Strain Distribution in loaded Double Lap Adhesive Joints

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Adhesive bonding is finding increasing application in failure critical applications such as aerospace and automotive structures. This bonding mechanism is acknowledged as superior to riveting in term of structural efficiency because of the weight penalty of introducing a mechanical fastener and the improved stress distribution and rigidity of the bonded joint. However, the adoption of adhesively bonded joints in structural applications has been inhibited by the lack of trusted design codes. The complexity of the stress distributions in bonded joints has lead to their analysis using finite element mechanics (FEM). The FEM models are usually only analysed in 2 dimensions to simplify the analysis and there is seldom any experimental verification of the predicted stresses and strains. Neutron diffraction provides a method in which strain distributions in the interior of metallic components can be mapped with mm resolution [1] and an initial investigation using this technique produced results which did not agree with accepted FEM calculations [2]. The purpose of the research described here was to carry out neutron (interior) strain mapping on double lap shear joints (Fig 1) in order to validate 3D FEM calculations of the strain distribution produced in loaded joints.

Strain Scanning experiments were carried out using the ENGIN-X diffractometer at ISIS on loaded joints made from 7075 Al Alloy bonded with FM73 film adhesive and also 7075 Alloy bonded to Carbon Fibre composite using a 1x1x10 mm^3 gauge volume. The overlap area was 25x25 mm^2 and the Al plates were 3.1 mm thick. Generally good agreement was found between the FE model and the experimental results for the Al/Al joints. However, measurements on the Al/composite joint do not conform to the expected strain distribution

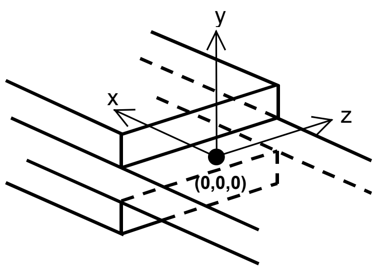

Figure 1: Co-ordinate system used in the measurements

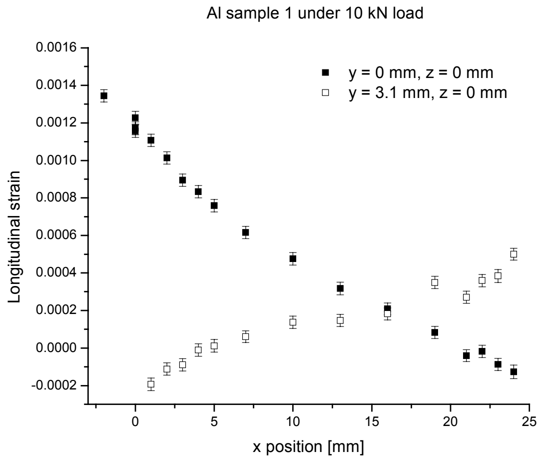

Figure 2: x direction strain measured along the central line of a loaded Al/Al joint

[1] Hutchings, M.T. and Krawitz, A.D. Eds *Measurement of Residual and Applied Stress using Neutron Diffraction,* Klewer, Dordrecht (1992)
[2] Swallowe G.M., Critchlow G.W., Wimpory R.C. and Pirling T. *J. Adhesion*, **70**, 1-11, (1999)