



Butt welded connections of high strength steel

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Abstract

High-performance materials such as high strength steels allow for resource-efficient innovative structures. Therefore, economical and user-friendly design concepts for welded connections of high strength steels are required. Current design rules had been developed mainly for mild steels, e.g. requiring an overmatching of the filler metal. It is not considered, that a soft area which may form in the heat-affected zone of welded high strength steel connections may lead to an overestimation of the load-carrying capacity. Besides, mixed connections as well as under- and overmatching filler metals are not included in the current design codes. Based on a large number of experimental and numerical investigations, a design concept has been developed which takes the characteristics of butt welded high strength steel connections into account. Additionally, experimental and numerical investigations are planned to transfer the new concept of design also to mixed connections.

Keywords: high strength steel; butt welds; heat-affected zone; soft area; mixed connections; undermatching; overmatching.

1 Introduction

The use of high strength steel enables slender constructions with large spans. They allow high stresses, especially in tension, and result in a reduced cross section.

The resource-efficient use of material contributes an overall improved life cycle assessment. The smaller construction weight due to reduced cross sections results in simpler substructure and additional cost savings [1].

Current European rules require matching or overmatching of filler metal [2]. Hence, the weld metal must have the same strength as the base material (matching) or a higher strength than the base material (overmatching). Whereas for mild steels matching or overmatching is usual, for high strength steels, there are good reasons to sometimes prefer an undermatching filler metal,

with a lower strength than the base material. An undermatching filler metal may be useful, for example, to increase the ductility of the connection.

In addition, the soft area that may form in the heat-affected zone should be considered, because it might lead to a significant reduction of the load-carrying capacity of butt welded high strength steel connections. Thus, the current design rules may lead to an overestimation of the load-carrying capacity. This, of course requires adapted rules that have been developed in the research project *HighButtWeld* (IGF: 19470 BG, DVS: 09.083) [3] and enable the safe use of butt welded high strength steel connections.

For optimum and versatile use of high strength steels, mixed connections of normal strength and high strength steel are necessary. This allows adjustments to be made to the load capacity of the