Index

Note to the Reader: Throughout this index boldfaced page numbers indicate primary discussions of a topic. *Italicized* page numbers indicate illustrations.

A

Accredited Professionals (AP) program, 22
accuracy vs. estimation in BIM methods, 34–35
ADA (Americans with Disabilities Act) compliance, 210
Adam Joseph Lewis Center, 24, 24
Air-Conditioning and Refrigeration Institute (ARI), 117
air-conditioning systems, 5, 117
air cooling efficiency, 116
air quality in natural ventilation, 105
Aldo Leopold Legacy Center, 214
Alhambra, 3, 32–34, 33–34
altitude, sun, 79–81, 80
American Institute of Architects (AIA) Committee on the Environment (COTE) (AIA/COTE) contributions, 6–7
Top Ten Award, 70
American Society of Heating, Refrigerating, and Air-Conditioning Engineers 90.1 (ASHRAE 90.1) building massing, 143
energy use baselines, 181–182
wall resistance, 148
Americans with Disabilities Act (ADA) compliance, 210
Amoco Cadiz oil spill, 6
amorphous PV arrays, 123
Anasazi people, 2
angles, sun, 79–81, 80
animal species, 86–87, 87
Anita B. Gorman Conservation Discovery Center decking, 97, 97, 114
PV arrays, 123
water treatment, 168
wetlands, 109
Antarctic ozone hole, 6
AP (Accredited Professionals) program, 22
application-specific energy modeling settings, 187, 188
architects
BIM methods vs. standard, 35–36
Renaissance, 54
area calculations for roof, 172–173, 173, 223, 223
ARI (Air-Conditioning and Refrigeration Institute), 117
artificial lighting and cooling loads, 110
ASHRAE 90.1 (American Society of Heating, Refrigerating, and Air-Conditioning Engineers 90.1) building massing, 143
energy use baselines, 181–182
wall resistance, 148
ATHENA EcoCalculator for Assemblies, 20
Atlanta water supply, 166
Autodesk 3ds Max application, 160
Autodesk Revit Architecture energy modeling, 186–187, 187–188
shading devices, 81, 81
automated lighting controls, 156
available sunlight data, 198
average monthly rainfall, 83–84, 84
average monthly temperature, 82, 82
average wind speed, 86, 86
azimuth, sun, 79–81, 80

B

Bailey, Gary, “Student Performance in Daylit Schools”, 154
Ballast Efficiency Factor, 120
Ballasts, 119–120
Bank of America Corporation, 218
barrels for rainwater collection, 107
BaseLineGreen tool, 202–203, 203
baselines
  building mass, 143–144
  energy modeling, 181–183, 182
  sustainable materials, 204
  water, 168–169
batt insulation, 149
beams, salvaged, 114
benchmarks for building mass, 143–144
Berkebile, Bob, 2, 6, 23–24
BGR Consulting Engineers, 216
big box design, 143, 144
BIM model and methods. See building
  information modeling (BIM) and
  methods
biomass energy, 194
bioswales, 109, 171
blackwater vs. graywater, 173
BNIM Architects, “Building for
  Sustainability”, 11
boiler thermal efficiency, 118, 118
BREEAM (Building Research
  Establishment’s Environmental Assessment Method), 18–19
Brundtland Commission, 10
Brunelleschi, 54
building codes, 148
building envelope
  BIM model, 186
  optimizing, 148–150, 150–151
Building Environmental Efficiency principal, 17
Building Environmental Quality and
  Performance (Q), 17
“Building for Sustainability”, 11–12, 15, 22
building form, 127
  daylighting. See daylighting
  massing. See massing
  orientation. See orientation
  overview, 128–131, 128, 130
Building Green Inc., 7
“Building Green” segment, 57
building information modeling (BIM) and
  methods, 25
benefits, 34–35
daylighting, 49, 50, 159–164, 161–164
documentation, 38–43, 39, 41–42
downstream effects, 130
energy modeling, 48–49, 49, 185–192, 185–192
future, 210–212, 210–212
importance, 29–32
Lewis and Clark State Office Building,
  47–51, 47–50
methodology, 32–34, 33–34
migrating to, 43–45, 43–44
overview, 26–27, 26, 28
ranges, 51–52, 52
renewable energy, 196–198, 197–198
  vs. standard, 35–38
sustainable materials, 204–208, 205–207
  water harvesting, 172–177, 173–176
  as workflow, 46
Building Research Establishment’s
  Environmental Assessment Method
  (BREEAM), 18–19
building systems, 165
  energy modeling. See energy modeling
  renewable energy. See renewable energy
  sustainable materials. See sustainable
  materials
  water harvesting. See water and water
  harvesting
buildings
  energy and resource consumption, 57
  load factors in water harvesting, 175, 175
  mass in energy needs, 99
  materials. See materials
  types, 91–96, 92–95
C
C.K. Choi Center for Asian Research, 101, 101
CAD-based drawings, 26–27, 28
calculations
  BIM, 51
  roof area, 172–173, 173, 223, 223
  water analysis, 169
California Public Utilities Commission, 214
California water supply, 166
can-do spirit, 69
Cannibals with Forks (Elkington), 10
Capital E firm, 15
capture potential in water harvesting, 176–177, 176
carbon, 15
carbon accounting, 222–223
carbon dioxide emissions, 57
carbon offsets, 125
Carson, Rachel, *Silent Spring*, 5, 14
CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), 17
Cascadia Living Building Challenge program, 215
Cascadia Region Green Building Council, 215
Cathode Ray Tube (CRT) displays, 121
CCI (Clinton Climate Initiative), 218–219
ceiling materials, 222
Center for Maximum Potential Building Systems, 106
CFDs (computational fluid dynamics), 37, 189, 190
change opportunities, 219–220
Chazen Companies, 216
children in schools, daylighting effects on, 153–154
chimney components, 141
cisterns, 107
civil engineers for water harvesting, 171
Climate Atlas of the United States, 85
“Climate Code with Dr. Heidi Cullen”, 57
Climate Consultant tool, 82, 84–85
climate factors, 76–78
  building envelope, 148
data files, 82, 82
data interactivity, 224–225, 224–225
daylighting, 157
daylighting, 157
development
  BIM, 51
  roof area, 172–173, 173, 223, 223
  water analysis, 169
California Public Utilities Commission, 214
California water supply, 166
can-do spirit, 69
Cannibals with Forks (Elkington), 10
Capital E firm, 15
capture potential in water harvesting, 176–177, 176
carbon, 15
carbon accounting, 222–223
carbon dioxide emissions, 57
carbon offsets, 125
Carson, Rachel, *Silent Spring*, 5, 14
CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), 17
Cascadia Living Building Challenge program, 215
Cascadia Region Green Building Council, 215
Cathode Ray Tube (CRT) displays, 121
CCI (Clinton Climate Initiative), 218–219
ceiling materials, 222
Center for Maximum Potential Building Systems, 106
CFDs (computational fluid dynamics), 37, 189, 190
change opportunities, 219–220
Chazen Companies, 216
children in schools, daylighting effects on, 153–154
chimney components, 141
cisterns, 107
civil engineers for water harvesting, 171
Climate Atlas of the United States, 85
“Climate Code with Dr. Heidi Cullen”, 57
Climate Consultant tool, 82, 84–85
climate factors, 76–78
  building envelope, 148
data files, 82, 82
data interactivity, 224–225, 224–225
daylighting, 157
daylighting, 157
development
computer screens, 121
cement, 97–98, 204–207, 206
conduction of heat, 92, 94, 97
connectivity, 57
Conservation Design Forum, 216
construction
demolition waste, 57
documents model, 49, 50
emissions from, 222
planning, 40, 41
construction delivery methods, 67
design-bid-build process, 67–69, 68
design-build, 71–73, 72
negotiated guaranteed maximum price, 69–71, 70
summary, 73
consultants, 35–36
contractors on integrated design teams, 60
controls for daylighting, 156
cooling
daylighting load reductions, 110
wind for, 103–105, 104
cooling degree days (CDD), 83, 83
“Cost of Green Revisited, The” report, 15
“Costing Green” report, 15
costs
green buildings, 128–219
renewable energy, 124
counts in BIM, 51
Critical Planet Rescue (CPR), 6
cross-team knowledge sharing, 61
CRT (Cathode Ray Tube) displays, 121
crystalline PV arrays, 123
culture factors
communities, 87–89, 88–89
daylighting, 157
massing, 141–142, 142
organization, 87, 90
overview, 76–78, 87
sustainable materials, 201–203

daylighting
BIM analysis, 40, 41, 44
BIM model, 49, 50, 159–164, 161–164
climatic, culture, and place, 157
ergie modeling, 180
as free resource, 110–113, 112–113
overview, 151–156, 152–153, 155–156
project goals, 157–159, 158–159
“Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance”, 154
Daysim application, 160
decision-making time for renewable energy analysis, 201
decking, 97, 97, 114, 115
depression from magnetic north, 137, 137–138
degree days, 82–83
Department of Energy (DoE), 7
design-bid-build process, 67–69, 68
design-build delivery method, 71–73, 72
design development and process
Lewis and Clark State Office Building, 69
waste in, 211
workshops, 66–67
design fees, 65
design phase visualization, 38–39, 39
designers
in BIM, 46, 220–221
design teams. See integrated design teams
dew point, 81–83, 82–83
dialogue in integrated design teams, 61
digital design model, 48, 48
documentation in BIM, 38–43, 39, 41–42
drinkable water usage
in buildings, 57
reduction, 101–102
drought conditions, 166
drug-dependent rugs, 102

early phase costs, 65
Earth Day, 5
east-west axis orientation, 155
“Eco-tech”, 57
EcoCalculator for Assemblies, 20
EcoMachine, 168
Ecoregion Level IV data, 86
Ecotect application, 189
EcoWORKS, 124
EECR (external environmental cost ratio), 202
EER (Energy Efficiency Ratio), 117
efficacy of lighting, 120
efficiency
  air cooling and heating, 116–117
  boiler, 118, 118
  cumulative effects, 128–129, 128
  energy modeling, 180–181
  vs. redundancy, 35
  water-use reduction, 167
efficient man-made systems, 115
electric lighting, 119–120
equipment, 120–121
  mechanical, 115–118, 116–118
  plumbing, 119
EIR (employment impact ratio), 202
electric lighting, 119–120
electric resistance heat, 118
electricity consumption by buildings, 57
Elements division, 70
Elkington, John, 10
embodied energy for materials, 97, 222
emissions from construction, 222
employment impact ratio (EIR), 202
energy
costs history and projections, 30–32, 31
  efficiency. See efficiency
  envelope use, 148–149
  load charts, 92, 93
  renewable. See renewable energy
  resource consumption needs, 98–100, 99–100
Energy Committee, 6
Energy Efficiency and Renewable Energy website, 122
Energy Efficiency Ratio (EER), 117
Energy Efficiency Strategic Plan, 214
energy modeling, 178–180, 179
  analysis, 184
    application-specific settings, 187, 188
    baselines and goals, 181–183, 182
    BIM, 48–49, 49, 185–192, 185–192
    building envelope, 186
    climate impacts, 180
    Lewis and Clark State Office Building, 183
    location factors, 186, 186
    needs reduction, 180–181
    optimizing, 191–192, 191–192
    room volumes, 186–187, 187–188
    use analysis, 188–190, 189–190
energy performance matrix, 95, 95, 99, 99
Energy Policy Act, 168
Energy Star program, 7, 120
EnergyPlus format, 82, 85
envelopes
  BIM model, 186
  optimizing, 148–150, 150–151
Environmental Protection Agency (EPA)
  Energy Star program, 7
  founding, 5
Environmental Resource Guide (ERG), 6–7
eQUEST (Quick Energy Simulation Tool), 189, 189
equipment
  efficiency, 116, 120–121
  energy modeling, 180–181
estimation vs. accuracy, 34–35
export model geometry, 51
external environmental cost ratio (EECR), 202
external shading devices
  in daylighting, 156, 156, 161
  in energy modeling, 51, 191, 191–192
  for glazing, 111–113, 112–113
tools for, 81, 81
Exxon Valdez oil spill, 6
eye adaptation to light, 155
facilities management, 40
Facilities Steering Committee of Packard Foundation, 11
false color images, 162, 163
Fayez S. Sarofim Research Building, 139
Federal Emergency Management Program, 149
Fisk, Pliny, 202
fixed-tilt photovoltaic (PV) panels, 79
fixtures
  graywater models, 174
  lighting, 119–120
flora and fauna, 86–87, 87
flow rate in graywater models, 174
fly ash, 98, 204–207, 206
foam based insulation, 149–150
foot-candles, 151
form analysis, 147–148, 147
free/local resources and natural systems, 103
materials, 114, 115
  rainwater, 106–107, 106–109
  sun, 107, 110–113, 110, 112–113
  wind, 103–106, 103
fuel emissions, 222
funding green buildings, 218–219
furnace thermal efficiency, 118, 118
future, 209
  opportunities for change, 219–220
  sustainable design, 212–218, 213–218

G
Gastinger, Kirk, 6
Gastinger Walker Harden Architects, 124
GBC (Green Building Challenge), 18
GBI (Green Building Initiative), 19
GBS (Green Building Studio) service, 189–190, 189–190, 192
GBTool, 18
gbXML file format, 185–187
Geographic Information System (GIS) data, 37
glare
  in daylighting, 161, 162
  defined, 153
  shading for, 112–113
glass office towers, 76–77, 77
glazing
  building envelope, 148–150, 151
  considerations, 111–112
  in daylighting, 155
  and orientation, 131
  glazing factor calculations, 164
global warming, 213
goals
  daylighting, 157–159, 158–159
  energy modeling, 181–183, 182
  identifying, 63
  integrated design teams, 63
  orientation in, 135, 135
  water harvesting, 168–169
Gold Standard system, 125
Gore, Al, 56–57
grass, 102
graywater
  reuse, 168
  in water harvesting, 173–175, 174
Green Building Challenge (GBC), 18
Green Building Initiative (GBI), 19
Green Building movement, 5–6
Green Building Research page, 14
Green Building Studio (GBS) service, 189–190, 189–190, 192
green buildings
  defining, 9–10
  funding, 218–219
  rating systems, 16–23, 17, 21
Green-E Certified program, 124
Green Glazing, 149
Green Globes system, 19–20
“Green in America”, 57
Green Schools Program, 219
Greenbuild conference, 8
greenhouse gas emissions, 15
Greensburg, Kansas
   LEEDS certification, 23
   rebuilding, 88–89, 88–89
   grids in daylighting, 162, 163
   “Guide to Daylighting”, 113

H
Habitat for Humanity, 114
Habitat Restore retail outlets, 114
Happiness over Time curve, 44, 44
Hathaway, Hargreaves, Thompson and Novitsky, 153
Hawley Peterson & Snyder Architects, 11
heat from sun, 107
heat pumps, 117
heating
   efficiency, 116
   load charts, 92, 92, 94, 94
   water, 119, 193
heating, ventilation, and air-conditioning
   (HVAC) systems, 5, 129
heating degree days (HDD), 83, 83
Heifer International Center
   daylighting, 158, 159
   GMP process, 70–71, 70
   natural ventilation cooling, 105
   water treatment, 168
Heschong Mahone Group, 154
holistic view in water runoff strategy, 67
Hoover Dam, 166, 166
hot-water heaters, 119, 193
HVAC (heating, ventilation, and air-conditioning) systems, 5, 129
hydro power
   location requirements, 194
   negative impacts, 196
   percentage, 122

I
IES <VE> energy analysis tool, 188–189, 189
IFC (Industry Foundation Classes), 131
IISBE (International Initiative for a Sustainable Built Environment), 18
illuminance, 151, 164
Illuminating Engineering Society of North America, 157
Imperative teach-in, 214
“Inconvenient Truth, An” (Gore), 56–57
Indoor Environmental Quality (IEQ) Credit 8.1, 157, 164
Industrial Revolution, 3
Industry Foundation Classes (IFC), 131
insolation data, 79, 81
insulation
   building envelope, 149–150, 150
   regional, 150, 150
integrated design model
   components, 37, 37
   Lewis and Clark State Office Building, 69
integrated design teams, 53
   benefits, 55–58, 55
   collaboration, 60–63, 62
   commitment, 63–64
   construction delivery methods, 67–73
   members, 58–60, 61
   Montana State University Epicenter, 59
   passion, 64
   process integration, 64–65
   responsibility shifts, 54–55, 54
   workshops, 65–67
integrated documents, 38
Integrated Environmental Solutions Virtual Environment, 160
Integrated Part Load Value (IPLV), 117
integration, 57
   carbon accounting, 222–223
   process, 64–65
   tools for, 211–212, 211–212
Integrative Design Collaborative, 12
interactivity with weather data, 224–225, 224–225
interdependence, 57
internal lightshelves, 161
International Glazing Database, 222
International Initiative for a Sustainable Built Environment (IISBE), 18
interoperability of software packages, 220
Iowa Association of Municipal Utilities (IAMU)
native plantings, 103, 103
Office Building and Training Complex, 214–215, 215
IPLV (Integrated Part Load Value), 117
irrigation systems
  high-efficiency, 119
  rainwater collection for, 106
iterative processes, 46

J
Japan Sustainable Building Consortium (JSBC), 17
John Todd Ecological Design, Inc., 168, 216

K
Kahn, Louis, 25, 165
Kats, Greg, 15
Kay, Alan, 1
Keen Engineering, 11, 22
knowledge sharing, 61–62

L
Laiserin, Jerry, 209
Lake/Flato Architects, 98
Lake Lanier, 166
Lake Mead, 166, 166
  landscaping
    materials, 102–103, 103
    water for, 166
    for water harvesting, 171
Langdon, Davis, 15
Las Vegas valley, 166
latitude and longitude in climate, 78–79
Lawrence Berkeley National Laboratory (LBNL)
  daylighting, 113
  Radiance engine, 160
layers of design, 29–30, 29, 55, 55
LBC (Living Building Challenge), 23, 215
LCA (lifecycle assessment), 20
LCD (Liquid Crystal Display) screens, 121
lean construction, 73
LEED (Leadership in Energy and Environmental Design), 12
daylighting credits, 164, 164
energy baselines, 182
lifecycle analyses, 213
Pilot project, 59
rating system, 8, 14–15, 20–23, 21
water efficiency credits, 168
levels in daylighting, 156
Lewis and Clark State Office Building
  BIM model, 47–51, 47–50
certification, 213
daylighting, 110
design-bid-build process, 68–69, 68
energy-savings goals, 183
rainwater collection, 106
Libby-Owens-Ford, 79
“Life Cycle Inventory of Portland Cement Concrete”, 97
lifecycle analyses, 213
lifecycle assessment (LCA), 20
light from sun, 107
light shelves, 156, 161
Light to Solar Gain Ratio (LSG), 149
lighting
daylighting. See daylighting
efficiency, 116
electric, 119–120
lights, 119–120
Liquid Crystal Display (LCD) screens, 121
Living Building Challenge (LBC), 23, 215
Living Buildings, 12, 23–24, 24
Living Site and Infrastructure Challenge, 215
local materials, 114
local resources. See free/local resources and natural systems
locally produced materials, 204
location factors, 90–91
  building envelope, 148
  climate, 78–79
daylighting, 157
ergy modeling, 186, 186
massing, 141–142, 142
materials, 114, 201–203
overview, 76–78
renewable energy, 193–194, 195
water harvesting, 169–170, 170
Loftness, Vivian, 218
longitude and latitude in declination, 137, 137–138
loose insulation fills, 149
Los Altos Project, 11
losses
boilers and furnaces, 118
in renewable energy analysis, 199
Love Canal, 6
low-flush toilets, 102
LSG (Light to Solar Gain Ratio), 149
luminance, 153

M
MacMath, Rich, 202
magnetic declination, 79, 137, 137–138
maintenance
in energy modeling, 181
water-use equipment, 168
man-made efficient systems, 115
electric lighting, 119–120
equipment, 120–121
mechanical, 115–118, 116–118
plumbing, 119
massing
BIM for, 143–147, 144–146
building, 139
building envelopes, 148–150, 150–151
building form analysis, 147–148, 147
climate, culture, and place, 141–142, 142
resource needs reduction, 143
master-builders, 54
materials
BIM database, 39–40, 39
construction use statistics, 30, 30
in daylighting, 156
free resources, 114, 115
Heifer International Center, 71
landscaping, 102–103, 103
resource consumption needs, 96–98, 97–98
sustainable. See sustainable materials
USG website for, 222
McCownGordon Construction, 71–72
McDonough, Bill, 12
McLennan, F. Jason, 23–24, 215
mechanical efficient systems, 115–118, 116–118
mechanical, electrical, and plumbing (MEP) integration, 72–73
migrating to BIM, 43–45, 43–44
Missouri Botanical Gardens, 108
Missouri Department of Natural Resources (MoDNR), 68
models
BIM. See building information modeling (BIM) and methods
energy. See energy modeling
moisture data, 83
moisture sensors, 119
Montana State University Epicenter project, 24, 59
monthly data
rainfall, 83–84, 84
temperature, 82, 82
Montreal Protocol, 6
mutual respect in integrated design teams, 61

N
National Climatic Data Center, 85
National Construction Employment Cost Index, 31, 31
National Geophysical Data Center’s (NGDC) website, 137
National Institute of Standards and Technology, 59
National Renewable Energy Laboratory, 84
National Resource Council Canada, 160
National Wilderness Preservation System, 5
Native Americans, 2
natural daylight. See daylighting
natural gas heating, 118
Natural Resources Canada, 18
natural systems. See free/local resources and natural systems
Natural Systems International, 216
natural ventilation
orientation for, 133
wind, 103–105
needs reductions
efficiency, 98–100
energy modeling, 180–181
massing, 143
materials, 96–98
orientation, 134–135
renewable energy, 195–196
water, 101–103
negative impacts
offsetting, 125–126
renewable energy, 195–196
sustainable materials, 203–204
negotiated guaranteed maximum price delivery method, 69–71
Nelson, Arthur C., 56
Nelson, Gaylord, 5
net zero results, 125
neutral results, 125
Nevada water supply, 166
NGDC (National Geophysical Data Center’s) website, 137
Nicklas, Michael H., “Student Performance in Daylit Schools”, 154
Nixon, Richard, 5
Norris, Greg, 202

occupancy in graywater models, 174
offsetting negative impacts, 125–126
oil spills, 6
Omega Institute Center for Sustainable Living
design, 216–218
Living Building Challenge, 215
water treatment, 168
on-demand water heating units, 119
On the Boards Award, 215
online data for water harvesting, 169
operable windows, 104
operations
negative impact offsets, 125–126
water-use equipment, 168
Oppenheim Lewis, 11
opportunities
for change, 219–220
future, 225–226
order of operations in sustainable solutions, 76
building type, 91–96
climate. See climate factors
culture, 76–78
energy, 98–100
materials, 96–98
space, 96
water, 101–103
organizational culture, massing, 87
orientation, 131–132
BIM model, 136–137
and building type, 139–140
climate impact, 132–134
daylighting, 110–111
energy efficiency, 99
project goals, 135
resource needs reductions, 134–135
sun angles, 80
“Our Common Future”, 10
output data for photovoltaic systems, 199
Owens Corning, 150
owners in integrated design teams, 59, 63–64
ozone hole, 6

P
Packard Foundation, 11
parameters and parametric modeling
BIM model, 143–145, 144–146
future, 210, 225
sustainable materials, 205, 205–206
parcel surveys for water harvesting, 169
partnering in Lewis and Clark State Office
Building, 69
passion in integrated design teams, 64
passive heating, 141
people, sustainability importance to, 10, 11, 13–14
Perez sky model, 160
perimeter walls in daylighting, 155
permeable paving systems, 71
Pervious paving, 108
photovoltaic (PV) systems
analysis, 198–200, 199
location factors, 79, 193
renewable energy systems, 122–124, 123
physical design model, 47, 47
Pilkington Sun Angle Calculator, 79
place factors. See location factors
planet, sustainability importance to, 10, 11, 14–15
plants, 86–87, 87
Platinum Certified buildings, 213–214
plumbing
efficient systems, 119
graywater models, 174, 174
point of temporary diminishing returns, 44
Polk Stanley Rowland Curzon Porter
Architects, 70
Portland cement, 97–98, 204–207, 206
postconstruction resources, 42, 42
postoccupancy management, 40
potable water consumed
in buildings, 57
reduction, 101–102
predesign stage
renewable energy, 196–197
workshops, 65–66
process integration, 64–65
project goals. See goals
prosperity, sustainability importance to, 10, 11, 15–16
psychometric charts, 84–85, 85, 105
Pueblo peoples, 2
pumping systems, 107

Q
Quick Energy Simulation Tool (eQUEST),
189, 189

R
R-values, 149
Radiance engine, 160
rainfall data, 83–84, 84
rainwater
as free resource, 106–107, 106–109
harvesting. See water and water harvesting
Heifer International Center, 71
in massing, 141
raised floor air distribution, 116, 116
ranges of BIM, 51–52, 52
rating systems, green buildings, 16
BREEAM, 18–19
CASBEE, 17, 17
Green Globes, 19–20
LEED, 20–23, 21
SBTool, 18
Rauch, Emily M., “Sustainable Building
Rating Systems Summary”, 16
raw materials, 57
reclaimed materials, 204
recycled materials, 40, 204
reductions, needs. See needs reductions
redundancy vs. efficiency, 35
reflectance values, 156
regional insulation, 150, 150
relative humidity, 83
Renaissance architects, 54
renewable energy, 193
analysis, 198–200, 199
BIM model, 196–198, 197–198
climate and location factors, 193–194, 195
efficient man-man systems, 121–124, 122–124
needs reductions, 195–196
optimizing, 200
wind, 103
renewable energy certificates (RECs), 124
resource consumption needs, 96
energy, 98–100, 99–100
Lewis and Clark State Office Building, 69
materials, 96–98, 97–98
reductions. See needs reductions
space, 96
water, 101–103, 101–103
responsibilities in integrated design teams, 54–55, 54
retail sales, daylighting effects on, 154
Revit Architecture
energy modeling, 186–187, 187–188
shading devices, 81, 81
rigid insulations, 149–150
roof area
calculations, 223, 223
renewable energy analysis, 198
water harvesting, 172–173, 173
room volumes in energy modeling, 186–187, 187–188
Rose Bowl Stadium, 102

S
salvaged materials
Anita B. Gorman Conservation Discovery Center, 114, 115
C.K. Choi Center for Asian Research, 101
Heifer International Center, 71
transport savings, 103
SBC (Sustainable Building Challenge), 18
SBIC (Sustainable Buildings Industry Council), 84
SBSE (Society of Building Science Educators), 79
SBTool, 18
schedules
graywater models, 174, 174
sustainable materials, 205, 205
schematic design
renewable energy, 197
workshops, 66
schools
culture, 88–89, 88–89
daylighting effects on, 153–154
Green Schools Program, 219
Scientific Advisory Group on the Environment (SAGE), 6
seasons, 79
set point temperatures, 100, 100
shading devices
in daylighting, 156, 156, 161
in energy modeling, 51, 191, 191–192
for glazing, 111–113, 112–113
tools for, 81, 81
shelves in daylighting, 156, 161
SHGC (Solar Heat Gain Coefficient), 149–150
shipping materials, 114
Silent Spring (Carson), 5, 14
simulations in energy modeling, 181, 184
single-source model, 32
site factors for water harvesting, 171
“Skylighting and Retail Sales: An Investigation into the Relationship Between Daylight”, 154
social indicators in Gold Standard system, 126
Society of Building Science Educators (SBSE), 79
software package interoperability, 220
solar factors, 40
BIM analysis, 47, 48
photovoltaic systems
analysis, 198–200, 199
location factors, 79, 193
renewable energy systems, 122–124, 123
solar south
in climate impact, 133–134
in daylighting, 110–111, 155
finding, 136–137, 136–138
for sun angle, 79–80
solar heat gain coefficient (SHGC), 111
solar hot-water heaters, 193
solar time, 79
Solarban 70XL glazing, 150
sorting in BIM, 51
southern orientation
building mass, 99
in climate impact, 133–134
in daylighting, 110–111, 155
finding, 136–137, 136–138
for sun angle, 79–80
space resource consumption, 96, 116
Spearville wind farm, 126
specialization, 58
Spectrally Selective Glazing, 149
spreadsheets for water analysis, 169
St. Basil’s Cathedral, 3
St. Peter’s Basilica, 3, 3
stack ventilation, 104
stakeholders
integrated design teams, 59
predesign workshops, 65
steel contractor savings, 72
Stepping Stone Award, 215
stormwater
infiltration, 71
runoff strategies, 67
strip malls, 91
“Student Performance in Daylit Schools” (Nicklas and Bailey), 154
“Study into the Effects of Light on Children of Elementary School Age: A Case of Daylight Robbery”, 153–154
sun
angles, 79
in climate data, 79–81, 80–81
for daylighting. See daylighting as free resource, 107, 110–113, 110, 112–113
and orientation, 131
in renewable energy analysis, 198
western, 224
Sunset Drive Office Building, 71–73, 72
sunshading devices
in daylighting, 156, 156, 161
in energy modeling, 51, 191, 191–192
for glazing, 111–113, 112–113
tools for, 81, 81
sustainability, 2
BIM strategies, 40
defining, 9–12, 11
future, 212–218, 213–218
green building rating systems, 16–23, 17, 21
history, 2–6, 2–4
importance, 13–16
living buildings, 23–24, 24
order of operations. See order of operations in sustainable solutions
trends, 6–9, 7, 9
Sustainability Matrix, 11
Sustainability Report, 11
Sustainable Building Challenge (SBC), 18
“Sustainable Building Rating Systems Summary” (Fowler and Rauch), 16
Sustainable Buildings Industry Council (SBIC), 84
Sustainable By Design, 79
sustainable materials, 200–201
baselines, 204
BIM model, 204–208, 205–207
climate, culture, and place, 201–203
needs reduction, 203–204
optimizing, 208
system coordination, virtual models for, 212
T
Taj Mahal, 102
tall windows, 155
Target Finder baseline, 181–182, 182
teams, design. See integrated design teams
temperature
data, 81–83, 82–83
in daylighting, 157
Texas Guide to Rainwater Harvesting, 106
thermal efficiency of boilers and furnaces, 118, 118
thermal resistance, 94
3D energy model, 49, 49
3D simulation vs. 2D representation, 34
three-dimensional virtual models, 211–212
3ds Max application, 160
Three Mile Island nuclear incident, 6
Thule area, 2
Tipping Mar + associates, 216
TMY2 data, 160
toilets
composting, 101
efficient, 119
low-flush, 102
rainwater collection for, 106
Top Ten Award, 70
Top Ten Green Projects program, 6–7
“Toward a New Metropolis: The Opportunity to Rebuild America” (Nelson), 56
Trajectory of Environmentally Responsive Design, 12
treatment of water, 168
Turf Bottom Line accounting, 10
turf grass, 102

U
U-value measure, 111, 149–150
UN General Assembly, 10
Underfloor Air Distribution (UFAD), 116, 116
University of British Columbia-Vancouver (UBC), 101
University of Texas Health Science Center at Houston (UTHSCH)
BaseLineGreen tool, 202
external shading, 112–113, 112–113
materials, 96, 98, 98
orientation, 139
rainwater collection, 106, 106
Top Ten Green Projects, 7, 7
urinals
efficient, 119
water-free, 102
U.S. Green Building Council (USGBC), 6, 57
growth, 8–9
LEED. See LEED (Leadership in Energy and Environmental Design) studies, 14
wall and ceiling materials data, 222
U.S. Solar Radiation Resource Map site, 198, 199
useful daylight illuminance, 164

V
ventilation
natural, 133, 133
wind, 103–105, 104
virtual models, 211–212
visible light transmittance (VLT), 111, 149–150
visual acuity, 153

W
Wainwright Building, 4, 4
walls
BIM, 39, 39
climate factors, 148
in daylighting, 155
materials, 222
Ward, Greg, 160
Washington, D.C. LEEDS certification, 23
water and water harvesting, 166–168
baselines and goals, 168–169
BIM, 40, 170, 170, 172–177, 173–176
building load factors, 175, 175
capture potential, 176–177, 176
climatic impacts, 167
conservation programs, 166
graywater, 173–175, 174
heating units, 119
Heifer International Center, 71
location factors, 169–170, 170
for materials, 96
needs
analysis, 175–176, 176
optimizing, 178
rainfall factors, 170, 170
roof areas, 172–173, 173
runoff strategies, 67
site factors, 171
treatment onsite, 168
Water Efficiency Credits 3.1 and 3.2, 168
water-free urinals, 102
weather. See climate factors
Weather Maker tool, 84
Weatherbase site, 82–83, 85
wetlands, 107, 109, 171
White, E. B., 75
Wilderness Act, 5
William McDonough + Partners, 24
wind
charts, 105
data, 85–86, 86
as free resource, 103–106, 103
for renewable energy, 122, 124, 193, 196
Wind Powering America site, 193
window-to-wall ratio, 223, 224
windows
daylighting, 155
natural ventilation cooling, 104, 104
“Windows and Classrooms: A Study of Student Performance and the Indoor Environment”, 154
wood decking, 114, 115
worker performance, daylighting effects on, 154–155
workflow, 46
workshops for integrated design teams, 65–67
World Commission on the Environment and Development, 10
WorldClimate website, 170, 170
Wright, Frank Lloyd, 127
xeriscaping, 166
XML schema, 185–187
Zimmer Real Estate Services, 124