AIN SHAMS UNIVERSITY

Faculty of Engineering

Department of Structural Engineering

BEHAVIOUR AND STRENGTH OF DIAPHRAGMS IN STEEL STRUCTURES

By

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A thesis submitted to Ain Shams University in partial fulfillment of the requirements for the award of the degree of

Master of Science
In
Civil Engineering
(Structural Engineering)

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2013

Ain Shams University
Faculty of Engineering
Structural Engineering Department

Abstract of the M.Sc. Thesis submitted by:

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Title of Thesis:

Behavior and Strength of Diaphragms in Steel Structures

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Registration date: 19/ 12/ 2010
Examination date: 9/7/2013

Abstract

In steel construction, it has been a common practice to provide a separate bracing system to resist horizontal loads due to wind loads, or earthquakes. However, roof panels are capable of resisting horizontal loads in addition to the strength of gravity loads if they are adequately interconnected to each other and to the supporting frame. The effective use of steel floor and roof panels can therefore eliminate separate bracing systems and result in a reduction of building costs. For the same reason, wall panels can provide not only enclosure surfaces, but they can also provide diaphragm action in their own planes. This research aims to define the structural contribution of single skin sheets with frames to resist lateral loads. Finite Element models (FEM) have been developed through different stages. For a specific arrangement of framed system, different forms of steel sheets are analyzed and the behavior under lateral load is examined. In each case, the efficiency of the steel sheet is quantified by comparing the horizontal displacement of the loading point

with the reference basic case of truss system. An exact model is created to predict the effect of the corrugated sheets with the contribution of purlins and columns. Full scale experimental models are performed to investigate the effectiveness of steel sheets in resisting lateral loads. The FEM models are validated by experimental results. The developed diaphragm action of sheets is compared against the existing formulas in the international codes. Parametric studies are carried out to identify the effect of sheet thickness and number of fasteners on the global stability of the structural system. Finally, this research project can lead to recommendations for the national code in order to make use of corrugated sheets in resisting lateral loads.
Keywords: Steel structures, single skin corrugated sheets, diaphragm action, finite element modeling, experimental program, membrane forces, lateral loads, sway of structures.

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of M. Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the Department of structural Engineering, Ain Shams University from 2009 to 2013.

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

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ACKNOWLEDGEMENT

The present work was conducted out at the Department of Structural Engineering, Faculty of Engineering, Ain Shams University.

It was completed under the supervision of Prof. Dr. Adel Salem, Ass. Prof. Dr. Abdel-Rahim Badawy, and Ass. Prof. Dr. Abdel Menam Sanad, whom the author has the pleasure of working under their supervision. The author expresses his sincere appreciation for their help, generous advice and guidance throughout the period of this research.

The author would like to thank his supervisors who have been very instrumental in enriching his thesis. Appreciably, he thanks them so much for accepting him to be their student and for providing him with the guiding hand of Great Spirit in carrying out this research.

The author would like to thank Zamil Steel Egypt and all its staff especially Eng. Khalid Saad and Eng. Ashraf Younis for their great contribution in his thesis, and sponsoring the experimental work through supplying the materials, manufacturing, and transporting the model.

He would also like to thank the Material laboratory staff in the Arab Academy for their valuable helps during the testing period, and supporting him with valuable experimental tools. A debt of gratitude is to all people who in one way or another contributed idea directly or indirectly. The author gratefully thank all of them collectively, and Eng. Hassan Ahmed in person.

Last, he would like to express his deep feelings towards each member of his family to whom he owes every success in his life. His cordial thanks spread out to his mother and father for their love, support and guidance throughout his life and for inculcating in him the passion for knowledge.

Mostafa Yossef
July, 2013

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