Tubular Trusses for Steel-Concrete Composite Bridges

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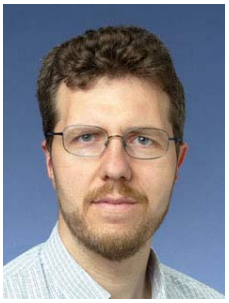

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Summary

The main subject area of this contribution is the recent development of composite bridges in Europe using welded steel truss girders made of circular hollow sections. The governing criterion for the design of such tubular structures with welded nodes often is fatigue. Comparison between cast steel nodes and welded nodes is made. Also, the beneficial effect of weld peening on the fatigue strength is mentioned. Finally, a brief summary on the development of a new shear connection for prefabricated concrete deck elements is made.

Keywords: Bridges, circular hollow sections, welded joints, cast steel nodes, fatigue, peening, shear connection.

1. Introduction

Research in the domain of fatigue has been started at the Steel Structures Laboratory (ICOM) of the Swiss Federal Institute of Technology in Lausanne (EPFL) in 1972. Research on tubular bridge structures (Figure 1) started in the late 1990's with a series of large-scale fatigue tests of tubular bridge trusses with directly welded joints (Thesis Ann Schumacher in 2003 [2]). Included in this work was a finite element analysis-based parametric study, which resulted in a set of stress concentration factor (SCF) tables for the design of tubular K-joints with geometries typical to bridges. Along with this work, the total SCF concept was introduced and a prospective study on the problem of size effect was made.

Following the work of Ann Schumacher, two additional projects were initiated to examine possible ways of improving the fatigue performance of tubular bridge joints. One of these projects is summarized in (Thesis Haldimann-Sturm in 2005 [3]). The possibility of improving the fatigue performance of tubular bridge structures by replacing the directly welded joints with cast steel nodes is examined.

In looking for ways of improving the fatigue performance of welded joints, the third project (Thesis Walbridge in 2005 [4]) had the objective of studying the beneficial effects of residual stress-based post-weld treatment methods, in particular needle peening. Although encouraging, a number of concerns with the use of these methods have limited the extent to which findings can be translated into practical guidelines. Firstly, there is some concern about the reliability of these methods under

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