Effect of Short Term Rust on Low Cycle Fatigue Strength of Welded Joints

Geir Tuntland Hauge, Samdar Kakay, Sudath C. Siriwardane

Department of Structural and Mechanical Engineering and Material Science, University of Stavanger, N-4036, Norway

Contact: sasc.siriwardane@uis.no

Abstract

The corrosion induced rusting may develop micro-pits in welded area and finally surface roughness may increase. This localized micro-pits may reduce the cyclic load capacity, which is a necessary parameter for lifting operations in installation phase of construction process of majority of offshore installations. However, the effect of this short-term rust induced micro-pits in cyclic load capacity has not been properly studied. To overcome this problem to some extent, this paper presents a study of low cyclic fatigue tests of rusted welded joints. The sample welded joints were allowed for rusting in two different corrosive environments and two different time durations. The specimens were subjected to low cycle fatigue tests on three different stress levels. The specimen surfaces and fracture surfaces were investigated using a scanning electron microscope. The results show that the rusted specimens fail considerably lower cycles than the non-corroded specimens. The pictures obtained from the microscope hasve showed over 20 individual pits formed over a period of four weeks. This shows the rapid formation and initiation of micro-pits in the surface, and it is reasonable to state that the effects of this type of corrosion may play a significant role on cyclic load capacity of welded steel joints, which are subjected plastic stresses.

Keywords: welded joint; corrosion rust; low cycle fatigue; fatigue test.

1 Introduction

Construction process of structures consists of different stages and phases. Among these, transporting and lifting/installation phases may significantly cause to induce cyclic stresses at detail categories of part of structure or components. Offshore installation in the Norwegian continental shelf including smaller modifications are also subjected to cyclic stresses in harsh environmental conditions during transporting and installation phases.

The transporting and lifting objects vary in shape, size and weight. Many of the objects weigh below 50 tons and it would be of great advantage if calculations regarding such lifting operations could be standardized [1]. However, large scale installations are case dependent operational and environmental loading conditions and short term structural degradation mechanisms [2-4].

After the welding of steel joints in the workshop, it takes short period to coating, painting or cathodic protection. During this short period, joint can be subjected to corrosion induced rust. This may develop micro-pits in welded area and finally surface roughness may increase. This localized micro-pits may reduce the fatigue strength in large plastic strain ranges. This reduction may vary

https://doi.org/10.2749/stockholm.2016.0292
Distributed by structurae