ABSTRACT

The web crippling is a common failure mode for cold formed steel sections. It occurs at locations of concentrated loads or reactions where no stiffeners exist. The web crippling loads (concentrated loads or reactions) may be accompanied by bending moments. The interaction of bending moments and web crippling loads reduces the load capacity of the structural members and may control the design. In the past, the theoretical analysis of web crippling of cold formed steel sections was found difficult and for that the experimental investigations were the best solution for researchers. The design codes contain empirical equations based on experimental investigations for both web crippling and interaction between bending and web crippling. These equations are based on limited cross-section shapes and geometries.

In this research, numerical study on the web crippling and the interaction between bending and web crippling was presented and both material and geometric nonlinearities were included in the finite element analysis. The study was carried out on cold formed steel channel sections (C-sections) subjected to web crippling under interior one flange (IOF) loading conditions. Finite element models were first verified against experimental tests and then a series of finite element models were carried out to predict the web crippling strength of the studied channels. Additional models were also conducted to study the interaction between bending and web crippling of C-sections under IOF loading.

The predicted web crippling strengths from finite element models were used in a parametric study for different cross section parameters, bearing load lengths and material yield strengths. Based on the parametric study results it was realized that, the main factors affecting the web crippling strength of the studied range of channel dimensions are web thickness (t), material yield strength (F_y) and bearing load length (N).

The web crippling strengths predicted by finite element analysis in addition to test data points from literature were compared with the design strengths calculated using; Australian/New Zealand Standard (AS/NZS), British Standard (BS), Egyptian Code of Practice (ECP) and North American Specification (NAS). It was found that the design strengths are generally inadequate for channels with web slenderness ranging from 25.3 to 117 and subjected to IOF loading. Therefore, new modifications were proposed to improve

the predicted web crippling strengths using (ECP) and (NAS). The predicted web crippling strengths using the modified ECP and NAS were acceptable for 73 and 80% of data points respectively compared to 4 and 53% before modifications.

On the other side, the finite element strengths obtained from combined bending and web crippling models were compared with the un-factored design strengths predicted using AS/NZS, BS, ECP and NAS. It was observed that the bending and web crippling interaction equations in the design codes are adequate provided that the predicted web crippling strength be modified.