Anchor plates with headed studs as fastening solutions between steel and concrete

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Summary

In mixed building structures of steel elements with concrete structures the design of steel-to-concrete joints is a challenge to solve. Such joints can easily be realized by using anchor plates with welded headed studs or other fasteners in reinforced concrete structures. But the absence of a consistent design procedure, covering the steel behaviour as well as the concrete, is a gap that has to be filled. A suitable procedure to evaluate the behaviour of steel-to-concrete joints is presented by the component method, which already forms the basis for the design of steel joints within EN1993-1-8. Due to the modular assembly of the joint components, it is possible to consider concrete components also in order to extend the design of steel-to-concrete joints. However the current approach is mainly focused on the steel components.

Based on an earlier work which had developed a first two-dimensional mechanical model combining the component method and the design methods for fastenings of semi-rigid steel-to-concrete joints, within the European project "InFaSo" experimental and numerical investigations on anchor plates in reinforced concrete walls have been carried out, mainly in cracked concrete, to simulate a realistic situation. As an outcome a component model has been developed which predicts the resistance, stiffness and deformation of the joint in shear (and tension) in a satisfying way. This improved component model combines the design method of EN 1993-1-8 and the plastic design approach for fastenings in concrete.

Keywords: Anchor plates, headed studs, fastening technique, component method.

1. Introduction

Steel and composite structures like mixed buildings or steel frames are often designed using plastic design methods. Then beside load capacity also stiffness and ductility of joints have to be taken into account. The usual assumption of a rigid or pinned connection often does not comply with the real behaviour of the steel-to-concrete joints. Therefore an appropriate design model for steel-to-concrete joints is needed, determining the realistic structural behaviour of these joints under normal and shear forces. There are different existing methods for the design of steel-to-concrete joints, but each of them shows limitations:

According to elastic theory the loading of the anchors is calculated assuming a stiff anchor plate remaining flat without deformations. The use of flexible anchor plates is not possible, the stiffness of anchors in the concrete compression zone is neglected and the stiffness of the anchors on the tension side is determined by the modulus of elasticity and the cross section of the anchors, see [1]. Following the plastic design approach for fastenings for flexible anchor plates the position of the concrete compression forces is calculated under consideration of the bending resistance of the an-

https://doi.org/10.2749/222137912805112202