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FATIGUE BEHAVIOUR OF WELDED STRUCTURAL STEEL SUBJECTED TO HOT-DIP GALVANIZATION PROCESS

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This paper investigates the effect of a galvanizing coating on the fatigue strength of S355 structural steel. While in the literature some results from fatigue tests made on unnotched specimens can be found, very few results are available dealing with notched components and, at the best of authors' knowledge, no results are available dealing with welded joints. The aim of the present paper is to partially fill this lack of knowledge. A comparison is carried out, between hot dip galvanized fillet welded cruciform joints made by S355 structural steel and not treated welded joints characterized by the same geometry, subjected to a load cycle $R = 0$. 34 new experimental data are summarized in the present contribution, in terms of stress range $\Delta\sigma$ and averaged stress energy density range $\Delta\overline{W}$ in a control volume of radius $R_0 = 0.28$ mm.

Keywords: galvanized steel, high cycle fatigue, fillet welded cruciform joint, SED.

Introduction

Hot-dip galvanizing is a surface treatment that allows to protect components from corrosion. Galvanizing is found in several industrial applications, in particular when iron or steel are used. The utilities, chemical process, construction, automotive, and transportation industries, to name just a few, historically have made extensive use of the galvanizing treatment for protection against corrosion. Hot-dip galvanizing has a proven and growing history of success in a large number of applications worldwide.

This process was patented in France about 150 years ago and it has been never used for Italian steel bridge construction due to the lack of knowledge on the fatigue behaviour of hot dip galvanized structures.

While the monotonic behaviour of steel is not greatly affected by the presence of the zinc layer, except for the yield stress, under cyclic stress the fatigue strength is usually reduced. This point has been discussed in Ref.[1] dealing with high-strength steels without any stress concentration effect or geometrical discontinuity. In [1] it was found that the fatigue strength is generally correlated to the coating thickness with a reduction of the fatigue life increasing with the thickness of the zinc layer. On the other hand other authors did not find any correlation in terms of loss of the fatigue strength due to the coating thickness [2, 3]. The effect of a galvanizing coating on the fatigue strength of unnotched ferritic steel has been extensively investigated in [4] and a tool based on the Kitagawa–Takahashi diagram has been