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Design and Development of Constant Stress Composite Cantilever Beam

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Abstract : Glass fiber reinforced composites materials, due their unique properties such as high mechanical strength to weight ratio, corrosion resistance, and impact resistance have huge potential as structural materials in automotive, construction and transportation applications. However, these properties often come at higher cost owing to complex design methods, difficult manufacturing processes and raw material cost. In this paper, a cost effective design and manufacturing approach for a composite cantilever beam structure is presented. A constant stress (variable cross section) beam concept has been used to design and optimize the shape of composite cantilever beam and thus obtain the reduction in material used. The variable cross section beam was fabricated from the glass epoxy prepregs using cost effective out of autoclave process. The drop ply technique has been successfully used to obtain the variation in the cross section along the span of the beam. In order to test the beam and validate the design, the beam was subjected to different end loads. Strain gauges were mounted along the length of the beam to obtain strains in the beam at different sections and loads. The strain values were used to calculate the flexural strength and bending stresses in the beam. The stresses obtained through strain measurements from the experiment were found to be uniform along the span of the beam, and thus validates the design. Finally, the finite element model for the constant stress beam was developed using commercial finite element simulation software. It was observed that the simulation results agreed very well with the experimental results.

Keywords : beams, composites, constant cross-section, structures
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