

ASI Advisory Note

Design method for eccentrically connected cleats not to be used

In Steel Construction Vol. 38 No. 1, March 2004, the Australian Steel Institute published a warning about eccentric hollow section bracing connections. At this time the ASI website also contained the warning. The warning stated that the method for calculating the compression capacity of overlapped gusset plates or “eccentrically connected cleats” may be unconservative. The method is found in *Design of Structural Steel Hollow Section Connections*, the hollow section design manual published in 1996 by the Australian Institute of Steel Construction, now the Australian Steel Institute. The problem arises because of the assumption that “the connection may be treated as two eccentrically connected cleat components whose ends are fixed and prevented from sway”. (*See Note 1.*)

The connection types to which this advisory applies are the slotted tube, welded tee end, and flattened end connections. Unless restrained against sidesway, each of these connections deflects laterally as it is loaded in compression, developing a plastic hinge in each plate at a fraction of the section compression capacity. The real capacity of the connection is very much less than would be computed assuming the presence of lateral restraint or the absence of eccentricity. The problem is exacerbated for connections in short compression members and for compression members that are not exclusively wind bracing.

The small eccentricity occurring when a stiff member is connected to a gusset plate (e.g. channel web bolted to gusset plate) has traditionally been ignored in the design of simple bracing connections and this is permissible in some cases because most of the eccentricity moment acts on the stiff bracing member and only a small bending moment acts on the flexible cleat component. There is an important difference between this situation and that with hollow section bracing connections. In these connections there are two flexible components bolted together – “eccentrically connected cleats”. The problem is that the eccentricity moment is shared between the two flexible plates and plastic hinges develop at a very low load unless there is lateral restraint. The cleat assembly deflects sideways during loading. Eccentrically connected cleats should not be designed as a concentric column even when a large effective length factor is used. It is necessary to apply the existing design code rules for combined bending and compression (AS 4100 Section 8 – Members Subject to Combined Actions). Software is available to perform the necessary code checks.

Recommendations

- Do not use an eccentric hollow section bracing connection for a short compression member unless it is stiffened against sidesway. *A concentric connection should be used if there is no sidesway stiffening.*
- Design eccentric hollow section bracing connections taking eccentricity into account by rigorous application of design code rules for combined bending and compression – do not use the method in *Design of Structural Steel Hollow Section Connections*.

Scott Munter, National Manager – Engineering & Construction

Note 1: The original reference paper was “Eccentrically Connected Cleat Plates in Compression”, Journal of Structural Engineering, ASCE Vol 119, No3, 1993 pp 767–781.