Numerical Prediction of Penetration Shape in Metal Active Gas Welded Joints of Steel Plates

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Abstract: It is important to predict the penetration shape of welded joints because the penetration shape strongly affects the strength of joints. As one of the methods for simulating gas metal arc welding (GMAW) process, a three-dimensional, non-stationary thermal model has been developed. By using a finite differential model based on the heat flow equation and taking account of the balance of gravity, surface tension and arc pressure, both molten pool and the penetration shape are successively demonstrated. Although the finger type penetration which is generally observed in metal insert gas (MIG) welding of aluminum alloy can reproduced by developing an additional line heat source, the finger type penetration obtained in metal active gas (MAG) welding of the steel plates cannot be predicted. In this research, a new point heat source was developed instead of the line type heat source and the applicability of this new model was examined. From the serial computations for the penetration shape of bead-on welding, the dominant parameters in the new model which are thermal efficiency, ratio of heat source and radius of arc pressure were determined. Then, by using these values obtained, the penetration shapes of lap and fillet joints of steel plates can be successively reproduced, where the influence of arc radius change on the ratio of heat source was taken into account.

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