

**Ain Shams University
Faculty of Engineering
Department of Architecture**



**TRANSPARENCY IN TWENTIETH CENTURY
ARCHITECTURE:
BETWEEN THEORY AND PRACTICE**

BY

Mohamed Ezz Eldin Abd Elaziz Hassan
B.Sc. Architecture – Ain Shams University, 2001

A Thesis submitted in Partial Fulfillment
of the Requirements of
M.Sc. DEGREE IN ARCHITECTURE

Supervised by

Prof. Dr. Khaled Dewidar
Professor – Department of Architecture
Faculty of Engineering – Ain Shams University

Prof. Dr. Lobna A. Sherif
Professor – Head of Architectural Engineering & Environmental Design Department
Arab Academy for Science and Technology & Maritime Transport in Cairo

Prof. Dr. Mohamed Ibrahim Gabr
Professor – Department of Architecture
Faculty of Engineering – Ain Shams University

**CAIRO, EGYPT
2008**

STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Architecture.

The work included in this thesis was accomplished by the author at the Department of Architecture, Faculty of Engineering, Ain Shams University, and During the Period from January 2002 to January 2008.

No Part of this thesis has been submitted for a degree of a qualification at any other university or institute.

Name: Mohamed Ezz Eldin Abd Elaziz Hassan

Signature:

Date:

BOARD OF EXAMINERS

<u>Board</u>	<u>Signature</u>
Prof. Dr. Mohamed Tawfik AbdelGawad Professor of Architecture Departement of Architecture Faculty of Fine Arts Helwan University	
Prof. Dr. Sayed Madbouly Aly Professor of Architecture Departement of Architecture Faculty of Engineering Ain Shams University	
Prof. Dr. Khaled Dewidar Professor of Architecture Departement of Architecture Faculty of Engineering Ain Shams University	
Prof. Dr. Lobna Abelazim Sherif Professor of Architecture Head of Architectural Engineering & Environmental Design Department Arab Academy for Science and Technology & Maritime Transport in Cairo	

Date: / / 2008

To My Parents
To My Loving Wife Noran
To My Little Daughter Malak

ACKNOWLEDGEMENTS

After thanking God Almighty for accomplishing this work, I am indebted to many people who have directly and indirectly influenced and inspired me through the different stages of this research. Without their guidance, enthusiasm and continuous support, this work would not have been successfully achieved.

I would like to acknowledge my particular and extreme gratitude to Prof. Dr. Lobna A. Sherif , Prof. Dr. Khaled Dewidar and Prof. Dr. Mohamed Gabr under their supervision this thesis was accomplished. Through their constant support, endless advices, fruitful ideas, and significant directions, they have generously made a major contribution towards the completion of the thesis. I would like to thank them for the time spent in completing this research through their constructive discussions and suggestions, and for tolerating my frequent long visits.

I would like to convey my special thanks to my parents and my father, my mother and my sister for their continuous encouragement and support. My finest gratitude goes to my loving wife Noran for her perpetual support, directions, care, concern, and constant interest and motivation, and endless help throughout the duration of this thesis.

I would like to express my deepest gratitude and appreciation for my friends and brothers Ayman Assem, Hossam Masoud, and Mohamed Abdallah for their great efforts and assistance in accomplishing the thesis through its different stages. Without their generous help and support I wouldn't have accomplished this thesis.

I would also like to thank all my colleagues at the Department of Architecture, Faculty of Engineering, Ain Shams University, for their continuous support and enthusiasm.

Mohamed Ezz Eldin Abd Elaziz Hassan

January, 2008

Cairo, Egypt

ABSTRACT

Transparency is a word that carries a lot of meanings and contradictions, whether understood as physical meanings in optics and perception or understood as metaphorical meanings of truth and openness. Between theory and practice, transparency has always been a fascination for architects to study, understand, or just use as a building material. Understanding the meanings of transparency in architecture moves between practice and theory, physical and conceptual, literal and phenomenal, figures and ideas, and real and virtual.

Transparency since the beginning of the 20th century became a symbol of architecture modern movement and one of its basic identifications. Between the practical use of glass as the unique transparent material, and conceptual ideas of phenomenal meanings, transparency has been moving between these double meanings in architecture practice and theories, since then modern movement beginning and till this moment.

The thesis aims at discussing the basic meanings of transparency in 20th century between literal and phenomenal, in order to clarify the role of transparency in developing both the architectural practice and theories, discussing the basic characteristics of literal transparency and the impact of glass technology on architecture practice, outlining its main factors and effects, then illustrating the main concepts of phenomenal transparency between figures and ideas. The thesis tries to cover in brief the related topics and ideas of transparency in 20th century architecture.

LIST OF CONTENTS

ACKNOWLEDGEMENTS.....	i
ABSTRACT	iii
LIST OF CONTENTS	v
LIST OF FIGURES	xii
INTRODUCTION.....	xxxiii

SECTION I: INTRODUCTION TO TRANSPARENCY1

Chapter 1: Definitions of Transparency3

Introduction.....	5
1.1 Linguistic Definitions and related terms.....	6
1.1.1 Transparency	6
1.1.2 Translucency	11
1.1.3 Opacity.....	12
1.2 Transparency in Nature	14
1.2.1 Transparency in Natural Materials	14
1.2.1.1 Gas as a Transparent State of Matter.....	15
1.2.1.2 Water and Opacity Levels	16
1.2.1.3 Transparent Minerals.....	16
1.2.2 Transparency in Outer Space.....	19
1.2.3 Transparency in Living beings	19
1.2.3.1 Transparency in Insects	19
1.2.3.2 Transparency in life under water.....	20
1.2.3.3 Transparent World under Microscope.....	21
Summary.....	21

Chapter 2: Physical Meanings of Transparency23

Introduction.....	25
2.1 The Physical Theory of Transparency	25
2.1.1 Glass the Unique Transparent Material.....	25
2.1.1.1 Glass in Nature	26
2.1.1.2 Glass Physical Properties	27
2.1.1.3 Glass Transparent Nature and Light Modifications	28
2.1.1.4 Glass Manufacturing and Performance	32
2.1.1.5 Passive Glass Materials	38
2.1.1.6 Active Glass Materials	40
2.1.2 Other Transparent Materials	43

2.1.2.1 Glass Fiber Optics.....	43
2.1.2.2 Transparent Plastics.....	44
2.2 The Perceptual Theory of Transparency	47
2.2.1 Basic Characteristics of Transparency Perception.....	49
2.2.1.1 Metelli's Episcotister Model of Transparency.....	50
2.2.1.2 Conditions of Transparency.....	51
2.2.1.3 Contrast and Transparency Perception	54
2.2.1.4 Lightness and Transparency Perception	56
2.2.1.5 Luminance and Transparency Perception.....	57
2.2.1.6 Color and Transparency Perception.....	58
2.2.2 Transparency Perception in 3D	59
2.2.3 Transparency Perception and Thinking	59
Summary	62
Chapter 3: Conceptual Meanings of Transparency	63
Introduction	65
3.1 Transparency as a Concept in Humanities	65
3.1.1 Literature Transparency.....	65
3.1.2 Political Transparency.....	66
3.1.2.1 Radical Transparency	66
3.1.2.2 Democracy and Transparency	66
3.1.3 Transparency and Globalized Capitalism	67
3.2 Transparency in Modern Art.....	69
3.2.1 Modern Art Basic Characteristics.....	69
3.2.2 Introduction to Cubism	69
3.2.3 Transparency between Literal and Phenomenal	70
3.2.3.1 The Beginnings of Literal and Phenomenal Transparency.....	71
3.2.3.2 Examples of Literal Transparency in Modern Art..	79
3.2.3.3 Examples of Phenomenal Transparency in Modern Art.....	83
Summery	92

**SECTION II: LITERAL TRANSPARENCY: THE PHYSICAL
MEANINGS OF TRANSPARENCY IN 20TH CENTURY
ARCHITECTURE93**

**Chapter 4: History and Evolution of Literal Transparency in Architecture
.....95**

Introduction.....	97
4.1 Beginnings of Literal Transparency.....	98
4.1.1 Transparency without Transparent Materials	99
4.1.2 Transparent Glass Windows in Roman Architecture ...	100
4.1.3 Gothic Transparency: The First Age of Architectural Glass.....	100
4.1.3.1 Transparency as a Search for Light in Gothic Architecture	100
4.1.3.2 Transparency and Architectural Morphology.....	101
4.1.3.3 Transparency and Development of Colored Glass:	102
4.1.4 Transparency from Spiritual to Secular:	104
4.1.5 Development of Glass Quality	105
4.1.6 Conservatories: Transparency in the Minimal Glass Structure	106
4.2 Literal Transparency and Machine Aesthetics.....	110
4.2.1 Crystal Palace: The Transparent Beginning of Machine Age	110
4.2.2 Transparency and Industrial Revolution	112
4.2.2.1 Transparency in Railways Roofs.....	112
4.2.2.2 Transparency in Shopping Arcades.....	114
4.2.3 New Transparent Morphology: Between Frames and Skins.....	115
4.3 Literal Transparency Rising in Modern Architecture	118
4.3.1 Werkbund Transparent Beginnings	119
4.3.2 Mies van der Rohe's Beginnings of Literal Transparency	121
4.3.2.1 Transparency in Mies's Dreams of Skyscrapers	122
4.3.2.2 Transparency in Mies's Small Buildings	124
4.3.3 Le Corbusier and Transparency	125
4.3.4 Literal Obsession of Transparency	126
4.3.5 Frank Lloyd Wright and Transparency.....	128
4.3.6 Commercial Literal Transparency.....	129
Summery	131