Effect of welding sequence and direction on angular distortions in butt-welded plates

During arc welding process, non-uniform heating and cooling lead to non-uniform expansion and contraction of the weld and surrounding base metal which result in undesirable residual stresses and distortions in the welded joint. Among different types of welding distortions, angular distortions produced by butt welding of plates are of major concern in industry. Various methods are currently being used to control and reduce angular distortions. Among different types of distortion control methods the ones which can also reduce residual stresses are preferred. In this paper, the effect of welding sequence and direction on reduction of welding-induced angular distortions in single-pass butt-welded 304 stainless plates and also their effect on residual stresses are investigated by numerical simulation. Welding simulation has been performed using a three-dimensional thermo-elastic–plastic finite element model. In order to verify the numerical model, experiments have also been carried out and temperature histories, angular distortions and residual stresses have been measured. The results of this study showed that welding sequence and direction have a great influence on angular distortions. The results revealed that welding symmetrically from center towards the edges of the plate not only decreases angular distortions but also reduces residual stresses. Thus, welding symmetrically from center towards the edges of the plate can be used as a cost-effective method for mitigating angular distortions in butt-welded plates.