Lifetime Performance of GFRP Pultruded Profiles for Structural Applications

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Summary

This paper presents results of an ongoing experimental research performed at IST on two critical topics, regarding the use of glass fibre reinforced polymer (GFRP) pultruded profiles in structural applications: the long-term durability and the fire behaviour. The first part of this paper presents test results on the changes suffered by GFRP pultruded profiles under accelerated exposure to moisture, temperature and UV radiation. Although some reduction was observed in the mechanical properties, the durability tests proved the generally good long-term behaviour of this material. The second part of this paper presents results of experiments on the fire behaviour of GFRP profiles. Large-scale fire resistance tests on both unprotected and protected GFRP profiles (with different active and passive protection systems) were conducted to investigate the thermal and mechanical response of the material under fire and to determine the fire resistance and applicability of the investigated systems.

Keywords: GFRP pultruded profiles; long-term behaviour; accelerated ageing; thermomechanical behaviour; fire resistance tests.

1. Introduction

Glass fibre reinforced polymer (GFRP) pultruded profiles have great potential for bridge and building construction, presenting several advantages when compared with traditional materials, namely high strength/stiffness to weight ratios, lightness, low maintenance requirements and improved durability. There are already several examples of bridges [1] and buildings in which GFRP profiles have been used as primary structural elements, either isolated or combined with other materials in hybrid structures [2].

Although there is evidence of improved performance of GFRP composites when used in aggressive environments, the lack of comprehensive and validated data on durability constitutes an obstacle for the widespread acceptance of these new materials [3]. Aiming to clarify the durability behaviour of GFRP structural elements, the first part of this paper presents results of an experimental research on the physical, chemical, mechanical and aesthetical changes presented by GFRP pultruded profiles following accelerated exposure to moisture, thermal effects and ultraviolet (UV) radiation. Specimens from GFRP pultruded profiles, currently being used in structural applications, were submitted to different exposure environments: (i) an immersion chamber, (ii) a condensation chamber and (iii) an artificial accelerated weathering in a QUV equipment. After submitting the material to those aggressive environments, the weight changes were analysed, the flexural behaviour was studied, the chromatic and gloss variations were measured and the chemical changes were investigated by means of Fourier transform infrared (FTIR) spectroscopy.

For building applications, there is an additional concern regarding the fire behaviour of GFRP profiles, since structural members are required to provide fire ignition prevention (limiting fire and smoke spread), and fire resistance to prevent structural collapse under fire. Due to the use of polymeric resins in their matrix, GFRP profiles present high flammability and inherently poor fire resistance. Therefore, in building applications, the use of active or passive fire protection systems

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