% RG and 100% RG.




### Publication :

Bendimerad, A. Z.; Delsaute B.; Rozière, E.; Staquet S.; Loukili, A. Restrained shrinkage of recycled concrete aggregates at early age, this work will be in the near future submitted to an international journal.

### Conclusions

-Concrete damage increased with the substitution rate of recycled gravel,
-Concrete with 100% of recycled gravel was characterized by the lowest cracking sensitivity and the highest relaxation,
-Extraction of viscoelastic properties of RCA at early age by associating the TSTM to a mechanical characterization.

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