OFFICIAL ABSTRACT and CERTIFICATION

Validation of High Order Theories for Sandwich Beam Bending Behavior Using Direct Image Correlation (DIC) Techniques

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Using direct image correlation techniques, the real behavior of a sandwich beam composite was studied in comparison to the predictions made by the Classical, First Order, Elasticity, HSAPT, and EHSAPT theories. The model sandwich beam was constructed of a core of glass-embedded foam and two face sheets of woven carbon fiber. The components of the sandwich beam were bonded using an epoxy-based binder. Loading was then done on the sandwich beam using a three-point loading machine until the proportionality limit is reached. Using the loading machine control software, force and loading displacement data were collected. This data was then used to calculate normalized deflection and produce a graph comparing the normalized deflection predictions of the five theories with the normalized deflection found in the model sandwich beam. The investigation showed that the Classical Theory was inadequate in accurately predicting the bending stress response of the sandwich composite. The Elasticity, HSAPT, and EHSAPT theories all predicted much more accurately the normalized deflection of the sandwich beam than the classical theory, but their accuracy was impeded by the relatively stiff beam core used in the model sandwich beam. The low stiffness of the face sheets was advantageous to the First Order theory, and it performed the best in modeling normalized deflection of the model sandwich beam out of the five theories investigated. It is proposed that future investigations into sandwich beam theories vary the stiffness of the core and the face sheets in order to analyze the performance of the theories under a broad spectrum of conditions.

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