



Contents

I. PROJECT DEVELOPMENT	1	3. Luminous Composition / 21
1. Assessing Project Needs / 3		Defining Objectives / 21
Interviewing Clients and the Design Team / 3		Expressing Ideas / 22
Clients / 3		Observation / 22
Clients' Expectations / 4		Imagination / 22
Maintenance / 5		Composition Elements / 23
Landscape Maintenance / 5		Depth / 23
Lighting Maintenance / 5		Quality and Direction of Light / 23
Budget / 6		View / 23
Deadlines / 6		Mood or Atmosphere / 27
Other Design Team Members / 6		Balance / 27
Reviewing Architectural and Landscape Plans / 7		Focal Points / 31
Visiting the Site / 8		Cohesion / 31
Documenting Site Conditions / 9		4. The Design Process: Documenting and Installing Landscape Lighting / 36
Soils Considerations / 13		Project Communications / 38
Synthesizing the Information / 14		Computer-Aided Design (CAD) / 39
References / 14		Conceptual Design Phase Documents / 44
		Presentation Drawings / 46
2. Vision and Perception of Light / 15		Types of Presentation Drawings / 48
How the Eye Works / 15		Mock-up Sessions / 49
Designing for the Eye / 19		Preliminary Budget / 50
Perception / 19		Design Development Phase / 51
References / 20		Construction or Contract Documents / 51
		Plans or Working Drawings / 61
		Index of Drawings / 62

- Project Layout Key / 62
- Standard Symbols and Abbreviations / 62
- Notes / 62
- Lighting Layout, Schedule, and Detail Sheets / 62
- Details Including Schedules / 67
- Specifications / 68
 - General Section / 69
 - Lighting Fixture Section / 69
 - Three Typical Fixture Specification Formats / 69
 - Cut Sheets / 70
- Bidding Process Phase / 70
- Construction Phase / 71
 - Submittal Drawings and Samples / 71
 - Construction / 71
 - Locating Fixtures On Site / 72
 - Locating Tree-Mounted Fixtures / 72
- Aiming and Adjusting the Lighting System / 72

5. Follow-up Work: Record Documents and Project Maintenance / 74

- Record Documents Package / 77
 - Updated Design and Installation Documents / 77
 - Updated Lighting Plans / 78
 - Fixture Locations / 79
 - Using Photographs to Locate Lighting Equipment / 79
 - Lamping Information / 81
 - Aiming Notation / 81
 - Shielding Notation / 81
 - Updated and New Project Schedules / 81
 - Project Service Directory / 84
 - Controls Adjustments and Settings / 84
 - Maintenance Documents / 84
 - Maintenance Issues / 84
 - Maintenance Equipment and Spare Parts / 85
- Maintenance Work / 85
 - Focus Adjustment / 85
 - Lamp Replacement / 85
 - Fixture Cleaning / 89
 - Maintaining the Proper Fixture

- Aiming / 89
- Stocking and Restocking Supplies / 89
- Design Adjustment / 89
 - Reaiming Existing Fixtures / 90
 - Relamping Existing Fixtures / 90
 - Relocating Existing Fixtures / 90
 - Removing Existing Fixtures / 90
 - Adding New Fixtures / 90
- Updating the Record Documents / 90
- References / 91

II. MATERIALS AND TECHNOLOGY

6. Light Sources / 95

- Physical Characteristics / 95
 - Bulb or Envelope / 95
 - Shapes and Sizes / 95
 - Base / 98
 - Filament, Electrodes, and Arc Tubes / 98
- Types of Lamps / 98
 - Filament Lamps / 99
 - Tungsten-Halogen Lamps / 99
 - Frequently Used Types / 100
 - MR Lamps / 100
 - PAR Lamps / 100
 - R Lamps / 101
 - Miniature and Subminiature Lamps / 101
 - Comparing 120-Volt and Low-Voltage Lamps for Landscape Use / 101
 - Discharge Lamps / 101
 - High-Intensity Discharge Lamps / 102
 - Mercury Vapor / 102
 - Metal Halide / 102
 - High-Pressure Sodium / 102
 - Low-Pressure Sodium / 104
 - Fluorescent Lamps / 104
 - Jacketed, Aperture, and Reflector Types / 104
 - Cold Cathode, Including Neon / 104
- Functional and Operating Characteristics / 106
 - Physical Dimensions / 106
 - Operating Characteristics / 106
 - Lamp Operating Position / 106

- Bulb-Wall and Base Operating Temperature / 107
 - Voltage / 107
 - Lumen Maintenance / 107
 - Life / 107
 - Color of Light Produced / 108
- 7. Light Fixtures / 109**
- Selection Criteria / 109
 - Aesthetics / 109
 - Function / 109
 - Lamp Type and Wattage / 110
 - Adjustment Capabilities / 110
 - Ability to Add Accessories / 111
 - Mechanical Features / 111
 - Attachment of Lenses / 111
 - Access to Lamp, Transformer, and Ballast
 - Compartments / 111
 - Waterproofing / 112
 - Locking Mechanisms / 113
 - Lamp Shielding / 113
 - Optics / 113
 - Environmental Considerations / 114
 - Thermal Considerations / 114
 - Fixture Types / 114
 - Decorative Fixtures / 114
 - Lanterns / 114
 - Bollard and Path Fixtures / 114
 - Post, Wall-Mounted, and Hanging Fixtures / 115
 - Functional Fixtures / 115
 - Ground-Mounted Adjustable Fixtures / 115
 - Hanging Fixtures / 116
 - Surface-Mounted Fixtures / 116
 - Ground-Recessed Fixtures / 116
 - Underwater Accent Fixtures / 123
 - Underwater Niche Fixtures / 123
 - Strip-Light Fixtures / 123
 - 120-Volt or Low-Voltage Fixtures / 125
 - Fiber Optics / 125
 - Custom Fixtures / 125
 - Accessories / 125
 - Ballast / 125
 - Transformer / 125
 - Mounting Boxes / 127
 - Mounting Stakes / 128
 - Shrouds / 128
 - Louvers / 128
 - Lenses / 130
 - Color Media / 132
 - Safety / 132
 - Codes / 132
 - Labels / 134
 - Testing / 135
 - Damp Location Requirements / 135
 - Wet Location Requirements / 135
 - Underwater Requirements / 136
 - Salt Spray Tests / 136
 - Scratch Test / 136
- 8. Corrosion, Materials, and Finishes / 137**
- Corrosion / 137
 - Water / 138
 - Soil / 138
 - Presence of Soil Moisture / 138
 - Oxygen Supply / 139
 - pH Value / 139
 - Temperature / 141
 - Prevention / 141
 - Atmosphere / 141
 - Corrosion Protection / 141
 - Types of Corrosion / 143
 - Uniform Corrosion / 143
 - Pitting Corrosion / 143
 - Crevice Corrosion / 143
 - Deposit Corrosion / 143
 - Erosion Corrosion / 144
 - Bimetallic or Galvanic Corrosion / 144
 - Stray-Current Corrosion / 144
 - Selective or Dealloying Corrosion / 145
 - Materials / 145
 - Ferrous Metals / 145
 - Ferrous / 145
 - Cast Iron / 145
 - Stainless Steel and Alloys / 146
 - Nonferrous Metals and Alloys / 146
 - Aluminum and Alloys / 146
 - Copper and Alloys / 149
 - Brass / 149
 - Bronzes / 150
 - Zinc / 151
 - Glass / 151
 - Plastics / 151

- Polyvinyl Chloride (PVC) / 151
- Acrylonitrile-Butadiene-Styrene (ABS) / 152
 - Epoxy / 152
 - Silicone / 152
- Polymethyl Methacrylate (Acrylic) / 152
- Polycarbonate (Lexan) / 152
- Ethylene Propylene Diene Monomer Rubber (EPDM) / 152
- Neoprene / 152
- Finishes / 153
 - Anodizing / 153
 - Clear Anodize and Dye / 154
 - Two-Step or Two-Step Electrolytic / 154
 - Duranodic (Alcoa) or Kalcolor (Kaiser) / 154
 - Powder Coat / 154
 - Verdigris or Verdi Green / 154
 - Temporary Finish / 156
- References / 156

9. Controls / 157

- Control System Issues / 157
- Designing Control Systems / 158
 - Residential Spaces / 160
 - Commercial Spaces / 163
 - Single-Use Spaces / 163
 - Multiuse Spaces / 163
- Types of Control Devices / 164
 - Manual Switches / 164
 - Dimming Switches / 165
 - Incandescent Dimming / 166
 - Preset Incandescent Dimming Systems / 167
 - Fluorescent Dimming / 167
 - HID Dimming / 167
 - Photoelectric Controls / 168
 - Time Switches / 169
 - Motion Detectors / 169

10. Wiring / 171

- Power and Power Distribution / 171
 - Safety / 171
 - Complying with the National Electrical Code / 171

- Grounding / 174
- Fuses and Circuit Breakers / 174
- 12-Volts Versus 120-Volts / 175
 - Type, Size, and Condition of a Site / 175
- Lamps and Fixtures / 176
 - Amperage / 176
 - Fixture Mounting / 177
 - Connections / 177
- Voltage Drop / 177
- Elements of a Wiring System / 179
 - Conductors / 179
 - Electrical Connections / 181
 - Conduits / 183
- Wiring Approaches / 187
 - Fixtures Mounted at Grade / 187
 - Daisy-Chain Wiring Method / 187
 - Loop Wiring Method / 187
 - Multiple-Feed Wiring Method / 191
 - Multiple-Transformer Wiring Method / 191
 - Fixtures Mounted in Trees / 191
- Planning for the Future / 194

III. APPLICATIONS

11. Residential / 197

- Working with the Owner / 197
- Design Considerations / 201
 - Property Characteristics / 204
 - Arrival / 204
 - Circulation / 204
 - Views / 205
 - Owner's Preference / 205
 - Equipment Selection / 206
 - Light Sources / 206
 - Fixtures / 207
 - Controls / 208

12. Public Spaces / 209

- Design Issues / 209
 - Nature of Public Projects / 209
 - Safety and Security / 209
 - Circulation / 210
 - Anticipated Activities / 211
 - Image / 212
 - Controls / 213

Equipment Selection / 214
 Light Sources / 214
 Fixtures / 217
 Project Management / 217

13. Atria / 219

Residential Spaces / 219
 Commercial Spaces / 220
 Lighting for Plant Growth / 221
 Quality of Light / 222
 Quantity of Light / 223
 Light and Dark Time Periods / 223
 Intensity Level / 225
 Acclimatizing Plants for Atrium Life / 226
 Direction of Light / 226
 References / 226

IV. ELEMENTS OF DESIGN 227

14. Plant Materials / 229

Techniques for Lighting Plants / 229
 Evaluating Plant Materials / 230
 Physical Characteristics / 234
 Physical Appearance / 236
 Growth / 237
 The Plant's Role in Composition / 239
 The Role of the Transition Plant / 242
 Boundary or Divider Role / 242

15. Garden Evolution: Changes That Affect Lighting / 264

Lighting System Infrastructure / 264
 Garden Evolution / 264
 Changes Through the Seasons of One Year / 265
 Winter / 273
 Spring / 276
 Summer / 280
 Fall / 280
 Changing Roles / 280
 Growth of an Individual Plant / 281
 Garden Evolution Influences Plant Role / 282
 Gradual Change / 289
 Radical Change / 289

The Relationship of Pruning with Lighting / 289

16. Sculpture, Architectural Structures, and Signage / 291

Sculptures / 291
 Uplighting Versus Downlighting / 293
 Techniques / 295
 One Viewing Direction / 295
 Multiple Viewing Directions / 297
 Architectural Structures / 298
 Signage / 305
 Reference / 306

17. Pathways, Walkways, and Stairs / 307

Walkways / 307
 Planning Issues / 310
 Lighting Level / 310
 Safe Movement / 312
 Paving or Path Material / 312
 Light Patterns / 313
 Fixture Selection / 314
 Decorative Fixtures / 317
 Hidden Fixtures / 317
 City Streets and Sidewalks / 317
 Steps and Staircases / 320
 Downlight / 321
 Sidelight / 321
 Tread-Integrated Light / 322
 Decorative Fixtures / 322

18. Building or Elevation Lighting / 325

Luminous Composition / 326
 Floodlighting / 328
 Grazing / 329
 Patterns of Light / 329
 Internal Building Lighting / 330
 Color / 330
 Fixture Location / 330
 Equipment / 333
 Light Sources / 333
 Incandescent / 334
 Fluorescent / 334
 High-Intensity Discharge / 335

Fixtures / 335
Lighting Levels / 335
Maintenance / 339

19. Water Features / 341

Design Considerations / 341
Physical Properties of Light / 341
 Refraction of Light / 341
 Effect of Light on Aerated or Turbulent
 Water / 342
 Effect of Light on Flat or Smooth Water /
 342
 Dispersion of Light in Water / 342
Fixture Location / 342
 Locating Fixtures Below the Water's
 Surface / 345
 Locating Fixtures Above the Water's
 Surface / 348

Types of Water Features / 348
 Waterfalls / 348
 Fountains / 349
 Ponds and Pond Surfaces / 350
Safety / 352
Equipment for Underwater Use / 352
 Lamps / 353
 Fixtures / 353
 Fiber Optics / 354

APPENDIX / 357

Documents / 358
Lighting Manufacturers Directory / 387

BIBLIOGRAPHY / 394

INDEX / 398