

Behavior of bonded pultruded beams via an imperfect interface model with damage

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The connections in FRP structures are commonly made using bolted connections, akin to those used in steel structures. In fact, some FRP profiles manufacturers [1] and design guidelines [2] stipulates that bonded connections should not be allowed for primary load bearing components, where failure of the connection could lead to progressive collapse or unacceptable risks. In the latter situations, their use is permitted only in combination with or as a backup for bolted connections. As stated in [1], the main reason for the prohibition of bonded connections is lack of knowledge about and experience with the performance of such connections. Theoretically, there are reasons to believe that bonded connections can **surpass** bolted connections in FRP composite structures. While bonded lap joints have been extensively investigated in composites, for beam-to-column bonded connections there are no experimental or numerical results available to assess their strength, stiffness and overall performance. To fill this gap in knowledge, recently the authors experimentally investigated the behavior of full-scale bonded beam-to-column moment resisting connections demonstrating that the complete aforementioned prohibition appears to be unjustified.

The next step consists to develop a predictive model of such a connection in order to make a comparison with experimental results, in terms of ultimate bending moment, as well as to analyze the role played by several features. Among them, the main ones are the thickness of the adhesive layer (in the experimental program it was constant and equal to 2mm), the friction at the interface (before applying the adhesive the surfaces are treated removing the chopped-glass-mat in order to permit the resin to permeate between the fibers) and the load condition (in the experimental program the connection was subjected to shear and bending moment).

Within this framework, an interface model, able to take into account finite strains [4] as well as damage, was developed using asymptotic techniques [5].

In a first study [6], dealing with a classical double lap joints made of GFRP material and an epoxy resin as a glue, under tensile load condition, the model was tested reproducing damage in the adhesive interface as experimentally observed .

Relative to the beam-to-column connection, the numerical model furnished useful informations in view of an improvement about its strength and stiffness.

References

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