ABSTRACT

Gusset plate connections are widely used in steel frames to transfer forces from the bracing member to the framing elements. Due to the complexity of these connections, it is extremely difficult to evaluate the strength of gusset plate connections. Hence, a research program was initiated to investigate the compressive behavior and strength of gusset plate connections. The analytical study of the inelastic compressive behavior and strength of gusset plate connections was performed by the finite element method and the commercial program ABAQUS (Version 5.6 1996) was selected for this study. The first phase of the research program was to predict the test results from an extensive experimental investigation of the compressive strength of gusset plate connections conducted by Yam and Cheng (1993). The predictions by ABAQUS were generally in good agreement with the test results (Yam and Cheng 1993) with a test-to-predicted ratio ranged from 0.98 to 1.13. Subsequently, the finite element model was used to perform an inelastic parametric study of gusset plate connections to investigate the effects of beam and column moment, longer unsupported edge length of gusset plate, gusset plate shapes, types of connection between the splice member and the gusset plate, rotational restraint at the conjunction of bracing member and gusset plate, splice member stiffness, splice member length, and stiffeners.

The results showed that the presence of beam and column moments did not have appreciable effect on the ultimate loads of the gusset plate connections, however, reduction in the in-plane stiffness of the gusset plate was observed. In addition, when the width-to-thickness ratio of the plate was close to $945/\sqrt{f_y}$, early instability failure occurred due to the local buckling of the plate and the ultimate load of the specimen was decreased significantly. Shaping the rectangular gusset plate according to 30° load dispersion angle did not affect the ultimate load of specimens significantly provided that the splice member was extended sufficiently beyond the

bending line. The ultimate load of the gusset plate was increased by 10 to 20 percent when a welded connection was used to connect the splice member to the gusset plate instead of a bolted connection. Providing infinite rotational restraint at the conjunction of bracing member and gusset plate increased significantly the ultimate load of the gusset plate. The types of splice member (tee-section or tubular section) did not affect the compressive behavior and strength of gusset plate connection so long as they provided high bending rigidity to the connection. This high bending rigidity ensured that full rotational restraint was provided to the gusset plate by the bracing member. The ultimate loads of the gusset plate specimens increased significantly with increasing the splice member length, in addition, the energy absorption behavior of the gusset plate could be improved by increasing the splice member length which provided more a stable postbuckling behavior. Adding stiffeners along the centerline of the splice member or along both free edges of the plate increased the ultimate load of the gusset plate significantly; in particular, stiffened gusset plates experienced a slightly more stable postbuckling behavior which may be important for earthquake loading where energy absorption is required. Finally, a design method accompanied by some design charts for the rectangular type gusset plates subject to compression was proposed based on the inelastic plate buckling equation (Bleich 1952).