

## Cyclic and fatigue behaviour of the hybrid glass / carbon composites

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**Relevant Working Groups:** WG2

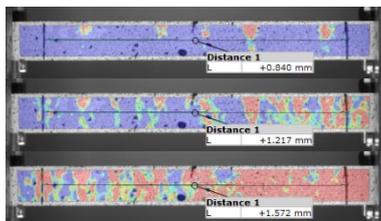
### Objectives / Description / Main outcomes

The quasi-static, cyclic and fatigue responses of unidirectional (UD) interlayer pseudo-ductile glass/high modulus carbon and standard-modulus carbon/high modulus carbon hybrid FRP composites were studied. Properties such as the yield stress and strain, pseudo-ductile strain, elastic modulus and strength were investigated for both quasi-static and cyclic loading. Digital image correlation (DIC) was used to observe damage evolution.

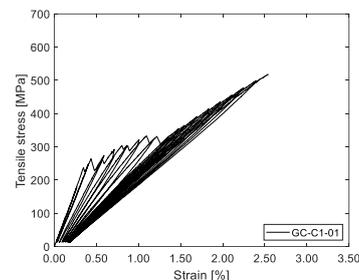
DIC allowed to observe fragmentation and delamination propagation in both combinations (see Figure 1). This is an important output, since in the case carbon/carbon combinations this phenomenon cannot be checked by visual inspection.

Low-cyclic tests allowed to observe that there is a very small residual (plastic) deformation of the hybrid specimens (see Figure 2). Furthermore, the low-cyclic loading did not change the main tensile properties of hybrid FRP composites (comparatively to quasi-static results), mainly elastic modulus, strain at the failure of LS fibres, tensile strength, strain at the failure.

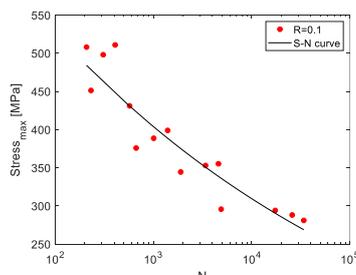
Fatigue tests allowed to observe that the fatigue life of composites involving glass fibre is very low. The variation of the fatigue maximum stress level versus fatigue life on a semi-logarithmic scale is shown in Figure 3. With an increasing number of cycles, the fatigue stiffness dropped at a higher rate at higher stress levels than at lower ones (see Figure 4).



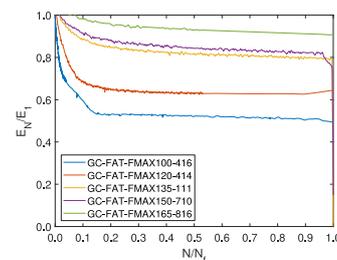
**Figure 1:** Strain field's evolution of 1C/1CHM/1C combination during the test.



**Figure 2:** Low-cyclic test response.



**Figure 3:** Experimental fatigue data and S-N curve.



**Figure 4:** Variation of normalized fatigue stiffness versus normalized number of cycles.