Eccentricity in Vertical Brace Connections Connected to Column Webs

I have several vertical brace connections connecting to column webs. Some of the columns have stiffener plates for moment connections. The erector has indicated that it will be difficult and costly to use double-angle connections for the beam-to-column and gusset-to-column connections, so we have elected to use extended single-plate connections so that the beam can stop short of the column flanges and be erected more easily. The extended plates for the beam and gusset to column connections are separate plates, not one continuous plate running through both the gusset and the beam.

We have designed these connections using the uniform force method, with e_c taken as half the column web thickness. V_c, H_c, V_b and H_b have been calculated per Equations 13-2 through 13-6 of the AISC *Manual of Steel Construction*. The extended single-plate at the gusset-to-column connection has been designed for V_c and H_c, and the extended single-plate at the beam-to-column connection has been designed for V_b and H_c. Both of the shear plates have been designed for the eccentricity from the face of the column web to the centroid of the bolt group. Must the extended single-plate connections be continuous between the beam-to-column and gusset-to-column interfaces in order to transfer the H_c? In order to avoid the need for a continuous connection, should double angles be used? Also, does AISC define a standard connection type and can the extended single-plate option be rejected as a non-standard connection?

If you consider the eccentricity of half of the column web, to balance the free-body diagrams for the extended single-plates you will have to transfer the H_c between the two plates somehow. Either you will have to connect them to each other or you will have to pass the H_c into and out of the column web. It is common to take e_c equal to zero and simply neglect the eccentricity of half the web. Since the calculation of H_c is determined only from statics and engineering judgment relative to the value of e_c, changing the connection type from an extended single-plate to a double angle will have no effect. If, based on your own engineering judgment, the eccentricity due to the thickness of the column web must be taken into account and the connection must therefore be continuous, then this applies to equally to extended single-plate and double angle connections.

Though several beam-end connection types are included in Part 10 of the *Manual*, the inclusion of these connections is not intended to restrict the use of other configurations. In this case, however, both alternatives—the double angles and the extended single-plate connections—are included in Part 10 of the *Manual*.

You might also want to look through AISC Design Guide 29: *Vertical Bracing Connections—Analysis and Design* (a free download for members from **www.aisc.org/designguides**) for further information. In particular, Appendix A includes a design example that uses an alternative location for ec to achieve a more optimal design.

Larry S. Muir, P.E.

Concentrated Loads on S-shapes

The paper "Flange Bending in Single Curvature" in the second quarter 2013 AISC

Length Tolerance on Members

Section 6.4.1 of the AISC *Code of Standard Practice*