



SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ENGINEERING

SCHOOL OF CIVIL ENGINEERING

DEPARTMENT OF STRUCTURE

**A Thesis Submitted In Partial Fulfillment For B.SC.
Degree In Civil Engineering**

Structural Behavior And Design Of Steel Systems

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August- 2014

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Preface

قال تعالى :-

بسم الله الرحمن الرحيم

((يَا أَيُّهَا الَّذِينَ آمَنُوا
إِذَا قِيلَ لَكُمْ تَفَسَّحُوا فِي
الْمَجَالِسِ فَافْسَحُوا يَفْسَحِ
اللَّهُ لَكُمْ وَإِذَا قِيلَ
انْشُرُوا فَانْشُرُوا يَرْفَعِ
اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ
دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ
خَبِيرٌ))

{سورة المجادلة : 11}

Dedication

I dedicate this project to:-

The first teacher ..To an orphan who made the nation underwent its east and west ...**Sir, the Messenger of Allah Muhammad (peace be upon him)**

To the person who taught me the path to success and gave me confidence in myself and do the impossible for my happiness (**Dear Dad**)

To the Princess of women who taught me the meaning of love and was beside me throughout my life (**My beloved mother**)

To pure hearts and kind souls Which gave us happiness and a smile and gave a special taste of life on their side (**my brothersmy Friends**)

And to all my teachers or anyone who has to help us in any business We have done or provided us with any information helped us to do this project (**Thank you**)

With love

Acknowledgment

We first thank God for finishing the project and simplifying it for us to work on it easily and comfortably. In addition that we thank our supervisor(**T- Mahmoud Khogali**)for guiding us through the steps of performing this project and providing us with much details about it and we apologize for all the mistakes we've made. We would specially thank all the people who were cooperating with us and were the reason of the production of such project(**Eng.NyaziTawfeg**). Each one of us teammates would like to thank his other teammates that have been through hard obstacles but were able to pass it due to teamwork and cooperation and the ability to communicate with each other efficiently.

التجريد

يعد الحديد من أهم المواد في المواد الإنشائية لأسباب إنشائية , ولديه عدد من الخصائص التي تجعله من المواد المثالية للتشييد وتتضمن النسبة العالية لقوة الحديد على وزنه , وأن وزن الحديد الإنشائي نسبيا قليل, هذه الخصائص تجعل الحديد مادة إنشائية جيدة للمباني العالية وجسور ذات الأبحر الطويلة .وتعد سرعة التشييد من أهم العناصر لاختيار الحديد كمادة إنشائية , ومقاطع الحديد المستخدمة في التشييد لها أشكال مختلفة وأحجام متنوعة .

الأنظمة الإنشائية للحديد الإنشائي تتكون من الإطارات الصلبة و الإطارات المثلثة التي تحمل جميع الأحمال المعرضة على المنشأ والسلوك الإنشائي للإطارات يعتمد على التحميل ونوع الوصلات المستخدمة .

التصميم الإنشائي للحديد الإنشائي تطور في خلال الأعوام السابقة من معادلات حسابية بسيطة معتمدة على بعض الخصائص للحديد الإنشائي إلى تعامل معقد من خلال معرفة السلوك الإنشائي للمادة المستخدمة

في هذا البحث تم دراسة السلوك الإنشائي , والتحليل والتصميم لمجموعة من الأنظمة الإنشائية منها الإطار البابي , الجملونات , الأعضاء المركبة مع وجود امثلة تصميميه تشرح السلوك الإنشائي

Abstract

Steel is one of the most important and efficient material for structural purposes. There are a number of inherent characteristics that make steel an ideal construction material; these include its high strength to weight ratio, the weight of steel structure is relatively small. This property makes steel a very attractive structural material for high rise building and long span bridges. Speed of erection is often one of the main criteria for selecting steel. Steel sections used for construction are available in a variety of shapes and sizes that make it a remarkably versatile and an aesthetically pleasing material.

Structural steel systems consist of a rigid frame and triangulated frame which carries all the loads to which the building is subjected. The behavior of a structural frame depends on its arrangement and loading, and on the type of connections used.

Design of structure steel has developed over the past 95 years from a simple approach involving a few basic properties of steel and elementary mathematics, to a sophisticated treatment demanding a thorough knowledge of structural and material behavior.

In this research the structural behavior, analysis and design of different steel structural systems has been studied, including Portal frame, trusses, composite and bracing systems several applications to analysis and design have been done for demonstration.

List of Contents

Item	Subject	Page
	Preface	
	Dedication	
	Acknowledgment	
	Abstract	
	List Of Contents	
	List Of Figures	
	List Of Symbols	
1	C H A P T E R 1 : INTRODUCTION & SCOPE OF SEARCH	1
1.1	Introduction	2
1.2	Project Significance	3
1.3	Project Objectives	4
1.4	Project Methodology	4
2	C H A P T E R 2 : MATERIALS AND DESIGN PHILOSOPHY	5
2.1	Introduction	6
2.2	Material	6
2.3	Structural Steel Products	7
2.4	Structural Steel Design	10
2.4.1	Steel Design Philosophy	10
2.4.1.1	Structural Steel Loads	12
2.4.1.2	Structural Integrity	13

2.4.1.3	Serviceability Limit State Deflection	14
2.4.2	Design Of Steel Members	15
2.4.2.1	Tension Members	15
2.4.2.2	Compression Members	19
2.4.2.3	Flexural Members	26
3	C H A P T E R 3 :STEELWORK STRUCTURAL SYSTEMS	33
3.1	Introduction	34
3.2	Plate Girder	36
3.2.1	Behavior Of Plate Girder	36
3.2.2	Design Of Plate Girder	38
3.3	Trusses And Bracing System	43
3.3.1	Behavior Of Trusses	43
3.3.2	Design Of Truss Members	45
3.3.3	Bracing System	45
3.4	Portal Frames	48
3.4.1	Behavior Of A Portal Frames	48
3.4.2	Design Of Portal Frames	50
3.5	Composite System	55
3.5.1	Behavior Of Composite System	55
3.5.2	Design Of Composite	56

4	C H A P T E R 4 :ANALYSIS AND DESIGN APPLICATIONS	60
4.1	Introduction	61
4.2	Analysis And Design Of Truss	61
4.2.1	The Loading Data	63
4.2.2	Analysis Of Truss	65
4.2.3	Design for Trusses Member	68
4.2.4	Design And Analysis Of Bracing	71
4.3	Design and Analysis of Portal Frame	77
4.3.1	Frame Analysis	77
4.3.2	Portal Frame Design	80
4.4	Analysis & Design for Composite Beams	86
5	C H A P T E R 5 :SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	91
5.1	Summary	92
5.2	Conclusions	94
5.3	Recommendations	95
	REFERENCES	96

List Of Figure

Figure	Description	Page
(2.1)	Hot Rolled And Cold Formed Sections	8
(2.2)	Cold-Rolled Sections	9
(2.3)	Compound Sections	9
(2.4)	Built-Up Sections	10
(2.5)	Tension Members In Buildings	16
(2.6)	Types Of Compression Members	20
(2.7)	Compression Member Sections	20
(2.8)	Behavior Of Members In Axial Compression	23
(2.9)	Load Cases For Struts	24
(2.10)	Behavior In Bending	29
(2.11)	Section With One Axis Of Symmetry	29
(2.12)	Biaxial Bending	31
(3.1)	Plate Girder Construction	37
(3.2)	Intermediate Transverse Web Stiffeners	41
(3.3)	Load-Bearing Stiffener	41
(3.4)	Roof Trusses And Lattice Girders	44
(3.5)	Bracing For Single-Storey Building	46
(3.6)	Bracing For Multi-Storey Building	47
(3.7)	Portal Frames	49
(3.8)	Bending Moment Diagram For Portal Frame	50
(3.9)	Equivalent Rectangular Portal	52
(3.10)	Column And Rafter Restraints	54

List Of Symbols

Symbols	Description
D	Depth
T	Thickness
Vw	Shear Buckling Resistance
Qw	Shear Buckling Strength
Py	Design Strength
V	The maximum shear in the web panel adjacent to the stiffener
Vcr	The critical shear buckling resistance of the same web panel
Ps	The Bearing Capacity Of The Stiffener
As net	The Net Cross Sectional Area
Pv	The Shear Capacity
S	The Length Of Web Between Stiffeners
Mcx	The Moment Capacity
B	The Stiffener Width
T	The Stiffener Thickness
Mtf	The Moment Due To Tension Field
M	The Number Of Members
J	The Number Of Joints
LE	The Effective Length Of Column
LC and LR	The Actual Length Of Column And Rafter
IC and IR	The Second Moment Of Area Of Column And Rafter
E	The Young's Modulus

Symbols	Description
LER	The Effective Length Of Rafter
LR	The Actual Length Of Rafter
PCC, PRC	The Critical Loads For Column And Rafter Loads
PC, PR	The average design axial load
Bf	The Ultimate Design Moment
MU	The Effective Breadth Of The Concrete Flange
S	The Plastic Section Modules
Δ	The Deflection
W	The Serviceability Load
L	The Beam Span
I	The Second Moment Of Area Of The Steel Section
f	The Elastic Bending Stresses
M	The Design Bending Moment
Z	The Elastic Section Modulus Of The Steel Section
ν	Poisson's Ratio
γ_f	The Partial Load Factor
A_g	The Gross Cross-Sectional Area
a₁	The Gross Sectional Area Of The Connected Leg
F	The Applied Axial Load
A_e	The Effective Area
M_x	The Applied Moment About The X–X Axis
M_{cx}	The Moment Capacity About The X–X Axis

Symbols	Description
My	The Applied Moment About The Y–Y Axis
Mcy	The Moment Capacity About The Y–Y Axis
K	The Effective Length Ratio
Aeff	The Effective Sectional Area
Pc	The Compressive Strength
λ	Slenderness Ratio
R	The Radius Of Gyration
Fc	The Compressive Force Due To Axial Load
Pcs	The Compressive Resistance
M	The Equivalent Uniform Moment Factor
Mb	The Buckling Resistance Moment
Ao	The Area Of The Rectilinear Element
F	The Average Shear Force