

Investigations on the Influence of Web Openings on the Load Bearing Behavior of Steel Beams

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Abstract : A building should maximize the potential for use through its design. Therefore, flexible use is always important when designing a steel structure. To create flexibility, steel beams with web openings are increasingly used, because these offer the advantage that cables, pipes and other technical equipment can easily be routed through without detours, allowing for more space-saving and aesthetically pleasing construction. This can also significantly reduce the height of ceiling systems. Until now, beams with web openings were not explicitly considered in the European standard. However, this is to be done with the new EN 1993-1-13, in which design rules for different opening forms are defined. In order to further develop the design concepts, beams with web openings under bending are therefore to be investigated in terms of damage mechanics as part of a German national research project aiming to optimize the verifications for steel structures based on a wider database and a validated damage prediction. For this purpose, first, fundamental factors influencing the load-bearing behavior of girders with web openings under bending load were investigated numerically without taking material damage into account. Various parameter studies were carried out for this purpose. For example, the factors under study were the opening shape, size and position as well as structural aspects as the span length, arrangement of stiffeners and loading situation. The load-bearing behavior is evaluated using resulting load-deformation curves. These results are compared with the design rules and critically analyzed. Experimental tests are also planned based on these results. Moreover, the implementation of damage mechanics in the form of the modified Bai-Wierzbicki model was examined. After the experimental tests will have been carried out, the numerical models are validated and further influencing factors will be investigated on the basis of parametric studies.

Keywords : damage mechanics, finite element, steel structures, web openings

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