IATpp001-033_rev2.qxd 7/7/08 17:48 Page 6

Contents

Foreword 9
Hanif Kara

Introduction 10

Structure and Form 12

Structural Physics 15

Materials Science 16
Forces: 16
Stress
Strain
Properties of Materials: 18
Strength
Stiffness and Flexibility
Reactions: 20
Bending
Shear

Materials Technology 22
Stone 22
Timber 23
Steel 24
Reinforced Concrete 25
Glass 26
Fabrics 27
Fibre-Reinforced Plastic 28
Sheet Materials 29

Structural Integrity 30
Loads: 30
Live and Dead Loads
Lateral Loads
Bracing
Torsion
Stability: 32
Anchorage
Height
Centre of Gravity
Cantilever Principle

Structural Elements 35

Bearing Elements 36
Bearing Walls: 36
Stacked Masonry
Composite Construction
Columns 40
Foundations: 42
Strip
Pad
Raft
Pile
Retaining Walls

Unidirectional Spanning Elements 44
Beam: 44
Cross-Sections
Linear Profiles
Profiled Plate 48
Reinforced-Concrete Slab
Profiled-Sheet
Composite
Wafer/Laminate

Multidirectional Spanning Elements 50
Reinforced-Concrete Slab
Coffer
Space Frame
Wafer/Laminate

Connections and Joints 52
Dry Joint
Stone
Nail
Screw
Bolt
Rivet
Turnbuckle
Adhesives (Glue)
Welding
Brazing

Structural Logic 57

Compressive Structures 58
Two-Dimensional Shapes: 58
Post and Beam
A-Frame
Portal Frame
Arch
Vault
Dome
Three-Dimensional Surfaces: 62
Diamatic Dome
Lamella Dome
Geodesic Dome
Shell and Monocoque 64

Tensile Surfaces 66
Membrane 66
Cable Net 66
Tensegrity 66

Climate and Shelter 68

Human Comfort 71

Thermal Comfort 72

Solar Geometry 74

Building Performance 77

Climatic Envelope 78
Thermal Mass 78
Thermal Insulation: 80
Principles
Types
Air Movement 84
Natural Ventilation
Passive Control
Windows and Glass 88
Weathering: 90
Masonry
Cladding Systems
Membranes
Bonded Surfaces

Sound and Light 98
Acoustics: 98
Properties of Sound
Acoustic Control
Daylight

Building Services 104
Heating 104
Mechanical Ventilation 106
Air-Conditioning: 108
Principles
Systems

Computational Tools and Techniques 113

Data Structures 114
Materials Selection and Design
Building Information Modelling

Structural Analysis 116
Form Finding
Finite Element Analysis

Environmental Analysis 118
Thermal
Daylight
Air Movement
Acoustic

Case Studies 123

Mud House 124
Tepee 126
Igloo 128
Obelisk 130
The Pantheon 132
The Ironbridge 134
The Bell Rock Lighthouse 136
The Crystal Palace 138
Clifton Suspension Bridge 140
Tropical House (Pavilion Demontable) 142
Kresge Auditorium 144
Palazzetto Dello Sport 146
The Houston Astrodome 148
The German Pavilion 150
The USA Pavilion 152
Self-Build House 154
Sydney Opera House 156
HSBC Headquarters 158
The Pavilion of the Future 160
The Portugal Pavilion 162
The Lord's Media Centre 164
30 St Mary Axe 166
'D' Tower 168
Davies Alpine House 170
International Space Station 172

Building Codes 175

Rules Governing Construction Technology 176

European Guidelines on Sustainable Construction 178

Further Reading 180
Sources 182

Picture Credits 183
Author Profiles 184

Index 185