Contents

Preface to the third edition viii
Acknowledgements ix
Introduction 1

1 The relationship of structure to building 9

2 Structural requirements 21
   2.1 Introduction 21
   2.2 Equilibrium 21
   2.3 Geometric stability 21
   2.4 Strength and rigidity 29
   2.5 Conclusion 36

3 Structural materials 39
   3.1 Introduction 39
   3.2 Masonry 40
   3.3 Timber 43
   3.4 Steel 51
   3.5 Reinforced concrete 56
   3.6 Conclusion 59

4 The archetypes of structural form – the relationship between structural form and structural efficiency 61
   4.1 Introduction 61
   4.2 The effect of form on internal force type 62
   4.3 The concept of ‘improved’ shapes in cross-section and longitudinal profile 67
   4.4 Classification of structural elements – the archetypes of structural form 74

Appendix to Chapter 4 – a note on the use of the term ‘form-active’ 76
5 Complete structural arrangements

5.1 Introduction 79
5.2 Post-and-beam structures 81
5.3 Semi-form-active structures 91
5.4 Fully form-active structures 93
5.5 Conclusion 96

6 The critical appraisal of structures

6.1 Introduction 99
6.2 Reading a building as a structural object 99
6.3 The appropriateness of structural choices: complexity and efficiency in structural design 100
6.4 Critical appraisal of structures 108
6.5 Conclusion 112

7 Theory of structures

7.1 Introduction 117
7.2 Example 1: the use of 'geometric rules' – structural theory in Antiquity and the medieval period 119
7.3 Example 2: the evolution of structural theory based on the use of 'grounded rules' – calculations based on elastic theory 133
7.4 The role of structural theory – overall conclusions 154

8 Philosophy of structures and its relationship to architectural theory in the Modern period

8.1 Introduction 157
8.2 'Building correctly' – the writings of Torroja and Nervi 158
8.3 Structure in relation to architectural theory: technology treated as a 'style' 165
8.4 Structural technology and Modern architecture 185
8.5 Conclusion 188

9 The engineers – their role in developing the imagery of Modern architecture

9.1 Introduction 191
9.2 The engineer/architects – their role in the creation of new images for architecture 192
9.3 The engineers who worked with architects in design teams 222
9.4 Conclusion 251
10 Structure and architecture 255

10.1 Introduction 255
10.2 The types of relationship between structure and architecture 256
10.3 Conclusion 294

11 Structure and sustainability 297

11.1 Introduction 297
11.2 General background 298
11.3 Relevant concepts 300
11.4 Recent practice in relation to ‘sustainable’ architecture 310
11.5 Structural design for sustainability 317
11.6 Conclusion 335

Glossary of structural terms 339
Selected bibliography 345
Index 347