Investigation into the distribution of residual stresses in pressed-braked thin-walled steel lipped channel sections using the 3D-FEM technique

ABSTRACT

Cold formed steel sections are normally produced by cold work manufacturing processes. The amount of cold work to form the sections may induce residual stresses in the section, especially in the area of bending. Studies by previous researchers of the effects of local buckling on the failure mechanics of thin-walled compression members have shown that ultimate failure will occur when the yielding has reached most of the middle surface in the corner region of the sections. Hence, these cold work processes may have significant effects on the section behaviour and load-bearing capacity. Most of the studies have investigated the effect of residual stresses raised from roll-forming operation and its influence on steel section behaviour. However, press-braking has not received much attention. Therefore, a 3D finite element simulation has been employed to simulate this forming process. This study investigated the magnitude and distribution of residual stresses along the length of the corner region and through thickness residual stress variations induced by the press-braking forming process. The study concluded that residual stresses are not linear longitudinally (along the corner region). Maximum residual stresses exist near the middle surface of the plate. The neutral surface contains a combination of compressive and tensile residual stresses. The neutral axis is shifted from mid-surface by 7.5% of the plate thickness due to bending. The comparison of the 3D-FE results with the existence of 2D-FE results illustrates that the 3D-FE results show a variation in the transverse and longitudinal residual stresses along the plate length.

Keyword: Cold formed steel; FEM; Residual stresses