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Behavior of Hollow Flange C-Section Beams

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Structural Engineering.

The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain Shams University, from Jan. 2010 to June 2013.

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

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ABSTRACT

In the past decade, the use of hollow flange beams (HFB) has found many applications in the building industry and it has been used in many projects instead of the common C and Z cold-formed sections. The unique shape of HFB, comprising two torsionally stiff hollow flanges and a slender web, is a double-edged weapon. As it overcomes most of the disadvantages of open cold-formed sections, it is the main reason for limiting the bending capacity of HFB to its lateral distortional buckling (LDB) capacity. The current study aims at optimizing the cross sectional configurations of HFBs for performance improvement. Also, an investigation to alleviate LDB using web stiffeners with different configurations is performed.

A brief introduction and literature review of previous works in the field of hollow flange beams is presented. Also, a summary on the cold-formed works anddifferent welding processesis introduced. The finite element model used to solve the current problem is presented and validated by comparing its results with experimental results found in the literature. The model takes into account material and geometric non-linearities as well as the initial geometric imperfections and the residual stresses.

84 models are performed to study the configuration of the HFB taking variable parameters as; flange depth-to-flange width ratio, width of plate performing the HFB section and beam span. A comprehensive parametric study is conducted to study the best geometric configuration of hollow flange beams against LDB. Values for the hollow flanges aspect ratios ranging from 0.67 to 0.80 are recommended for better cross sectional utilization.

A comparison between finite element results and the current design rules is conducted and found that the current rules are conservative when dealing with HFB.A modification to the HFB slenderness equation, presented in the AS/NZS-4600 (2005) standards, is proposed to accurately predict the bending strength of the HFBs.

The finite element study is extended to study the effect of adding web stiffeners to the HFBs. 59 models are performed in this study using the proposed best section configuration. The spacing between stiffeners as well as stiffener depth and thickness are taken as the variable parameters. The obtained results revealed that the gain in bending strength of the HFB is directly proportional to both the web ratio and the unsupported length of HFBs. New equations that accurately predict the bending capacity of strengthened HFBs are also proposed.

Finally, a summary of the work carried out in this thesis along with general conclusions obtained from the study and recommendations for future studies in same field are presented.

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