The Mechanical Behaviour Of Foam-Filled Corrugated Core Sandwich Panels In Lateral Compression

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Abstract

A series of experimental investigations and numerical analyses is presented into the compression response, and subsequent failure modes in foam-filled corrugated core sandwich panels. The corrugated cores based on carbon fibre reinforced plastic (CFRP) and glass fibre reinforced plastic (GFRP) were fabricated using a hot press moulding technique and then bonded to face sheets based on the same material, to produce a range of lightweight sandwich panels. A liquid of low density Rigid Polyurethane (PUR) foam was injected to fill the empty space of the sandwich panels, where to investigate the influence of filling the corrugation with the foam. The experiments also provide an insight into the post-failure response of the sandwich panels. The results are compared with the numerical predictions offered by a finite element analysis (FEA). Buckling of the cell walls has been found to be initial failure mode in these corrugated systems. Continued loading resulted in fracture of the cell walls, localised delamination as well as debonding between the skins and the core. The predictions of the FEA generally show reasonably good agreement with the experimental measurements, for semi-filled and fully-filled foams. Finally, filling the inside of the corrugated core sandwich panels with the foam significantly improved the specific strength as well as the specific energy absorption (SEA) characteristics of the structures. The SEA for the GFRP and the CFRP fully-filled specimens were improved by almost 160% and 105%, respectively. This improvement was due to the constraint effects between the foam and the corrugated core members.

Keywords: Carbon fibre ; Glass fibre ; Foam ; Finite element analysis ; Specific energy absorption