Assessment of the Current Approach in Eurocode 4 to Determine the Load Capacity of Headed Stud an a Trough of Trapezoidal Steel Sheetings

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Summary

This contribution reports briefly of a recently finished research project [1] at the Institute of Structural Design, Universität Stuttgart. The main focus of the project was to assess the quality of the given approach in Eurocode 4 to determine the load capacity of headed studs used in trapezoidal steel sheetings in comparison to further approaches/models given literature. Therefore, 17 new push-out tests with steel sheeting within the field of application of Eurocode 4 have been performed. At the moment the existing design rules in Eurocode 4 for headed studs in trapezoidal steel sheeting do not take into account the position of the stud in the trough nor the variety of failure modes. So the investigation was focused on the influence of the position of the headed stud and on the influence of the various geometric parameters on the failure mode. The test results showed that the predicted load capacity acc. to Eurocode 4 overestimates the observed load capacity in a number of cases. Also the constructions rules of Eurocode 4 aiming at a ductile behavior could not always assure this. On the other hand ductile failure occurred though some of the construction rules were not respected. As a result the need for further in depth investigation is underlined.

Keywords: stud resistance, shear connector, composite beams, trapezoidal steel sheeting

1. Introduction

According to most of the codes the design load capacity of headed studs in composite beams with profiled steel sheeting transverse to the supporting beam is determined by multiplying the shear resistance of headed studs in solid slabs of composite beams with a reduction factor k. This approach considers neither the different failure modes in comparison to studs in solid slabs nor the real deformation behavior. Further, it has to be mentioned that the influence of the stud position in the trough is not considered sufficiently. Especially, headed studs in unfavorable position have insufficient load capacities in comparison to their predicted capacities and may fail brittle. According to Hawkins [2], four different failure modes may be noted for headed studs with steel sheetings transverse to the supporting beam:

- "Stud-shearing failure" due to a high tension-shear force combination of the headed stud
- "Stud pull-out failure" due to an insufficient anchoring depth of the headed stud in the concrete topping
- "Rib shearing failure" due to an exceeding of the concrete tension strength at a level between the concrete in the trough and the concrete topping
- "Rib punch through failure" due to a failure of the embedded concrete in front of the headed stud and an additional failure of the steel sheeting in this area

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