Solid State Science and Technology, Vol. 11, No.1 (2003) 16-24

EFFECTS OF INDUCED DAMAGES ON THE FLEXURAL FATIGUE BEHAVIOR OF GLASS FIBER REINFORCED PLASTIC (GFRP)

Wong Teck Kai and Ha How Ung Faculty of Engineering,
Universiti Malaysia Sarawak, Sarawak, Malaysia
Phone: (60) 82-671000 Fax: (60) 82-672317
Email: donaswtk@yahoo.com

ABSTRACT

The paper presents the flexural fatigue loading of single lap with single and multiple bolted joints made from 3mm thick Glass Fiber Reinforced Plastic (GFRP) flat sheet. This is accomplished by creating an accurate finite element model in three-dimensional and analyze the stress distribution for various bolted joints. In this aspect, the geometry and different joint configurations were altered in order to determine their effects on the overall behavior of the joint. Physical flexural fatigue tests by three-points bending were carried out using universal testing machine at specified frequency and stroke mode. Any internal activities that leads to failures such as the propagation of crack and the ultimate failures subjected to flexural loading were investigated using real-time acoustic emission monitoring equipment. Both physical and microstructure observation of specimens were done to determine the characteristic and extent of the damages in specimens after experiments. It is found that special specimen that designed to fail under well-defined modes, micro-cracks generate in the matrix before any effect was noticeable in the macroscopic mechanical behavior. These micro- cracks included matrix cracking, interface fracture, debonding and fiber breakage. Simulation showed that stresses were not evenly distributed throughout the bolted joints but rather concentrate on specific location. The damages initiated at the first few cycles were due to the porosity and defect during manufacture and the cumulative number of AE events does not exhibit a linear increase with time for all the configurations but exhibited their own characteristic of damage development. Increasing number of fasteners did not show significant improvement in joints strength but their arrangement play more important role.

http://journal.masshp.net/wp-content/uploads/Journal/2003/Wong%20Teck%20Kai%2016-24.pdf

REFERENCES

[1] P.K. Mallick (1993), "Fiber Reinforced Composites: Materials, Manufacturing, and Design", Marcel Dekker, Inc.,
[2] Kretsis, G. and Matthew (1985), "The strength of bolted joints in glass fiber/epoxy laminates", *Composites*, 16, 92-105.
[3] F.K. Chang and K.Y.Chang (1987) "A progressive damage model for laminated composites containing stress concentrations", Journal of Composite Materials, 21, 834-855.
[4] S.Barre & M.L.Benzeggagh (1993), "On the use of Acoustic Emission to investigate damage mechanisms in Glass-Fiber-Reinforced Polypropylene" Journal of Composite Science and Technology, 369-376.
[5] L.B. Lessard and M.M. Shokrieh (1995), "Two dimensional modeling of composite pinned-joint failure", Journal of Composite Materials, *29*, 671-697.
[6] J.Carvill (1993), "Mechanical Engineer's Data Handbook",Butterworth-Heinemann Ltd.