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Flexural Performance of the Sandwich Structures Having Aluminum Foam Core with Different Thicknesses

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Abstract : The structures obtained with the use of sandwich technologies combine low weight with high energy absorbing capacity and load carrying capacity. Hence, there is a growing and markedly interest in the use of sandwiches with aluminium foam core because of very good properties such as flexural rigidity and energy absorption capability. The static (bending and penetration) and dynamic (dynamic bending and low velocity impact) tests were already performed on the aluminum foam cored sandwiches with different types of outer skins by some of the authors. In the current investigation, the static three-point bending tests were carried out on the sandwiches with aluminum foam core and glass fiber reinforced polymer (GFRP) skins at different values of support span distances (L= 55, 70, 80, 125 mm) aiming the analyses of their flexural performance. The influence of the core thickness and the GFRP skin type was reported in terms of peak load, energy absorption capacity and energy efficiency. For this purpose, the skins with two different types of fabrics ([0°/90°] cross ply E-Glass Woven and [0°/90°] cross ply S-Glass Woven which have same thickness value of 1.5 mm) and the aluminum foam core with two different thicknesses (h=10 and 15 mm) were bonded with a commercial polyurethane based flexible adhesive in order to combine the composite sandwich panels. The GFRP skins fabricated via Vacuum Assisted Resin Transfer Molding (VARTM) technique used in the study can be easily bonded to the aluminum foam core and it is possible to configure the base materials (skin, adhesive and core), fiber angle orientation and number of layers for a specific application. The main results of the bending tests are: force-displacement curves, peak force values, absorbed energy, energy efficiency, collapse mechanisms and the effect of the support span length and core thickness. The results of the experimental study showed that the sandwich with the skins made of S-Glass Woven fabrics and with the thicker foam core presented higher mechanical values such as load carrying and energy absorption capacities. The increment of the support span distance generated the decrease of the mechanical values for each type of panels, as expected, because of the inverse proportion between the force and span length. The most common failure types of the sandwiches are debonding of the upper or lower skin and the core shear. The obtained results have particular importance for applications that require lightweight structures with a high capacity of energy dissipation, such as the transport industry (automotive, aerospace, shipbuilding and marine industry), where the problems of collision and crash have increased in the last years.

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