



Cairo University

**A PROPOSED METHOD TO REDUCE VULNERABILITY  
OF STEEL MOMENT RESISTING FRAMES TO  
PROGRESSIVE COLLAPSE**

By

**Mina Diaa Shoukry Nageeb**

A Thesis Submitted to the  
Faculty of Engineering at Cairo University  
in Partial Fulfillment of the  
Requirements for the Degree of  
**MASTER OF SCIENCE**  
in  
**Structural Engineering**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY  
GIZA, EGYPT  
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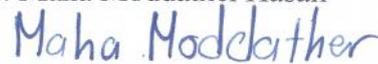
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**Title of Thesis:**

A Proposed Method to Reduce Vulnerability of Steel Moment Resisting Frames to Progressive Collapse

**Key Words:**

Progressive Collapse; Steel Moment Resisting Frame; Linear Static Analysis; Linear Dynamic Analysis; Time History

**Summary:**

Progressive collapse may be defined as the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it. There is uncertainty regarding which column(s) will be lost during extreme events (blast, moving truck collision, plane collision, earthquake, fire, overloading, etc.) which makes it very complicated to consider all the possibilities of column loss scenarios. In addition to the mentioned uncertainty, choosing the proper method of analysis based on the available resources is an important factor to consider — The benefits and drawbacks of each method need to be assessed. In this study, multi-story steel moment resisting frames were studied (6, 9, and 12 floors). Each structure had multiple column loss probabilities that were considered using static linear analysis and dynamic linear analysis methods. The dynamic amplification factor was determined for each structure. A new structural system consisting of tension ties was proposed to improve the performance of structures under the extreme event that causes loss of columns leading to progressive collapse and decrease the domino effect or stop it. The new structural system was checked under different column loss scenarios and its impact on reducing the vulnerability of the structures to progressive collapse was evaluated. Also, a method of simple procedure was proposed to predict the straining actions in members near to the lost column. The research was concluded by a summary of the findings in addition to recommendations for future research.



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Finally, I would like to thank my parents and brother for their support and encouragement not only through this study, but also all the way.



## **Dedication**

To my family, supervisors, and work boss, your support always pushed me forward. To Progressive Collapse's victims, I hope this work would help us to overcome this phenomenon properly. To the human curiosity and precise questioning, thank you.



# Table of Contents

<b>ACKNOWLEDGMENTS .....</b>	<b>I</b>
<b>DEDICATION .....</b>	<b>II</b>
<b>TABLE OF CONTENTS.....</b>	<b>III</b>
<b>LIST OF TABLES.....</b>	<b>IX</b>
<b>LIST OF FIGURES.....</b>	<b>XIV</b>
<b>NOMENCLATURE.....</b>	<b>XX</b>
<b>ABSTRACT .....</b>	<b>XXII</b>
<b>CHAPTER 1 : INTRODUCTION.....</b>	<b>1</b>
1.1. GENERAL .....	1
1.2. PROBLEM STATEMENT.....	1
1.3. OBJECTIVE OF THE RESEARCH .....	1
1.4. SCOPE OF THE RESEARCH.....	2
1.5. ORGANIZATION OF THE RESEARCH .....	3
<b>CHAPTER 2 : LITERATURE REVIEW.....</b>	<b>5</b>
2.1. DEFINITION AND HISTORICAL BACKGROUND.....	5
2.2. METHODS FOR PROGRESSIVE COLLAPSE ANALYSIS .....	7
2.3. REDUNDANCY'S BENEFIT .....	9
2.4. DETAILING, DUCTILITY AND REDISTRIBUTION .....	10
2.5. DYNAMIC AMPLIFICATION FACTOR .....	11
2.6. VERY IDEAL ASSUMPTION FOR EXTREME EVENTS COMPARED T O UNCERTAINTY .....	12
2.7. CONCLUSION .....	12
<b>CHAPTER 3 :METHODOLOGY .....</b>	<b>13</b>
3.1. INTRODUCTION.....	13
3.2. MODELING ASSUMPTIONS.....	13
3.3. LINEAR STATIC ANALYSIS .....	13
3.3.1. LOADING.....	13
3.3.2. LINEAR STATIC ANALYSIS' ASSUMPTION .....	14
3.3.3. LINEAR STATIC ANALYSIS STEPS .....	14
3.4. LINEAR DYNAMIC ANALYSIS.....	14
3.4.1. LOADING.....	14
3.4.2. LINEAR DYNAMIC ANALYSIS' ASSUMPTIONS.....	14
3.4.3. LINEAR DYNAMIC ANALYSIS' STEPS.....	15
3.5. DEMAND CAPACITY RATIO AND INTERACTION EAQUATIONS (ACCEPTANCE CRITERIA) .....	15
3.5.1. DCR LMITATIONS .....	15

3.5.2. FOR BEAMS .....	17
3.5.3. FOR COLUMNS.....	17
3.5.4. INTERACTION EQUATIONS AND DCR RATIOS CONSIDERED IN THIS STUDY .....	18
3.5.4.1. BEAMS .....	18
3.5.4.2. COLUMNS.....	19
3.5.4.3. USING SAP2000 .....	19
<b>CHAPTER 4 : CASE STUDY AND VERIFICATION.....</b>	<b>20</b>
4.1. Case study .....	20
4.1.1. ITRODUCTION.....	20
4.1.2. STRUCTURAL DESIGN.....	20
4.1.3. DESIGN RESULTS .....	21
4.1.4. LOAD COMINATIONS .....	21
4.1.5. RESULTS .....	22
4.2. MODEL VERIFICATION .....	25
4.2.1. INTRODUCTION .....	25
4.2.2. MOMENTS CALCULATED BY ELASTIC LIMIT ANALYSIS AND LIMIT ANALYSIS.....	26
4.2.2.1. FRAME 13 .....	26
4.2.2.2. FRAME 10 .....	27
4.2.2.3. FRAME 6 .....	28
4.2.3. RESULTS COMPUTED USING SAP2000.....	29
4.2.3.1. LINEAR STATIC ANALYSIS METHOD .....	29
4.2.3.1.1. FRAME 13.....	29
4.2.3.1.2. FRAME 10.....	30
4.2.3.1.3. FRAME 6 .....	32
4.2.3.2. TIME HISTORY LINEAR DYNAMIC ANALYSIS METHOD .....	33
4.2.3.2.1 FRAME 13.....	33
4.2.3.2.2. FRAME 10.....	34
4.2.3.2.3. FRAME 6 .....	36
4.2.4. CONCLUSION.....	37
4.3. DYNAMIC AMPLIFICATION FACTOR .....	38
4.3.1. INTRODUCTION .....	38
4.3.2. COMPUTING DAF USING SAP2000 RESULTS.....	38
4.3.2.1. FRAME 13 .....	38
4.3.2.2. FRAME 10 .....	38
4.3.2.3 FRAME 6 .....	39
4.3.3. DAF OF LINEAR STATIC SOLUTION.....	39
4.3.3.1. FRAME 13 .....	39
4.3.3.2. FRAME 10 .....	40
4.3.3.3. FRAME 6 .....	41
4.3.3.4. CONCLUSION.....	42
4.3.4. DAF OF LINEAR DYNAMIC SOLUTION.....	43

4.3.4.1. FRAME 13 .....	43
4.3.4.2. FRAME 10 .....	44
4.3.4.3. FRAME 6 .....	45
4.3.4.5. COMPARISON BETWEEN THE VALUES OF DAF FOR THE LINEAR STATIC ANALYSIS (WITH NO LOAD AMPLIFIED) AND LINEAR DYNAMIC ANALYSIS METHODS .....	46
4.3.4.6. CONCLUSION .....	50

**CHAPTER 5 : PARAMETRIC STUDY AND SIMPLIFIED LINEAR STATIC  
METHOD ..... 51**

5.A.1. Parametric study .....	51
5.A.1. INTRODUCTION .....	51
5.A.2. A NEW PROPOSED SYSTEM .....	52
5.A.3. TENSION MEMBERS MODELING .....	54
5.A.4. SCOPE OF STUDY .....	57
5.A.4.1. USING LINEAR STATIC ANALYSIS- FRAME 13.....	58
5.A.4.1.1. BEAM ABOVE THE LOST COLUMN ( $B_A$ ) .....	58
5.A.4.1.1.1. OBSERVATIONS .....	61
5.A.4.1.2. THE COLUMN(S) ADJACENT TO THE LOST COLUMN ( $C_{ADJ}$ ) .....	62
5.A.4.1.2.1. MOMENTS IN ( $C_{ADJ}$ ).....	62
5.A.4.1.2.2. OBSERVATIONS .....	64
5.A.4.1.2.3. AXIAL IN ( $C_{ADJ}$ ) .....	64
5.A.4.1.2.4. OBSERVATIONS .....	66
5.A.4.1.3. THE COLUMN(S) ABOVE THE COLUMN(S) ADJACET TO THE LOST COLUMNS ( $C_{AADJ}$ ).....	67
5.A.4.1.3.1. MOMENTS IN ( $C_{AADJ}$ ) .....	67
5.A.4.1.3.2. OBSERVATIONS .....	69
5.A.4.1.3.3. AXIAL IN ( $C_{AADJ}$ ) .....	69
5.A.4.1.3.4. OBSERVATIONS .....	71
5.A.4.1.4. THE BEAM ABOVE THE BEAM ABOVE THE LOST COLUMN ( $B_{AA}$ ) .....	71
5.A.4.1.4.1. OBSERVATIONS .....	73
5.A.4.1.5. THE BEAM ADJACENT TO THE BEAM ABOVE THE LOST COLUMN ( $B_{ADJ}$ ).....	73
5.A.4.1.5.1. OBSERVATIONS .....	75
5.A.4.1.6. TENSION IN MEMBERS OF THE NEW SYSTEM ADJACENT TO/CONNECTED WITH THE LOCATION OF THE LOST COLUMN .....	75
5.A.4.1.6.1. OBSERVATIONS .....	79
5.A.4.1.7. RATIO BETWEEN THE TENSION MEMBERS OF THE NEW SYSTEM ADJACENT TO/CONNECTED WITH THE LOCATION OF THE LOST COLUMN AND THE MAXIMUM AXIAL FORCE IN THE BELOW COLUMNS .....	80
5.A.4.1.7.1. OBSERVATIONS .....	83
5.A.4.1.8. BEAMS ABOVE AND BELOW THE TENSION MEMBERS (SUBJECTED TO TENSION/COMPRESSION FORCES) .....	84
5.A.4.1.8.1. OBSERVATIONS .....	88