Contents

1 What Is a Real Intelligent Envelope? ........................................... 1
   1.1 Definition of Intelligence ............................................... 1
   1.2 Stages of the Intelligent Process ..................................... 2
   1.3 Applying Artificial Intelligence to Objects .......................... 8
   1.4 Intelligent and Responsive Architectural Envelopes .............. 13
   1.5 Types of Inputs and Responses for the Intelligent Envelope ... 15
   References ............................................................................. 19

2 History and State of the Art ..................................................... 21
   2.1 Early Developments and Postulates .................................... 21
   2.2 Historical Points of View for Intelligent Building Envelopes ... 24
      2.2.1 The Highly Mechanized Envelope ............................... 24
      2.2.2 The Naturalistic Envelope ......................................... 29
   2.3 Recent Developments and Examples ................................... 31
      2.3.1 The Integrative View ................................................. 31
   2.4 Classification System for Intelligent Envelope Components .... 34
      2.4.1 Class A—Perception/Input Elements ............................ 34
      2.4.2 Class B—Control Processing Elements ........................... 35
      2.4.3 Class C—Actuator Elements ....................................... 39
   2.5 Comparison of Two Smart Actuator Systems ....................... 42
      2.5.1 Lighting Redirection Systems and Their Calculation ........ 43
      2.5.2 Smart Shading Systems and Their Implementation Process ........................................... 45
   References ............................................................................. 48

3 Design Considerations ............................................................ 51
   3.1 Stages of the Architectural Design Process of an Intelligent Envelope and Impact on Performance ............. 51
   3.2 Architectural Design Strategies for Intelligent Envelopes ....... 52
   3.3 Impact of Design Decisions Due to the Addition of Intelligence ......................................................... 55
3.4 Difference Between the Architectural Design Process of Intelligent Envelopes for New and Retrofit Buildings 62
3.5 How to Form Design Strategies 63
3.6 The Self-shading Building Envelope 70
3.7 Considering Intelligence for a Good Design 77
References 78

4 Design Tools 81
4.1 Brief Overview of Existing Design Tools 81
4.2 Tool Classification 82
4.3 Tools Providing Basic Guidelines 82
4.4 Generation Tools 84
4.5 Generation Tools Incorporated in Existing Programs: SunTools as Case Study 86
4.6 Single-Aspect Evaluation Tools 90
4.7 Single Aspect Evaluation Tools: The Lighting Simulation Case 92
4.8 Tools for Whole-Building Simulation 94
4.9 Other Tools 96
4.10 Design Suggestion Tools 97
4.11 NewFacades: Advice Tool for Early Design Stages of Intelligent Envelopes 98
4.12 Conclusions About the Tools 102
References 103

5 Application Examples 107
5.1 Scenario One: New Office Building 107
5.2 Considerations for Alternative Selection in a New Project 112
5.3 Scenario Two: Residential Building Retrofit 114
5.4 Considerations for Element Selection in a Retrofit Project 126
References 127

Conclusions—The Intelligent Envelope, Where To? 129

Index 133
Intelligent Envelopes for High-Performance Buildings
Design and Strategy
Capeluto, G.; Ochoa, C.E.
2017, VIII, 134 p. 51 illus., 42 illus. in color., Hardcover
ISBN: 978-3-319-39254-7