Deutsches Institut für Bautechnik

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Composite Structures in Buildings with Lying Shear Studs Subjected to Vertical and Longitudinal Shear

Abstract

Within the scope of this research project the structural behaviour of horizontally lying headed studs subjected to both vertical shear and combined vertical and longitudinal shear has been investigated. Both the structural behaviour and the carrying capacity of lying shear studs significantly differ from the behaviour of conventional "standing" shear studs.

On the basis of experimental results and in consideration of numerical investigations an equation describing the carrying capacity of lying shear studs under **vertical shear in edge position** of the shear connection has been presented. Based on them and considering the partial safety concept a design proposal has been derived. The investigations indicate, that the carrying capacity is mainly influenced by the effective edge distance of the studs, the concrete strength and the alignment of reinforcement close to the shear connection.

First preliminary studies confirm, that the structural behaviour of lying shear studs under **vertical shear in middle position** of the shear connection is basically more complex than in edge position. For applications in practice the *load transfer by friction* due to flexural compression plays a more decisive role than the *load transfer by the studs* itselves. In contrast the influence of the *load transfer by contact* on the upper face of the steel web is rather negligible for the overall carrying capacity of the connection. The experimental investigations of 16 tests and further parametrical studies show, that the carrying and deformation behaviour of the shear connection is decisively dominated by friction. In practical applications in buildings the vertical shear can generally be transferred by friction without considerable slip deformation in the interface. Therefore only in special cases the load transfer by the studs itselves is activated in addition. On the basis of theoretical investigations design equations for the load transfer by studs and friction are developped. Further recommendations for the design of the reinforced concrete slab close to the support by lying studs complete the investigations.

For the determination of the structural behaviour of lying studs under **combined vertical and longitudinal shear** two different test series for both edge and middle position have been carried out. For the design in *edge position* an elliptical interaction equation is presented. In *middle position* of the shear connection with rising vertical shear forces also both the hogging moment and the activated frictional forces in the interface increase. This effect leads to even a small rise of the longitudinal shear resistance per stud. For design in the case of middle position of the shear connection no further interaction between vertical and longitudinal shear has to be considered.