EVALUATION OF THE PROCESS INDUCED RESIDUAL STRESSES AT THE WEB-FLANGE JUNCTIONS OF PULTRUDED GFRP PROFILES

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Abstract

Pultrusion is one of the most cost efficient composite manufacturing processes in which constant cross sectional continuous composite profiles are produced. Recently, pultruded structures are foreseen to have potential for the replacement of conventional materials used in the construction industry. A consequence of the increasing usage of pultruded profiles in the construction industry requires detailed understanding of the mechanical behavior as well as the failure mechanism of the profile.

The process induced residual stresses and distortions for the pultrusion of an I-beam profile, which has not been considered in the literature up to now, are predicted in the present study. The residual stresses most likely have an important effect on the mechanical behaviour of the pultruded I-beam especially at the web-flange junction. The temperature and the cure degree distributions are first obtained at steady state in the thermo-chemical analysis of the pultrusion process and afterwards used in the mechanical analysis in which the residual stresses and distortions are evaluated. More specifically, a 3D transient Eulerian thermo-chemical analysis is coupled with a 2D quasi-static Lagrangian plane strain mechanical analysis of the pultrusion process which is a quite new approach in this specific field. The instantaneous cure dependent resin modulus is used for the present simulation of the pultrusion process since post-curing after cooling is normally not used in pultrusion.