Appendix IV Theory and discussion steel connections

1 Introduction

The steel code AS4100 contains only minimal information about the design of steel connections. Basically it defines the design capacity of bolts and of welds while giving only very generic guidance concerning how to determine the corresponding design action effects in connection assemblies.

Hogan TJ and Thomas IR 'Design of Structural Connections' 4th edition published by AISC effectively represents an Australian defacto code for steel connection design. The text represents an excellent summary of the analytical and experimental work forming the basis of the design approaches it defines for a wide range of connection types. The text also represents the theoretical basis of the steel connection design software package 'Limcon'.

Relatively few design engineers have a full understanding of the design methods proposed in Hogan and Thomas and most steel connection design tends to use simpler approaches applying some but not all of the design checks recommended in Hogan and Thomas. This is in part supported by traditional Australian steel design textbooks such as Trahair and Bradford 'The Behaviour and Design of Steel Structures to AS4100' and Gorenc, Tinyou and Syam 'Steel Designers' Handbook'. Such texts provide detailed coverage of member design but only minimal coverage of connection design.

The reality is that design engineers cannot afford the time required to manually implement in full the design methods defined by Hogan and Thomas while at the same time many designers prefer to rely on manual connection design techniques rather than on a design aid such as Limcon. This reality is normally satisfactory provided that the connections being designed fall within the 'normal' range and that standard detailing practices (that tend to avoid some of the secondary design issues) are applied.

Beam connections in composite steel framed high rise construction generally fall within this 'normal' range except that, particularly with closely spaced secondary beams, beams tend to be of long span and lightly loaded. This means that shear is generally non critical and that end connections tend in turn to be more lightly loaded than might otherwise be expected for the same size of beam as used in non composite construction. This makes lots of things easy but causes a potential excessive rotation problem that is 'normally' not an issue but that needs to be checked when designing connections for composite beams.

2 Alternatives for beam connections

Recall that the decision was made to rely on 'pure shear core action'. Consequently all beam to column and beam to beam connections are to be 'pinned' connections. There are a number of connection types that have sufficient rotation capacity to classify them as being 'pinned'. These include (using the terminology of Hogan and Thomas that is fairly well accepted throughout the industry):

- Angle seat connection (a rarely used 'old fashioned' connection)
- Bearing pad (possibly the best 'pinned' connection – but expensive)
- **Flexible end plate (slightly more 'robust' than the web side plate – and slightly more expensive)**
- Angle cleat (again "old fashioned" but one has found application on recent composite projects)
- **Web side plate or fin plate (generally the best compromise between quality and price)**
- Stiff seat (a simple bearing connection where one member sits on top of another)

Without further discussion the web side plate connection will be adopted to all beam to beam connections and the flexible end plate for beam to column connections.

The stiff seat could be used for the beam to core wall connection where the beam is supported in a pocket in the concrete wall. This 'bearing' connection is covered by Clause 5.13 of AS4100 and no discussion is provided.

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