DUCTILITY OF THIN EXTENDED ENDPLATE CONNECTIONS

Abstract

A model of the extended endplate behaviour has been developed in this thesis, which allows the prediction of the endplate contribution to the connection rotation in terms of the connection strength (moment capacity) and ductility (rotation capacity). The extended endplate strength model developed in this thesis is unique in that it addresses the possibility of strain hardening and membrane action in the endplate. These phenomena are shown to be critical for the ductility and strength of thin endplates, but they have not previously been modelled by other researchers. Because the leading models of the day have not catered for these effects, they seriously underestimate the strength of thin extended endplates.

The model is bi-linear, with the strength and ductility evaluated at two points – the swivel and maximum strain points. The flush region strength behaviour is based on a yield-line analysis of the endplate flush region at the swivel point, and an analysis for a plate supported on three sides and with a central point load, at the maximum strain point. The deformation of the flush region is based on the plate model. The strength and deformation of the extended region is based on uni-axial double-curvature bending of the portion between the bolt line and the weld line, for both the swivel and maximum strain points. Strain hardening and membrane action are catered for in the model by adjusting the material properties from elastic values to strain-hardening values, and by applying solutions for the deformation that takes account of large deflections and thick member theory. This makes the model developed here unique.

This thesis model is also unique in that the ductility of the endplate is measured directly by the model in a mechanical analogy. There are existing FEA and mathematical models of the moment-rotation curve, but these tend to be mostly empirical and completely opaque to the user. Comparisons with connection tests and published test results show that the ductility model developed here provides an excellent assessment of the ultimate rotations of a thin extended endplate connection.