Fatigue strength of large diameters tension rods with metric cut thread

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Abstract

The present paper deals with the fatigue strength of large diameters tension rods with metric, cut thread of S460N steel grade. In total 36 fatigue tests equally categorised to 4 experimental series with two varying parameters (i) size diameter, M68 and M100, and (ii) surface treatment, hot-dip galvanized or as-rolled, were performed by the Institute of Structural Design at the Material Testing Institute of the University of Stuttgart. The tests conducted herein for rods of metric, cut threads validated the detail category 50 as well as its factor for size effect, while being slightly on the safe side.

Additionally, one specimen of M100 as-rolled tension rods, equipped with six miniature strain gauges placed on the thread root of the upper tension rod was tested up to 4,8 MN of quasi-static monotonic tension loading until complete failure. Strain concentration factors for the thread root of the M100 tension rod were calculated.

Keywords: large diameters tension rods; metric thread; cut thread; fatigue; size effect.

1 Introduction

Tension components are used in various situations: for bridges as cable stays or hangers, for masts and towers to stabilize them or simply for hangers of roofs or other type of buildings. A tension rod with a cut thread at the end is a typical relatively simple tension component for situations like that. They are fabricated at standard steel works, but also in specialized firms where the attachments to fix the tension rod to the structures are highly developed and shaped kits, which quite often are ruled by European specialized approvals (EAD). This is especially the case if the loading on the tension rod is a cyclic loading as e.g. for bridges, where large diameters tension rods find often application, see figure 1.

The idea of the project (AiF/DASt project “Zyklische Bemessung von Zugstäben mit Endgewinden” [1]) of which the research reported here is part, was to investigate the fatigue behaviour of “normal” tension rods in dependence on the type of fabrication and its dimensions.

Usually the fatigue behaviour of tension components is given in EN 1993-1-11 [2] assuming mainly an approach based on individual testing. Meanwhile, with the new version prEN1993-1-11 [3] it is made clear that the fatigue verification of rods with threaded ends follows the detail category 50 of EN 1993-1-9 [4], which is similar to that of bolts. When starting the project open questions have been (i) the absence in the literature of tests for tension rods or bolts of large diameters up to M100 and the consequently deficient validation of the size effect as described in the constructional detail 14 for bolts and rods of EN 1993-1-9 [4] as well as (ii) the influence of surface treatment, hot-dip galvanisa-

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