Numerical modelling of beam-to-column connections under column loss scenarios

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Summary

When steel moment frames are properly designed and detailed, additional capacity of carrying loads by catenary action can secure the resistance against progressive collapse in case of extreme load events. This may be accomplished by providing beam-to-column connections with improved ductility and strength properties. In order to achieve this aim, the connections should be designed for the combined effects of flexure and axial tension. This requirement is more demanding for partial-strength connections, where the plastic deformations are designed to develop within the connection components.

The paper presents the results of a research program that aimed at evaluating the capacity of typical beam-to-column connections to allow the development of the catenary action following the loss of a column. Two types of connections have been studied, i.e. end plate bolted connection and reduced beam section welded connection. Finite Element Method numerical models were used to design the test specimens and optimize the testing procedure. Using the FEM model, the evolution of bending moment and axial force at different cross sections with important plastic deformations has been monitored. These parameters give valuable information about the redistribution of stresses when connections are loaded beyond flexural capacity.

KEYWORDS: end-plate bolted connection, reduced beam section, catenary action, robustness, column loss scenario, FEM modelling, M-N interaction

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