

An Investigation on the Sandwich Panels with Flexible and Toughened Adhesives under Flexural Loading

Authors : Emre Kara, Şura Karakuzu, Ahmet Fatih Geylan, Metehan Demir, Kadir Koç, Halil Aykul

Abstract : The material selection in the design of the sandwich structures is very crucial aspect because of the positive or negative influences of the base materials to the mechanical properties of the entire panel. In the literature, it was presented that the selection of the skin and core materials plays very important role on the behavior of the sandwich. Beside this, the use of the correct adhesive can make the whole structure to show better mechanical results and behavior. By this way, the sandwich structures realized in the study were obtained with the combination of aluminum foam core and three different glass fiber reinforced polymer (GFRP) skins using two different commercial adhesives which are based on flexible polyurethane and toughened epoxy. The static and dynamic tests were already applied on the sandwiches with different types of adhesives. In the present work, the static three-point bending tests were performed on the sandwiches having an aluminum foam core with the thickness of 15 mm, the skins with three different types of fabrics ($[0^\circ/90^\circ]$ cross ply E-Glass Biaxial stitched, $[0^\circ/90^\circ]$ cross ply E-Glass Woven and $[0^\circ/90^\circ]$ cross ply S-Glass Woven which have same thickness value of 1.75 mm) and two different commercial adhesives (flexible polyurethane and toughened epoxy based) at different values of support span distances ($L= 55, 70, 80, 125$ mm) by aiming the analyses of their flexural performance. The skins used in the study were produced via Vacuum Assisted Resin Transfer Molding (VARTM) technique and were easily bonded onto the aluminum foam core with flexible and toughened adhesives under a very low pressure using press machine with the alignment tabs having the total thickness of the whole panel. The main results of the flexural loading are: force-displacement curves obtained after the bending tests, peak force values, absorbed energy, collapse mechanisms, adhesion quality and the effect of the support span length and adhesive type. The experimental results presented that the sandwiches with epoxy based toughened adhesive and the skins made of S-Glass Woven fabrics indicated the best adhesion quality and mechanical properties. The sandwiches with toughened adhesive exhibited higher peak force and energy absorption values compared to the sandwiches with flexible adhesive. The core shear mode occurred in the sandwiches with flexible polyurethane based adhesive through the thickness of the core while the same mode took place in the sandwiches with toughened epoxy based adhesive along the length of the core. The use of these sandwich structures can lead to a weight reduction of the transport vehicles, providing an adequate structural strength under operating conditions.

Keywords : adhesive and adhesion, aluminum foam, bending, collapse mechanisms

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