INDEX

1:1 prototyping 9, 75, 77, 79, 80, 89, 163
2030 Challenge 7, 24
2D drafting technology 4
3D Studio Max 167, 173
3XN 9, 129-37

A
abiotic consumption of resources 113
acidification potential (AP) 113
acoustic analysis 104
acoustic atmospheres 53-5
acoustic comfort 45
acoustic performance: wave-based and ray-based 55
acoustic walkthroughs 169
‘active insulation’ approach 115
Addington, Michelle ix, 24
adiabatic cooling 109
Aedas: Computational Design Research group (CDR) 193
aerospace software 4
agent modelling 52, 197
‘agile principle’ 197
AHR 193
Aish, Robert 4
Al Fayah Park, Abu Dhabi 108
Albatross 53
Alexander, Christopher viii, ix
Notes on the Synthesis of Form (1964) vii
Algonquin Centre for Construction Excellence 63
American Institute of Architects (AIA) 21, 23
‘Amphibious Architecture’ 81
Anderson, Kjell 3, 15, 29, 41, 45
Android 77
Ansys 53, 145
Aravana, Alejandro 115
Architect Magazine 61
architectural space 7
architecture as meteorology 87-9
‘architecture of energies’ 7
Arcsim 19
Arduino circuit boards 71
artificial intelligence (AI) 193, 234
artificial life (AL) 193
Arup 51, 139
ASHRAE 90.1 19
associative modelling 4
Atelier Lyon 113
Athena Sustainable Materials Institute 65
‘atmosphere’ 43-57
Attia, Shady 41
Auer, Thomas 108, 115
‘Augmented Atmospheres’ installation, Venice
Biennale (2014) 109
AutoCAD 31
Autodesk 87, 119, 121, 167
Insight 360 tool 24
Revit 5, 24, 32, 65, 67, 99, 101, 121, 191
Autodesk Ecotect Analysis see Ecotect
Autodesk Research 71, 80, 135

B
Bailey, Carlo 215
Ballerup Recycling Center, Denmark 129
Banham, Reyner 151
Banke, Tore 153
Bateson, Gregory 75
Bauer, Brent 71
BE10 159
Behnisch Architekten 111
‘benchmarking’ 61, 109, 195, 225
Benjamin, David 79, 80, 82, 87
Bernstein, Phil 87
Bhooshan, Shajay 201, 207
bi-directional design process 17
BIG see Bjarke Ingels Group (BIG)
BIM (building information modelling) vii-viii, 32, 33, 49, 101, 119, 183, 185, 193, 212, 217
laser scanning for 213-15
BIM/SIM model 56
Bjarke Ingels Group (BIG) 9, 151-61, 187
‘Bladerunner’ 135
Böhme, Gernot 43
Box, George 59
Braham, Williams W. 224-6
Breathe.Austria pavilion, Milan Expo (2015) 109
British Airways Lounge Futures project 169
British Land 61
Brunelleschi, Filippo 1
building 661, Consortium for Building Energy
Innovation, Philadelphia Navy Yard 123
Building Energy Software Tools index 29
building information modelling see BIM
building performance simulations (BPS) 177
Buildings=Data concept 213
Buildings=Data conference (2015) 81
Burohappold Engineering 9, 51, 139-49
Sustainability group 51
Burry, Jane 77, 89
Burry, Mark 89
Butterfly 53
INDEX 236-237

C
C++ 194
CAD vii, 4, 25, 31, 33, 36, 47, 99, 161, 169, 189, 194, 219
Capra, Stefano 103
Carbon Calculator 65
carbon 14-27
carbon footprint 7, 65, 220
CarbonBuzz 61
Caruso St John 161
Case 81, 85, 212-13
CATIA 31, 39, 99
Cellophane House (2008) 119
Centre for Evolutionary Computing in Architecture (CECA), University of East London 193
Centre for Information Technology and Architecture (CITA), Denmark 75-7
CFX 167
Chadwick International 141
Cherrey, John 89
climat change 5, 25-6
‘cloudscapes’ 108-9
Clover Tower project, Mumbai, India 135
Coates, Paul 31, 193, 195
‘Commonground’ 185
Computational Design Research group (CDR), Aedas (now AHR) 193
computational fluid dynamics (CFD) 52-3, 87, 89, 101, 113, 167, 207
computer-aided design see CAD
CORE 185-91
Cramp, Nick 163, 165, 167, 168, 169, 175
custom software 39

d
Danish National Advanced Technology Foundation 135
DASHER project 71
data visualisation 23, 193
data-integrated design 195
Davis, Daniel 89, 213
daylight simulation 47, 49, 221
Daysim 24, 103, 189
De Kestelier, Xavier 95, 97, 103, 105
Dean, Ptolemy 169
Delos 71
Derix, Christian 31, 193, 194, 195, 197, 199, 200
Design Explorer 187, 190, 225, 234
design for disassembly 222, 223
design for sun and light 47-9
Diamond Schmitt Architects (DSAI) 23, 61, 63
Dick, Philip K. 1
digital energy modelling 17, 19
Diller Scofidio + Renfro 109, 185, 187
Dilworth Park 119
DIVA 24-5, 34, 129, 161, 167, 232
Dogan, Timur 53, 69, 71, 219-21
Dsearch group 177
DXF file 36
Dynamo 32, 39, 101, 225

e
ecoMetrics 61-4
Ecotect 24, 36, 39, 99, 141, 145, 167, 169, 190, 205
embodied energy 19
energy, definition 17
energy budgeting 23
energy consumption 7
Energy Cost Range of model 7
energy modelling 21-3
Energy Systems Language 226
energy use 141-3
‘predicting 19-21
EnergyPlus 19, 24, 25, 125, 143, 145
environmental impacts 5-7
eQuest 25
eutrophication potential (EP) 113
evatranspiration 109
Excel 141, 143, 145, 147, 232
‘expressionist crisis of formalism’ 37

f
FabPod 89-91
facade analysis 168
Facebook 213
Faircloth, Billie 75, 119, 125, 126
‘falsecolour’ maps 49
Fano, David 212, 213
Fathom 207
Feilden Clegg Bradley Studios 165
‘filtering forward’ 224, 225
Fischer, Alex 52
Fischer, Nils 205
‘flash research’ 80
Flovent 145
Fluent 113, 167
fluid flows 52-3
fog formation 125
Foliente, Greg 15
FootPrint app 65
Fordham, Max 169
form without formalism 37
Foster + Partners 9, 95-105, 107, 141, 143
Specialist Modelling Group 31, 95-105
Frazer, John 31
frit patterns 187-9
future of simulation 39-41

GaBi 113, 121
Galapagos 41
Gallou, Irene 95, 99, 101, 105
game software 4
Gaudi, Antoni 1
Gehry, Frank 31
Gehry Partners 107
generative algorithms 197
Generative Components 31
generative design 87
genetic algorithm 145
GenSky 173
geographic information systems (GIS) 147
German Sustainable Building Council (DGNB) 135
Gibson, William 234
global warming potential (GWP) 113
Google 213
gradients of performance 87
Graduate School of Architecture, Planning and Preservation 80
graphical user interface (GUI) 36
Green Solution House, Rønne 129, 135, 137
Greenberg, Don 225
greenhouse gas emissions 220, 226
Grove Towers, Mumbai, India 133, 135
GXN 129-37

H)
Happold, Sir Edmund 139
Haramain High Speed Rail project 141
Harten, Arthur van der 161
Hayward Gallery renovation 165-7
heating ventilation and air conditioning (HVAC) systems 21
Heller Manus Architects 99
Hensen, Jan 41
Herzog & de Meuron 107, 113
Heschong, Lisa 91
heterogeneity 45-7
Hill 12
Hirst, Damien 163
history of computer-aided design (CAD) 4
2D drafting era 4
building information modelling (BIM) era 4
design computation era 4
‘hockey stick’ graph 35
HOK 21
Honeybee 9, 19, 24, 25, 34, 99, 161, 187, 189, 190, 225, 232
Hualien, resort and residences, Taiwan 155-7
‘HVAC-centric’ approaches 71
iBeacon 217
ICD/ITKE annual research pavilion, University of Stuttgart 77
IES 19, 143, 145, 167
Impact Estimator for Buildings software tool 65
‘in silico’ experiments 1
indoor air quality 53, 71
indoor-tracking sensors 85
industrial software 4
information driven design 151-3
Ingels, Bjarke 1, 3, 151-61, 185
inherent energy 19
in-occupancy data 67
Insight 360 tool 7
Institute for Lightweight Structures and Conceptual Design (ILEK), University of Stuttgart 221
Intel 31
Intelligent Space Partnership 207
International Energy Conservation Code (IECC) 19
International Green Construction Code (IgCC) 19
interoperability of software landscape 33-4
Inventory of Carbon and Energy (ICE) 65
IPCC climate change scenarios 26
Issam Fares Institute for Public Policy and International Affairs building, American University in Beirut, Lebanon 201
Izaki 197
J
Jade Ecopark 89
Jahn Architects 189
Java 194
Jensen, Kasper Guldager 129
Jeremijenko, Natalie 81
John and Frances Angelos Law Center, University of Baltimore 111
K
Kahn, Louis 60
Kalay, Yehudi 17
Kathleen Grimm School for Leadership and Sustainability 69
Katz, Neil 229-32
Kean Apartments 119
Khan, Azam 3
Kieran, Stephen 119
KieranTimberlake 7, 9, 25, 65, 119-27
King Street West, Toronto, Canada 159-61
Kiruna, Sweden 177-83
Klimaengineering 107
Knott, Daniel 49, 51, 139-49
Kondo, Tetsuo 108
KT Innovations 65, 67, 71
KT Solar Modeler tool 126
Kuwabara Payne McKenna Blumberg 109
L
Ladybee 99
Ladybug 9, 24, 25, 99, 129, 161, 167, 190, 225, 232
Lally, Sean 7, 47
Lange, Jakob 153
Latifi, Mehrnoush 77
Leadership in Energy and Environmental Design (LEED) 7, 17-19, 60-1, 72
  MRpc63 credit 65
  Platinum 110, 119
  version 4 61, 65-7
  version 4 Building Life-Cycle Impact Reduction credit 65-7
Liansheng Financial Center 231
Liber Regalis 173
life cycle analysis (LCA) 7, 65, 121
life cycle impact assessment (LCIA) 113
life cycle inventory (LCI) data 121
Lightscape 169
‘Lightscapes’ installation, Venice Biennale (2016) 115
Living, The 79
Living Architecture Lab 79, 81
‘Living Glass’ 80
Loblolly House, Maryland 119, 123
Louisiana State Museum and Sports Hall of Fame, 212
Loukissas, Yanni 1, 35
Lycée Français Charles de Gaulle, Damascus, Syria 113
Lynn, Greg 31
M
Manitoba Hydro 109-11
Manning equation 155
Marsh, Andrew 3, 24, 36
Masdar City masterplan, Abu Dhabi 108
MASS Design Group 107
Massachusetts Institute of Technology (MIT) 77
MassMotion 51
Matlab 145
Maver, Tom 55
Max Fordham Designs 9, 163-75
Max/MSP 32
MAXXI Museum of 21st Century Art, Rome 163, 168-9
Maya 31, 39, 205, 207
Mayo Clinic 71
McNeel, Robert 5
Megacities Carbon Project 59
Microsoft 31
MicroStation 31, 99, 143
middle ground tools 103
‘model’, definition 1
Moe, Kiel 226-8
Montana, Rachel 215
Morrison Hershfield 23
Mosbach Paysagistes 90
Moussavi, Farshid 43
Mueller, Volker 4
multi-zone airflow network simulation 53
Museum of Contemporary Art, Tokyo 108
Museum of the Human Body, Montpellier, France 153-5, 161
N
Nanjing International Youth Cultural Centre 141
NASA 25
National Bank of Kuwait tower 141, 143
natural light in buildings 47, 133, 169
Naugle, Matthew 189-91
Negendahl, Kristoffer 153
Negro, Federico 212, 213
New York City Economic Development Corporation 81
Newport Street Gallery, London 163
Noma restaurant, Copenhagen 129
non-renewable energy 19

O
‘occupant-centric’ approaches 71
Oceanwide Center, San Francisco 99-105
Octopus 41
Odum, H.T. 17
‘open innovation’ concept 5
OpenFOAM 53, 103, 167
open-source simulation 103
OpenStudio 24
operational energy 19
Orrell, David 59
Otto, Frei 139, 221
Oxman, Neri 37
ozone depletion potential (ODP) 113

P
Pachyderm 55, 104, 161
Pallasmaa, Juhani 43
parametric CAD 39
parametric design 28-42, 143
parametric geometry model 207
parametric modelling 145, 167, 231
parametricism 193
Patte, Pierre 1
‘pattern language’ vii
Payne, Andy 81
PE International (now thinkstep) 113, 119, 121
Pearman, Hugh 173
Peña de León, Alexander 89
‘performance gap’ 61, 121
performance-based design 15-17, 21-3, 37
personal weather stations (PWS) 126
Peters, Brady 89
Phelan, Nicole 215
phenomenology 197
photovoltaic (PV) energy production 7, 24
Pier 35 EcoPark 81
Pochee, Hareth 167
Pointelist 67, 71, 119, 125-6
Pompidou Centre, Paris 139
post-occupancy data 61, 67
post-occupancy evaluations (POE) 61, 81, 95, 127
post-occupancy studies 39
Pratt, Kevin 225
prescriptive approach 21-3

Private Microclimates workshop cluster,
Smartgeometry 2014 77
Processing 31
Prohasky, Daniel 77
Project Dasher 69
Python 194

Q
qualitative soundscape analysis 104
Quay Quarter Tower, Sydney, Australia 131
Quelea 52

R
Radiance 24, 34, 49, 69, 99, 103, 113, 167, 169, 173, 187, 189
radiation-rose diagrams 24
Rahm, Philippe 45, 46, 87-9
Rau, Thomas 19
real-time data 39, 59, 79, 81, 135, 147, 175, 215-17
real-time monitoring 69
Reinhart, Christoph 47, 49
remote sensing 25
renewable energy 5, 21, 27, 61, 135
Revit 5, 7, 24, 32, 39, 65, 67, 99, 101, 121, 191
Rhino 5, 31, 32, 55, 101, 104, 126, 129
Grasshopper3D 5, 24, 32-4, 39, 52, 53, 65, 99,
147, 148, 155, 159, 161, 165, 167, 187, 189, 190,
219, 225, 232
Rhinoceros see Rhino
Ricky Liu and Associates 89
Ricola Herb Centre, Laufen, Switzerland 113
Rittel, Horst vii
Robinson, Philip 103
Roudsari, Mostapha Sadeghipour 9-11, 24, 53, 187,
189, 190, 225, 232-4
Rowe, Peter vii
Royal Festival Hall, London 163
Royal Melbourne Institute of Technology (RMIT
University), Melbourne 75, 77-9
RMIT Design Hub 89
Spatial Information Architecture Laboratory (SIAL)
77
Runberger, Jonas 177

S
Sabine, Wallace 53, 55
Sagan, Carl 1
Samba Bank Head Office, King Abdullah Financial
District Riyadh, Saudi Arabia 141, 207
SANAA 107, 115
Sanderson, Steve 212, 213
satellite data 25, 147
Schlaich, Jörg 221
Schumacher, Jonatan 185, 187
Schumacher, Patrik 201
SEB Bank Headquarters, Stockholm 181-3
Sefaira 19
sensing the environment 121-5, 190-1
Sensory Detectives cluster 77
shareware 53
Sharma, Shrikant 51, 147
Shed, The’ 185, 187
Shimoga Processing Centre 139-41
SIAL 77, 81, 85
Sketchpad 31, 32
Skidmore, Owings & Merrill (SOM) 69, 229-32
sky model 49
Smart Rooms 136
SMART Solutions group 147, 149
SmartForm 147
Smartgeometry 31, 85, 77, 87, 95, 105
workshops 75, 91
SmartMove 51, 147
SmartSpaceAnalyzer.147
Smith, Makai 4
Sobek, Werner 5, 221-3
‘soft metrics’ 149
solar energy 220
solar modelling and sensing 129-37
SolidWorks 31
Southbank Centre, London 163
space as heuristic generation 197
spatial analysis 193
spatial cognition theories 197
Spatial Information Architecture Laboratory (SIAL), RMIT 77
‘spatialisation’ 193, 199
Specialist Modelling Group (SMG) 31, 95-105
St Martin-in-the-Fields, London 163
Stec, Peter 69, 71
Stettin 7 Residences, Stockholm, Sweden 157-9, 161
summer smog potential (POCP) 113
sun-path diagram 24
SuperSpace 51, 193-200
sustainability 5, 7, 23, 51, 69, 141, 227, 228, 231
Sutherland, Ivan 4, 32
Swedbank 129-31,, 137
Sydney Opera House, Australia 133, 139

T
Taichung Jade MeteoPark 87
Tally 7, 65-7, 119, 121
Tate Britain 161
Termite 19, 159, 161
thermal comfort 45, 49-51, 91
thermal simulation 49
Thierfelder, Anja 115
thinkstep (formerly PE International) 113, 119, 121
Thornton Tomasetti 9, 185-91
CORE studio 65, 225, 232, 234
TTX tool 190
Timberlake, James 119
time-lapse photography 85
Trahan Architects 212
Transamerica Pyramid 99
TRaNsient SYstems Simulation program see TRNSYS
Transsolar KlimaEngineering (Transsolar Climate Engineering) 9, 89, 107-17, 219
TRNSYS (TRaNsient SYstems Simulation program) 33-4, 107, 109, 111, 113
TT Toolbox 190
TTX tool (Thornton Tomasetti Exchange) 190
Tulane University 125
Turkle, Sherry 3
typical meteorological year (TMY) files 25, 26, 125

U
UNESCO World Heritage Site. 201
Universal Thermal Climate Index (UTCI) 51, 103, 141, 149
urban building energy models (UBEM) 26-7
urban heat islands (UHI) 26, 109, 125
Urban Heritage Administration Centre in Diriyah, Saudi Arabia, 201

V
Vasari 77
Velux Daylight Visualizer simulation tool 129
Venice Biennale 2010 108
‘Augmented Atmospheres’ installation (2014) 109
‘Lightscapes’ installation (2016) 115
virtual reality (VR) 56, 169, 171, 234
visitation data 147
visual comfort 45
volatile organic compounds (VOCs) 71
VTC Tower, Copenhagen, Denmark 161
W

W57 project, New York City 157
Waelkens, Anne 187
Weather Underground 126
WELL building standard 71-2
Well Living Lab 71
Westminster Abbey, London 163, 169-75
Wetter, Michael 33-4
WeWork 9, 85, 211-17
White Architects 9, 177-83
Williams, Mani 77, 81-5, 87, 217
Williams, Nick 89
wind analysis 95, 207
wind-rose diagram 24
wind tunnel testing 52
Winsberg, Eric 229
Woods Bagot 9
SuperSpace 51, 193-200
WUFI Plus 113

Z

Zaha Hadid Architects (ZHA) 9, 141, 170, 201-9
ZHACODE 201-9
ZigBee data 85
Zollverein School of Management and Design, Germany 115
Zumthor, Peter 43