Investigations of the properties of fiber-metal laminates with stiffening rib embossed by the Incremental Sheet Forming technology.

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Abstract. The paper presents the manufacturing process and the results of experimental investigations of 2/1 Fibre Metal Laminates with stiffening ribs made as a longitudinal embossment. The idea of such composites is presented in Fig. 1. The structure consists of two external metal layers and one composite layer in the form of GFRP. The layers were adhesively bonded in an autoclave process, the GFRP layer was made from a prepreg, while the metal layers were made of aluminum alloy sheets 2024-T3 alclad with a thickness of 0.5 mm.

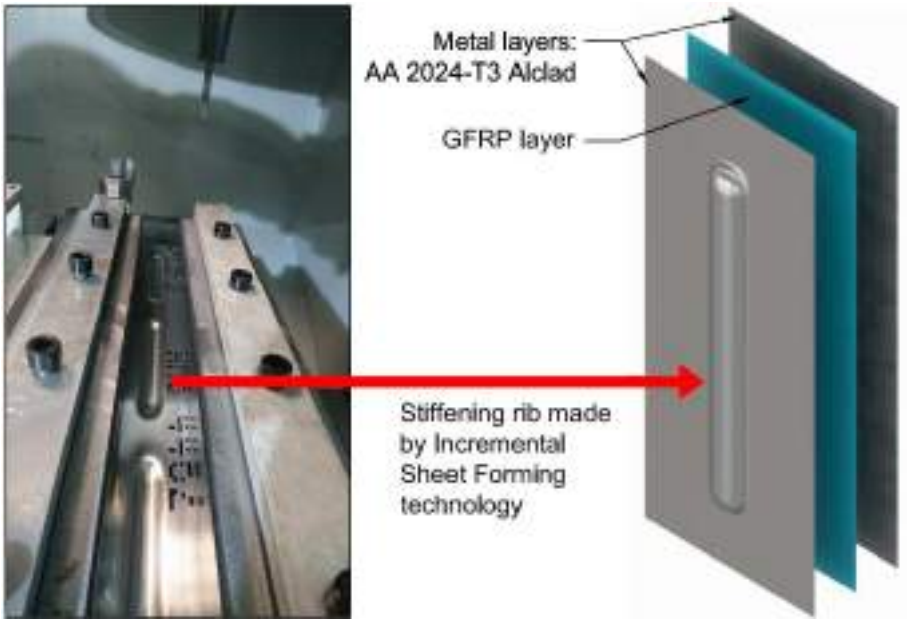

FIGURE 1. Structure of a layered composite sample with stiffening rib in the form of a embossment made by the Incremental Sheet Forming technology

Two variants of adhesive bonding were used, the first of which was an epoxy resin being a prepreg matrix, while in the second variant an additional layer of adhesive film was used between the sheet and the prepreg layer. The stiffening embossing in the metal layer was formed using the Incremental Sheet Forming technology. Different depths of embossments were made to determine the effect of depth on the buckling load of the sample. In the work the process of shaping the ribbing was analyzed, cross-sections of different embossments were verified to determine the sheet thickness distribution in the embossing area. The shaped sheets were anodized in a solution of sulfuric acid, then coated with the primer and all layers were bonded in an autoclave at a pressure of 3 bar. Composite sheets were cut into samples of appropriate dimensions using a WaterJet cutting machine. The samples were subjected to buckling tests specifying the influence of the depth of the embossment and the effect of the type adhesive used to bond the layers to the critical force causing the buckling of the sample.

Based on the results of experimental studies, it has been shown that the use of adhesive film as an additional adhesive layer has a positive effect on buckling resistance, while in terms of the depth of embossing, the most advantageous value is 4 mm, because above this depth the sheet thickness in the crease area decreases, which affects the decrease of the critical force during compression of the sample.