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# PROGRESSIVE FAILURE OF PULTRUDED FRP COLUMNS: NUMERICAL STUDY

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**Summary:** Pultruded fibre reinforced polymer (FRP) profiles are finding increasing applications in civil engineering due to their advantages over traditional construction materials, such as high strength, lightness and improved durability.
The structural behavior of pultruded FRP beams and columns has been investigated in the past both through experimental and numerical studies. However, very little information is available regarding the progressive failure mechanisms of those members.
In the numerical simulations of FRP composite members the criteria most frequently used to model the ultimate behaviour (e.g., Tsai-Hill, Tsai-Wu, maximum stress and maximum strain) are only able to identify failure initiation. If for some failure mechanisms such criteria provide reasonable estimates of the collapse load of FRP members, for other types of mechanisms they have been found to largely underestimate the load carrying capacity.
This paper presents a numerical study about the progressive failure of I-section (200x100x10 mm) pultruded FRP columns with three different lengths (600, 1000 and 2000 mm), comprising different types of carbon and glass fibre reinforcement. Three-dimensional finite element models of the columns were developed using the commercial software Abaqus. The section walls were simulated using 8-node continuum shell elements, therefore considering the three-dimensional geometry of the webs and flanges, and simultaneously allowing using a plane stress formulation. Failure progression was modelled using the Hashin criterion, which encompasses the progressive stiffness degradation of the FRP material when the failure index is attained. In addition, when using this criterion, it is also possible to model progressive delamination phenomena.
The numerical results are compared with experimental data, namely in what concerns (i) the axial load vs. shortening, (ii) the axial load vs. horizontal deflection, (iii) the axial stress vs. strain, (iv) the critical loads, and (v) the ultimate loads. A general good agreement was obtained between the experimental and numerical responses.