## INDEX

### A
- Acoustics, 115–118
- Acoustic comfort, 8–9, 115–118
- Active energy-generation systems, 149–153.
  See also Photovoltaic (PV) glass; Photovoltaic (PV) panels
- Advanced facade materials, 122–126
- Aerogels, 25, 52, 124, 125
- Air barriers, 67, 119
- Air cavity:
  - brick veneer facades, 40, 41
  - Case Western Tinkham Veale University Center, 146
  - double-skin facades, 135, 137, 141–148
  - rainscreen facades, 47, 48
- Airflow, 42, 66–67, 135, 137, 140, 144
- Air infiltration, 93, 118–119
- Air-insulated glazing units, 92–93, 175
- Air leakage, 18, 67, 93
- Air movement, thermal comfort and, 86, 93, 94
- Air pollution:
  - ETFE and, 122
  - indoor air quality, 118
  - self-cleaning materials, 128, 129
- Air quality, 118–119, 216
- Alternative energy, facades as source of, 149–153
- Aluminum curtain-wall system:
  - Bigelow Laboratory for Ocean Sciences, 225
  - Center for Urban Waters, 174
  - King Abdullah Financial District Parcel 4.01 Building, 193
  - King Abdullah Financial District Parcel 4.10 Building, 202–205
  - Princess Nora Bint Abdulrahman University for Women Academic Colleges, 132
- Aluminum mullions, 50, 57, 223
- Ambient sounds, 115, 116
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
  - building performance metrics, 11
  - climate classification system, 6–8
  - Energy Standard for Buildings except Low-Rise Residential Buildings, 10–11
  - hygrothermal analysis guidelines, 75
  - OITC recommendations, 116
  - R-value recommendations, 11–12
  - SHGC recommendations, 13–14
  - thermal comfort measurement, 87–89
  - U-value recommendations, 12–13
- Amorphous silicon PV cells, 150
- Amorphous thin PV films, 130
- Anidolic lighting, 101
- Argon-gas-filled IGUs, 52, 59, 80
  - Bigelow Laboratory for Ocean Sciences, 223, 225
  - King Abdullah Financial District Parcel 4.01 Building, 194
  - Arizona State University Science & Technology Building (Tempe, Arizona), 159–167, 231
- ASTM standards:
  - acoustic comfort, 116
  - air barriers, 67
  - air leakage, 67
  - vapor barriers, 68
- Atriums, 212, 215
- Axial fans, 146–148
- Batt insulation, 55, 56, 58, 181, 183
- Bigelow Laboratory for Ocean Sciences (East Boothbay, Maine), 218–226, 234
- Box window double-skin facades, 136–138
- Brick cavity walls, 39–41
- Brick ties, 57, 58, 70
- Brick veneer facades:
  - dew-point analysis, 70–73
  - elements of, 40
  - hygrothermal analysis, 77–78
  - R-values, 55–56
- Building orientation, see Orientation
- Case Western Tinkham Veale University Center (Cleveland, Ohio), 145–148, 230–231
- Cast-in-place concrete, 41, 65, 160
- Centers for Disease Control and Prevention, National Center for Environmental Health (Atlanta, Georgia), 107–109, 229
- Center for the Built Environment (CBE), 89–91
- Center for Urban Waters (Tacoma, Washington), 167–177, 231–232
- Ceramic frit:
  - back-coated glass, 53
  - Center for Urban Waters, 174
  - components, 52
  - King Abdullah Financial District Parcel 4.01 Building, 193
  - King Abdullah Financial District Parcel 4.10 Building, 210
  - Kuwait University College of Education, 182
  - University of Texas Dallas Student Services Building, 216
- Channel glass, 124
- CIE (International Commission on Illumination), 109
- Circadian rhythms and daylight, 95
- Cladding:
  - aerogel inserts, 124
  - concrete facades, 41
embodied energy of, 65–66
rainscreen facades, 47, 48
Clerestory windows, 170
Climates, 2–14
classification systems, 3–8
defined, 3
Climate-specific design:
design strategies, 9–14
environmental considerations and design
criteria, 8–9
guidelines for facades, 8–14
CMU wall, see Concrete masonry unit wall
Coatings, glass, 52. see also Frit/fritted glass;
Low-emissivity coatings
Comfort, designing for, 86–119
acoustic comfort, 115–118
air quality, 118–119
daylight and glare, 95–115
thermal comfort, 86–94
Composite wood panels, 168, 223, 225, 226
Concrete:
cast-in-place, 41, 65, 160
glass-fiber-reinforced, 132–135, 182, 183, 185
insulating concrete blocks, 41
insulating concrete forms, 41
precast panels, 18, 24, 41–47, 63, 65, 66
self-cleaning, 129
thin-shell precast panels, 44–45
Concrete facades, 41–42
Concrete masonry unit (CMU) wall, 40, 41, 55, 56, 65
Condensation, 68, 77
Control systems, 153–154
Corridor double-skin facades, 136, 137
Courtyards, 23, 160, 179
Curtain walls:
Bigelow Laboratory for Ocean Sciences, 222, 224, 225
Center for Urban Waters, 168, 174, 175
daylighting, 103–105, 107
defined, 48
external shading elements, 211–217
Expanded polystyrene insulation, 41, 55, 56, 70, 75
External shading elements, 211–217

D
Daylight:
Arizona State University Science &
Technology Building, 164
Bigelow Laboratory for Ocean Sciences, 220
and facade design strategies, 8, 10
and glare, 111
Kuwait University College of Education, 179
University of Texas Dallas Student
Services Building, 212
Daylight harvesting, 164, 195, 212
Daylighting:
Bigelow Laboratory for Ocean Sciences, 220
Center for Urban Waters, 168
design strategies, 95–109
King Abdullah Financial District Parcel
4.10 Building, 201
and orientation, 22
Daylight simulations, 166, 184
Daylight studies, 43
Desiccated air space, 51
Design guidelines, climate-specific, 8–14
Dew point, 69, 77, 78
Dew-point analysis, 69–73
Dew-point temperature, 68, 69
Diffusion (vapor), 67
Double glazing, 51, 117, 175, 194
Double-skin facades, 135–148
Case Western Tinkham Veale University
Center, 145–148
in cold climates, 143–148
elements of, 135–140
in hot and arid climates, 141–142
peak energy load, 147, 148

E
Electrochromic glass, 126, 127
Embodied energy, 62–66
Emerging technologies, 122–155
advanced facade materials, 122–126
control systems for facades, 153–154
double-skin facades, 135–148
facades as energy generators, 149–153
smart materials, 126–131
Energy codes, 10–11. See also ASHRAE 90.1
energy standard
Energy conservation, xiii, 98
Energy demand, 143–144
Energy efficiency, 18–39
fenestration, 24–37
orientation of structure for, 19–22
University of Texas Dallas Student
Services Building, 212
Energy generators, facades as, 65, 130, 131, 149–153
Energy performance modeling, 8
Energy Standard for Buildings except Low-Rise
Residential Buildings, 10–11
Environmental Health Laboratory Building
(CDC), 107–109, 229
ETFE (ethylene tetrafluoroethylene), 122–123
Exhaust air-curtain flow in double-skin
facades, 146
Expanded polystyrene insulation, 41, 55, 56, 70, 75
Exterior shading elements, 211–217

F
Facades, functions of, xiii, 8
Fans, 144, 146–148
Fenestration, energy-efficient, 24–37
Fins:
Arizona State University Science &
Technology Building, 160, 166
for energy consumption reduction, 61
horizontal, 98
King Abdullah Financial District Parcel
4.01 Building, 193, 194, 197
King Abdullah Financial District Parcel
4.10 Building, 203, 204, 206
Kuwait University College of Education, 182–184
and light shelves, 98
and orientation constraints, 22
Foam insulation, 44, 55, 56, 220, 223, 225, 226
Framing:
brick cavity walls, 40
brick veneer facades, 40, 55
design strategies, 11–13
dew-point analysis, 71
embodied energy of, 65–66
hygrothermal analysis, 75
importance of design, 25
King Abdullah Financial District Parcel 4.01 Building, 193
opaque facades, 18
precast concrete panels, 42
pressure-equalized rainscreens, 47
R-values for brick veneer, 55–57
U-value reduction, 59
Fraunhofer Institute for Building Physics (IBP), 74
Frit/fritted glass:
back-coated glass, 53
Center for Urban Waters, 174–176
components, 52
daylighting, 103–105, 107
ETFE membrane, 123, 124
King Abdullah Financial District Parcel 4.01 Building, 193–195
King Abdullah Financial District Parcel 4.10 Building, 203, 209
Kuwait University College of Education, 182
solar heat gain reduction, 25, 61, 62

GFRC, see Glass-fiber-reinforced concrete
Glare, 109
Glare reduction, 109–115, 182, 184
Glass, see glazing entries, e.g.: Insulated glazing units (IGUs); specific types of glass, e.g.: Laminated glass
Glass, surface temperature of, 91–94
Glass-fiber-reinforced concrete (GFRC), 132–135, 182, 183, 185
Glazed facades:
acoustic performance, 117–118
defined, 18
heat transfer analysis, 79–83
materials, 48–54
origins, 18
R-values, 58–59
thermal bridging, 58
U-values, 59–60
Glazing:
aerogel inserts, 124
Center for Urban Waters, 167
curtain wall thermal performance, 51
double-skin facades, 137, 142, 144
Kuwait University College of Education, 183
materials for, 92–94, 101
and thermal comfort, 92, 93
Glazing units, see Insulated glazing units
Green Building Council LEED certification, see LEED Gold certification; LEED Platinum certification
Gypsum board, 55, 56, 65–66, 71

H
Heat transfer, 66–69, 182
Heat transfer analysis, 79–83
Heat transfer coefficient (U-value):
ASHRAE recommendations, 12–13
Bigelow Laboratory for Ocean Sciences, 223, 225
for curtain walls, 59–60
defined, 11
for glazed facades, 59–60
King Abdullah Financial District Parcel 4.01 Building, 194
for triple-insulated glazing unites, 129
vacuum-insulated glazing units, 124
Hector Garcia Middle School (Dallas, Texas), 38–39, 228–229
High-performance sustainable facades, 2
Human body:
light’s effect on, 95, 97
and thermal comfort, 86, 87, 89
HVAC systems:
and air quality, 118
and daylighting strategies, 95, 96
and intelligent systems, 154
and interior air pressure, 93
and self-shading exterior skin, 182
and solar air heating, 149
and thermal comfort, 86, 89, 93
Hybrid ventilation, 141, 146
Hygrothermal analysis, 74–79

I
IAQ (indoor air quality), 118
IBP (Fraunhofer Institute for Building Physics), 74
ICBs (insulating concrete blocks), 41
ICFs (insulating concrete forms), 41
IECC (International Energy Conservation Code), 6–8
IESNA (Illuminating Engineering Society of North America), 96, 109
IGUs, see Insulated glazing units
IIC (impact insulation class), 116
Inclination angle, for PV cell efficiency, 150–152
Indoor air quality (IAQ), 118
Inert gases, 25, 59, 129
Inorganic phase-change materials, 129
Insulated glazing units (IGUs):
aerogel vs. vacuum insulation, 131
Bigelow Laboratory for Ocean Sciences, 223, 225
Center for Urban Waters, 175
curtain wall thermal performance, 51–52
glass property calculation with WINDOW software, 81
King Abdullah Financial District Parcel 4.01 Building, 194
King Abdullah Financial District Parcel 4.10 Building, 203, 204
Kuwait University College of Education, 182
low-e coatings for, see Low-emissivity coatings
phase-changing materials for, see Low-emissivity coatings
U-values for, 59–60
vacuum-insulated, 124–125, 131
Insulating concrete blocks (ICBs), 41
Insulating concrete forms (ICFs), 41
Insulation. See also specific types, e.g.: Batt insulation
glazed facades, 51–54
opaque facades, 40–42
R-values, 12
U-values, 25
Intelligent facades, 153–154
Interdisciplinary Science & Technology Building, Arizona State University (Tempe, Arizona), 159–167, 231
International Building Code, 116
International Commission on Illumination (CIE), 109
International Energy Conservation Code (IECC), 6–8

K
Kendall Academic Support Center, Miami Dade College (Miami, Florida), 42–46, 229
King Abdullah Financial District Parcel 4.01 Building (Riyadh, Saudi Arabia), 186–199, 233
King Abdullah Financial District Parcel 4.10 Building (Riyadh, Saudi Arabia), 200–209, 233
Koppen Climate Classification System, 3–5
Kuwait University College of Education (Shadadiyah, Kuwait), 178–186, 232

L
Laminated glass, 117, 126–128, 130, 131, 182
Landscaping, 168
Latitude, PV cell efficiency and, 150–151
Lawrence Berkeley National Laboratory, 97
LEED Gold certification:
  Arizona State University Science & Technology Building, 167
  Bigelow Laboratory for Ocean Sciences, 226
  Kuwait University College of Education, 186
LEED Platinum certification:
  Center for Urban Waters, 177
  University of Texas Dallas Student Services Building, 216
Life-cycle assessment, 62, 138
Lighting, see Daylight; Daylighting
Light shelves:
  Center for Urban Waters, 170, 173, 174
daylighting strategies, 101–103, 107, 110 defined, 98
  summer vs. winter performance of, 101
Light-to-solar gain (LSG) ratio, 22, 60, 61
LIM (Lowest Isopleth for Mold), 79
Liquid crystals, 126–128
Louvers:
  Arizona State University Science & Technology Building, 160, 166
  CDC Environmental Health Laboratory Building, 107, 108
daylighting strategies, 103
  in spandrels, 54
University of Texas Dallas Student Services Building, 214
Low-emissivity coatings:
  advanced glazing materials vs., 131
  Arizona State University Science & Technology Building, 164
  Center for Urban Waters, 175
  and daylighting strategies, 103
  for double-skin facades, 141–143
effects on energy consumption, 62
  King Abdullah Financial District Parcel 4.01 Building, 194
  King Abdullah Financial District Parcel 4.10 Building, 203, 204
  Kuwait University College of Education, 182
  light-to-solar-gain ratios for, 60, 61
  and thermal comfort, 92–93
U-values for, 59–60
for vacuum-insulated glazing units, 124
WINDOW software for evaluation of, 80–81
Lowest Isopleth for Mold (LIM), 79
LSG (light-to-solar-gain) ratio, 22, 60, 61
M
Materials, 40–66
  advanced, 122–126
  Bigelow Laboratory for Ocean Sciences, 218–226
  embodied energy of, 62–66
  glazed building facades, 48–54
  opaque building facades, 40–42, 46–49
  properties, 54–66
  smart materials, 126–131
Mean radiant temperature, 86, 87
Mechanical ventilation:
  Case Western Tinkham Veale University Center, 146
  Center for Urban Waters, 168
double-skin facades, 135–139, 141
  and thermal comfort, 89
Moisture resistance, 66–83
Mold, 67, 68, 74, 79, 118
Monocrystalline silicon PV cells, 150
Mullions:
  Bigelow Laboratory for Ocean Sciences, 223
curtain walls, 49–53
  King Abdullah Financial District Parcel 4.01 Building, 193
  shading strategies, 62
  thermal bridging, 57
O
National Fenestration Rating Council (NFRC), 59, 80
Natural light, see Daylight; Daylighting
Natural ventilation:
  and acoustic performance, 118
  Center for Urban Waters, 167, 168, 171
  and design strategy, 10
  for energy-efficient facades, 18
  Kuwait University College of Education, 182
  and thermal comfort, 88, 89
NFRC (National Fenestration Rating Council), 59, 80
Noise, 115–118
OITC (Outdoor-Indoor Transmission Class), 116–118
Opaque facades:
  acoustic performance improvement, 117
  Bigelow Laboratory for Ocean Sciences, 220
defined, 18
  hygrothermal analysis for, 74–79
  materials, 40–49
R-values for, 54–55
  steady state heat and moisture transfer analysis, 69–73
  Vincent Triggs Elementary School, 24
Organic phase-change materials, 129
Orientation:
  Arizona State University Science & Technology Building, 159–167
  Bigelow Laboratory for Ocean Sciences, 220
  Center for Urban Waters, 167–177
  and daylighting, 97
  for energy efficiency, 19–22
  Hector Garcia Middle School, 38–39
  King Abdullah Financial District Parcel 4.01 Building, 188–189, 194
  King Abdullah Financial District Parcel 4.10 Building, 201
  Kuwait University College of Education, 179
  for PV cell efficiency, 150
  Vincent Triggs Elementary School, 23
Outdoor-Indoor Transmission Class (OITC), 116–118

P
Panels, see specific type of panels, e.g.:
  Precast concrete panels
Passive design:
  for air circulation in hot and arid climates, 141
  Arizona State University Science & Technology Building, 159, 160, 167
  Bigelow Laboratory for Ocean Sciences, 220
  Center for Urban Waters, 168, 171
  King Abdullah Financial District Parcel 4.01 Building, 186, 194, 199
  Vincent Triggs Elementary School, 22
Passive solar energy/solar heating:
  Bigelow Laboratory for Ocean Sciences, 218, 220
  Center for Urban Waters, 170, 171
  defined, 149
  facade design strategies, 10
  light-to-solar gain ratio, 22
  and orientation, 19, 22
  solar air heating curtain walls, 149
  solar dynamic buffer zone curtain walls, 149
PER (pressure-equalized rainscreen), 47, 48
Permeance, 68
Phase-change materials (PCMs), 129–130
Photocatalysts, 128, 129
Photovoltaic (PV) glass, 130, 131
Photovoltaic (PV) panels, 64, 149–152
PMV (Predicted Mean Vote), 87, 91
Pollutants, airborne, 118, 122, 128, 129
Polycrystalline silicon PV cells, 150
PPD (Predicted Percentage of Dissatisfied), 87–88
Precast concrete panels, 41–47
embraced energy, 63, 65, 66
Kendall Academic Support Center, Miami Dade College, 42–46
for opaque facades, 18, 24
Predicted Mean Vote (PMV), 87, 91
Predicted Percentage of Dissatisfied (PPD), 87–88
Pressure-equalized rainscreen (PER), 47, 48
Princess Nora Bint Abdulrahman University for Women Academic Colleges (Riyadh, Saudi Arabia), 132–135, 230
Punched windows, 24, 38, 168, 220
PV (photovoltaic) glass, 130, 131
PV (photovoltaic) panels, 64, 149–152
Radiance (lighting simulation software), 97, 98, 109
Radiant temperature, 86, 87
Rainscreen facades, 46–49, 168, 174–176, 203, 205, 207

R
Relative humidity (RH):
defined, 67, 86
dew-point analysis, 69–71
in heat transfer analysis, 81
in hygrothermal analysis, 74, 76, 77
and isopleths for mold, 79
and thermal comfort, 8, 9, 86–87
and weather patterns, 8
Retrofit projects, vacuum-insulated glazing units for, 125
R-value, see Thermal resistance

S
Salts, 129, 220
SDBZ (solar dynamic buffer zone) curtain walls, 149
Self-cleaning glass, 128–129
Self-healing materials, 131
Shading:
Arizona State University Science & Technology Building, 160, 166
Bigelow Laboratory for Ocean Sciences, 221
Center for Urban Waters, 168, 174, 175
double-skin facades, 137, 141–142
ETFE and, 123
external shading elements, 211–217
King Abdullah Financial District Parcel 4.01 Building, 189, 193
King Abdullah Financial District Parcel 4.10 Building, 203, 204
Kuwait University College of Education, 181–185
and solar heat gain, 61–62
and thermal comfort, 94
University of Texas Dallas Student Services Building, 212–214, 216
Shadow boxes, 53, 203, 204
Shaft box double-skin facades, 136, 138
SHGC, see Solar heat gain coefficient
Silica aerogel, 52, 124
Silicon PV cells, 150
Single glazing, 51, 117, 137
Single-skin facades, 135, 141, 143, 144, 148
Smart materials, 126–131
Solar cells, 64, 130, 131, 149–152
Solar dynamic buffer zone (SDBZ) curtain walls, 149
Solar energy/solar heating, see Passive solar energy/solar heating
Solar heat gain:
Bigelow Laboratory for Ocean Sciences, 218
Center for Urban Waters, 168, 170
King Abdullah Financial District Parcel 4.10 Building, 202
Kuwait University College of Education, 182
orientation and, 19
shading devices and, 61–62
University of Texas Dallas Student Services Building, 212
Solar heat gain coefficient (SHGC):
ASHRAE recommendations, 13–14
defined, 11
for glazed facades, 58
for triple-insulated glazing units, 129
variability in electrochromic glass, 126
Solar orientation, see Orientation
Solid cell photovoltaics, 149
Sound transmission class (STC) rating system, 116–118
Spandrels:
Bigelow Laboratory for Ocean Sciences, 225
Center for Urban Waters, 175
in curtain walls, 52
embraced energy in, 66
King Abdullah Financial District Parcel 4.10 Building, 203
Kuwait University College of Education, 183
and photovoltaic devices, 130, 149
SPD (suspended particle device) glass, 126–128, 131
Spray-foam insulation, 55, 56, 220, 223, 225, 226
Static air-buffer flow pattern in double-skin facades, 146
STC (sound transmission class) rating system, 116–118
Steady state heat and moisture transfer analysis, 69–73
Steel, embodied energy of, 64–66
Steel framing:
brick cavity wall, 40
brick veneer facades, 40, 55
design strategies using, 11–13
dew-point analysis, 71
embraced energy, 65–66
hygrothermal analysis, 75
King Abdullah Financial District Parcel 4.01 Building, 193
opaque facades, 18
precast concrete panels, 42
pressure-equalized rainscreens, 47
R-value calculation problems, 57
R-value for brick veneer with, 55–57
Stick curtain wall systems, 49, 51, 205
Sunshades, see Shading
Suspended particle device (SPD) glass, 126–128, 131

T
Tectonic sun exposure control, 178–209
King Abdullah Financial District Parcel 4.01 Building, 186–199
King Abdullah Financial District Parcel 4.10 Building, 200–209
Kuwait University College of Education, 178–186
Terra cotta, 47, 214, 216, 217
THERM (software), 80–82
Thermal behavior, 66–83
heat transfer, 66–69
heat transfer analysis, 79–83
hygrothermal analysis, 74–79
steady state heat and moisture transfer analysis, 69–73
Thermal breaks, 50

P
Thermal bridging, 57–59
Thermal comfort, 86–94
defined, 86
facade design for, 91–94
facade properties affecting, 8–9
methods of measurement, 87–91
Thermal Comfort Model, 89–91
Thermal comfort zone, 159, 167, 186, 211
Thermal conductivity:
aerogels, 124
aluminum mullions, 50
and material selection, 54
terra cotta, 216
vacuum-insulated panels, 126
Thermal gradient, 70–73, 80–83
Thermal performance, see specific metrics, e.g.: Heat transfer coefficient
Thermal resistance (R-value):
aerogels, 124
ASHRAE minimum recommendations, 11–12
brick veneer facades, 55–56
defined, 11
facades at Center for Urban Waters, 175
glazed facades, 58–59
opaque building envelopes, 54–55
thermal bridging and, 57
vacuum-insulated glazing units, 124
Thin film photovoltaics, 149
Thin-shell precast concrete panels, 44–45
Ties (brick), 57, 58, 70
Tinkham Veale University Center (Case Western Reserve University, Cleveland, Ohio), 145–148, 230–231
Tinted glass, 51
Titanium dioxide, 128, 129
Transient-analysis method, 73–79
Triple-insulated glazing units (IGUs):
aoustic performance, 118
phase-changing materials for, 129–130
and thermal comfort, 92, 93
thermal performance, 51–52
U-values, 82
Unitized curtain wall systems, 49
University of California at Berkeley–Center for the Built Environment (CBE), 89–91
University of Texas Dallas Student Services Building, 211–217, 234
U-value, see Heat transfer coefficient
Vacuum-insulated glazing units, 124–125, 131
Vacuum-insulated panels (VIPs), 126
Vapor, 67
dew-point analysis, 69–73
diffusion, 67
hygrothermal analysis, 74–79
non-rainscreen facade systems, 46
thermal comfort and, 86–87
Vapor barriers, 46, 68–73, 75, 77
Vapor infiltration, 67
Vapor pressure, 70–73
VCP (Visual Comfort Probability), 109, 110, 114–115
Ventilated air cavities, 47, 135, 141–148
Ventilation:
acoustic performance, 118
Center for Urban Waters, 167, 168, 171
courtyards as source of, 23
double-skin facades, 135, 136, 141
thermal comfort and, 91–94
Kuwait University College of Education, 182
thermal comfort, 91–94
WINDOW (heat-transfer analysis software), 80–81
Window-to-wall ratio (WWR), 25–37
Wood, 64–66, 79
Wire ties (brick), 57, 58, 70
Z-girts, 57–59
Zones, see Window-to-wall ratio
Ultraviolet radiation, 95, 122, 128, 129
Unified Glare Rating (UGR), 109, 114–115
U.S. Green Building Council LEED certification, see LEED Gold certification; LEED Platinum certification
Princess Nora Bint Abdulrahman University for Women Academic Colleges, 132–135
R-values, 55–56
U-values, 59–60
Water vapor, see Vapor
Wind, 47, 80, 160
Windows:
acoustic qualities, 117–118
Arizona State University Science & Technology Building, 160
ASHRAE thermal comfort measurement, 88
Bigelow Laboratory for Ocean Sciences, 220, 223
box window double-skin facades, 136–138
Center for Urban Waters, 168, 170, 173–175
daylighting, 95–103
double-skin facades, 135, 136, 141
energy consumption management, 141
glare, 110–115
King Abdullah Financial District Parcel 4.10 Building, 203
Kuwait University College of Education, 182
thermal comfort, 91–94
Wind, 47, 80, 160
Windows:
acoustic qualities, 117–118
Arizona State University Science & Technology Building, 160
ASHRAE thermal comfort measurement, 88
Bigelow Laboratory for Ocean Sciences, 220, 223
box window double-skin facades, 136–138
Center for Urban Waters, 168, 170, 173–175
daylighting, 95–103
double-skin facades, 135, 136, 141
energy consumption management, 141
glare, 110–115
King Abdullah Financial District Parcel 4.10 Building, 203
Kuwait University College of Education, 182
thermal comfort, 91–94
WINDOW (heat-transfer analysis software), 80–81
Window-to-wall ratio (WWR), 25–37
Bigelow Laboratory for Ocean Sciences, 220
Center for Urban Waters, 175
daylighting and, 97
Hector Garcia Middle School, 38, 39
King Abdullah Financial District Parcel 4.01 Building, 193–194
King Abdullah Financial District Parcel 4.10 Building, 202, 209
thermal comfort and, 91–92, 94
Wire ties (brick), 57, 58, 70
Wood, 64–66, 79
Wood-framed walls, 12, 13
WUFI® (Wärme und Feuchte instationär) software, 74, 79
WWR, see Window-to-wall ratio
Zones, see Window-to-wall ratio
Z-girts, 57–59
Zone method, for R-value calculation, 57