Accepted Manuscript

Fatigue life assessment of welded joints by two local stress approaches: the notch stress approach and the peak stress method

Leonardo Bertini, Francesco Frendo, Giuseppe Marulo

PII: S0142-1123(18)30030-6
DOI: https://doi.org/10.1016/j.ijfatigue.2018.01.024
Reference: JIJF 4553

To appear in: *International Journal of Fatigue*

Received Date: 5 December 2017
Revised Date: 24 January 2018
Accepted Date: 25 January 2018

Please cite this article as: Bertini, L., Frendo, F., Marulo, G., Fatigue life assessment of welded joints by two local stress approaches: the notch stress approach and the peak stress method, *International Journal of Fatigue* (2018), doi: https://doi.org/10.1016/j.ijfatigue.2018.01.024

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Fatigue life assessment of welded joints by two local stress approaches: the notch stress approach and the peak stress method

Leonardo Bertini, Francesco Frendo*, Giuseppe Marulo

Department of Civil and industrial Engineering, Largo Lucio Lazzarino, 56122 Pisa, Italy

Abstract

This paper presents a comparison between two local methods that can be used for the fatigue life assessment of welded joints: the notch stress approach and the peak stress method. Even if they have been derived starting from entirely different theoretical backgrounds, both methods are based on the evaluation of a local stress acting at the notch tip of the seam weld, which is usually obtained through a finite element simulation.

Said methods are applied to a collection of experimental data from three kinds of welded joints, which are characterized by different geometric parameters and, in particular, by a wide range of the element thickness. A total of 177 experimental tests are evaluated in this investigation, 31 of which are taken from literature while the other 152 are published here for the first time.

The performance of the two methods is discussed in terms of the statistical dispersion in the analysed data. This is accomplished comparing the scatter bands obtained from a regression procedure in the S-N plot.

In addition, some practical aspects related to the implementation of both methods are discussed, with particular attention to the ease of use offered, considering that this may represent a relevant aspect for the method's diffusion in practical applications.

Keywords:
Fatigue strength, Welded joints, Steel, Notch stress approach, Fictitious notch radius, Peak stress method

1. Introduction

The fatigue life assessment of welded joints can be significantly improved by the use of local stress approaches. Indeed, the lack of geometrical information in a global method, e.g. a method based on the use of nominal stresses, can result in rough fatigue life assessments, especially when dealing with welded joints of complex geometry [1].

To the macro category of local methods pertain both the notch stress approach (NSA) and the peak stress method (PSM) discussed in this work; these methods are derived from quite different theoretical background, but show similar application guidelines. The NSA was proposed by Raday [2] based on the micro-support theory of Neuber [3]. The equivalent (von Mises or maximum principal) stress evaluated at the notch, modelled with a reference radius (r_{ref}), is assumed as the endurable stress. Radaj suggested the use of r_{ref} = 1 mm, for the application to steel welded joints with a thickness $t > 5$ mm, while smaller radii have been proposed in case of smaller thicknesses. This method has been successfully applied to a wide range of engineering problems (e.g. [4, 5]) and it is among the fatigue life assessment methods recommended by the International Institute of Welding (IIW) [6]. On the other side, the PSM was proposed by Meneghetti et al. [7, 8] and is related to the Notch Stress Intensity Factors (NSIFs) [9]. In this case the endurable fatigue action is measured in terms of the peak stress obtained by a FE model where the weld root and toes are modelled as sharp V-notches (null tip radius) and are meshed with a specific coarse mesh. Even if it has not yet been included in any design code, the effectiveness of the method has been already discussed by its application to a large database of experimental data [10].

One of the main advantages of both the NSA and the PSM, and more generally for all local stress based methods, is the possibility to compare the results from any kind of joint with a single reference curve, representative of the local fatigue strength of the weld. This is a major improvement compared to global approaches, such as the nominal stress method [6], since it greatly reduces the amount of experimental tests that are needed for the calibration of the method. Local assessment procedures are usually based on a linear elastic finite element (FE) model of the joint where the actual joint geometry is taken into account except for the details of the weld, which have to be modelled according to the selected method. Therefore the fatigue lives of components presenting different geometries can be compared among each other.

Global approaches, instead, demand experimental tests to be performed on components of the same geometry and load conditions as those of the real case under study [11]. For this,

*Corresponding author: Tel.:+39(0)502218074; fax:+39(0)502210604
E-mail address: frendo@ing.unipi.it

Download English Version:

https://daneshyari.com/en/article/7171559

Download Persian Version:

https://daneshyari.com/article/7171559

Daneshyari.com