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BEHAVIOR OF UNSTIFFENED SLENDER WEB OF TAPERED I-SHAPED STEEL MEMBERS

By
Eng. Mohamed Mostafa Mohamed Ibrahim
B.Sc., M.Sc. Civil Engineering
Ain Shams University

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Supervised by

Prof. Dr.
Sherif Abdel-Basset Ibrahim
Professor of Steel Construction and Bridges
Structural Engineering Department
Ain Shams University

Dr.
Ihab Mohamed El-Aghoury
Associate Professor
Structural Engineering Department
Ain Shams University

Cairo – 2020

Examiners Committee

1- Prof. Dr. Ahmed ElGhazouli (....)

Professor of Structural Engineering
Imperial College London

2- Prof. Dr. Abdelrahim Khalil Dessouki (....)

Professor of Steel Construction and Bridges
Structural Engineering Department
Faculty of Engineering
Ain Shams University

3- Prof. Dr. Sherif Abdel-Basset Ibrahim (....)

Professor of Steel Construction and Bridges
Structural Engineering Department
Faculty of Engineering
Ain Shams University

4- **Dr. Ihab Mohamed El-Aghoury** (....)

Associate Professor
Structural Engineering Department
Faculty of Engineering
Ain Shams University

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Statement

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

The work included in this thesis has been carried out by the author in the period from June 2018 to June 2020.

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

Date : / /

Signature :

Name : Mohamed Mostafa Mohamed Ibrahim

Abstract

To evaluate the tapered-web plates coefficients of elastic buckling, an extensive finite element analysis was conducted. different boundary conditions for the web plate were included along with different geometric parameters. Three loading conditions were considered: uniform compression, pure bending, and pure shear. New formulas are proposed for the axial, bending, and shear buckling coefficients for tapered plates. The existing procedure for the combined compression and bending interaction is validated against the proposed formulas. Moreover, a new expression for the tapered plates slenderness limit is proposed meeting the AISC methodology. The proposed formulas were found to be valid for singly tapered members by introducing newly proposed reduction factors.

An experimental program is performed using three specimens that are axially loaded. A three-dimensional numerical finite element model is established considering both material and geometrical nonlinearities. The finite element model successfully simulates the experimental tests. New procedures are proposed to predict the web's effective width in the same AISC generalized effective width formula. The new procedures are validated against both the experimental results and the finite element models. Another experimental program is performed using three specimens that are selected to fail in shear without any significant flexural deformations. A three-dimensional numerical finite element model is established considering both material and geometrical nonlinearities. The finite element model is successfully calibrated to simulate the experimental tests. New procedures are proposed to predict the ultimate shear strength which is validated against the existing experimental results.

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