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Effects of Different Fiber Orientations on the Shear Strength Performance of Composite Adhesive Joints

Authors : Ferhat Kadioglu, Hasan Puskul

Abstract : A composite material with carbon fiber and polymer matrix has been used as adherent for manufacturing adhesive joints. In order to evaluate different fiber orientations on joint performance, the adherents with the 0°, ±15°, ±30°, ±45° fiber orientations were used in the single lap joint configuration. The joints with an overlap length of 25 mm were prepared according to the ASTM 1002 specifications and subjected to tensile loadings. The structural adhesive used was a two-part epoxy to be cured at 70°C for an hour. First, mechanical behaviors of the adherents were measured using three point bending test. In the test, considerations were given to stress to failure and elastic modulus. The results were compared with theoretical ones using rule of mixture. Then, the joints were manufactured in a specially prepared jig, after a proper surface preparation. Experimental results showed that the fiber orientations of the adherents affected the joint performance considerably; the joints with ±45° adherents experienced the worst shear strength, half of those with 0° adherents, and in general, there was a great relationship between the fiber orientations and failure mechanisms. Delamination problems were observed for many joints, which were thought to be due to peel effects at the ends of the overlap. It was proved that the surface preparation applied to the adherent surface was adequate. For further explanation of the results, a numerical work should be carried out using a possible non-linear analysis.

Keywords : composite materials, adhesive bonding, bonding strength, lap joint, tensile strength
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