

Investigation of Residual Stress in Single and Multi-Bead on Plate

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Residual stresses in welded structures result primarily from differential contractions which occur as the weld metal solidifies and cools to ambient temperature. Such stresses have important consequences for the performance of engineering components.

In this study fully-restrained weldment samples have been prepared with increasing number of beads on the surface of carbon steel plates. The plate dimensions were 100 x 200 x 12 mm³. A single and multi-bead welds were deposited in the centre of the plate using the FCAW (flux-cored arc welding) process.

Residual strain measurements have been made using TASS (The Australian Strain Scanner) at the HIFAR research reactor. For the experiment the gauge volume was located 1.5 mm below the plate surface containing the weld in each sample, as defined by the entrance and exit beam slits. The scattering geometry involved an approximately diamond-shaped gauge volume, as determined by the most suitable wavelength from the Ge monochromator, and the αFe (211) Bragg peak at a scattering angle of approximately 73°.

The longitudinal, y, (parallel to the weld bead), transverse, x, (perpendicular to the beads and in the sample surface) and normal, z, (perpendicular to weld and sample surface) components of the residual stress field have been determined in each case from the appropriate residual strain components, using standard elasticity theory.

In this paper, the experimental measurements of weld stresses generated by single- and multi-bead-on-plate welds of low-carbon steel using the FCAW process are presented. This research has focussed on the influence of the starting and ending effects during welding, and increasing the number of passes (Figure 1) on the residual stress behaviour, with the intention of providing key data for the validation of design and fitness-for-purpose methodologies and finite-element tools.

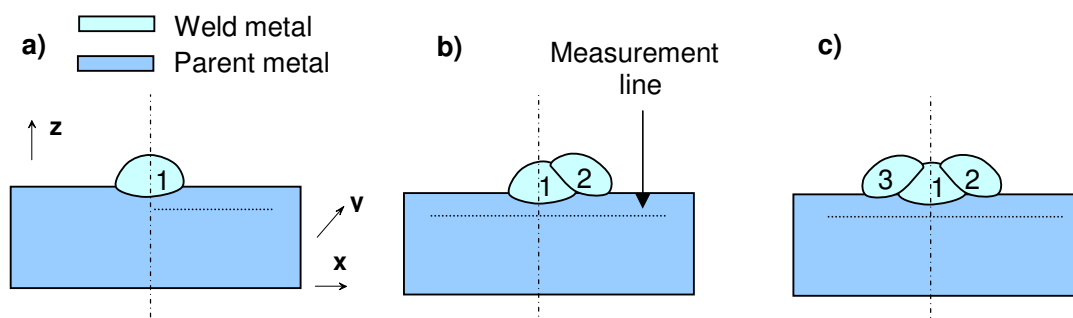


Figure 1. Illustration of the weldments: a) single bead on plate (Sample I), b) two beads on plate, 50% overlapping (Sample II), c) three beads on plate, 50% overlapping (Sample III).

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