# بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

# شبكة المعلومات الجامعية

# التوثيق الالكتروني والميكروفيلم

HANAA ALY

شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

***HANAA ALY***

Cairo University

# RE-VISITING CATENARY STRUCTURES; TOWARDS NEW SPATIAL PROPERTIES

By

**Eslam Abdelkhalek Metwally Sayed Metwally**

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**
**Architectural Engineering**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

# RE-VISITING CATENARY STRUCTURES; TOWARDS NEW SPATIAL PROPERTIES

By

**Eslam Abdelkhalek Metwally Sayed Metwally**

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
**Architectural Engineering**

Under the Supervision of

| | |
|---|---|
| **Prof. Dr. Mohamed Medhat Dorra** | **Prof. Dr. Khaled Mohamed Dewidar** |
| ……………………………….. | ……………………………….. |
| Professor of Architecture<br>Department Name<br>Faculty of Engineering, Cairo University | Professor of Architecture<br>Department Name<br>Faculty of Engineering, Ain Shams University |

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

# RE-VISITING CATENARY STRUCTURES; TOWARDS NEW SPATIAL PROPERTIES

By
**Eslam Abdelkhalek Metwally Sayed Metwally**

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
**Architectural Engineering Department**

Approved by the
Examining Committee

___________________________

**Prof. Dr. Mohamed Medhat Dorra**, Thesis Main Advisor
Professor of architecture, Department of Architecture
Faculty of Engineering, Cairo University

_____________________

**Prof. Dr. Khaled Mohamed Dewidar**, Advisor
Professor of architecture, Department of Architecture
Faculty of Engineering, Ain Shams University

_____________________

**Prof. Dr. Medhat Mohamed El Shazly**, Internal Examiner
Professor of architecture, Department of Architecture
Faculty of Engineering, Cairo University

_______________________

**Prof. Dr. Hazem Mohamed El Daly**, External Examiner
Professor of architecture, Department of Architecture
Faculty of Engineering, Ain Shams University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

**Engineer's Name:** Eslam Abdelkhalek Metwally
**Date of Birth:** 30/09/1992
**Nationality:** Egyptian
**E-mail:** eslam.abdelkhalek@bue.edu.eg
**Phone:** +201001615012
**Address:** Al Ashgar St. Mokattam, Cairo, Egypt
**Registration Date:** 1/03/2017
**Awarding Date:** …./…./2021
**Degree:** Master of Science
**Department:** Architectural Engineering Deparment

**Supervisors:**

Prof. Mohamed Medhat Dorra
Prof. Khaled Mohamed Dewidar

**Examiners:**

Prof. Mohamed Medhat Dorra (Thesis main advisor)

Prof. Khaled Mohamed Dewidar (advisor)
Professor of Architecture, Ain Shams Unveristy

Prof. Medhat Mohamed El Shazly(Internal examiner)

Prof. Hazem Mohamed El Daly(External examiner)
Professor of Architecture, Ain Shams Unveristy

**Title of Thesis:**

Re-Visiting Catenary Structures; Towards New Spatial Properties

**Key Words: (must be 5 words only)**
Shell Structures ; Grid Shells; Form Finding; Material Manipulation; Transparent Shells;

**Summary: (not more than 150 word and the summary must be in the same page)**
Nowadays due to the variety of materials in the construction market, new materials could be used in shell construction; such as resin with clear crystal effect, which can give a new spatial property to such structures. The research aim is to develop a prototype for a grid shell structure made of transparent polymer. Research objective was set to facilities the achievement of its aim, by firstly building a background about shells and form find a catenary grid. As, it will be the simplified example for shells in order to experiment new material and spatial property. Moreover, identifying the local materials to be used.

# Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Eslam Abdelkhalek Metwally Sayed Metwally Date: ../../…

Signature:

# Acknowledgments

I would like to thank god first for all I have achieved, then I would like to thank my supervisors; Prof. Mohamed Dorra, Prof. Khaled Dewidar and the jury members; Prof. Medhat El Shazly, Prof. Hazem El Daly for their efforts. I would like specially thank my parents for always motivating towards research. Last, I would like to thank Prof. Amr Helmy for his explanations about shells structural engineering. Finally, I would like to thank Electro Plast and CMB for their cooperation

# Table of Contents

# List of Tables

# Table of Figures