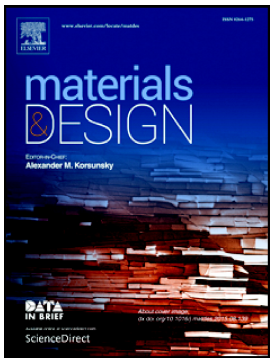

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PII: S0264-1275(17)31047-X
DOI: doi:10.1016/j.matdes.2017.11.016
Reference: JMADE 3493

To appear in: *Materials & Design*

Received date: 1 June 2017
Revised date: 8 November 2017
Accepted date: 8 November 2017

Please cite this article as: Wei Zhang, Hang Fu, Jikang Fan, Renjie Li, Haiying Xu, Fangjun Liu, Bojin Qi , Influence of multi-beam preheating temperature and stress on the buckling distortion in electron beam welding. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2017), doi:10.1016/j.matdes.2017.11.016

Influence of Multi-beam Preheating Temperature and Stress on the Buckling Distortion in Electron Beam Welding

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Abstract: In order to decrease the buckling distortion of thin-walled structures, a new electron beam welding method with simultaneous multi-beam preheating on both sides of the weld is proposed. Compared with traditional electron beam welding, this method can effectively reduce welding distortion, without the use of auxiliary clamping fixtures or post-weld heat treatment. In the finite element analysis, the conical Gaussian heat source model was selected as the heat source for welding and the rectangle uniform plane heat source model was selected as the heat source for multi-beam preheating. The temperature distribution, thermal stress and welding distortion of welded SUS304 stainless steel sheets were simulated and a series of experiments were conducted to verify the feasibility of electron beam welding with multi-beam preheating. Experiment and simulation results show that the temperature distribution with multi-beam preheating is more uniform and thermal tensioning effect caused by multi-beam preheating can reduce the compressing stress in the welding zone. Therefore, the application of multi-beam preheating method can reduce the plastic compressing deformation and final buckling distortion of thin-walled structures. Using this method, maximal 80% reduction of the buckling distortion can be achieved.

Keywords: electron beam welding; multi-beam preheating; buckling distortion; thermal tensioning effect; finite element analysis

1. Introduction

The thin-walled structures are widely used in aerospace structures such as airframe panels, fuel tanks and shells of engine cases. But thin-walled metals are prone to buckling distortion during the