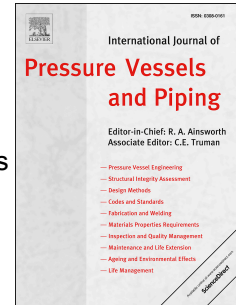


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# Analysis of Residual Stresses and Variation Mechanism in Dissimilar Girth Welded Joints between Tubular Structures and Steel Castings

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## Abstract:

The application of cast steel nodes for the welded joints between hollow section structures provides a novel joining method in engineering projects. Its great advantages are the significant improvement of ~~fatigue strength~~ safety and ease of fabrication geometries. The ~~fatigue~~ mechanical behavior of welded connection between steel castings and tubular members becomes critical and complicated because of the combined effects of asymmetry ~~geometry~~ of welded detail and mismatch of base material properties. Welding simulation procedure is established in presented paper based on thermal elastic-plastic theory, and verified by corresponding experimental studies. A typically ~~applied~~ geometry of dissimilar welded joint between steel castings and circular hollow sections is analyzed for the comprehensive understanding of welding residual stress and temperature field in such special dissimilar welded joint. The special distributions and formation laws of residual stresses are revealed considering the combined influence of asymmetrical welded detail and dissimilar base materials. Analysis of different ~~geometry~~ types of welded joints contributes to understanding the impact of welded details on residual stress formation. The results conduct that residual stress profiles and mechanical behavior are out of the expectation based on the knowledge of ordinary girth-welded joint owing to the combined influences of asymmetry geometry of welded joints and dissimilarity of parent materials. Since the ~~dominating~~ dominant effects of asymmetrical geometry of this dissimilar welded joint, residual stress in steel castings is larger than that in hollow section members with higher yield strength. The mechanical behavior of such dissimilar welded joint is essentially different from that of ordinary girth-welded joint.

## Keywords:

Steel castings; Circular hollow sections structure; Dissimilar girth welded joint; Residual stresses; Welding simulation; Finite element theory

## 1. Introduction

The application of structural hollow sections almost includes all fields for its aesthetic shape and mechanical properties [1]. One important method of joint fabrications is the direct welding for the tubular connection. The braces are cut to fit and welded to the continuous chord in structure. The directly welded joints present severe stresses concentration and the complicate weld geometry; it is deleterious to the fatigue behavior of welded tubular joints [2]. The use of steel castings provides another method of jointing manufacture. The steel castings are employed to offer a smooth transition between welded members for the ~~qualification~~ requirement of

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