Residual Stresses in Friction Stir Welded Lap Joints by Neutron Diffraction

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We use the crack compliance method to measure the residual stresses in this friction stir welded (FSW) stringer to skin lap joints. However, an independent verification method is needed to determine the validity of the residual stresses calculated using the crack compliance method. Therefore, neutron diffraction was chosen as a non-destructive method of determining the internal distribution of strains by means of intersecting incident and diffracted neutron beams to form a small sampling volume that was fixed in space. The corresponding residual stresses were then calculated in the three principle directions and compared with the results of the compliance method. Neutron diffraction has proven to be a highly reliable method of nondestructively examining test specimens and has the ability to map strains and therefore stresses in all principle directions at a single point.

All neutron diffraction experiments were carried out at the National Research Council's Canadian Neutron Beam Center in Chalk River on an L3 spectrometer. Two test specimens were used in the experiments. The first specimen was an as-welded plate measuring 190 x 95 x 3.9 mm, and the second specimen was the hammer peened plate with identical dimensions. The strain measurement directions were selected by orientating the components such that the bisector lay parallel to the direction of interest. Measurements were taken at varying depths, *y*, in the transverse, normal, and longitudinal directions. Sample data taken in the longitudinal direction is show in figure 1.

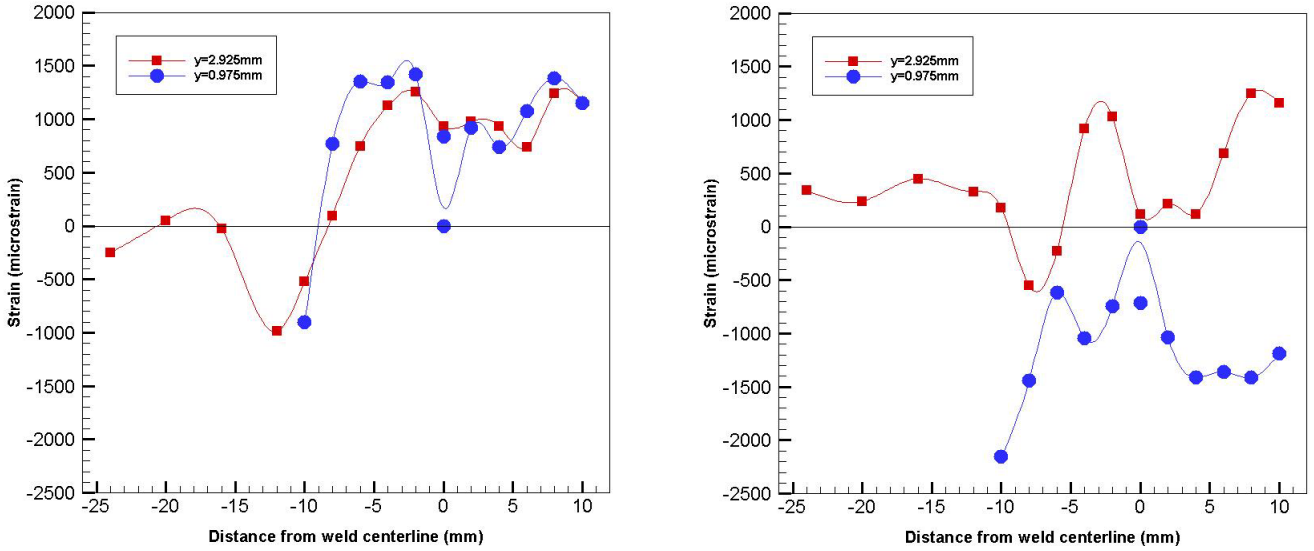

Fig. 1 (left) Longitudinal strain in as-welded plate. (right) Longitudinal strain in hammer peened plate.