Fatigue Strength of Lamellae Joints in Steel and Composite Bridges

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Summary

In a research project dealing with the improvement and the specification of the fatigue assessment for highway and railway steel bridges, the construction detail of a lamellae joint has been investigated. This joint represents a typical transverse butt weld realised on site at plated steel girders with flanges consisting of multiple lamellae. This detail is typical for German bridge design in practice, but almost unknown in other European countries. Therefore there is no fatigue detail category for the lamellae joint given in Eurocode 3 Part 1-9. The paper presents first research results which will allow the application of the construction detail of lamellae joint also in the context of Eurocode design.

Keywords: steel bridge; fatigue detail category; lamellae joint; end groove weld.

1. Introduction

Nowadays for wide spanned steel and steel-composite bridges the flanges of large plated girders typically consist of thick plates of more than 80 mm thickness. In order to adjust to the moment distribution for a constant height of the girder, either a variable width or a variable thickness of the flange may be used. In most cases it is more efficient to adjust the flange thickness instead of changing the flange width, because due to shear lag effects only the effective width can be taken into account. The flange thickness can be increased locally, e.g. at support areas, by welding additional plates to the flange base plate. Due to restricted transport length and assembly weight it is often inevitable to have a joint assembly of the bridge girders on site, where the flanges consist of several plates. As a consequence fully welded butt joints of packages of lamellae have to be realized on site. This construction detail of the lamellae joint is a common detail in German bridge design, also of railway bridges with high fatigue loading, but it is almost unknown in other European countries.
The first lamellae joint known was realised at the railway bridge Strelasund [7] which had been erected in 1935. Flanges had been strengthened through several lamellae and were welded on site. Since then lamellae joints were used for many bridges in Germany. Therefore former German standards such as DS 804 [4] or TGL 13500 [8] cover design and construction rules for this detail. In these standards the lamellae joint is described as a construction detail for several plates which are connected through a transverse butt joint. This detail is mainly used as a joint assembly on site. The necessity that a flange consists of multiple plates is also caused by design rules: In DS 804 [4] a maximum plate thickness of 50 mm was permitted and nowadays the maximum plate thickness should not exceed 100 mm (Ril 804 [5]). Furthermore for thicker plates the possibility of a brittle fracture is more likely and therefore the permitted thickness is limited by rules given in Eurocode 3 Part 1-10 [6].
The lamellae joint consists of two plate packages which are connected with a transverse butt weld on site (see Fig. 1). At first the single lamellae are placed on top of each other. Then the lamellae are

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