The load bearing capacity of fillet welded connections of high strength steels

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Summary

This paper presents results of a research project analysing the strength of fillet welded connections of high strength steels. Particularly, the influence of the strength of filler metals on the behaviour of welded connections is discussed. Tests on longitudinal fillet welded lap joints and cruciform joints have been conducted together with numerical simulations to investigate the load bearing behaviour. The aim is to determine the load bearing capacity of these connections in dependence on both, the strength of the filler metal as well as the base material and the influence of the load direction. The results show that the load bearing capacity of the connections is not only dependent on the base metal but also on the strength of the filler metal.

Keywords: fillet welds, high strength steel, β_w-formula, Eurocode 3, load bearing capacity, filler metal.

1. Introduction

In the last years high strength steels with good welding characteristics and a high ductility in addition to higher strength have been developed by the steel industry. Regarding welded connections in the building industry fillet welds are commonly used because they are inexpensive to produce as they do not need any joint preparation. With increasing strength of the steel also the loads are growing which have to be transferred in the welded connections. The use of high strength steels can bring significant savings in terms of material consumption, weight, transportation and fabrication costs. When using high strength steels it is very important to ensure strength as well as sufficient ductility and toughness of the welded connections in order to allow for the necessary redistribution of stresses and internal forces. However, especially for high strength steel grades S460 and S690 the benefit of savings cannot be used due to the present restrictive design rules in EC 3 ([8], [9]).

According to EC 3 ([8], [9]), there are two methods to calculate the strength of fillet welded connections: the directional method and the mean stress method. The design resistance is expressed by a function of the tensile strength of the base metal, f_u, in combination with the correlation factor β_w. The strength of the filler metal is not considered. Instead of that [8] prescribes matching or overmatching filler metal. But according to [9] f_u has to be replaced by the strength of the filler metal when using under-matched electrodes for steels grades higher than S460 up to S700. The correlation factor β_w, given in [8] and [9], increases from 0,8 for mild steel to 1,0 for high strength steel. The partial safety factor γ_{M2} describing the resistance of welds is γ_{M2} = 1,25.

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