Strength and Ductility of Welded High Strength Steel (HSS) Connections in Bridges

Hans-Peter GÜNTHER
Senior Researcher
University of Stuttgart
Germany
hp.guenther@ke.uni-stuttgart,de

Hans-Peter Günther, born 1971, received his PhD from the Univ. of Stuttgart in 2001. Since 2001 he is senior researcher at the Univ. of Stuttgart.

Christina RASCHE
Research Engineer
University of Stuttgart
Germany
chistina.rasche@ke.uni-stuttgart.de

Christina Rasche, born 1980, received her civil engineering degree from the Univ. of Karlsruhe in 2004. She works at Univ. of Stuttgart since 2005.

Ulrike KUHLMANN
Professor
University of Stuttgart
Germany
sekretariat@ke.uni-stuttgart.de

Ulrike Kuhlmann, born 1957, received her PhD 1986 from the Ruhr-Univ. Bochum. Since 1995 she is professor for steel, timber and composite constructions at the Univ. of Stuttgart.

Summary

High strength steels are more and more used in structural applications such as bridges or high-rise buildings. By increasing the strength of the steel the loads which have to be transferred in the welded connections increase in the same way. As high strength steels in general have a lower deformation capacity it is especially of importance for the connections to ensure beside the strength also sufficient ductility. This paper presents first results of a research project analysing the strength and ductility of welded high strength steel connections. Existing design rules according to Eurocode 3 are introduced and discussed showing that these rules are in many ways inadequate for high strength steel connections as they give e.g. very thick welds. First results of static strength tests on fillet welded connections together with numerical simulations are presented.

Keywords: High strength steel, welded connections, fillet welds, filler metal, mismatch, bridges.

1. Introduction

High strength steels (HSS) are a continuously winning market share in the construction industry especially in bridges as they can bring significant savings e.g. in terms of material consumption, weight, transportation and fabrication costs see e.g. [1] and Fig. 1. For the design and fabrication of high strength steel structures welding plays an important role. Fillet and partial penetration welds are commonly used in bridge structures because they are inexpensive to produce. However, it is well known that when dealing with high strength steel it is of great importance to ensure sufficient ductility of the weld respectively weld metal in order to allow local yielding and redistribution of stresses as a basis for a full plastic design. The present European design rules for welded high strength steel connections are in this matter in many cases inadequate as they always require that the weld metal should at least match the base metal in terms of strength and toughness. When dealing with welded joints of high strength steel weld metals with a lower strength (undermatching) but higher ductility than the base metal have advantages regarding weldability and quality control, possibly leading to better ductility and redistribution of stresses and therefore to a higher strength of the overall joint.

Fig. 1 *Application of high strength steel in bridge structures [1]*

https://doi.org/10.2749/222137807796120175