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TECHNICAL BULLETIN 1

Special Moment Frame Connections with Sloped Columns

Paul Richards, PhD, PE¹

Abstract: Welded moment connections in special moment frames are more susceptible to fracture when the connections are sloped. DuraFuse connections can accommodate slope without changing the stress states in the critical elements.

Introduction

Some architectural expressions call for sloped moment frame connections. This can be a result of a non-horizontal beam [Figure 1(a)] or a non-vertical column [Figure 1(b)]. Some studies have been performed to investigate the impact of this slope on connection performance.

“Testing from both Kim et al. (2016) and this research consistently showed the vulnerability to fracture at the heel.”

The failure mode for the sloped RBS connections was different from that typically observed in RBS testing [Figure 2].

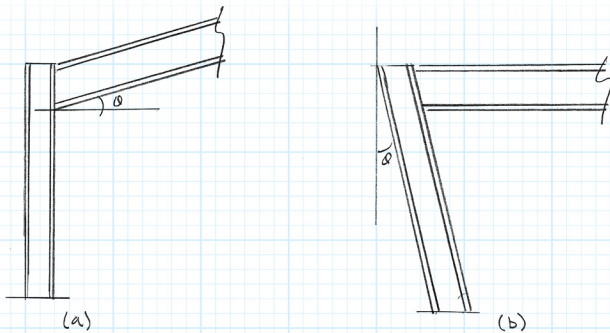


Fig. 1. Conditions that result in sloped moment frame connections: (a) non-horizontal beam; (b) non-vertical column.

RBS Performance for Sloped Connections

Adel and Uang (2019) report two experiments on sloped RBS (reduced beam section) connections that were compared with the same connection without the slope.

The conclusions from Adel and Uang (2019) include:

“Sloping the beam with respect to the column produced force concentration at the heel, and the force demand there can be significantly higher than that at the toe. The degree of force concentration increases with the sloping angle.”



Fig. 2. Ultimate failure observed in sloped connection testing of RBS connections [from Adel and Uang (2019)].

DuraFuse Benefits for Sloped Connections

When a DuraFuse connection is used in a sloped configuration, the stress state in the fuse plate is identical to the regular configuration, and the stress state in the external continuity plates is the same. The column slope is resolved by the cover plates which act like rigid diaphragms to transfer the forces to the column.

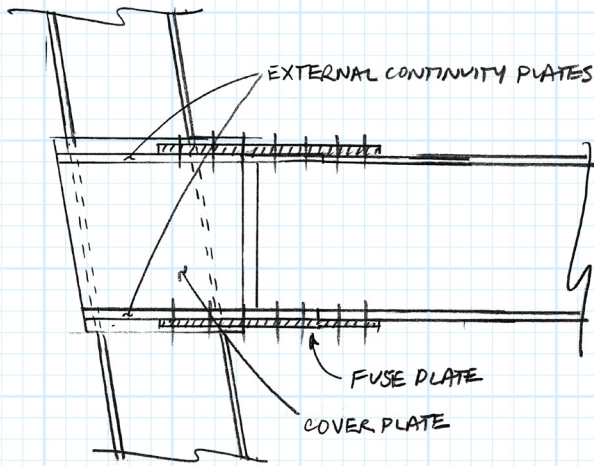


Fig. 3. DuraFuse connection with a sloped- column configuration.

DuraFuse Testing and Prequalification

The DuraFuse connection has been prequalified for use for beam depths of up to 40 inches and beam weights up to 309 lb/ft (UES, 2019). The prequalification is based on full-scale testing conducted in accordance with procedures outlined in Chapter K of AISC 341 (AISC, 2016). The full-scale testing was conducted at the University of California, San Diego [Reynolds and Uang, 2019a; Reynolds and Uang, 2019b].

References

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