

# بسم الله الرحمن الرحيم





# شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم





# جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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لم ترد بالأصل





Ain Shams University  
Faculty of Engineering

## **SEISMIC BEHAVIOR OF SKY STEEL BRIDGES CONNECTING ADJACENT BUILDINGS**

Thesis Submitted to the Faculty of Engineering at Ain Shams University  
in Partial Fulfillment of the Requirements for the Degree of  
Master of Science in Structural Engineering

**MINA REFAAT FARAH ESKANDER**

### **SUPERVISED BY**

<b>Prof. Dr. Ahmed Hassan Youssef</b> Professor of Steel Structures and Bridges Faculty of Engineering Ain Shams University	<b>Prof. Dr. Osman Mohamed Osman Ramadan</b> Professor of Structural Analysis Faculty of Engineering Cairo University
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**Cairo  
2020**



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**Title of Thesis : Seismic behavior of sky steel bridges connecting adjacent buildings**

**Key Words : Sky-bridge - Adjacent buildings - Seismic excitation - Response spectrum analysis - Parametric study**

## **STATEMENT**

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This thesis 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 at the Department of Structural Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

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

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## ACKNOWLEDGMENT

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Gratitude is due to the merciful generous God that guided me throughout this study.

Thanks are due to ***Prof. Dr. Ahmed Hassan Youssef***, Professor of Steel Structures, Faculty of Structural Engineering at Ain Shams University for his constant assistance and valuable advice throughout this study.

Gratitude is also extended to ***Prof. Dr. Osman Mohamed Osman Ramadan***, Professor of Structural Analysis, Faculty of Structural Engineering at Cairo University, for his valuable supervision, continuous encouragement, useful suggestions, and active help during this investigation.

My sincere appreciation and gratitude are due to my family for their help and patience during the preparation of this study. Without their assistance, this investigation would have never ended.

Gratitude is to be extended to the staff members and colleagues who assisted me to accomplish my thesis.



## ABSTRACT

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Due to the limitation of land in the capitals with the increase of population, buildings are often built close to each other. In most cases, these buildings are separated without any structural connections or are connected only at the ground level. Accordingly, the seismic behavior of sky bridges linking two adjacent steel buildings is theoretically evaluated via numerous three-dimensional analyses. While the study focuses on the earthquake effects on internal forces induced in the bridge itself, the effects of the link presence on the global performance of the two buildings are also briefly addressed. About 300 three-dimensional models of the building and connecting bridge are developed and analysed using the response spectrum method. These models consider various controlling parameters such as bridge span, elevation, and end conditions; relative stiffness of the two buildings; as well as direction of ground motion excitation with respect to bridge axis. Results showed that the connections of the linking bridge have a significant effect on the overall dynamic response of the bridge in both longitudinal and transverse directions. Also, the linking bridge itself was found to be significantly affected, with varying of the buildings stiffness and it is direction of inertia.

**Keywords:** Sky-bridge - Adjacent buildings - Seismic excitation - Response spectrum analysis  
- Parametric study

# TABLE OF CONTENTS

STATEMENT.....	5
ACKNOWLEDGMENT.....	6
ABSTRACT .....	7
TABLE OF CONTENTS.....	8
ABBREVIATIONS AND SYMBOLS .....	10
LIST OF FIGURES .....	12
LIST OF TABLES .....	14
CHAPTER (1): INTRODUCTION .....	17
1.1 THESIS OBJECTIVES .....	21
1.2 THESIS OUTLINE .....	21
CHAPTER (2): LITERATURE REVIEW .....	24
2.1 SKY BRIDGES WORLDWIDE PRACTICES .....	24
2.2 LITERATURE REVIEW OF SKY-BRIDGE .....	31
2.3 ENERGY DUE TO EARTHQUAKE.....	34
2.4 SEISMIC ANALYSIS.....	35
2.5 IRREGULAR STRUCTURES.....	35
2.6 COMMENTS.....	36
CHAPTER (3): STRUCTURAL MODELS AND PARAMETRIC STUDY .....	39
3.1 DESIGNING TALL STRUCTURES LINKED BY SKY BRIDGES.....	40
3.2 ADJACENT BUILDINGS.....	40
3.3 LATERAL FORCE-RESISTING SYSTEMS .....	41
3.4 PROCEDURE OF ANALYSIS.....	43
3.4.1 AVAILABLE ANALYTICAL METHODS.....	43
3.4.2 IMPLEMENTED ANALYSIS TECHNIQUE AND HYPOTHESIS .....	45
3.5 IMPLEMENTED FINITE ELEMENT MODELING .....	46
3.5.1 MODELED BUILDING DESCRIPTION .....	47
3.5.2 MODELED SKY-BRIDGE DESCRIPTION .....	47
3.5.3 MODELED MATERIAL PROPERTIES.....	47
3.5.4 MODELED BOUNDARY CONDITIONS .....	48
3.5.5 MODELED LOADS .....	48
3.6 COMPARISON BETWEEN EQUIVALENT STATIC METHOD AND RESPONSE SPECTRUM METHOD .....	50
3.7 MODELED SKY BRIDGE PARAMETERS .....	51
3.7.1 MODELED GENERAL PARAMETERS.....	51
3.7.2 MODELED BUILDING SHAPE.....	51
3.7.3 MODELED TYPES OF CONNECTIONS .....	54
3.7.4 MODELED SPAN OF THE SKY BRIDGE.....	56
3.7.5 MODELED SKY BRIDGE LEVEL.....	56
3.8 CALCULATED LOADS AND FORCES BY CODE ECP- 201-2012.....	57
3.8.1 CONSIDERED IMPORTANCE FACTOR.....	57
3.8.2 CONSIDERED SEISMIC MASS .....	57
3.8.3 CONSIDERED SOIL SITE CLASSIFICATION .....	57
3.9 REMARKS .....	58
CHAPTER (4): NUMERICAL RESULTS & STRUCTURAL ANALYSIS .....	60
4.1 NUMERICAL PROCEDURE .....	60
4.2 SIMULATION AND RESULTS OF CASE I .....	64

4.2.1 EQx .....	64
4.2.2 EQy .....	66
4.2.3 COMPARISON OF FOUR SUBCASES FOR CASE I .....	68
4.3 SIMULATION AND RESULTS OF CASE II .....	70
4.3.1 EQx .....	70
4.3.2 EQy .....	71
4.4 SIMULATION AND RESULTS OF CASE III .....	72
4.4.1 EQx .....	72
4.4.2 EQy .....	73
4.5 SIMULATION AND RESULTS OF CASES IV AND V .....	74
4.5.1 SIMULATION AND RESULTS OF SUBCASE a .....	74
4.5.2 SIMULATION AND RESULTS OF SUBCASE b .....	78
4.5.3 SIMULATION AND RESULTS OF SUBCASE C .....	81
4.5.4 SIMULATION AND RESULTS OF SUBCASE d .....	84
4.6 COMMENTS .....	84
CHAPTER (5): EFFECT OF LINK ON COUPLED BUILDINGS .....	88
5.1 Introduction .....	88
5.2 SIMULATING AND ANALYZING (WITHOUT SKY BRIDGE) .....	89
5.3 SIMULATING AND ANALYZING (CASE I) .....	90
5.3.1 SUBCASE a .....	90
5.3.2 SUBCASE d .....	91
5.4 SIMULATION AND ANALYSIS FOR UNEQUAL BUILDINGS .....	94
5.4.1 SUBCASE a .....	94
5.4.2 SUBCASE d .....	100
5.5. REMARKS .....	105
CHAPTER (6): CONCLUSIONS AND RECOMMENDATIONS .....	107
6.1 CONCLUSIONS .....	107
6.2 RECOMMENDATIONS .....	109
LIST OF REFERENCES .....	110
APPENDIX A .....	116
ملخص البحث .....	120
مكونات الرسالة .....	121



## **ABBREVIATIONS AND SYMBOLS**

- **F:** Force of Inertia
- **m:** Mass of the structure
- **a:** Acceleration due to gravity
- **S:** Soil-factor
- **$\gamma$ :** Response-factor
- **T1:** Building fundamental-period
- **Ct:** Coefficient related to the structural system and material
- **Fy:** Minimum yield-stress
- **Fye:** Effective yield-stress
- **Fu:** Minimum tensile-stress
- **Fue:** Effective tensile-stress
- **$\nu$ :** Poisson-ratio
- **A:** Thermal expansion coefficient
- **E:** Elasticity Modulus
- **G:** Modulus of Shear
- **A:** Building with fixed dimensions
- **B:** Building with variable dimensions
- **H:** Building height above foundation level
- **h:** Sky-bridge level
- **S:** Sky-bridge span
- **EQx:** Earthquake in X-direction
- **EQy:** Earthquake in Y-direction
- **MAF:** Main girder maximum axial load
- **MSF:** Main girder maximum shear load
- **Case I:** Identical buildings
- **Case II:** longitudinal inertia of building B = 3 of building A
- **Case III:** Transverse inertia of building B = 3 of building A
- **Case IV:** Longitudinal inertia of building B = 5 of building A
- **Case V:** Transverse inertia of building B = 5 of building A
- **Sub-case a:** Connection between B and sky-bridge is a hinged