



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

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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° . 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.

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TABLE OF CONTENTS

THESIS SUMMARY	I
ACKNOWLEDGEMENTS	III
TABLE OF CONTENTS	IV
LIST OF FIGURES	VII
LIST OF TABLES	XIV
LIST OF ABBREVIATIONS	XV
LIST OF SYMBOLS	XVII
CHAPTER 1	1
INTRODUCTION	1
1.1 Introduction	1
1.2 Structural Members	1
1.3 Research Objectives	2
1.4 Research Methodology	3
1.5 Thesis Outline	4
CHAPTER 2	5
LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Literature in the Field of Cold-Formed Sections	5
2.3 Literature in the Field of Plates	7
2.4 Literature in the Field of Beams	10
2.5 Literature in the Field of Columns	13
2.6 Literature in the Field of Beam-Columns	18
2.7 Literature in the Field of Base Connections	18
CHAPTER 3	32
FINITE ELEMENT MODEL AND VERIFICATIONS	32

3.1 Introduction	32
3.2 Elements Properties and Input together with Output Data.....	32
3.2.1 SHELL181	32
3.2.2 BEAM4	33
3.2.3 LINK10	34
3.2.4 BEAM44	35
3.2.5 CONTA178.....	36
3.2.6 SOLID185	36
3.3 Verifications	37
3.3.1 Verification of Double-Shear Lap-Joint.....	37
3.3.1. a. Previous Work:	37
3.3.1. b. Finite Element Results by the Author:	38
3.3.2 Verification of Bolted Moment Connections	39
3.3.2. a. Previous Work:	39
3.3.2. b. Finite Element Results by the Author:	40
CHAPTER 4	55
PARAMETRIC STUDY AND FEM OF FIXED BASE CONNECTIONS	55
4.1 Introduction	55
4.2 Parametric Study Variables	55
4.3 Finite Element Model.....	57
4.3.1 Model Description.....	57
4.3.2 Modelling of Bolts	58
4.4 Finite Element Model Results	59
4.4.1 Base Plate Thickness	59
4.4.1. a. Moment-Rotation Relationships.....	59
4.4.1. b. Stress Distribution and Failure Modes	60

4.4.2 Frame Base Configurations	61
4.4.2. a. Moment-Rotation Relationships.....	61
4.4.2. b. Load- Displacement Relationships.....	62
4.4.2. c. Stress Distribution and Failure Modes	63
CHAPTER 5	110
PARAMETRIC STUDY AND FEM OF PARTIALLY FIXED BASE CONNECTIONS..	110
5.1 Introduction	110
5.2 Parametric Study Variables	110
5.3 Finite Element Results	111
5.3.1 Moment-Rotation Relationships	111
5.3.2 Load- Displacement Relationships.....	111
5.3.3 Stress Distribution and Failure Modes	112
CHAPTER 6	128
COMPARISON BETWEEN FINITE ELEMENT RESULTS AND EUROCODE	128
6.1 Introduction	128
6.2 Classification Criteria of Column Base in EC3 [60].....	128
6.3 Classification of Base Connection According to EC3	130
6.3.1 Fixed Base Connections	130
6.3.2 Partially Fixed Base Connections	131
CHAPTER 7	153
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	153
7.1 Summary	153
7.2 Conclusions	154
7.3 Recommendations for Future Work.....	155
References	Error! Bookmark not defined.

LIST OF FIGURES

Figure (2. 1) Buckling modes of lipped channel in bending	23
Figure (2. 2) Finite strip discretization, strip degree of freedom, dimensions, and applied edge tractions	23
Figure (2. 3) Un-lipped channel interior one flange and interior two flanges loading case buckling mode	23
Figure (2. 4) Geometric imperfections	24
Figure (2.5) Finite element model of a bolted connection between cold-formed steel strip and hot-rolled steel plate.	24
Figure (2. 6) Post-buckled mechanism in stiffened and un-stiffened elements	24
Figure (2. 7) Schematic view of numerical model: (a) boundary conditions and (b) initial imperfection, load, measures together with location of points A and B	25
Figure (2. 8) ABAQUS boundary and loading conditions for a uniformly compressed simply-supported plate.	25
Figure (2. 9) FE model for post-buckling analysis on joists with stiffened holes.....	25
Figure (2. 10) Steel plate connection and bolt model	26
Figure (2. 11) (a) Box-beam cross-section and (b) I-beam cross-section	26
Figure (2. 12) Basic imperfection modes: (a) distortional buckling mode: anti-symmetric and symmetric, (b) local buckling mode and (c) lateral torsional buckling mode.....	26
Figure (2. 13) Ideal model of LCB subject to lateral–torsional buckling. (a) Half span beam model, (b) Support end and (c) Symmetric plane	27
Figure (2. 14) Scheme of the cross-sections of the tested beams.....	27
Figure (2. 15) Local and distortional elastic buckled mode shapes for short specimens.	28
Figure (2. 16) Elastic local buckling, distortional buckling and increased elastic deformation.	28
Figure (2. 17) Different Cross Sections (a) Plain-channel section and (b) Lipped-channel section.....	28

Figure (2. 18) General set-up and instrumentation of column base connection tests	29
Figure (2. 19) General test setup of cold-formed steel column-base connections with T section.....	29
Figure (2. 20) Column base connection shapes and column closed member	30
Figure (2. 21) Actual specimen layout for system tests single bay frame (left) and double bay frame (right)	30
Figure (2. 22) Details of column base connection and failure mode	30
Figure (2. 23) Angle cleats base connection types and details.....	31
Figure (3. 1) SHELL181 element geometry.....	41
Figure (3. 2) BEAM4 element geometry	41
Figure (3. 3) LINK10 element geometry	42
Figure (3. 4) BEAM44 element geometry	42
Figure (3. 5) CONTA178 element geometry	42
Figure (3. 6) SOLID185 element geometry	43
Figure (3. 7) Laboratory test set-up and measuring bolt-hole elongation, after Lim [58]	43
Figure (3. 8) Variation of load against bolt-hole elongation determined experimentally, after Lim [58].....	44
Figure (3. 9) FEM results, Loading and boundary conditions	44
Figure (3. 10) FEM result and axial stress in middle plate	45
Figure (3. 11) FEM result and elongation of bolt hole in middle plate.....	45
Figure (3. 12) Comparison between experimental J.B.P. lim [58] and FEM result.....	46
Figure (3. 13) General setup and instrumentation of column base connection tests, after Chung [46].....	46
Figure (3. 14) Moment rotation curves of column base connections CB02, CB03 and CB04, after Chung [46].	47
Figure (3. 15) FEM, Loading and boundary conditions.....	47
Figure (3. 16) Moment rotation relationship of column base connection (CB04).....	48

Figure (3. 17) FEM deformed shape and failure mode (FFCs).....	48
Figure (3. 18) FEM stresses and stress state ratio at failure zone (FFCs).....	48
Figure (4. 1) (a) Column cross-section, (b) detail of I-shape stub and base plate.....	65
Figure (4. 2) Anchorage types.....	65
Figure (4. 3) Arrangement of web transfer bolts for I-shape stub, type (H) and type (T)	65
Figure (4. 4) The general instrumentation for anchor bolts models.....	66
Figure (4. 5) The general instrumentation for embedded plates models.....	67
Figure (4. 6) Bilinear stress-strain relationship for steel element and bolts.....	68
Figure (4. 7) The stress-strain relationship for concrete	68
Figure (4. 8) Boundary condition and load for the model.....	69
Figure (4. 9) Proportional moment-normal load relationship	69
Figure (4. 10) Modelling of connected member and the bolt.....	70
Figure (4. 11) Measurement station (a) for moment-rotation and (b) for load-displacement ..	71
Figure (4. 12) Moment-rotation relationship of different base plate thickness for models with B/D= 0.4.....	72
Figure (4. 13) Moment-rotation relationship of different base plate thickness for models with B/D= 0.8.....	72
Figure (4. 14) Moment-rotation relationship of different base plate thickness for models with B/D=1.2.....	73
Figure (4. 15) Moment-rotation relationship of different thicker base plate thickness for models with B/D= 0.4	74
Figure (4. 16) Moment-rotation relationship of different thicker base plate thickness for models with B/D= 0.8	74
Figure (4. 17) Moment-rotation relationship of different thicker base plate thickness for models with B/D=1.2	75
Figure (4. 18) Stress distribution and deformed shape for models with B/D= 0.4	76
Figure (4. 19) Stress distribution (Von Mises) in base plate and failure mode shapes for models with B/D= 0.4	77

Figure (4. 20) Stress distribution and deformed shape for models with B/D= 0.8	78
Figure (4. 21) Stress distribution (Von Mises) in base plate and failure mode shapes for models with B/D= 0.8	79
Figure (4. 22) Stress distribution and deformed shape for models with B/D= 1.2	80
Figure (4. 23) Stress distribution (Von Mises) in base plate and failure mode shapes for models with B/D= 1.2	81
Figure (4. 24) Moment-rotation relationship for models with B/D= 0.4 and anchor bolts	82
Figure (4. 25) Moment-rotation relationship for models with B/D= 0.4 and embedded plates	83
Figure (4. 26) Moment-rotation relationship for models with B/D= 0.8 and anchor bolts	84
Figure (4. 27) Moment-rotation relationship for models with B/D= 0.8 and embedded plates	85
Figure (4. 28) Moment-rotation relationship for models with B/D=1.2 and anchor bolts	86
Figure (4. 29) Moment-rotation relationship for models with B/D=1.2 and embedded plates	87
Figure (4. 30) Load-Displacement relationship for models with B/D= 0.4, 0.8 and 1.2 , type (H) and anchor bolts	88
Figure (4. 31) Load-Displacement relationship for models with B/D= 0.4, 0.8 and 1.2 , type (H) and embedded plates	89
Figure (4. 32) Load-Displacement relationship for models with B/D= 0.4, 0.8 and 1.2 , type (T) and anchor bolts	90
Figure (4. 33) Load-Displacement relationship for models with B/D= 0.4, 0.8 and 1.2 , type (T) and embedded plates	91
Figure (4. 34) Moment-rotation relationship for models with B/D= 0.4 and types of anchorage (A) and (P).....	92
Figure (4. 35) Moment-rotation relationship for models with B/D= 0.8 and types of anchorage (A) and (P).....	92
Figure (4. 36) Moment-rotation relationship for models with B/D= 1.2 and types of anchorage (A) and (P).....	93
Figure (4. 37) Load-Displacement relationship for models with B/D= 0.4 and types of anchorage (A) and (P)	93

Figure (4. 38) Load-Displacement relationship for models with B/D= 0.8 and types of anchorage (A) and (P)	94
Figure (4. 39) Load-Displacement relationship for models with B/D= 1.2 and types of anchorage (A) and (P)	94
Figure (4. 40) Stress distribution (Von Mises), failure mode shapes for models with B/D= 0.4 and anchor bolts	95
Figure (4. 41) Stress distribution (Von Mises), failure mode shapes for models with B/D= 0.4 and embedded plate	96
Figure (4. 42) Stress distribution (Von Mises), failure mode shapes for models with B/D= 0.8 and anchor bolts	97
Figure (4. 43) Stress distribution (Von Mises), failure mode shapes for models with B/D= 0.8 and embedded plate	98
Figure (4. 44) Stress distribution (Von Mises), failure mode shapes for models with B/D= 1.2 and anchor bolts	99
Figure (4. 45) Stress distribution (Von Mises), failure mode shapes for models with B/D= 1.2 and embedded plate	100
Figure (5. 1) Anchor bolts arrangements, eccentricities of fixed and partial fixed base connections.....	114
Figure (5. 2) Moment-Rotation relationship for models with B/D= 0.4	115
Figure (5. 3) Moment-Rotation relationship for models with B/D= 0.8	115
Figure (5. 4) Moment-Rotation relationship for models with B/D=1.2	116
Figure (5. 5) Load-Displacement relationship for models with B/D= 0.4	116
Figure (5. 6) Load-Displacement relationship for models with B/D= 0.8	117
Figure (5. 7) Load-Displacement relationship for models with B/D= 1.2	117
Figure (5. 8) Stress distribution and deformed shape of partially fixed connections for models with B/D= 0.4	118
Figure (5. 9) Stress distribution (Von Mises) in base plate and failure mode shapes of partially fixed connections for models with B/D= 0.4	119