Review of detail categories of lattice girder node joints of EC 3

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Abstract

The paper deals with the re-evaluation of detail categories of lattice girder node joints based on fatigue test data. An elaborate database structure has been set up to evaluate the available fatigue test data in a differentiated way. Detail categories of different types of K and N joints have been investigated and re-evaluated based on the developed data base. Geometric influences on the fatigue strength have been analysed and design recommendations are given.

Keywords: detail categories, detail catalogue, fatigue test, fatigue evaluation, lattice girder node joints.

1 Introduction

In many application fields, such as bridge construction, fatigue design of steel structures is an important issue. Compared to former national and international standards, however, the European standard for fatigue design of steel structures Eurocode 3 Part 1-9) (EC 3-1-9) [1] partly leads to over conservative and inefficient or unsafe results. The basis for the detail categories is from 1990 and earlier. The existing database is incomplete, and the evaluation methods are outdated. Therefore, recent studies aim to re-evaluate the existing database in order to develop recommendations for efficient and save categories of fatigue details for European standards. During recent research activities [2, 3, 4, 5, 6] an elaborate database structure has been set up to evaluate the available fatigue test data in a differentiated way. A variety of relevant information from the existing sources on fatigue tests, such as information on material, welding, environmental influences, loading and geometry, were considered. With the help of the newly established database, various possibilities of detail category evaluation of lattice girder node joints were investigated. Lattice girder node joints under fatigue stress are widely used in bridge construction. Here, the K and N joints depict frequently applied configurations in which the braces connected to a chord form the shape of a K or N, respectively. Due to high stress concentrations, the intersection areas of chord and braces of a lattice girder node joint represent locations of possible fatigue failure. In addition, the fatigue resistance in these areas is considerably reduced due to the metallurgical notches. Therefore, the design of many node joints is decisively influenced by the fatigue check. Detail categories of different types of K and N joints have been investigated and re-evaluated based on the newly developed data base. Geometric influences on the fatigue strength have been analysed and design recommendations are given.

2 Statistical evaluation method

In order to derive an S-N-curve out of a fatigue tests series, as a first step a regression analysis is conducted. The regression line establishes a linear correlation between the logarithm of stresses $log\ S$ and number of cycles $log\ N$, which fits bests to the test results. Equation 1 describes the linear regression function in fatigue context: [7]

$$log\ N = log\ A - m \cdot log\ S \quad (1)$$

The inverse slope of the regression line m, can be calculated by the least-square method. However,

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