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Abstract

This paper studies the main factors affecting the fatigue strength assessment of thin plates in large structures. The first part of study includes the influence of initial distortions, joints' flexibility and surrounding structure on structural stress analysis of welded joint. The second part covers the influence of joint and its geometrical properties on fatigue strength modelling. The third part includes also the material elastic-plastic behaviour and the influence of crack propagation. The results show that if the structural analysis considers secondary bending properly, the local elastic fatigue damage parameters such as J-integral range can be used to model fatigue strength at 2-5 million load cycles. However, to explain the slope variation of the fatigue resistance curve, the consideration of material elastic-plastic behaviour and short crack growth is needed. The strain-based crack growth simulations indicate that longer short crack growth period is the reason for the higher slope value. The importance of short crack growth is dependent on the weld notch geometry and plate thickness.

Keywords

Fatigue strength; Fatigue crack initiation; Local approaches; Weld; Thin plate

1 Introduction

New lightweight solutions are required to improve the energy efficiency of vehicles such as ships. Weight reduction of large structures is possible by using thinner plates and high strength steel materials. Their efficient utilisation typically requires new structural topology, alternative manufacturing technology and robust design methods for structural durability [1], [2]. One of the key challenges in structural design of welded structures is fatigue due to its