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Load-bearing behavior of bolted moment-bearing end plate connections under multi-axial moment loading | ICR No.: 21875N

Summary of the research project ICR No.: 21875N

End plate joints are a common detail in steel construction. The current European harmonized design concept according to DIN EN 1993-1-8 for determining connection stiffnesses and moment capacities for end plate joints with two screws per screw row is limited exclusively to bending moments around the major axis. While the load-bearing behavior of end plates around the strong component axis can largely be described in clear terms, bending stress around the weak axis or even combined stress due to oblique bending requires further clarification.

At the Münster University of Applied Sciences, experimental investigations on end plate connections were carried out within the framework of the ICR project 21875 N with regard to the determination of load-bearing capacities. Based on the standardized connections, connection configurations with two screws per screw row were experimentally tested and investigated. In order to gain insights into realistic connections, rolled sections HEA 340 and IPE 400 made of structural steel S235 were selected, taking into account suitable cross-section classes. With regard to the interaction behavior between $M_{y,y}$ and $M_{y,z}$, moment

loads were tested at angles from 0° to 90° to the y-axis. In the observations, small t_p/d ratios were primarily chosen to obtain a failure significantly influenced by the end plate.

The results of the experimental investigations served as the basis for an FEM model, on which a parameter study could then be carried out. The objectives of the numerical investigations were to describe the load-bearing behavior and to increase the amount of data for deriving regularities. A central component of the investigations was the evaluation of the individual moment-rotation characteristics. On this basis, factors such as the plastic moment resistance capacities of the bolted end plate joints could be determined on the basis of the failure patterns for plastic load-bearing behavior described in DIN EN 1993-1-8. Based on the representation of the plastic moment capacities in interaction diagrams and the findings from the experimental investigations as well as the parameter study, the load-bearing behavior of end plate connections with biaxial bending stress could be very well demonstrated and explained.

Based on the findings, a calculation approach was developed that extends the design concept according to DIN EN 1993-1-8 to biaxial moment loading. The calculation approach is applicable for doubly-symmetrical and singly-symmetrical one-sided projecting end plate joints. Furthermore, load-bearing effects were demonstrated that can lead to an increased moment load-bearing capacity of the end plate.



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