Index

Absolute humidity, 18
Absolute temperature, 41
Absolute zero, 41, 166
Absorptance (of light), 254
Absorption:
    chiller, 164–166, 168
    coefficient, 413, 417, 418, 430
Absorptivity, thermal, 5, 9
ACES, 202–203
Acoustics, 411
Acoustically absorptive materials, 417–418, 420, 421
Acoustically insulative construction, see Sound, insulation
Actuator, 204, 388
Airborne living organisms, 30, 31
Air change method, 104, 105–106
Air-conditioning system, 34, 35, 61–62, 140, 171–183
Air conditioning, process, 4
Air-cooled condenser, 164, 170, 168, 169, 170
Air-handling unit (AHU), 142, 143, 171, 172–180
Air infiltration:
    changes/hour (Appendix Table B6.2), 549
    rate:
        through curtain walls (Appendix Figures B6.4–B6.6), 548–549
        through revolving doors (Appendix Figure B6.3), 547
        through swinging door cracks (Appendix Figure B6.2), 546
        through swinging door entrances (Appendix Figure B6.1), 545
        through windows and doors (Appendix Table B6.1), 544
Air mass, 87–88, 153–154
Air sterilization, 31
Albedo, 61, 88
Alternating current (AC), 290, 293, 294
Ampacity, 302
Amperage, 289
Amperes, 289, 312
Angle of incidence:
    of light, 254–255
    of solar radiation, 46, 90
    of sound, 413, 416
Annual cash-flow method, 444–446
Annual Cycle Energy System (ACES), 202–203
Annunciation, 388
Antifreeze system, 402
Areaway drain, 375, 376
ASHRAE, 4
Aspect ratio, 182, 206, 220
Audio indicators, 335–336
Auditorium, acoustic design of, 416, 419–421, 422, 424
Automatic fire detection, 336–337, 385–387
Automatic fire-suppression system, 399–405
Automatic sprinkler system, 399–404
Average trip time, elevator, see Elevator, travel time
Avoided costs, 316
Backflow preventer, 365
Background mechanical noise, 141, 205–206, 422
Backwater valve, 373
Balance point temperature (BPT), 64, 107, 236–237
Ballast:
    factor, 102
    factors, for fluorescent lights (Appendix Table B5.3), 535
    lighting, 257, 265–266, 267
Bidet, 361
Bin method, 108, 109
Blackfields, 125
Blackwater, 129
Blowdown, 149
Body heat balance, 7–8, 9, 12–13
Boiler, 146–150, 171
    firetube, 149
    portable, 149
    waste heat, see Waste heat boiler
    watertube, 149
Bottoming cycle, 320
Branch circuit, electrical, 307, 308
Branch circuit panelboard, see Subpanel
Branch drains (branch lines), 370
Brightness, 255, 258, 260
Brownfields, 125
Btu (British Thermal Unit), 6, 150
Btuh (Btu/hr), 6, 150
Buffer space, 224
Building:
- drain, 370
- population, 33, 101–102, 103, 106, 343
- sewer, 370
Building storage factors (BSF), 1101–103
  for appliances (Appendix Table B5.7), 543
  for lights (Appendix Table B5.5), 538–540
  for people (Appendix Table B5.2), 534
Buoyancy, 44, 61
Bushar, 303. See also Conductor, electrical
Bus duct, 303, 307
Busway, see Bus duct
Cable, 303. See also Conductor, electrical
Cable bus, 303, 307
Cable tray, 303, 304, 305
Cable-type elevator, see Elevator, electric-type
Canal, 330
Candela, 253, 254
Candlepower, 253, 254, 256
Capacitor, 312
Capacity:
- defined, 61
- heat pump, 166
- HVAC equipment, 61, 141–142, 146
- solar energy system, 158
- water heater storage tank, 357–358
Capital recovery factor (CRF), 439
Car capacity, 343, 346
Car loading, elevator, see Passenger load, elevator
Carbon dioxide fire-suppression system, automatic, 404
Carousel toilet, 369
Catch basin, 376
Ceiling diffuser, 185–187
Ceiling raceway, 303, 307
Cellular floor raceway, 305, 306
Celsius, see Temperature scales
Central systems, HVAC, 141, 143, 179–180
Cesspool, 355
CFC, 119–121
CFM, defined, 44
Check valve, 365
Chilled water system:
  for air conditioning, 62, 162, 163, 164–166
  drinking fountain, 359
Chiller, 62, 163, 164–166, 170
Circuit:
  breakers, 292, 297, 300
  electrical, 290
Cistern, 131–132, 377–378
Clean-out, 373
Clearance correction, 89
Clerestories, 65, 224, 279, 280
Climate, design impacts, 64–65, 71, 214–216, 218–219, 221. See also Microclimate
Climatic conditions:
  for Canada (Appendix Table B2), 472–474
  for other countries (Appendix Table B2), 475–479
  for the United States (Appendix Table B2), 458–471
Clivus Multrum, 369
Clo, 14–16, 17, 25
Closed circuit:
  electrical, 290
  television (CCTV), 335, 338–339
Closed switch, 299
Clustering of buildings, 221, 222
Coal, xiii–xiv, 120, 144, 147–148
Coefficient:
  of beam utilization (CBU), 257
  of transmission, see Luminous transmittance
  of utilization (CU), 256–257, 271, 273
Cogeneration, 319–323
Coil, heating or cooling, 52, 172, 173–174
Collector panel, see Solar collector
Color rendition, 257, 264, 265, 267
Combination system, HVAC, 171
Combined heat and power (CHP) system, see Cogeneration
Comfort:
  ASHRAE standard on, 25
  chart, 22–25
  conditioning, 4
  conditions affecting, 4–5, 14–21, 35
  defined, 4
  design considerations, 10, 25–27, 66, 85
  envelope, 22–24
  indices of, 21–22
  nonthermal aspects, 4, 5, 30
  physiological, 7, 12, 35
  and productivity, 4, 7
  radiant, 10, 11
  thermal, 4–5
Commissioning, 433–435
Comparative value analysis, 447–448
Compartmentation, 391–393, 397
Composting toilet, 369
Compounding, 441, 448
Compressor, 162, 163, 168, 369
Computer room unit, air-conditioning, 179, 180
Concentration ratio, 327
Condensate, 52–53, 146, 163
Condensate drain, 52–53, 146, 163, 194
Condensation, 12, 23, 50, 52, 55, 72–75, 76, 146, 162
  concealed, 55, 72, 74–75, 76
  visible, 23, 72, 73–74, 76
Condenser:
  air-conditioning system, 162, 163, 164–165, 166, 168–170
  electrical, see Capacitor
Condensing combustion process, 146
Condensing unit, 170, 180
Conductance, thermal, 42–43, 44
Conduction, thermal, 41–43
  defined, 5, 41–42, 55
  sensation, 5, 11–12
Conductivity:
  electrical, 290, 302
  thermal (k), 7, 42–43
Conductor:
  electrical, 18, 290, 292, 302–303, 312
  thermal, 11, 14
Conduit, 303, 304
Connected load, 292, 297
Contrast, 258. See also Glare
Convection, 43–44
  and comfort, 8, 9, 11–12
  defined, 5, 41, 43–44, 55
  impact of air motion on, 11, 20–21
Convector, 142, 188. See also Finned-tube radiation
Convenience outlet, see Receptacle
Conveyors, 349
Cooling, 6, 50–53, 55, 141–142, 161–171
  degree day method, 108–109
  load, 61–63
  calculation of, 80–106, 113
  example of calculation, 110, 112
Cooling load check figures (Appendix Table B1), 456–457
Cooling approximate power inputs (Appendix Table B7.5), 589
Cooling system equivalent full load hours of operation (Appendix Table B7.6), 561
Cooling tower, 164, 168–170
COP (coefficient of performance), 166
Cost of capital, 442, 444, 446
Counteraction, 33
Crack length method, 104–105
Cross-contamination, 365
Cross-talk, 429–430
Current, electrical, 289, 312
Dampers, 174, 176, 179, 182, 185
Daylighting, 152, 153, 224, 235, 276–285
dBA (A-weighted sound level) scale, 415
DDC (direct digital control) system, 204–205
Dead space, acoustically, 417
Decibel (dB), 414–415, 422
Deciduous vegetation, 216, 217
Degree day:
  modification factors (Appendix Table B7.2), 560
  part load correction factors (Appendix Table B7.3), 560
  values for the United States and Canada (Appendix Table B7.1), 554–559
Degree day method, 107–108, 110
Degree of saturation, 18
Deluge system, 403
Demand charge, 310
Demand control, 310–311
Demand leveling, 310–311
Depreciation factor, see Maintenance factor
Design conditions, 81, 83, 85–87
Dew-point temperature, 6, 18, 49, 73
Diffuse lighting, see Indirect lighting
Diffuser, air, 142, 185–187
Diffuse reflection:
  of light, 255
  of solar radiation, 88
Diffuse solar radiation, 88, 89, 153, 155
Diffuse transmission of light, 255, 256
Direct Current (DC), 290, 293, 294
Direct effect, 120–121
Direct expansion (DX), 162, 163, 174, 180, 195
Direct gain, passive solar heating, 238, 239, 280
Direct lighting, 268–270
Direct solar radiation, 88, 89, 155–156
Direct transmission of light, 255, 256
Direct water heater, 358
Discounted payback period, 442
Discounting, 441, 449
Discount rate, 442, 444
Disposal field, 374–375
District heating and cooling, 145, 150, 206–207
Diurnal (day-night) cycle, 69
Diversity, 101, 103
  factor, 103
Diversity factors, typical, for large buildings (Appendix Table B5.8), 544
Domestic hot water (DHW), 357
Double-bundle condenser, 200
Downfeed distribution, 357, 379
Downspout, 375, 376, 377
Draft, flue, 145
Drain field, 374, 375
Drift, temperature, 17
Drinking fountain, 359, 360, 366–368
Dry air, 49, 53
Dry-bulb (DB) temperature, 6, 16–18, 21–22, 49
Dry chemical fire-suppression system, 405
Dry pipe system, 402
Dry well, 375, 377, 378
Dual duct system, 175, 177, 178
INDEX

Ducted system, 171
Dumbwaiters, 349
Dust, 30
Dust control, 31, 173
DX, see Direct expansion
Dynamic envelope, 65, 66, 214, 224, 225, 226, 247
Earth sheltering, 228, 234–235
Echoes, 420, 430
Economizer cycle:
using ventilation air, 68, 175, 176, 179
water-side, see Water-side economizer cycle
EER (energy efficiency ratio), 294–295
Efficacy of light sources, 256, 263, 264, 265, 266, 267
Efficiencies and fuel-heating values (Appendix Table B7.4), 560
Egress, means of, 285, 389–391
Electric:
control system for HVAC, 203–205
stairway, see Escalator
Electrical:
closets, 307–308, 337–338
current, see Current, electrical
energy, 289, 290–291, 312
panel, 300, 307–308
power, 290–291, 310–311, 312
resistance, see Resistance, electrical
supervision, 388
symbols, 312, 336
system space requirements, 297–299, 301, 307–308, 337–338
Electrolysis, 316, 326
Electromagnetic spectrum, 45, 153
Elevator:
average trip time, 344
car capacity, 343, 346
car loading, 343, 344
electric-type, 340, 341, 342, 346–347, 350
freight, 347
hydraulic-type, 340, 341–342, 343, 347, 350
recall (capture) system, 391
shaft, see Hoistway
time, 344
zone, 345
Embodied energy, 123–124, 132, 136
EMCS (energy management control system), 311, 340
Emergency electrical systems, 308–310, 319, 388
Emergency lighting, 285
Emissivity, 5, 67
EMT, 303, 304. See also Conduit
Energy:
in building materials, 220. See also Embodied energy
conversion efficiency, 13, 58. See also Efficiencies and fuel-heating values
for cooling in the U.S., 241
of electromagnetic waves, 45
for lighting, 257, 262, 263
resources, xiii–xv, 141–146, 151, 310
savings and clothing, 16
for ventilation, 33–34
Engine-generator set, 317. See also Internal combustion engine
Enthalpy (total heat), 5–6, 49, 52
Environmental amenity, 132
Equipment load, 81
Equivalent full-load hours, 107, 109, 110
Escalator, 347–348, 350
Estimated loads, 297–298
Evaporative condenser, 168, 169, 170
Evaporative cooler, 53, 170–171
Evaporative cooling:
of body, 7–9, 12–13, 16, 18, 20–21, 23
passive systems, 245
principle of, 53, 55
by water bodies, 59–61
Evapotranspiration, 61, 127, 218
Exfiltration, 69
Exhaust-air heat recovery, 34, 199–200
Expectancy, 27
Fahrenheit, see Temperature scales
Fan, 172–173
Fan coil unit (FCU), 142, 172, 191–194
Feeder, electrical, 300, 307–308
for daylighting, 214, 224, 279, 280, 281
heating and cooling loads due to, 63, 65–66, 87–95
Film coefficient, see Surface conductance
Film conductance, see Surface conductance
Finned-tube radiation, 172, 184, 188
Fire alarms, 336–337, 387–389
Fire barrier, 391
Fire compartmentation, 391–393, 397
Fire damper, 182, 398
Fire detectors, 335–337, 384–387, 398
Fire door, 392
Fire extinguisher, portable, 405
Fire-fighters’ communication system, 339, 389
Fire hose:
cabinet (F.H.C.), 405
standpipe (S.P.), 405
Fire-rated access panel, 392
Fire-resistance rating, 391–392
Fire sprinkler:
head, 399–401
system, automatic, 399–404
Flame detector, 385, 387
Flexible connectors, 206, 428, 429, 430
Flexible cord, 309–310
Floating floor, 426, 428
Floor drain, 164, 365, 373
Flow rate, river, 330–331
Flues, 142, 145, 146, 149–150, 151
Fluorescent lamp, 102, 256, 263, 264, 265–266, 277
Flush valve, 360, 361
FM-200, 404
Fog, 31, 403
Footcandle, 253–254, 255, 258, 259
  meter, 254
Footing drain, 377, 378
Footlambert, 255–256
Forced convection, 20, 44
Foreground reflectance correction, 88, 89
Four-pipe system, 183, 192–193
Free convection, see Natural convection
Frequency:
  of electrical power, 290, 293
  of sound waves, 412
Fresh-air vent (fresh-air inlet), plumbing, 371
Fuel:
  alternatives, xiii–xiv, 142–148, 296
  cell, 316, 317, 322, 326
  cost escalation, 449
Fumes, 30
Furnace, 146, 147, 179, 181
Fuses, 292, 297, 300
Gas turbine, 317–318, 321
Geometric acoustics, 416–417, 418
GFCI (Ground fault circuit interrupter), 308
Glare, 256, 258, 260, 279–285
Glass blocks, 92–93
Global warming, 120–122
Globe thermometer temperature, 22
Grains of moisture, 49–50
Grayfields, 125
Graywater, 129
Green design, 122–136
Greenfields, 125
Greenhouse effect, 120, 216
Greenhouse, passive solar heating, 239, 240–241
Green roof (eco-roof), 127, 128
Grilles, 141, 185, 186, 195
Grounding, 303
Gutter, 375–376, 377
Handling capacity, elevator, 343
Head, 330–331
Heat:
  addition rate, 81
  balance, body, 7–13
  capacity, see Thermal capacity
  content, see Enthalpy
  defined, 5
  detector, 385, 386
  exchanger, 150, 162, 168, 169, 173, 199–200
  extraction rate, 81
  gain:
    body, 7–12, 25, 28
    building, 46, 58–69, 80–81, 86
    latent, see Latent heat gain
    sensible, see Sensible heat gain
    solar, 87–95
  loss:
    body, 7–13, 18–20, 23, 25–26, 28–30
    building, 46, 58–69, 80–81, 85
    pipe, 200
    pump, 108, 145, 162, 166–168, 180, 196–197
    closed-loop system, 167, 196, 200
    hydronic, 166–167, 196–197
    solar-assisted, 157
    recovery incinerator, 151, 152, 201–202
    specific, see Specific heat
    stroke, 28
    wheel, 199–200
Heat gain, rate of:
  from miscellaneous appliances (Appendix Table B5.6C), 543
  from occupants of conditioned spaces (Appendix Table B5.1), 534
  from office equipment (Appendix Table B5.6B), 542
  from restaurant equipment (Appendix Table B5.6A), 541
Heating load:
  calculation of, 81–83, 85–86, 106, 110–113
  categorized, 62–63
  defined, 62, 81
  example of calculation, 110–111
Heating water converter, 141, 142, 146, 150–151, 162
Heat island, 127
Heat loss:
  through basement floors (Appendix Table B4.10A), 558
  through below grade walls (Appendix Table B4.9), 558
  through concrete floors on grade (Appendix Table B4.10B), 559
  Hertz, 290, 293, 322, 412
  H.I.D. (high-intensity discharge lamp), 263, 264, 266–267, 277, 309
Heating water converter, 141, 142, 146, 150–151, 162
Heat island, 127
Heat loss:
  through basement floors (Appendix Table B4.10A), 558
  through below grade walls (Appendix Table B4.9), 558
  through concrete floors on grade (Appendix Table B4.10B), 559
  Hertz, 290, 293, 322, 412
  H.I.D. (high-intensity discharge lamp), 263, 264, 266–267, 277, 309
  High-expansion foam fire-suppression system, 404
  High-pressure sodium (HPS) lamp, 263, 264, 267
  Hoistway, 340–341, 342, 346
  Home run, 307
  Horsepower (hp):
    boiler, 150
    motor, 293
  Hose bib, 365
  Hose standpipe, see Fire hose standpipe
  Hot gas, 162
  Hot refrigerant gas heat recovery, 200
Hourly computer simulation of energy use, 109–110
Hourly weather occurrences (bins) (Appendix Table B7.7), 562–563
Humidity ratio, 18, 49, 72–73
Humus type toilet, 369
HVAC (heating, ventilation, and air conditioning), 25
for smoke control, 395–398
symbols and abbreviations, 144
See also Air-conditioning system
Hydraulic-type elevator, see Elevator, hydraulic-type
Hydronic heating, 183
Hydropower (hydroelectric power generation), 328–332
IES (Illuminating Engineering Society of North America), 257
Illumination level, see Lighting, level
Image theory, 418
Immersed water heater, see Direct water heater
Impact noise, see Noise, impact
Incandescent lamp, 262–264, 277
Incineration:
heat recovery, 151, 152
toilet, 369
Incremental costs, 445, 451
Incremental savings, 451
Incremental unit (for heating and cooling), 195–197
Indicator devices, 204, 335, 336–337, 388–389
Indirect gain, passive solar heating, 238–241
Indirect lighting, 268–269
Indirect water heater, 358
Indoor air quality (IAQ) problem, 34, 133–134
Induction unit, 179, 195
Induction system, 175, 179, 195
Inductive loads, 293, 311
Infiltration, 44, 62–63, 68–69, 104–106
at entrances, 104–105, 224
through unit ventilators, 194
inflation, 448–449
Infrared heater, 189, 190
Initiating device, 336
In-line water heater, 357–359
Inrush current, 293, 308
Instantaneous water heater, see In-line water heater
Insulating glass, 66, 67
Insulation:
of clothing, 14–16, 17
and condensation, 73–75, 225–229
of ductwork, 181
of electrical conductors, 303
and MRT, 10, 20
of piping, 184, 206–207
principle of, 44
R-value of, 42–43, 46–47
of slab-on-grade floors, 98–99
window, see Operable thermal barrier
and zoning, 172
Insulator, electrical, 290
Interceptor, 373, 379
Interest rate, 441, 442, 445
Internal combustion engine, 168, 317, 321
Internal heat gains, 63, 69, 83–84, 100–103, 235
Internal-load-dominated building:
defined, 214, 220
design for, 221, 222, 225, 228, 236–238, 241
Internal loads, 63, 100–103, 235
Interval, elevator, 344
Intrusion detector, 339
Ionization detector, 385, 386
Irrigation quality (IQ) water, 129
Isolated gain, passive solar heating, 241
Jack, 341, 342
Joule, 6
Kelvin, see Temperature scales,
Known loads, 297
Lambert, 256
Lamp efficacy, 256, 262–267
Lamps, 256, 260, 262–267
Latent heat:
defined, 5, 49, 51
and evaporative cooling, 6, 53
loads, 8–9, 100–103
loss from body, 12–13, 25–26
on psychrometric chart, 51–52, 53
Latent heat of fusion, 5, 201
Latent heat gain, 62–63, 80–83
Latent heat of vaporization, 9, 170–171
Lavatory, 360, 362, 366–368
Leader, 376, 377
LEED, 123
Life-cycle cost, 129, 142, 158, 440–446, 451
of lighting, 262, 263
Lighting:
fixture, see Luminaire
heat from:
energy implications of, 262, 263, 276–277
internal load due to, 63, 67–68, 102
luminaire mounting concerns due to, 266
and MRT, 10
and thermal storage, 69
heat recovery, 200
level, 258, 259
watts/square foot (Appendix Table B5.4), 536–537
Light-loss factor, see Maintenance factor
Light pollution, 126
Light sources, 256, 262–267, 276
Light trespass, 126
Liquid line, 162
Live space, acoustically, 417, 419
Load:
  electrical, 290, 291, 292–296, 312
  thermal, 61–64, 79–106
Load center substation, see Unit substation
Load factor, 310
Load shedding, 311
Lobby dispatch time, see Interval, elevator
Local water heater, see Point-of-use water heater
Locked rotor current, 293
Low-pressure sodium (LPS) lamp, 263, 264, 267
Lumen, 253, 254, 255–260
  effect on cooling load, 102
Luminaire efficiency, 256
Luminance, see Brightness
Luminance ratio, see Contrast
Luminous ceiling, 270, 272
Luminous flux, 253, 256
Luminous intensity, 253, 254, 255–256
Luminous transmittance, 255–256
Lux, 253–254

Main switch, see Service disconnect
Maintenance factor, 270
Make-up air unit, 179, 180, 181, 197
Mass, thermal storage, 6–72, 228
MCM wire gauge, 303
Mean coincident wet-bulb temperature, 86–87
Mean daily temperature range, 87
Mean free path, 418–419
Mean radiant temperature (MRT), 6, 9–10, 12, 18–20, 22
Mean time, 87
Mercury vapor (M-V) lamp, 263, 264, 266–267
Metabolism, 6, 8, 9, 12, 13–14
Metal-halide lamp, 263, 264, 267
Metering, electrical, 301–302
Met units, 13–14, 25
Microclimate, 58, 126, 214, 215, 216
Micro-hydro, 328, 330
Millilambert, 256
Mist, 30–31
MIUS (modular integrated utility system), 322–323
Moisture content, see Humidity ratio
Monitors, daylight, 279, 280, 281
Motion detector, 338
Motors, electric, 293–296, 308, 311
Moving ramp, 349, 350
Moving stairway, see Escalator
Moving walk (moving sidewalk), 349, 350
Multiple-step methods, 107, 109–110
Multi-zone system, 176–177, 180
Municipal (public) sewer, 355, 370, 374
National Electrical Code (NEC), 291
National Electrical Manufacturers’ Association (NEMA), 293
National Fire Protection Association (NFPA), 291
Natural convection, 44, 241
Natural ventilation, 126, 224, 225, 242–245, 246
NC (noise criteria), 205, 415
NEII (National Elevator Industry, Inc.), 342
Negative pressure, 69, 104, 397. See also Pressurization
Net present value, 442, 444
New effective temperature (ET*), 22, 23
Night sky radiation, 73, 214–215, 241–242
Noise:
  background, 205–206, 266, 415–416, 421–423
  defined, 411
  impact, 422, 425–428
  mechanical equipment, 141, 205–206, 422
  control of, 206, 428–430
  layout considerations of, 141, 163, 206
  sources of, 163, 181, 422, 429–430
NPT (number of passengers per trip), elevator, see Passenger load, elevator
NRC (noise reduction coefficient), 413, 417, 430
Occupied zone, 17, 185, 186
Odor masking, 33
Odors, 21, 31, 32–33
Office acoustics, 416, 424, 428
Off-peak electricity, 202, 311, 357
Ohm’s Law, 290
One-pipe system, 183
Opaque material, 45
Open circuit, electrical, 290
Openness factor, 91
Open switch, 299
Operable thermal barrier, 231
Operable shading, 231–234
Operative temperature, 15, 22, 24
Optimum operative temperature, 15, 16
Outside air loads, 81–83, 104–106, 197–199
Overcurrent protection, 300, 308
Overshot water wheel, see Water wheel
Ozone depletion, 119–120
Panelboard, see Electrical panel
Passenger load, elevator, 343
Passive cooling, 241–245
Passive solar heating, 63, 153, 222, 235–241
  orientation for, 221, 222
  summer shading, 223
Payback period, 438–440
Payback ratio, see Simple payback
Percentage humidity, 6, 18
Perforated ceiling panel, 185, 186
Perimeter heat, 68, 172, 183, 187
PERS (public emergency reporting system), 389
Phase-change materials, 156, 201
Phon, 415
Photoelectric detectors, see Smoke detectors
Photovoltaic solar cell, 152, 326–328
Physical acoustics, 416
Piped system, 171, 183–184
Pitch, 412
Plumbing:
  core, 372, 379
  symbols, 379
Plunger, elevator, see Jack
Pneumatic tubes, 349
Point of diminishing returns, 229, 449–450
Point-of-use water heater, 386, 387
Positive pressure, 68–69, 106, 397–398. See also Pressurization
Power, relationship to energy, 290
Power factor, 310, 311–312
Power pole, 307
Preaction system, 402–403
Precooling, 72
Preheating, 307
Preheat coil, 174
Present value, 441–442
Present-worth method, 444
Pressurization, 68–69, 106, 179, 396–398
Pressurized air toilet, 369
Pressurized stairwell, 396–397
Primary source (of light), 256
Prime mover, 316, 317, 330–331
Products of combustion detector, see Ionization detector
Psychrometric chart, 18, 49–52
PTAC (packaged terminal air conditioner), see Incremental unit
  (for heating and cooling)
Public sewer, 355, 370, 374
Pull station, manual fire alarm, 336, 337, 386, 387
Pulse-combustion process, 146
Pumps, 142, 162, 183
Purging, 398, 404
PURPA (Public Utility Regulatory Act), 316, 319
Pyrolysis, 151
Raceway, 292, 303–307
Radiant heating equipment, 30, 189–191, 192
Radiant panel, 189–190
Radiant plate, 384
Radiation (radiant heat transfer), 9–11, 45–46, 140
  comfort aspects of, 6, 9–11, 12, 140
  defined, 5, 9, 41, 55
  and thermal storage mass, 69
Rainwater harvesting, 129, 130–132
Ramp, temperature, 17
Rankine, see Temperature scales
Rankine cycle, 156, 157
Rate of return (ROR), 439, 446–447
Receptacle, 292, 307, 308
Recharge basin, 377
Reciprocals, table of (Appendix Table B4.5), 526
Recirculating hot water distribution, 359
Reclaimed water, 129
Recovery rate, 358
Reflectance coefficient, see Reflectance (of light)
Reflectance (of light), 254, 255, 256, 258, 260, 271, 273
Reflection factor, see Reflectance (of light)
Reflector, light, 256
Refraction of light, 255, 256
Refractive index of light, 256
Refrigerant, 163
Refrigeration, 162, 164, 168
Refuge area, 388, 392–393
Refuse-derived fuel (RDF), 151, 152
Register, air, 21, 142, 185
Reheat coil, 174
Reheat system, 175–176
Relative humidity (RH), 18, 32, 73, 74, 75
  defined, 18, 49, 53
Resistance:
  electrical, 290, 312
  thermal (R-value), 42–43, 46, 47, 48, 55
Resistive loads, 293
Resistivity, thermal (r), 42–43
Resonance, room, 419
Return on investment (ROI), see Rate of return (ROR)
Reverberation, 411, 418–419, 430
  time, 418–419, 421
Roof:
  drain, 375, 376
  pond, 239, 240, 241–242, 245
Rooftop unit (RTU), 179, 180
Room:
  cavity ratio, 261, 271
  exhaust fan, 69, 197–199
RTT (round trip time), elevator, 343
Run-around heat recovery, 199
Running time, elevator, 343
R-value, see Resistance, thermal
R-values:
  of air (Appendix B4.1), 517–518
  of typical building materials (Appendix Table B4.2), 519–524
Sabin, unit of acoustic absorption, 417
Sanitary piping, 370–375
Saturated air, 6, 9, 49–52, 72–73
Saturation line, 49, 72
Seasonal performance factor (SPF), 108, 166
Secondary source (of light), 256
INDEX
Stormwater drainage, 355, 356, 375–378, 379
Storm sewer, 376
Storm window, 66, 67
Street main, 356
Structural discontinuity, 425–428
Subpanel, 292, 307–308
Suction tank, 357
Sunspace, passive solar heating, 239, 240–241
Supersulation, 68, 228–229
Supply water, 356–360
Surface conductance, 44, 46, 62
Surface effect, 185
Surface raceway, 303, 304
Surface runoff, 375, 377
Surveillance system, see Security systems
Sustainable design, see Green design
Sweating, 7, 8–9, 12–13, 24, 67, 73
Switchboard, 301
Switchgear, 297, 301
Takeoff water heater, see Indirect water heater
Tank-type water heater, see In-line water heater
Tankless water heater, see In-line water heater
Task lighting, 257–258
Tax credit, 443–444
Tax deduction, 439, 443–446
Temperature scales, 7, 23, 41
Terminal reheat, 175–176
Theoretical power, 330
Thermal acceptability limit, 15, 16
Thermal bridge, 96, 99
Thermal capacity, 70, 94, 228
Thermal conductivity, see Conductivity, thermal
Thermal detector, see Heat detector
Thermal energy storage (TES), 200–203, 311
Thermal equilibrium, 40
Thermal lag, 70, 94, 100, 228, 229
Thermal lag factor (TLF), 88, 94–95, 100
Thermal lag factors:
for glass solar load:
  with interior shading (Appendix Table B3.11), 516
  without interior shading (Appendix Table B3.10), 514–515
for walls and roof (Appendix Table B4.11), 532–533
Thermal storage mass, 58, 69–72, 94, 228, 238–241
Thermal storage wall, 71, 224, 228, 238, 239–240
Thermodynamics, laws of, 57
Three-phase power, 293, 294, 297
Three-pipe system, 183, 192
Through-the-wall unit, 195–196
Throw, 185
Time lag, see Thermal lag
Time-of-use metering, 202, 311
Time value of money, 441–444
TL (transmission loss), 414
Tone, 412
Ton of refrigeration, 162
Top-lighting, 279, 280
Topping cycle, 320
Total energy (TE), 319, 326
Total light wattage, 102
Traction-type elevator, see Elevator, electric-type
Transformer, 292, 296, 297–299
Transmission:
  of light, 255, 256
  of sound, 413–414, 423, 425–428, 429
  thermal, 46–47, 63, 81, 83–84, 97, 95–100
Transmission loss (TL), 414
Transmission factor, see Luminous transmittance
Transmittance:
  of light, see Luminous transmittance
  thermal, see U-value
Trap:
  plumbing, 365, 368, 370, 379
  sound, see Sound trap
Travel time, elevator, see Elevator travel time
Two-pipe system, 183, 192
U-factors:
  conversion table for various wind velocities (Appendix Table B4.6), 527
  for slab doors (Appendix Table B4.4), 526
  for windows and skylights (Appendix Table B4.3), 525
Underfloor raceway, 305, 306
Undershot water wheel, see Water wheel
Underslung arrangement, 346–347
Underwriters Laboratories (UL), 266, 292
Uninterruptible power system (UPS), 309
Unitary package unit, 179, 180, 195
Unitary split system, 179, 180
Unit conversions (Appendix Table A1), 453–455
Unit heater, 188–189
Unit substation, 301
Unit ventilator, 194
Upfeed distribution, 357
Urinal, 360, 361, 366–368
Usage charge, 310
Usage factor, see Diversity, factor
Useful life, 440
U-value, 46–47, 48, 55, 73, 74
Vacuum breaker, 365
Vapor:
  Barrier, 75
  -compression cycle, 162
  pressure, 18, 53, 55, 73, 74–75
Variable air volume (VAV), 175, 177–179
Ventilation, 33–35, 68–69, 106
  automatic control of, 205
defined, 32, 44
load, 62–63, 106
with various systems, 171, 183, 194, 195
Ventilation requirements (Appendix Tables B6.3 and B6.4), 550–553
Vent stack (vent pipe), 370–372
Vertical landscaping, 127
Vibration isolation mountings, 163, 206, 422, 428, 430
Visual indicators, 335–337
Voice fire alarm, 388–389
Voltage, 289–290, 295

Wall case, 195
Wall solar azimuth, 91, 93
Wash fountain, 363
Waste heat boiler, 200, 145. See also Heat, recovery incinerator
Waste piping (waste stack), 370, 371
Water closet (WC), 360, 361, 366–368
Water cooler, 359. See also Drinking fountain
Waterflow switch (waterflow detector), 336, 337, 386
Water heaters, 357–359
Water-side economizer cycle, 168
Water turbine, 328, 329–331
Water wheel, 328–331
Watt (W), 6, 63, 291, 292

Wavelength:
of solar radiation, 88, 153, 229–230
of sound waves, 412
of thermal radiation, 45–46
WECS (wind energy conversion system), see Wind turbine
Wet-bulb depression, 18
Wet-bulb (WB) temperature, 6, 18, 21–22, 49, 53, 54
Wet column, 372
Wet pipe system, 402
Wind channeling, 58–60, 220
Wind furnace, 325
Wind generator, see Wind turbine
Windmill, see Wind turbine
Wind sheltering, 219–220, 324
Wind turbine, 323–326
Wire, 302–303. See also Conductor, electrical
Wireway, 303–304
Work plane, 256, 257
Work station, 256
Xeriscape, 129, 130

Zones:
elevator, 345
HVAC, 63, 68, 172, 175–179, 183
Smoke-control, 397–398