

FireFloor – Fire Behaviour of GFRP Composite Sandwich Panels for Rehabilitation of Building Floors

Summary

This project addresses the fire behaviour of glass fibre reinforced polymer (GFRP) composite panels with the purpose of developing fire protection solutions to enable their structural use for rehabilitation of building floors.

The replacement of degraded floors (namely timber ones) with traditional materials introduces significant dead loads in constructions, increasing their seismic vulnerability. GFRP materials present several advantages, namely their high mechanical performance, lightness, durability and increasingly competitive costs. Although GFRP panels have been successfully used in a wide variety of structural applications, there are well-founded concerns about their fire behaviour. This issue is yet to be addressed in a comprehensive manner and has hampered their use in building floors, where strict fire requirements have to be respected.

In this project the fire behaviour of GFRP composite panels will be assessed; the influence of different core materials and GFRP architectures on their fire reaction and fire resistance properties will be evaluated. The effectiveness of different passive fire protection systems will be assessed to enable their structural use in buildings. This will imply coupling a comprehensive experimental study with the development of supporting numerical modelling tools.

The experimental study will include (i) specific tests to evaluate the thermophysical properties of all materials; (ii) small-scale mechanical tests (tension, compression, shear and flexure) at elevated temperatures; (iii) fire reaction tests and (iv) full-scale fire resistance tests on loaded GFRP panels insulated with different fire protection systems. The numerical modelling will comprise the incorporation of the constitutive

relations as a function of temperature of all materials and the assessment of appropriate failure criteria; after validation with the experimental results, the models will be used to optimize the geometry of the panels and the fire protection systems.

The following results are expected from this project:

- In-depth understanding of the fire behaviour of GFRP panels.
- Development of innovative passive protection systems for GFRP panels to enable their structural use in rehabilitation of degraded building floors, and therefore exploring the advantages they present over traditional solutions: high strength, lightness, durability, ease of application and minimal maintenance.
- Development of numerical models to simulate the thermochemical and thermomechanical response to fire of GFRP panels with arbitrary cross-section and different fire protection systems, with the aim of prototyping structural design supporting tools.
- Preparation of a design manual comprising rules, tables and technical specifications regarding the fire behaviour and fire protection of GFRP panels to be used for rehabilitation of building floors.

Collaboration with manufacturers and associated industry will also allow for the development of technical and industrial capacity in this arising area of structural rehabilitation.



a)



b)

Figure 1. a) Example of a fire resistance test performed on a loaded GFRP-sandwich panel;
b) Tensile tests on GFRP laminates at elevated temperatures.

Project Reference

PTDC/ECI-EGC/30611/2017

Leading Institution

IST-ID – Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal)

Partners

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CERIS

227 449.20€

Project Website

coregroup.tecnico.ulisboa.pt/research-projects/on-going/f