

Contents

GENERAL INDEX	7
INDEX OF FIGURES	11
INDEX OF TABLES	18
 Chapter 1. Introduction	 19
 Chapter 2. Light and architecture	 27
2.1. RADIATION AND HUMAN LIFE	28
2.2. SUNLIGHT AND SENSE PERCEPTIONS	28
2.3. LIGHT AND ARCHITECTURE	28
2.4. ARCHITECTURE AND CLIMATE	30
2.5. ARCHITECTURE, LIGHT AND CONTEMPLATION	31
2.6. THE REFLECTED LIGHT	34
2.7. REFLECTED LIGHT AND COLOUR: TEMPORARY VARIATIONS	35
2.8. NATURAL AND ARTIFICIAL LIGHT	36
2.9. BUILDINGS AND NIGHT LIGHTING	37
2.10. LIGHT AND ARCHITECTURE: BEAUTY	37
 Chapter 3. Basic lighting concepts in architecture	 39
3.1. RESEARCH ON LIGHT	39
3.2. LIGHTING MEASUREMENTS AND STANDARDS	42
3.2.1. Measurements of optical radiation: Radiometry and photometry	43
3.3. LIGHTING DESIGN IN ARCHITECTURE	46
3.3.1. Color temperature and its use in architecture	46
3.3.2. Perception of volume with light	51

3.3.3. Visualization of light	51
3.3.4. Light distribution: Direct vs. indirect lighting	52
3.3.5. Solid State Lighting (SSL)	54
3.3.6. LED lighting examples	54
Chapter 4. Principles on light guidance	59
4.1. PROPAGATION OF LIGHT IN OPTICAL MEDIA	59
4.1.1. Reflection and refraction	60
4.1.2. Total Internal Reflection	61
4.2. LIGHT GUIDANCE SYSTEMS IN ARCHITECTURE	63
4.2.1. Light collection systems	63
4.2.2. Light transport systems	64
4.2.3. Light extraction systems	65
4.2.4. Fiber optic guides	65
4.2.5. Hollow light guides	66
4.2.5.1. Prismatic optical lighting film	66
4.2.5.2. Hollow Prismatic Light Guides	69
Chapter 5. Lighting by Hollow Prismatic Light Guides	73
5.1. LIGHT EXTRACTION SYSTEM APPLIED TO BUILDINGS	73
5.1.1. Daylight illumination system by vertical Hollow Prismatic Light Guides for an office building	74
5.1.2. Evaluation of the luminous flux of the prismatic extraction system	79
5.2. HIGH EFFICIENCY CUSTOMIZABLE ELBOW	82
5.2.1. Design and characterization of a 90° elbow	83
5.2.2. Theoretical efficiency of 90° elbow	84
5.2.3. Efficiency of 90° elbow in hollow light guides	86
5.2.4. Performance in prismatic guides with 90° elbow, experimental prototypes	87
5.3. ILLUMINATION SYSTEM BY VERTICAL HOLLOW PRISMATIC LIGHT GUIDE WITH A CUSTOMIZABLE ELBOW APPLIED TO MUSEUMS	91
5.3.1. Customizable Bend Lighting System (BLS)	91
5.3.2. Ray-tracing simulations, bend lighting system performance	92
5.3.3. Experimental customizable Bend Lighting System (BLS)	94

5.4. OUTDOOR LIGHTING, AUTOMOTIVE LIGHTING	95
5.5. CHROMATICITY IN HOLLOW PRISMATIC LIGHT GUIDES	96
5.5.1. Measurement of color	98
5.5.2. Chromatic difference between prismatic and aluminum cylindrical guides	100
5.5.2.1. Chromatic analysis and theoretical analysis	101
5.5.2.2. Chromaticity in cylindrical guides, experimental setup	104
5.5.3. Influence of the geometry of light guides	106
5.5.4. Color performance in guides by theoretical analysis	107
5.5.5. Geometry influence in light guides	109

Chapter 6. Mathematical transmission efficiency model for Hollow Cylindrical Prismatic Light Guides 111

6.1. EFFICIENCY IN HOLLOW LIGHT GUIDES	111
6.2. CHARACTERIZATION METHOD OF MICROPRISMATIC DEFECTS	112
6.2.1. Approximation of defects in vertices in relation to the radius of curvature	116
6.3. MATHEMATICAL MODEL TO COMPUTE TRANSMISSION EFFICIENCY	117
6.4. TRANSMISSION EFFICIENCY IN CYLINDRICAL PRISMATIC LIGHT GUIDES, THEORETICAL ANALYSIS	119
6.5. TRANSMISSION EFFICIENCY IN CYLINDRICAL PRISMATIC LIGHT GUIDES, EXPERIMENTAL METHOD	121
6.6. MATHEMATICAL TRANSMITTANCE MODEL, ADJUSTMENT PROCEDURE	124
6.7. SOURCE SIZE INFLUENCE	125

Chapter 7. Characterization of deformation by curvature of prism structure 127

7.1. DEFORMATION CHARACTERIZATION METHOD OF CURVED PRISMATIC FILM	127
7.2. LIGHT TRANSMISSION IN CYLINDRICAL PRISMATIC GUIDES, EXPERIMENTAL MODEL	134
7.3. LIGHT TRANSMISSION IN CYLINDRICAL PRISMATIC GUIDES, THEORETICAL ANALYSIS	136

Chapter 8. Conclusions	139
Bibliography	143