Experimental and Computational Studies on Steel Beam End Framing Connections in Fire

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Summary

This paper summarizes the results of on-going research on the behavior of simple beam end framing connections in steel buildings subjected to fire. In this study, the behavior of single plate connections under elevated temperatures is studied both by experiments and by finite element analysis. Experiments are being conducted to better understand the load-deformation response and controlling failure modes of the connection at elevated temperatures. Test results are compared to modified limit state design equations from the AISC Specification. Finite element models are also being developed and validated by the experimental results. This paper will presents key results from the investigations conducted to date.

Keywords: Fire, Single plate connection, Elevated temperatures

1. Introduction

In a fire event in a steel building, large axial forces can often be generated in the beams. In the heating stage of a fire, these forces are initially compressive, while later on with fire growth and further increasing temperature, these forces can become tensile as catenary action starts to develop in the beam. Furthermore, in the cooling stage of a fire, thermal contraction of the beam occurs and large tensile forces can be generated. Both the compression and tension forces developed in a fire are usually not considered in the design of the beam end framing connections. Consequently, connection failure can occur during either the heating or cooling phases of a fire. This, in turn, can lead to local or complete collapse of a structure [1].

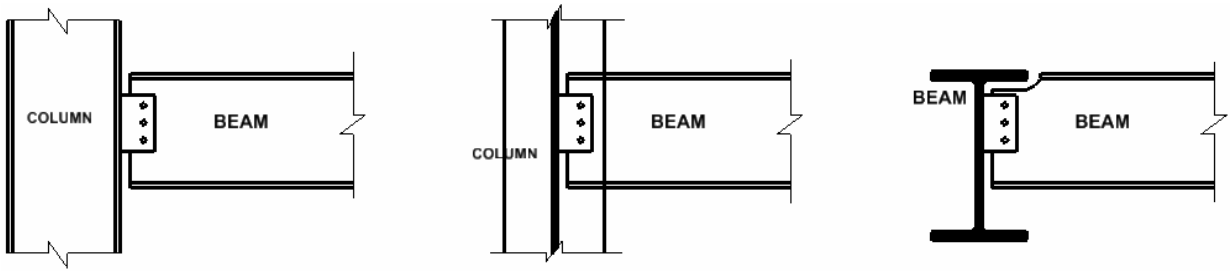

Fig. 1: Typical single plate shear connections

In US building construction practice for structural steel buildings, the most common type of simple beam end framing connection used is the single plate connection, also referred to as a shear tab or fin plate connection. Shown in Fig. 1, the connection consists of a single plate that is bolted to the beam web and then welded to the supporting element, which can be a column or a girder. Idealized as a pinned connection and designed to carry vertical shear forces only, the single plate connection can be vulnerable to failure under large axial loads and rotation demands resulting from a fire. Therefore, a good understanding of the performance of this connection in fire becomes essential.

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