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Design of Cold-Formed Steel Members Using Direct Strength Method

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A Thesis

Submitted in Partial Fulfillment of the Requirements
Of the Degree of Master of Science in Civil Engineering (Structural)

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ABSTRACT

One of the most interesting features of the Direct Strength Method (DSM) is its simplicity in calculating the capacity of cold formed steel members regardless their cross-sectional geometry if compared to the classical well-known Effective Width Method. However, the current DSM distortional design curve fails to adequately (safely and accurately) predict the ultimate loads of columns with boundary conditions other than fixed-end condition.

In this research, experimental and numerical investigations on cold-formed steel lipped channel columns were conducted. The specimens had hinged end support conditions. Different cross-sectional dimensions are selected to ensure the excitation of local, distortional and interactive local-global buckling modes. The experimental investigation comprises nine hinged-columns with different cross-sectional dimensions, failing in the three stated buckling modes. A numerical simulation by means of ANSYS finite element package was conducted and calibrated against the experimental results.

The calibrated numerical model was then used in a parametric study using carefully selected specimens to ensure that the majority of columns (i) buckle and fail in “pure” distortional mode, (ii) cover a wide distortional slenderness range. The results of the numerical simulation showed that the strength estimates of the current DSM for the hinged boundary conditions are inadequate. In order to overcome that limitation, an alternate design curve for the case of hinged lipped channel columns governed by distortional buckling mode is proposed.

Additionally, two parametric studies were conducted using the code CUFSM (which is based on finite strip method), in which a new design approach is suggested to estimate the local and distortional buckling loads in a simplified way. The proposed new design equations are then calibrated against the code CUFSM to ensure its applicability (safety and accuracy).

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STATEMENT

This dissertation is submitted to Ain Shams University for the MSc. degree in Civil Engineering (Structural Engineering).

The work included in this dissertation has been carried out by the author in the Department of Structural Engineering, Ain Shams University, from December 2013 to October 2015.

No part of this dissertation has been submitted for a degree or a qualification at any other university or institution.

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