UNIVERSITI TEKNOLOGI MARA

INVESTIGATION ON WELD INDUCED DISTORTION USING SIMULATION AND EXPERIMENTAL STUDY

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

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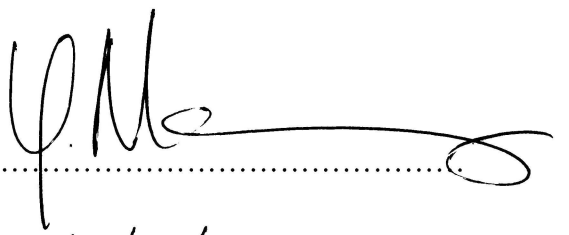
"I declare that I read this thesis and in my point of view this thesis is qualified in terms of scope and quality for the purpose of awarding the Master of Science in Mechanical Engineering."

Signed : 

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Welding is considered as the most efficient and economical means of fabrication to join metals permanently. However, distortion is frequently encountered as a result of the welding process that adversely affects the dimensional accuracy and aesthetical value leading to costly remedial work and high fabrication costs. This research focuses on investigation of welding distortion induced by GMAW process using simulation and experimental study. The investigations started with preliminary studies focusing on butt and T-joints with the thicknesses of 4 mm, 6 mm and 9 mm. FEM software used comprised SYSWELD, PAM-ASSEMBLY and WELD PLANNER. The purposes of these preliminary studies were to investigate the capability of the simulation methods in predicting welding distortions and also to obtain the optimum welding parameters especially for 9 mm butt and T-joints which would be further employed for the major investigations. At the final stage, the research proceeded with the main focus of this study to investigate welding distortion behaviour induced in ship panel structures with 9 mm in thickness by considering different clamping methods. In these cases, the simulation studies were performed using two different simplified simulation methods consisting of local/global approach executed based on the combination of non-linear thermo-elastic-plastic and linear elastic analyses, and shrinkage approach executed based on linear elastic analysis. Low carbon steel material was employed throughout the investigations from the preliminary studies up to the ship panel structures. A series of experiments were carried out for verification purposes by means of fully automated welding processes. When comparing between the predicted and experimental results, it was found out that the simulation methods offered low time consumption in predicting the welding distortions within good accuracy. The average error percentages of the distortion obtained from the investigations on ship panel structures laid in the range between 7 to 28 percent. The computational time required by both approaches was about 30 minutes compared to experiments which were completed within 12 hours. Besides, the clamping conditions were confirmed to have the influence on the distortion behaviour.

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