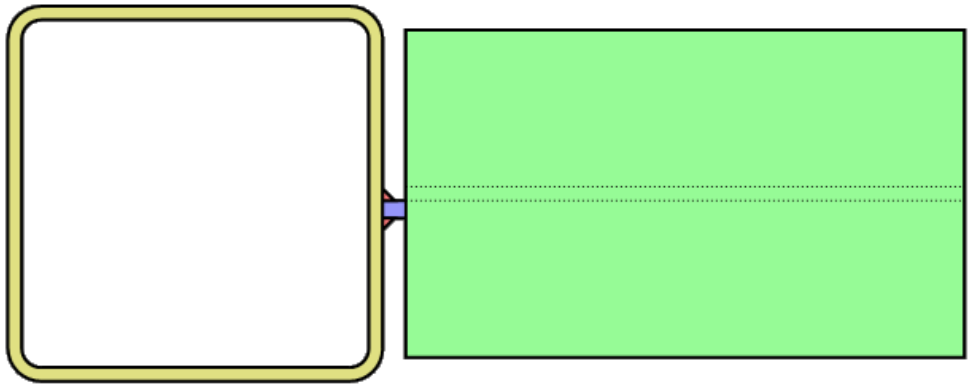
RISAConnection Software Adds HSS Connection Design for Columns and Braces

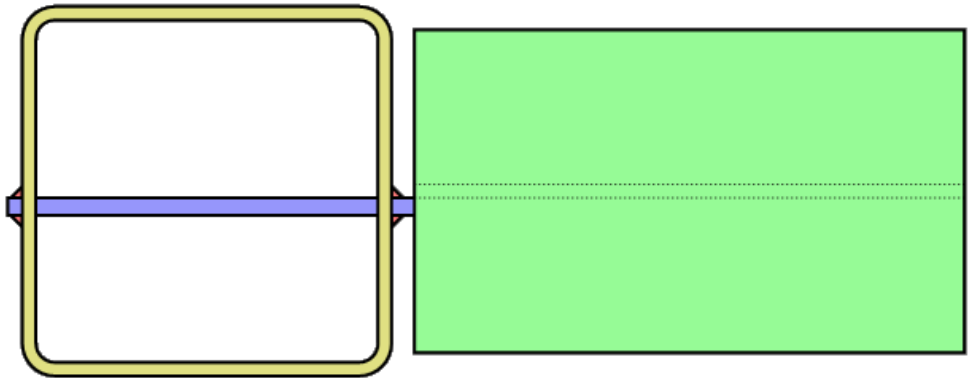
In recent years, there has been a strong demand by engineers for software to make the design of HSS connections easier. RISA Technologies, LLC has recently responded to that demand by adding a number of HSS connections to the growing libraries of RISAConnection. RISA has managed to fill in the gaps on certain aspects of connection design that are not explicitly covered in the design code by using a variety of resources including AISC 360 (14th Edition Steel Manual), AISC Design Guide #24 and the CIDECT guides. The new connection options added to the recent release of RISAConnection (v4.0) can be divided into two groups: Wide Flange Beam Shear Connection to HSS Column and HSS Brace to Gusset. Results from a poll of RISAConnection users showed that these are the most common connections so they were made the highest priority for development. For those who are looking for HSS Moment Connections and HSS Truss Connections, rest assured that these types are already slated for a future release.
For the Wide Flange Beam Shear Connection to HSS Column there are three connection types:

- Shear Tab
- Double Clip Angle
- End Plate

The Shear Tab connection can be designed as either welded directly to the face of the tube or inserted through a slot in the tube as a through-plate. While using a through-plate can be prohibitively expensive, it does eliminate the need to check the column for Punching Shear and Flexural Plastification. Therefore, if these limit states are failing in your RISAConnection model try enabling the through-plate option. The design of the weld is made easier with the through-plate by eliminating flexure on the weld since the moment due to eccentricity can be resolved as a couple of longitudinal forces on the welds.



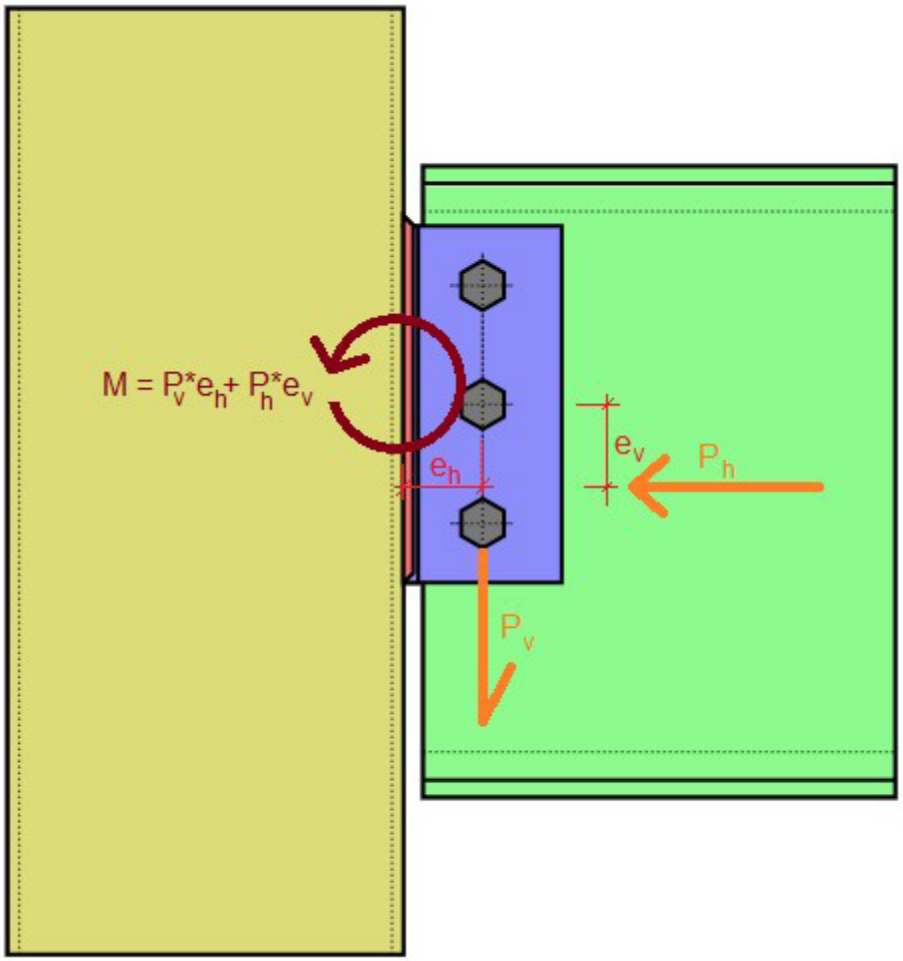
Section Cut (looking down) of Shear Tab Connection without Through Plate



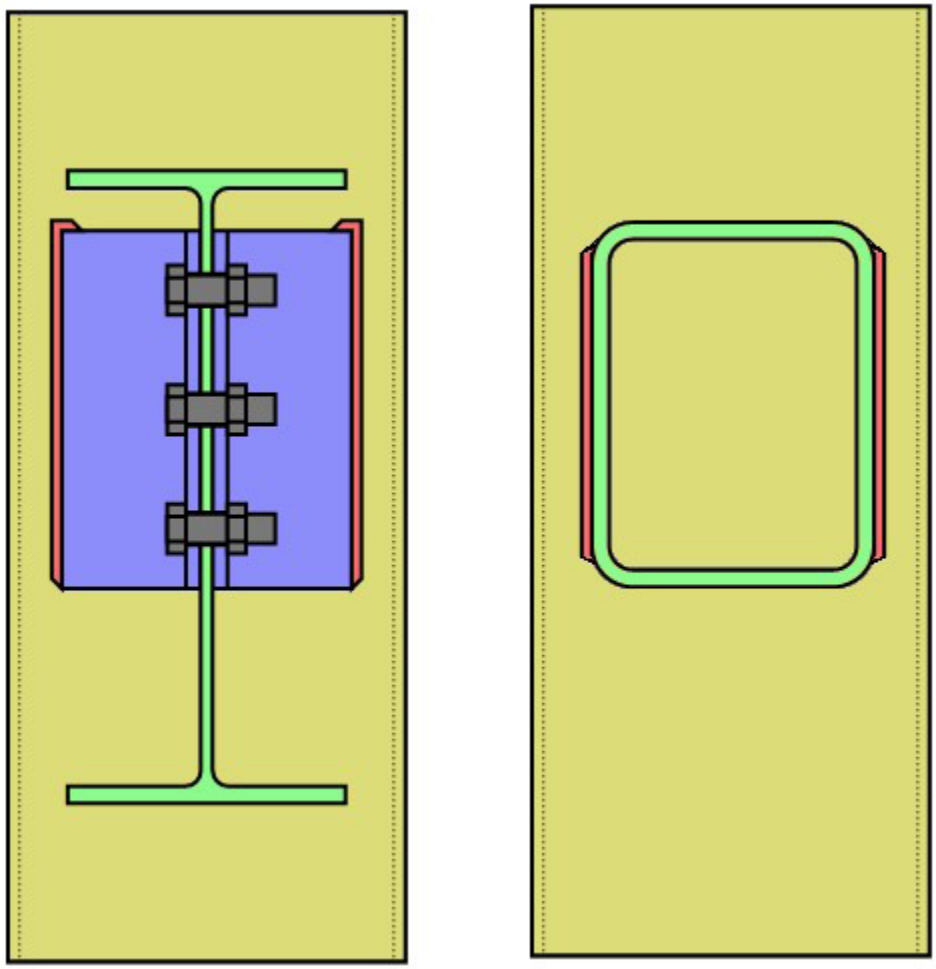
Section Cut (looking down) of Shear Tab Connection with Through Plate

The Double Clip Angle and End Plate connections presented a greater challenge in terms of implementation in the program. One major issue with connection design is that most engineering papers and example calculations ignore the presence of axial force (and sometimes even eccentricity) in shear connections. RISAConnection considers both axial forces and eccentricity for all shear connections, which has necessitated the "filling in of gaps" in the design code.

Consider the connection below which features an axial compression in the beam:



In this case, RISA draws a parallel between the way the clip angles attach to the face of the column and the way an HSS branch would attach to the face of an HSS chord in a truss. By using this comparison the column can be checked for Wall Plastification and Shear Yielding (punching) caused by the axial compression using the dimensions of the clip angles in place of the branch dimensions.

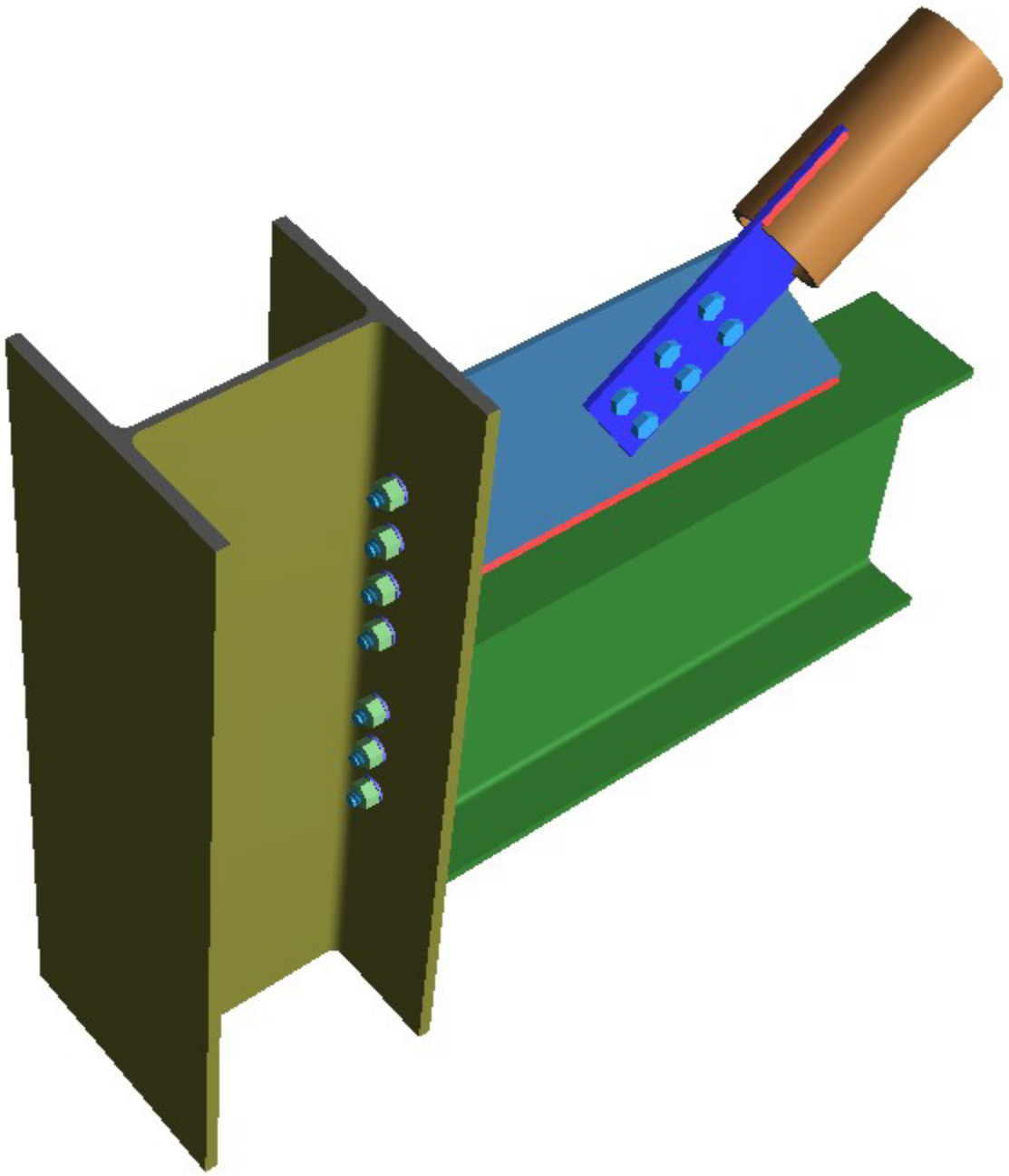


The moment due to eccentricity cannot be ignored either. When the chord/branch analogy is applied to this connection, the column can be checked for Wall Flexural Plastification and Sidewall Local Yielding where the moment capacities are compared against the net moment caused by both horizontal and vertical eccentricities on the connection.

There are three common methods of attaching an HSS brace to a gusset plate:

- Slotted Brace
- Knife Plate
- End Tee

RISAConnection v4.0 supports all three types and performs the local yielding checks associated with the End Tee connection and the shear lag checks associated with the other two. One major consideration associated with gusset design regardless of the brace type is the force distribution within the gusset. For the diagonal brace connection, RISAConnection uses the Uniform Force Method as prescribed by the AISC Manual. This method derives the forces at both the gusset-column and gusset-beam interface. While the basic method is intended for use with concentric workpoints, RISAConnection allows the user to specify any workpoint and compensates for this by introducing eccentricity at the gusset-column or gusset-beam interface, thereby introducing a moment. In the face of the Chevron Brace connection where there is no column at the connection, a free body diagram is used to derive all of the gusset forces at critical section cuts within the gusset.



Lastly, the consideration of effective length of welds was also included in RISAConnection v4.0. Due to the uneven distribution of forces on welds on the face of tube columns as well as welds on brace End Tees, some lengths of weld must be ignored. In the interest of economy, the engineer should pay close attention to the proportion of HSS connections to ensure that as little weld as possible is "wasted".

RISA Technologies is always interested in feedback from users. If you find any room for improvement or have any feature requests, please don't hesitate to contact info@risa.com