12th Pacific Structural Steel Conference
Tokyo, Japan, November 9 -11, 2019

NUMERICAL STUDY INTO RESIDUAL STRESSES AND AXIAL BUCKLING OF Q460 HIGH STRENGTH STEEL WELDED BOX-SECTIONS

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Keywords: High strength steel, residual stress, built-up box-section, finite element model, coupled thermomechanical analysis.

Abstract. *Owing to their excellent strength to self-weight ratios, many structural engineers are very interested to exploit effective use of high strength Q460 steels in construction. As these steels are normally produced as plates, they are adopted to form different structural sections, such as H-sections, I-sections, circular hollow sections and box-sections through welding. Hence, residual stresses are induced in these sections, and their effects on structural behaviour of these Q460 steels should be examined. This paper presents an advanced numerical investigation into residual stresses in high strength Q460 welded box-sections using coupled thermomechanical analyses. It should be noted that an advanced numerical model was established after calibration against measured residual stresses obtained with the sectioning method, and these predicted residual stresses were then incorporated into a structural model to examine axial buckling behaviour of these sections.*

When compared with the measured residual stresses, the proposed numerical models tend to give larger values to both the maximum tensile and the maximum compressive stresses. However, the predicted residual stress patterns are readily shown to attain force equilibrium across the cross-sections. After incorporating three different types of residual stresses and measured initial geometric imperfection into the structural model under compression, the residual stress pattern proposed by the current study is found to be able to give a good prediction to axial buckling behaviour of these welded box-sections. Therefore, the proposed coupled thermomechanical analyses are capable of generating accurate residual stress patterns, and the predicted residual stresses should be directly incorporated into structural models of Q460 welded box-sections to examine their structural behaviour.