AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural Engineering

Behaviour of Fixed Bases Connections for Cold-Formed Steel Frames

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Civil Engineering

(Structural Engineering)

By

Eng. Amr Mokhtar Mohamed El hady El sayd

Bachelor of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Higher Technological Institute, 2010

Supervised By

Prof. Dr. Mohamed Abdelkader El Aghoury

Dr. Essam Abdelaty Amoush

Cairo - (2015)

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural

Behaviour of Fixed Bases connections for Cold-Formed Steel Frames

by

Eng. Amr Mokhtar Mohamed El hady El sayd

Bachelor of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Higher Technological Institute, 2010

Examiners' Committee

Name and Affiliation	**Signature**
Prof. Dr. Mohamed Ibrahim El Naggar Structural , Alexandria University	.....
Prof. Dr. Adel Helmy Salem Structural , Ain Shams University	.....
Prof. Dr. Mohamed Abdelkader El Aghoury Structural , Ain Shams University	.....

Date: 28 October 2015

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Civil Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Eng. Amr Mokhtar Mohamed El hady El sayed

Signature

……..…….

Date: 21 December 2015

Researcher Data

Name	: Amr Mokhtar Mohamed El hady El sayed
Date of birth	: 23/9/1988
Place of birth	: Zagazig - Sharqia.
Last academic degree	: Bachelor of Engineering.
Field of specialization	: Civil Engineering.
University issued the degree	: Higher Technological Institute.
Date of issued degree	: 2010
Current job	: Instructor (Teaching Assistant).

THESIS SUMMARY

In terms of the importance of cold-formed steel structural members, that plays an important role in modern steel structures due to their high strength and light weight. This study is initiated with the objective of investigating the behaviour and strength of bolted base connections for cold-formed steel frames. New configurations of bolted fixed and partially fixed base connections for cold-formed steel frames are suggested. These configurations can be used for economic and easy construction.

Verifications of the previous studies are carried out by finite element software program (ANSYS 12.0). There has a good agreement between the finite elements and previous result.

A numerical study is carried out by using "ANSYS 12.0", different parameters are investigated for a fixed base connection that consists of double back-to-back cold-formed lipped channels, welded built-up I-shape stub with triangular stiffener plates and base plate. The channels column section is connected to the proposed welded built-up I-shape stub via transfer bolts. However, the I-shape stub is welded to the base plate and the base plate is connected to the concrete base by two types of anchorages. The first anchorage type is anchor bolts (A) and the other type is embedded plates (P) that consists of plates immersed in concrete base. Different parameters (i.e. different cold-formed column sections are chosen by their: width-to-depth ratio B/D, width-to-thickness ratio of their flanges, b/t, and depth-thickness ratio of their webs, D/t). Moreover, the I-shape stub is chosen according to its: width-to-thickness ratio of its flanges $(b/t)_I$ and the depth-thickness ratio of its webs $(D/t)_I$. In addition, the base plate thickness, the type of anchorage with the concrete base and the arrangement of the transfer web bolts are considered. Two different patterns of the transfer web bolts are arranged as two columns. In the first pattern type (H), the transfer web bolts are placed between two columns of bolts at a distance equals half depth of column section (H= D/2). In the second type (T), the transfer web bolts are placed between two columns of bolts at a distance equals one-third the depth of column section (T=D/3).

Both large deflection analysis and elasto-plastic material behaviour are incorporated in a non-linear finite element model (ANSYS 12.0). The end conditions of the columns elastic lines are treated as fixed-free condition. The model is loaded with proportional load. The load acts through the center of gravity of the model at an angle of 45^o. Newton-Raphson iteration technique is used in solving the nonlinear system of equations.

Based on the investigations, it is apparent that the stiffness of the base connections increases by decreasing both the width-depth ratio of cold-formed column section B/D and

depth-thickness ratio of the welded built-up I-shape stub $(D/t)_I$. Also, the stiffness of base connection increases by increasing the base plate thickness. Moreover, it is clear that the models with fixed base connections are more rigid than the models with partially fixed base connections. Eventually, the models with fixed and partially fixed base connections are classified as semi-rigid base connections according to Eurocode (EC3).

Key words: Cold-formed steel frame; Finite element numerical modelling; Base connection; Bolted moment connections; Column base connection; steel structures.

ACKNOWLEDGEMENTS

First, thanks to Mighty ALLAH who helped me through all days of work and on whom the author always depends, and by having faith in him he always fulfils his wishes.

The author would like to express his sincere gratitude to **Professor Dr. Mohamed Abdelkader El Aghoury,** for their great assistance in all stages of this research. He would also like to thank him deeply for their indispensable help, great encouragement and valuable advice, without which this study could not have been accomplished.

The author would like also to extend his profound gratefulness to **Dr. Essam Abdelaty Amoush,** for his continuous support throughout the whole work. And for his wise council, expert guidance and faithful advice.

To his beloved father who was the main reason for completing this stage of learning and whom without the support and encouraging none of this effort was ment to happen. To his mother, for her uncounted blessings, and unlimited support. To his wife for her great effort, to his brother, to his sister, to his family and to his friends for their blessings and encouraging.

Finally, grateful thanks to his close friends for their usual encouragement and support throughout all his studying years.

Also, many thank to everybody who ever gave me help and support.

December 2015

TABLE OF CONTENTS

LIST OF FIGURES