A Study of Structural Angle Beams Produced using Discontinuous-Fiber Composites

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ABSTRACT

The effective bending stiffnesses of angle beams produced using a discontinuous-fiber composite (DFC) and subjected to pure bending loads were obtained and compared with theory. The beams were compression molded using HexMC, which is a DFC composed of chipped AS4/8552R graphite epoxy prepreg. Results from the literature have shown that DFCs of this material type can exhibit an unusually large scatter in elastic properties. The underlying objective of this study was to determine how well the mechanical behavior of a DFC component can be predicted using properties inferred from simple coupon level tests. The elastic modulus inferred from flat coupon tensile specimens was used to predict the behavior of the angle beams. Relatively large strain gages with 25.4 mm (1-in) gage lengths were used to measure axial strains induced in the angle beams during testing. Three beam sizes were tested. The stiffnesses of two of the beams were slightly lower than predicted, whereas the stiffness of the third beam was roughly twice as high as predicted. Optical microscopy was used to measure local fiber volume fractions and through-thickness chip/fiber alignments at several locations within the beam flanges. The measured alignments explained the discrepancies between measured and predicted beam stiffnesses. Ultimately the results of the study will help establish a method to certify DFC aircraft parts by analysis supported by experimental measurements.