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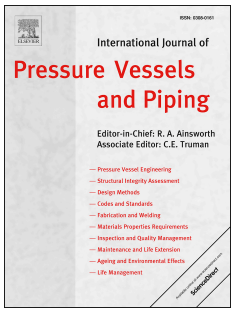

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Numerical analysis of welding deformation and residual stress in marine propeller nozzle with hybrid laser-arc girth welds

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Abstract

Deformation and residual stress of the large marine propeller nozzle in hybrid laser-arc girth welding were studied. Welding distortion and residual stress of the basic T-joint were firstly analyzed by thermal-elastic-plastic finite element method and verified by experiment. Combination form of the Gaussian surface heat source model and the conical heat source model was proposed to simulate the thermal flux of laser and arc power at the weld zone. The prediction errors of the width and penetration of the weld profile were respectively 5.26 % and 5.89 %. For angular distortion, experiment results have a good consistent with simulation results. An obviously gradient of the longitudinal stress and transverse stress was appeared at interface zone of flange and web. An optimal welding sequence was then obtained by analyzing welding deformation and equivalent residual stress. Based on the local-global mapping method, welding deformation of the marine propeller nozzle was further predicted by loading plastic strain sourced from local model.

Keywords

Laser-arc girth welding; Welding deformation; Local-global mapping; Residual stress; Finite element analysis

1. Introduction

Welding is an important manufacturing process for large-scale structures. The forming accuracy of large structures is directly influenced by the welding deformation. It is necessary to predict and mitigate welding deformation to improve the forming accuracy. Around this problem, many

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