CERIS : Civil Engineering Research and Innovation for Sustainability

Monotonic, cyclic and seismic behaviour of pultruded structures: from connections to full scale frames

PhD student
David José Medeira Martins

PhD program
Civil Engineering (IST, University of Lisbon)

Supervisor
João Ramôa Correia (CERIS, IST, University of Lisbon)

Co-supervisors
Nuno Silvestre (IDMEC, IST, University of Lisbon) and José Gonilha (CERIS, IST, University of Lisbon)

Period
2017-2022

Funding
FCT scholarship (SFRH/BD/141089/2018)

FCT Research Project (PTDC/ECM-EST/6464/2014)

Summary

The main objectives are three-fold: (i) to improve the understanding about the structural behaviour of bolted connections between GFRP profiles under non-conventional loadings (short-term cyclic and long-term monotonic), (ii) to develop innovative material-adapted connection systems for GFRP profiles, and (iii) to deliver reliable guidelines for computational simulations and design codes. The following results are expected:

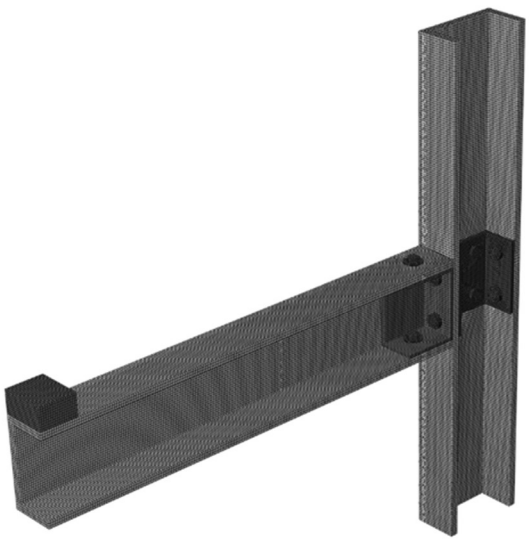
1) In-depth understanding of the mechanical behaviour of "conventional" GFRP connection systems subjected to cyclic loads, namely in what concerns the influence of the connection configuration (e.g. web cleat vs. flange cleat), bolts number and arrangement, and GFRP geometry and mechanical properties on stiffness, strength and failure modes. Preliminary study of GFRP connections under monotonic loading is planned as reference.

2) Innovative material-adapted connection systems for GFRP beam-to-columns joints, able to make a better use of the GFRP properties as well as those of auxiliary (metallic) parts in dissipating energy: (i) for I-section profiles, those systems will comprise stainless steel plates, judiciously located; in addition, the combination of those plates with ductile (polyurethane) adhesives will be pursued; (ii) for tubular profiles, those systems will comprise inner or outer stainless steel tubes.

3) Reliable guidelines to analyse and design GFRP bolted connections, both "conventional" and innovative. Non-linear FE models will be developed to accurately simulate GFRP beam-to-column joints, including progressive GFRP failure (delamination, crack growth) using Hashin criterion. Design formulas will be derived to estimate (i) the stiffness of the connections, (ii) the stress distributions per (rows of) bolts, and (iii) the strength for different mechanisms. The results of numerical analyses and analytical formulas will be validated with experimental data.

Keywords

Seismic behaviour, design, ductility, hysteretic, non-linear analysis.



Finite element model of a beam-to-column connection.