Flexural fatigue behaviour of UD, 2D and 3D woven solid woven composite core-based Sandwich panels

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Abstract: The combination of metal facesheets and solid composite core-based sandwich composite panels have appeared as the most suitable materials for automotive, shipbuilding, aeronautical and aerospace applications due to their superior flexural properties over traditional materials. However, there is a continuous need for further innovations to enhance their resistance to delamination, particularly in terms of their response to cyclic bending loads. One approach is the incorporation of new integrated fabric arrangements in the composite core materials into these structures, which allows for the modification and enhancement of their inherent properties. The present study involves an investigation of the flexural fatigue behaviour of metal-faced sandwich composite panels reinforced with unidirectional (UD), two-dimensional (2D), and three-dimensional (3D) fabric-reinforced composite cores. The objective was to understand and analyse the effect of core fabric design arrangement on the flexural performance of these composite panels. The panels were fabricated using various fabric reinforcement techniques, including UD, 2D woven fabric, and 3D woven fabric, combined with metal facesheets. Flexural fatigue tests were performed at different stress levels ($S = t_{max}/t_r$), where t_{max} is maximum fatigue stress and t_r is average static flexural strength of the panels. The fatigue performance was evaluated in the terms of S-N curves, safety factor, and failure modes of the panels. The results revealed that the fabric reinforcement significantly influenced the flexural fatigue behaviour of the panels. The 3D fabric-reinforced core-based panels exhibited the highest flexural fatigue strength, with enhanced load-carrying capacity and resistance to failure.

Keywords: *3-D weaving, flexural fatigue, sandwich composites, FRP composite cores, fatigue failure.*