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ON THE FEASIBILITY OF METAL-POLYMER FRICTION STIR JOINING IN BUTTSTRAP CONFIGURATION

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Summary: The development of innovative dissimilar metal-polymer hybrid joints has significantly contributed to advancements in lightweight structural designs, impelling engineers to increase the integration of innovative materials and design solutions in aeronautical structures. Overlap joints are one of the most adopted configurations to combine metals and polymers, mostly due to different technological limitations associated to mechanical fastening, conventional welding or even adhesive bonding. Nonetheless, the misalignment of the neutral lines between base materials leads to the development of a secondary bending moment that generates a bending stress component, limiting the admissible load. In this study, an aluminum alloy (AA6082-T6) and a glass fiber-reinforced polymer (Noryl GFN2) were friction stir joined in buttstrap configuration, addressing the limitations of overlap joints by significantly decreasing the secondary bending moment. As of today, there is no available literature that evidences the use of friction stir based technology in such configuration and, for that reason, exploratory experiments were conducted to assess the ability of friction stir based technology to join simultaneously two aluminum plates on top of a third polymer plate using variable travel and rotating speeds, while keeping the vertical position and the tilt angle constant. A total of nine buttstrap joints were successfully fabricated, exhibiting average ultimate tensile loads ranging from 4.9 to 8.4 kN, with no significant differences among the obtained hardness profiles. The microstructural analysis revealed that all the fabricated joints exhibited a defect at the interface among the three plates that combined the characteristics of the unwelded root defect, typically observed in butt joints, and hook shaped defect – mainly associated to overlap joints. The size of the defect significantly affected the effective joining thickness between the aluminum plates and, consequently, the associated mechanical performance.