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Investigations into the load-bearing behavior of connections between steel and concrete under superimposed load AiF No.: 20511N

Summary of the research project AiF No.: 20511N

Composite construction has established itself as an cost-efficient alternative for the construction of highly stressed structures. In order to be able to use the advantages of the mixed construction method, simple assembly of the connection area between steel and concrete must be ensured and the connections must be designed to be sufficiently load-bearing. Structures in which high loads must be transferred in a concentrated manner from steel to concrete components are increasingly in demand. Examples of this are column base connections in building construction and bearing connections in bridge construction. For these applications in particular, the standardization is conservative due to the risk of concrete failure and there are currently no conclusive verification concepts for edge-near connections with multi-sided edge influence that take load-bearing behavior and the possible failure mechanisms in the area of the connection into account. In applications such as column bases and bridge bearings, connections are subjected to superimposed load from the dead weight of the structure or to traffic loads acting simultaneously with the horizontal load. The load-bearing capacity of the concrete components can be increased with a superimposed load, since an additional shear force component is activated by friction and the concrete is overcompressed in the area of the anchor plate. By taking into account the influence of a superimposed load and the targeted arrangement of reinforcement in the area of the connection, the load-bearing capacity of a connection close to the edge can be increased. The aim of the project was to develop an analytical model for transversely loaded, edge-near connections between steel and concrete under superimposed load, with which the load-bearing capacity can be determined taking into account the possible failure mechanisms. Within the framework of the research project, the load-bearing behavior of connections under superimposed load was investigated using experimental investigations on transversely loaded anchor plates. With the appropriate choice of test parameters, different failure mechanisms were generated in the tests. By applying a superimposed load, the connection area could be overcompressed and additional friction components could be activated, and the load-bearing capacity of the connection could be increased. In the ap-

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plication cases investigated, the connecting structures are often subsequently cast into the concrete component with high-strength mortar. In addition to varying the edge distance and the reinforcement ratio, tests were carried out in which the anchor plate was cast into the concrete component using a high-strength mortar. In the tests with mortared anchor plate, it was shown that with increasing height of the mortar layer between anchor plate and concrete component the connection load-bearing capacity decreases. A numerical model was developed for further investigations. The numerical model was validated by experimental investigations. The numerical investigations made it possible to subsequently record the shear load distribution and to draw conclusions about the activation of the reinforcement and the load-bearing behavior of the mortar layer Based on the experimental and numerical investigations, an analytical model was developed for steel-concrete connections under superimposed load and edge influence based on the failure mechanisms of the fastening technology. With this model, it is possible to capture a load redistribution within the connection as a result of the edge influence and the influence of a superimposed load. Other influences, such as the load-increasing effect of reinforcement present in the component or load transfer due to friction, are also taken into account. In the case of column foot connections close to the edge and in the area of bearing bases in bridge construction, the force introduction areas can be designed more economically and, in particular, in a structurally simpler manner.

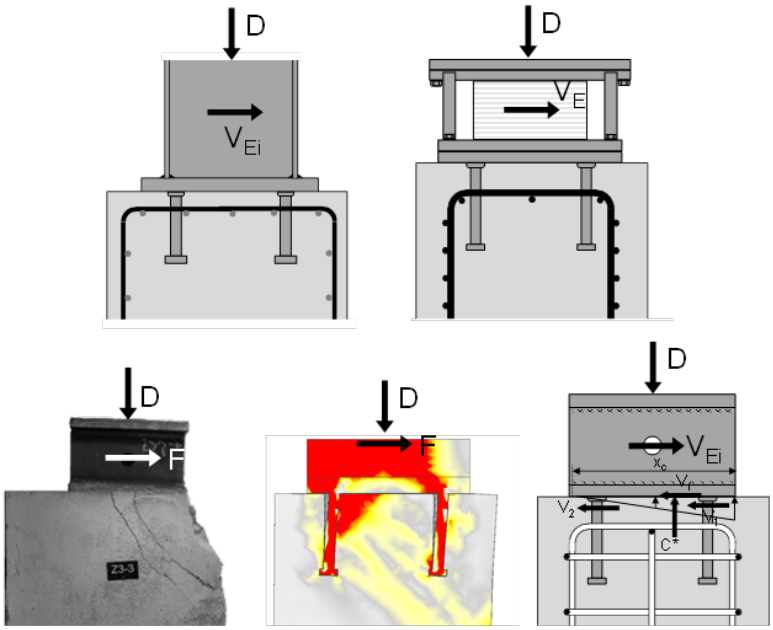

Image 1: Development of an analytical model for joints under superimposed load and edge influ-ence based on experimental and numerical investigations

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Special thanks go to the industrial partners mageba SA and Maurer SE for providing the anchor plates and the test setup, to Goldbeck GmbH for providing and manufacturing the test specimens with mortar pockets, and to Köster & Co. GmbH for providing and welding the shear studs.

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