Tubular trusses with K-joints in bridges

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Summary

This paper gives an overview of the state of the art of designing welded K-joints in tubular trusses under fatigue loading and presents first results of a running research project dealing with the fatigue resistance of thickwalled K-joints. In this research project K-joints with a particularly favourable weld configuration are investigated.
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1. Introduction

Architecturally sophisticated trusses made of circular hollow sections have become more and more popular in steel-concrete composite highway bridges. Especially, composite bridges consisting of a tubular truss with rising and falling (not crossing) braces that are arranged under a reinforced concrete slab serving as bridge deck have turned out to be very efficient. The so-called K-joint is an essential constructional detail of many tubular trusses in bridges. This joint is formed by two braces that intersect at a chord member in a symmetric pattern (lying ‘K’), Fig.1.

The design of the truss joints is the crucial point of any truss from a standpoint of economics and aesthetic appearance. Principally, there are two different kinds of constructing K-joints: the weld joint and the cast steel joint. In case of a weld joint the braces are directly fastened to the continuous chord. In contrast, the cast steel joint requires an individually produced cast steel element which all truss members are fastened to by butt joints. For bridges however the fatigue exposition due to the repeated loading by traffic is usually decisive for the design of either kind of truss joint.

Fig. 1: Bridge in Lichtenfels Germany, image source: Stahl-Informations-Zentrum

2. Scope

2.1 Definition of geometrical parameters

Multi-planar tubular trusses consist of chords (Index 0) and braces (Index 1), which are combined by welding in the brace-to-chord intersection, called K- or KK-joint. The commonly used geometrical parameters of K-joints are, compare Fig. 2.

$$\beta = \frac{d_1}{d_0} \tag{1}$$

$$\gamma = \frac{d_0}{2 \cdot t_0} = \frac{r_0}{t_0} \tag{2}$$

$$\tau = \frac{t_1}{t_0} \tag{3}$$

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