TENSILE- TENSILE FATIGUE STUDY OF DAMAGED AND REPAIRED CARBON-GLASS HYBRID COMPOSITE

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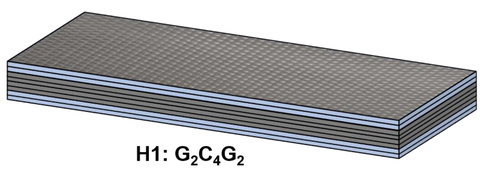
Introduction

- Studying the **fatigue behaviour of damaged and repaired composite** specimens is essential because of their high susceptibility to impact damage.
- Looking towards the application of fibre hybrid composite, the **tensile-tensile fatigue behaviour** of damaged and repaired specimens was studied in this work.
- Two parent hybrid configurations(**H1: $G_2C_4G_2$ and H2: $C_2G_4C_2$**) were used for this study to understand the effect of stacking sequence in a fatigue environment for drilled and repaired specimens.

Experimental Procedure



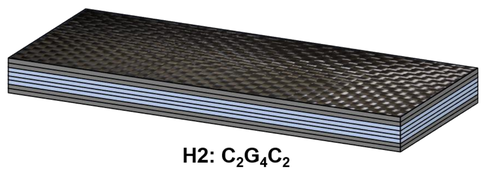


Figure 1: Two different parent hybrid configurations (H1: $G_2C_4G_2$ and H2: $C_2G_4C_2$) consisting of glass and carbon plies

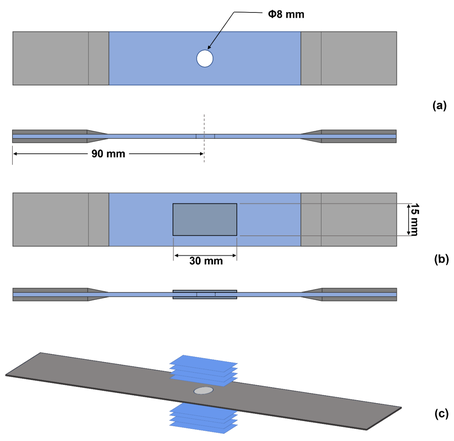


Figure 2: Detailed dimension and schematic of drilled specimen and repaired specimen (ASTM D3479/D3479M − 19).

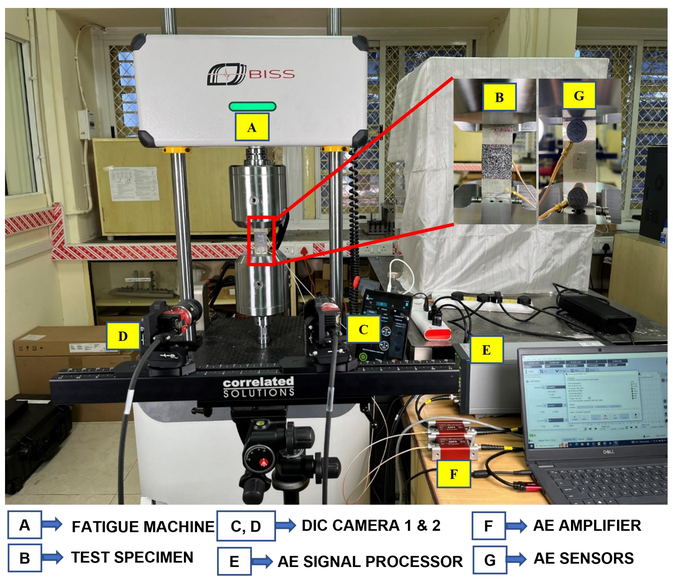


Figure 3: Tensile – Tensile fatigue test setup.

- **Drilled specimens** were fatigued at **90 %, 85 % and 75 %** of the static failure load of the corresponding drilled specimens, and a **stress ratio (R) of 0.1** was considered.
- Specimens were repaired with **four ply glass patch** on both the sides.
- Fatigue tests for **repaired specimens** were also performed at the load level of **90 %** of the drilled specimens

Results

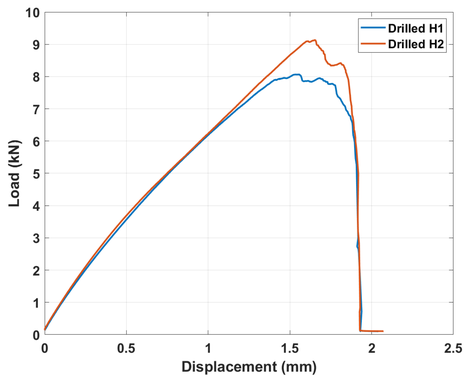


Figure 4: Load–displacement curve of drilled specimens

Maximum load (% of corresponding drilled static strength)	Failure cycle number Drilled H1	Failure cycle number Drilled H2
90 %	141,166,356	failed due to creep
85 %	70 k (no failure)	failed due to creep
75 %	70 k (no failure)	39k,57k,58k

Table 1: number of cycle attain by drilled H1 and H2 specimens for different load percentage values.

- Even if **drilled H2** specimen having higher static strength, it **failed early** compared to H1 specimen in **fatigue environment**

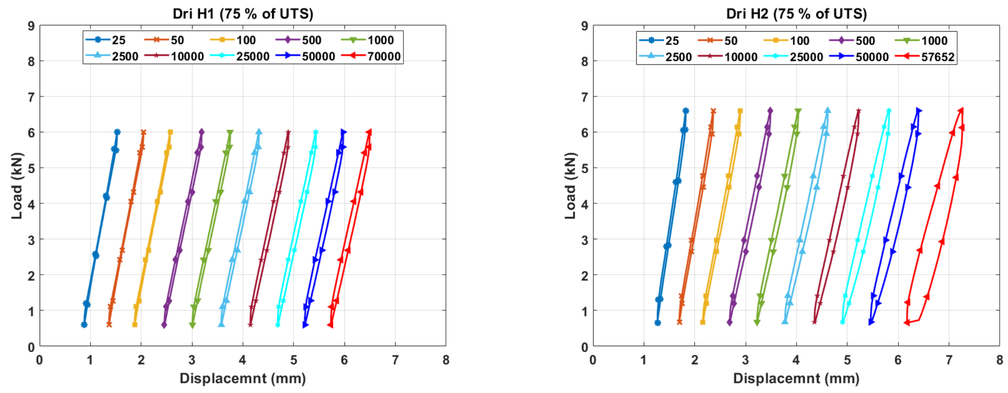


Figure 5: Hysteresis curve of drilled specimens (a) Dri H1 (75 % of UTS), (b) Dri H2 (75 % of UTS)

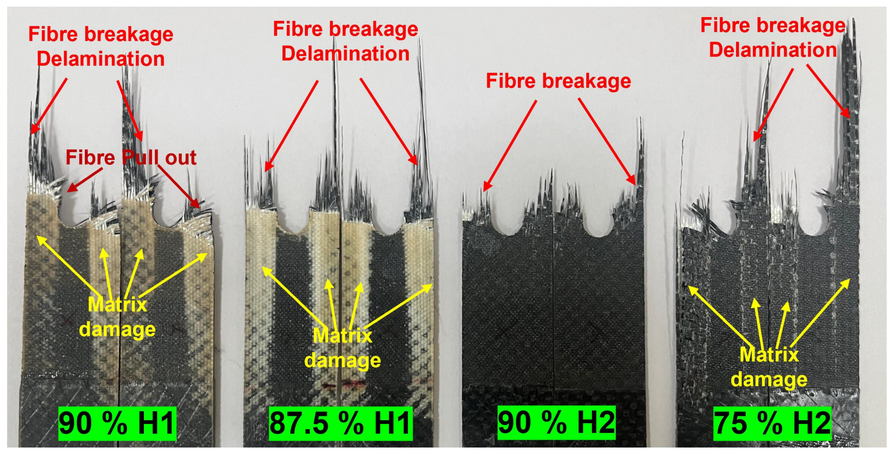


Figure 6: Different damages present in the H1 and H2 drilled specimen for different load level.

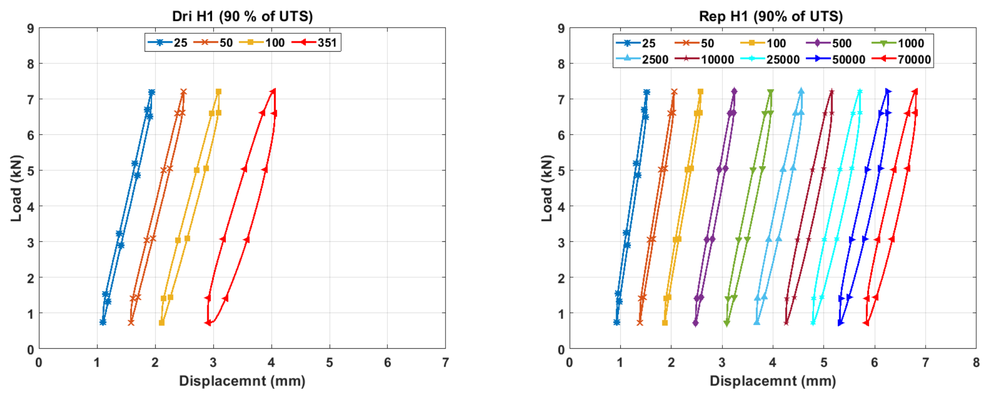


Figure 7: Hysteresis curve of drilled and repaired specimens (a) Dri H1 (90 % of UTS), (b) Rep H1 (90% of UTS)

- At **higher load fibre failure damage** is prominent, whereas at **lower load level both fibre failure and matrix cracking** are seen.
- **Repaired H2 specimen failed due to creep**, whereas repaired H1 specimen able to withstand 70k cycle without failure.

Conclusions

- Tensile-Tensile fatigue behaviour of the damaged and repaired specimens were studied in this work. Two different parent hybrid configurations (H1 and H2) were used to study the effect of the stacking sequence of the parent laminate
- In the **drilled specimens, H1 performed better**, whereas the H2 specimen failed because of the creep load at the higher load levels.
- In **repaired specimen** also, the **H1 specimen** was able to withstand a high number of cycles compared to its drilled specimen.
- In the **H2 repaired specimen, not much improvement** was observed compared to its drilled specimen.