GFRP beams by bonding simple panels: a low-cost design strategy

Francesco Ascione[1], Marco Lamberti[1], Geminiano Mancusi[1], Saverio Spadea[1]
Fréderic Lebon[2], Aurélien Maurel-Pantel[2]

[1]*Department of Civil Engineering, University of Salerno, Fisciano (SA), Italy*
E-mail: *fascione@unisa.it, malamberti@unisa.it, g.mancusi@unisa.it, sspadea@unisa.it*

[2]*Laboratoire de Mécanique et d'Acoustique, University of Aix-Marseille, Marseille, France*
E-mail: *lebon@lma.cnrs-mrs.fr,maurel@lma.cnrs-mrs.fr*

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Although traditional materials (steel, concrete, timber and masonry) still dominate the building industry, new materials are constantly being explored by engineers and scientists. For instance, the use of the so-called FRPs (Fibre-Reinforced Polymers) is gradually spreading worldwide. FRPs can be qualified as non-corrosive, high mechanical strength and lightweight materials. They have achieved in the last few years a relevant role as a building material for applications regarding both the strengthening and the realization of full-composite structures. Examples of applications of FRPs are numerous [1],[2]. The first buildings made from FRP profiles were single-storey gable frames used in the electronics industry for Electromagnetic Interference (EMI) test laboratories. A five-storey building, named the Eyecatcher Building was erected for the Swiss Building Fair in 1998. The most cost-effective way of producing FRPs is the automated process of pultrusion. This process optimizes the production of bars and thin/thick-walled profiles with both closed and open cross-sections which are constant over the length. Because the industrial process is optimized for mass pultrusion of a limited number of shapes, it is difficult to produce complex shapes with standard cost targets. A low-cost design strategy inspired by modularity, able to exploit the immediate availability of "ready-to-use" standard components, plays a crucial role for the large-scale viability of FRP structures. The idea discussed in this paper is focused exactly on the possibility of achieving a complex FRP shape by bonding an appropriate number of simple pultruded shapes with a common epoxy glue. For example, a generic I-profile may be obtained by bonding three rectangular panels (the top/bottom flanges and the web panel), rather than via a unique pultrusion application. In addition, web-to-flange junctions may also be strengthened by bonding appropriate angle profiles. In this view, the possibility of considering composite profiles of a generic cross-section from simple rectangular panels would be an interesting constructive simplification.
For this reason, the authors have recently initiated a large experimental investigation, still under development, in order to compare the flexural behaviour of pultruded FRP profiles with that of bonded FRP profiles. The results have shown the possibility of achieving a very good performance, in terms of both failure load and flexural stiffness, allowing us to consider the bonding system proposed as highly competitive in the field of construction of pultruded profiles.

References

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