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A NUMERICAL STUDY ON THE BEHAVIOUR OF A GLASS BEAM STRENGHTENED WITH GFRP PULTRUDED LAMINATES

P. Neto[1], J. Alfaiate[2], R. Graça-e-Costa[3], D. Dias-da-Costa[4], L. Valarinho[2], J. R. Correia[2], F. A. Branco[2] and J. Vinagre[1]

[1] ICIST and Escola Superior de Tecnologia do Barreiro, Polytechnic Institute of Setubal, Rua Américo da Silva Marinho, 2839-001 Lavradio, Portugal, pedro.neto@estbarreiro.ips.pt, joao.vinagre@estbarreiro.ips.pt, http://www.estbarreiro.ips.pt

[2] ICIST and Department of Civil Engineering, Instituto Superior Técnico, University of Lisbon, Av. Rovisco Pais, 1049-001 Lisbon, Portugal, jorge.alfaiate@tecnico.ulisboa.pt, luis.valarinho@civil.ist.utl.pt, jcorreia@civil.ist.utl.pt, fbranco@civil.ist.utl.pt, http://www.ist.utl.pt

[3] ICIST and Department of Civil Engineering, ISE, Universidade do Algarve, Campus da Penha, 8000-117, Faro Portugal, rcosta@ualg.pt, http://www.ualg.pt

[4] INESC and Department of Civil Engineering, University of Coimbra, Rua Luís Reis Santos, 3030-788 Coimbra, Portugal, dias-da-costa@dec.uc.pt, http://www.uc.pt

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This study is focused on the bond behaviour between glass fibre reinforced polymers (GFRP) and glass. In this case, the GFRP is not used for strengthening, rehabilitation or retrofitting; instead, the GFRP is introduced to overcome the brittle behaviour of glass and the corresponding reduced resistance to tensile stresses [1].

In this paper, a numerical study is presented based on data collected from experimental tests conducted by the authors. The finite element method is used to model a glass beam strengthened with GFRP pultruded laminates (Fig. 1). For this purpose, a discrete crack approach based on non-linear fracture mechanics is adopted. The following nonlinear phenomena are taken into account: (i) mode-I fracture of glass and (ii) mode-II fracture behaviour of the assemblage formed by glass-epoxy-GFRP. The bond between glass and GFRP is modelled by means of zero thickness interface elements.

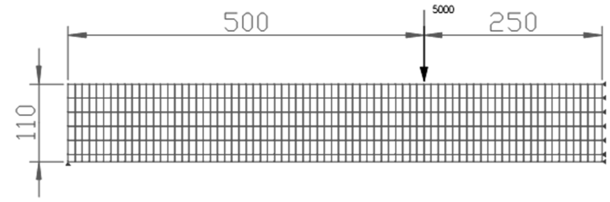

Fig. 1 - Finite element mesh adopted in the beam model (dimensions in mm).

The material properties used to characterize the interface are the shear stiffness, the cohesion and the mode-II fracture energy. These parameters are initially defined based on a previous study carried out with the objective of approximating the experimental results obtained from testing double lap joints in tension. Cracks in the beam model are modelled by discontinuities embedded inside the finite elements. In this case, the material parameters characterizing the interface behaviour are: the tensile strength and the mode-I fracture energy. A non-iterative energy based method is used in order to overcome the convergence difficulties found due to high non-linearity and brittleness of the studied behaviour. A parametric study is performed to evaluate the importance of each parameter on the modelling of the glass beam strengthened with GFRP. The beam response (Fig. 2) is compared with experimental data collected from four-point bending tests [2].

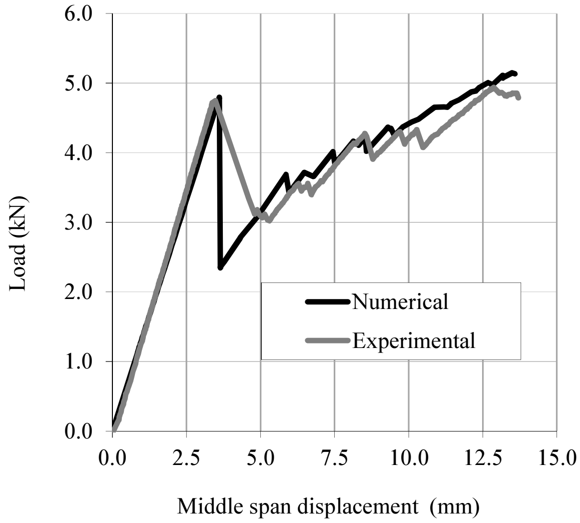

Fig. 2 - Load displacement curve of the glass beam strengthened with GFRP.

This work is expected to contribute for a better comprehension of the stress transfer mechanisms between the glass and GFRP and also the cracking behaviour of the glass. Particularly, this study aims at bringing some enlightenment on the qualitative and quantitative definition of mode-I and mode-II fracture for these types of structural solutions.

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