Index

A
Absorption, surface, 71–72
AC (alternating current), 225, 226
Accent lighting, 13
detail drawings, 214
luminaires, 145, 146
symbols for, 186
Accessories (luminaires), 154–156
Accommodation, 50
ADA (Americans with Disabilities Act), 3, 267
Adaptation, 50–51
Additive mixing, 124–125
Adjacent colors, 124
Adjustable luminaires:
for accent lighting, 214
recessed, 145, 146
symbols for, 186
Aesthetics, light supporting, 2
Aesthetic designs, 26–30
Aging eyes, 284–285
AIA (American Institute of Architects), 266
A lamps, 92, 93
Al-Haytham, Ibn, 38–39
Allen, Woody, 37
Alternate luminaires, 165
Alternating current (AC), 225, 226
Ambient lighting, 13
Ambient luminescence, 11, 12
American Institute of Architects (AIA), 266
American Society of Heating, Refrigerating,
and Air-Conditioning Engineers
(ASHRAE), 266–268
Americans with Disabilities Act (ADA), 3, 267
Ammons, A. R., 19
Amperes, 226
Angle of incidence, 67, 69
ANSI/ASHRAE/IESNA 90.1, 267–268
Aperture, 143
Apparent brightness, 54
Apparent color, 120, 121
Architects:
communication with, 164
as lighting designers, 2
preliminary design information from, 8–9
Architect (magazine), 290
Architectural Lighting Magazine, 289
Architectural Record, 290
Architectural SSL, 289
Architecture, in lighting design, 15–16
Arc tubes, 84–85
AR lamps, 93, 94
Art, light as, 41, 44, 45
ASHRAE (American Society of Heating,
Refrigerating, and Air-Conditioning
Engineers), 266–268
ASHRAE 90.1, 267–268
ASHRAE/USGBC/IES Standard 189.1, 268
Index

Astigmatism, 50
Astronomical time clock, 239
Average life, 84, 86, 88
Awnings, 176, 177

B
Baffle, 143, 144
Ballasts, 83, 85
dimming, 231
fluorescent lamps, 82–83
Ballast factor (BF), 257
Beam angle, 99–100
Bidding phase, 181
BIM (building information modeling), 260–261
Binning (LEDs), 87
Biological rhythms, 281–283, 285
Blackbody radiators, 110, 111
B lamps, 92, 93
Book of Optics (Ibn Al-Haytham), 38–39
Brightness, 9–10
adaptation to, 50–51
and aging eyes, 285
apparent, 54
colored light and perception of, 130–132
relative perception of, 54, 55
terms describing, 245
and visual performance, 53–54
Brilliants, play of, 11–13
Budget:
as design consideration, 34
in design development, 180–181
Building area method (LPD), 268
Building codes, 265
compliance with, 3
model, 266–267
and need for lighting designers, 2
Building Design + Construction, 290–291
Building information modeling (BIM), 260–261
Building orientation, 170
Building program, 179–180

C
CAD software, 258–260
CaGBC (Canadian Green Building Council), 274
Calendar events, 239
California Title 24, 269
Canadian Green Building Council (CaGBC), 274
Canadian Standards Association, 274
Candela (cd), 246
Candela per square meter (cd/m2), 247
Candelas table, 20–252
Candlepower (cp), 246
Candlepower distribution curve, 250–252
CA (construction/contract administration) phase, 182
Cataracts, 50
CCT (correlated color temperature), 111–113
cd (candela), 246
cd/m2 (candela per square meter ), 247
CD (construction documentation) phase, 181
Ceilings:
illuminating, 16, 17
luminous, 6, 65, 221–222
Centralized control systems, 235–236
Ceramic metal halide (CMH) lamps, 84
CFLs, see Compact fluorescent lamps
Chroma, 132
Chromaticity, 104, 123
CIE (International Commission on Illumination), 112–114, 288
Circadian rhythms, 168, 281–283, 285
The City Limits (A. R. Ammons), 19
C lamps, 92, 93
Clerestories, 172, 174
CM (construction manager), 164
CMH (ceramic metal halide) lamps, 84
Index

Codes:
  building, 265–267
  electrical, 227
  energy, 267–270
  resources, 270
Code of Hammurabi, 265
Coefficient of utilization (CU), 253–254
Cold cathode lamps, 89, 127
Color blindness, 50
Color consistency, 117
Color constancy, 120
Colored glass filters, 129–130
Colored light, 122–139. See also Color in light
  from cold cathode lamps, 127
  color filters for, 128–130
  and environment, 133–139
  from fluorescent lamps, 127
  from LED lamps, 127–128
  meanings associated with, 132–133
  from neon lamps, 127
  and reflectance, 71–72
  relative perception of, 55
  resources, 139–140
  use of, 130–139
  and vision, 130–132
Color fidelity indices, 116
Color filters, 128–130
Color gamut, 124, 126
Color in light, 10, 109–122. See also
  Colored light
  color reference system, 112
  color rendering, 80, 112–117
  color stability, 117–121
  color temperature, 109–113
  in halogen vs. incandescent lamps, 81
  from LEDs, 87, 88, 104
  white light, 109
Color preference indices, 117
Color quality scale (CQS), 117
Color references, 112
Color reference system, 112
Color rendering, 80, 112–117
Color rendering indices, 114–117
Color Rendering Index (CRI), 114–116
Color stability, 117–121
Color temperature, 109–113
Color vision, 51–53
COMcheck, 270
Commissioning, 231, 242
Communication:
  of design ideas, 17, 20–22
  through documentation, 182
Compact fluorescent lamps (CFLs), 83, 84
bases, 98
  colored light from, 127
  describing, 103
  shapes and sizes, 92–95
Complimentary colors, 123
Computer generated images, 20–22
Conceptual designs, 30–33
Cones (eye), 48–53
Construction (contract) administration (CA) phase, 182
Construction documentation (CD) phase, 181
Construction manager (CM), 164
Construction Specifications Institute (CSI), 209
Consumer information, 106, 107
Continuous runs of luminaires, symbols for, 187
Contract (construction) administration (CA) phase, 182
Contrast:
  and aging eyes, 285
  light and shadows for, 13–14
  and visual performance, 54–55
Controls, see Lighting controls
Control protocols, 237–239
Control zones, 233
Cool colors, 124, 131
Cornea, 48, 49
Correlated color temperature (CCT), 111–113
Cortisol, 282
Cost of ownership, 105, 276–277
Cove lights, 151
Cove lighting, 151, 215–218
cp (candlepower), 246
CQS (color quality scale), 117
Credentials, professional, 4–5
CRI (Color Rendering Index), 114–116
CSI (Construction Specifications Institute), 209
CU (coefficient of utilization), 253–254
Cultural color preferences, 133
Current, 225
Custom luminaires, 161, 162
Cut-off angle, 75
Cut sheets, see Luminaire cut sheets

D
DALI (digital addressable lighting interface), 237–238
Dark adaptation, 51
Daylight harvesting, 235
Daylighting, 167–177
benefits of, 167–168
to conserve resources, 3
designing, 171–176
glazing, 171
planning for, 168–170
resources, 176, 178
shading strategies, 176, 177
sidelighting, 172, 174–176
toplighting, 172–174
DC (direct current), 225, 226
DD (design development) phase, 168, 180–181
Decorative fixtures, 14
Decorative lighting, 3
Describing lamps, 100–104
Design, see Lighting design
Design development (DD) phase, 168, 180–181
Designers Lighting Forum (DLF), 288
Design Guides (IES), 248
Design phases, 179–182
Detail drawings, 210–222
accent lighting, 214
coves, 215–218
luminous ceilings, 221–222
scallops, 219–221
wall grazing, 212–213
wall washing, 210–212
Dichroic filters, 129–130
Dickens, Charles, 167
Diffuse distribution, 77
Diffuse lighting, subjective impressions and, 61, 62
Diffusers, 69
Diffusion, 69, 70
Digital addressable lighting interface
(DALI), 237–238
Digital multiplex lighting (DMX, DMX512), 237–238
Dimmers, 228–232
Dimming ballasts, 231
Dimming layout, 240, 241
Dimming systems, 233–234
centralized, 235–236
control protocols, 237–239
distributed, 236–237
Direct current (DC), 225, 226
Direct distribution, 76
Direct glare, 74, 75
Direct/indirect distribution, 77
Directional lamps, 93–94
beam angle and field angle, 99–100
describing, 100–102
Disability glare, 76
Distributed lighting systems, 10, 236–237
Distribution of light, 67–77
diffusion, 69, 70
to emphasize/deemphasize room elements, 3
glare, 73–76
interaction of light and materials, 67–72
reflection, 67–68
refraction, 69, 70
resources, 78
shadows and luminaires, 72–73
surface reflection and absorption, 71–72
transmission, 70–71
types of, 76–77
DLF (Designers Lighting Forum), 288
DMX, DMX512 (digital multiplex lighting), 237–238
Documentation, 179–222
and design phases, 179–182
fixture schedule, 199, 208–209
layout and installation details, 210–222
of lighting controls, 240–242
luminaire cut sheets, 199–207
luminaire schedule, 199
reflected ceiling plan (lighting plan), 183–198
resources, 222–223
specifications, 209–210
Domains of practice, 5
Downlights, 144–145
accent, 145, 146, 186, 214
recessed adjustable, 145, 146
scallops of light from, 210, 219–221
symbols for, 186
wall grazers, 147
wall washers, 145–147, 186–187
Downlighting, subjective impressions and, 59–62
Driver (LEDs), 87
Einstein, Albert, 37, 41
Electrical contractors (ECs), 2, 85, 165
Electrical engineers:
as lighting designers, 2
preliminary design information from, 9
Electrical engineering, 227
Electrical suppliers, 165
Electricity, 225–227
Electromagnetic interference, 229
Electromagnetic spectrum, 39
Electronic ballasts, 85
Ellipsoidal reflector spotlights, 152
Energy codes:
for commercial buildings, 34
compliance with, 3
model codes, 267–269
verifying compliance with, 269–270
Energy conservation, 3
daylighting for, 167
through lighting controls, 228
voluntary energy programs, 273–276
Energy consumption:
allotted to lighting, 227–228
as design consideration, 34
measured in watts, 226
Energy efficiency, 105
Energy Star, 275
Environment:
color in creating, 133–139
defined, 57
light supporting, 2
schemas relating to, 58
Euclid, 38
Expectations, 58
Exterior shelves, 176
External devices:
control of, 239–240
input from, 240
Eames, Charles, 179
ECs, see Electrical contractors
Eco-Structure, 291
Edison, Thomas, 79
Efficacy, 80, 84, 86, 105
Efficiency, 80, 81, 105
Eye(s), 48–51
  aging, 284–285
  defects of, 50
  ipRGC in, 281

F
fc (foot candle), 246
Field angle, 99, 100
Fixture schedule, 189, 199, 208–209
fL (foot-lambert), 247
F lamps, 92, 93
Flange, 143
Floor lamps, symbols for, 187, 188
Fluorescent lamps, 82–84. See also
  Compact fluorescent lamps (CFLs)
  bases, 98
  colored light from, 127, 129
  describing, 102–104
  dimming, 231
  linear, 83
  shapes and sizes, 94, 95
Fluorescent strips, 151
Flynn, John, 59–62
Focal glow, 11
Foot candle (fc), 246
Foot-lambert (fL), 247
Formality, impressions of, 59–62
Forward phase dimming, 229–230
Fovea, 50
Full-spectrum lighting, 284

G
GBI (Green Building Initiative), 274
General contractor (GC), 164
General diffuse lighting, subjective
  impressions and, 62
General (ambient) lighting, 13
G lamps, 92, 93
Glare, 73–76, 285
Glaucoma, 50
Glazing, 171
Green Building & Design, 291

Green Building Initiative (GBI), 274
Green Globes, 274–275
Guidelines for Specification Integrity (LIRC), 210

H
Halogen lamps, 81
  bases, 97
  describing, 100–102
  shapes and sizes, 92–95
Harmonics, 231
Health, 281–285
  aging eyes, 284–285
  biological rhythms, 281–283
  and daylighting, 168
  harmful effects of light, 284
  light deficiency and light therapy, 283–284
  resources, 285
Heat sink (LEDs), 87
Height, impressions of, 64, 65
Helmholtz, Hermann von, 51
Helmholtz-Kohlrausch Effect, 132
High intensity discharge (HID) lamps, 84–86
  bases, 98
  describing, 103
  shapes and sizes, 93, 94, 97
Hot restrike, 85
Housing (luminaires), 142
Hue, 123
Hunt Effect, 132
Huygens, Christiaan, 37, 39
Hyperopia, 50

I
IALD (International Association of Lighting
  Designers), 3–5, 287
IBC (International Building Code), 266
ICC, see International Code Council
Icon, 290–291
IECC (International Energy Conservation
  Code), 269
IES, see Illuminating Engineering Society
IgCC (International Green Construction Code), 266–267
Illuminence:
  defined, 245
  units for measuring, 246–247
  with windows, 175
Illuminance calculations, 248–262
  lumen method, 253–259
  point method, 248–253
  software for, 258, 260–262
Illuminating Engineering Society (IES), 4, 247–248, 267, 268, 287
Illumination, light as, 37–38
Illumination levels, 247–248, 284–285
Impressions, 58–65
  defined, 58
  and room lighting, 59–65
Incandescent lamps, 79–81
  bases, 97
  describing, 100–102
  shapes and sizes, 92–95
Index of refraction, 69
Indirect distribution, 77
Indirect lighting, subjective impressions and, 61, 62
Induction/induction discharge lamps, 88–89
Information:
  consumer information on lamps, 106, 107
  gathering, for design, 8–9
  on luminaires, 141, 161, 163–165
  in manufacturer’s literature, 158–161
Initial lumens, 256
Installation, see Detail drawings
Instant start electronic ballasts, 85
Insulating properties, of glazing, 171
Intensity, 9–10. See also Brightness
Interior designers:
  as lighting designers, 2
  preliminary design information from, 8–9
International Association of Lighting Designers (IALD), 3–5, 287
International Building Code (IBC), 266
International Code Council (ICC), 266, 269, 275
International Commission on Illumination (CIE), 112–114, 288
International Dark-Sky Association, 267, 288
International Energy Conservation Code (IECC), 269
International Green Construction Code (IgCC), 266–267
Inter-reflection, 71
Intrinsically photosensitive retinal ganglion cell (ipRGC), 281
Iris (eye), 48, 49

J
Johnson, Philip, 10

K
Kahn, Louis I., 10
Kelly, Richard, 1, 10–13, 20
Kelvin, Lord William Thomson, 111, 245
Kelvin scale, 111
Kerouac, Jack, 109
Kincaid, Jamaica, 67
Kruithof, A. A., 114
Kruithof Curve, 114

L
Lamps, 79–107. See also individual types of lamps
  bases, 96–98
  beam angle, 99–100
  cold cathode, 89
  consumer information on, 106, 107
  defined, 67
  describing, 100–104
  directional, 93–94
  field angle, 99, 100
Lamps (continued)
fluorescent, 82–84, 102–104
halogen, 81, 100–102
high intensity discharge, 84–86, 103
incandescent, 79–81, 100–102
induction/induction discharge, 88–89
light emitting diode, 86–89, 103–104
light emitting plasma, 91
omnidirectional, 91–93
organic light emitting diodes, 89, 90
resources, 106–108
selecting, 104–106
shapes, 91
sizes, 94–97
Lamp bases, 96–98
Lamp burnout factor (LBO), 257
Lamp lumen depreciation factor (LLD), 256
Lamp shapes, 91
Lamp sizes, 94–97
Language, descriptive, 19–20
Layering light, 16–18
Layout (luminaires). See also Detail
drawings
process for creating, 192–198
in reflected ceiling plan, 190–191
LBO (lamp burnout factor), 257
LC (Lighting Certified) credential, 4–5
LD+A, 289
LDD (luminaire dirt depreciation factor), 256–257
Leadership in Energy and Environmental
Design (LEED), 273–274
Le Corbusier, 1
LEDs, see Light emitting diodes
LEED (Leadership in Energy and
Environmental Design), 273–274
Leukos, 289
Life-cycle cost analysis, 276–277
Light, 1, 37–45. See also Psychology of
light and vision
accent, 13
and aging eyes, 284–285
ambient, 13
amount required, 247–248
as art, 41, 44, 45
design elements of, 9–10
on electromagnetic spectrum, 39
harmful effects of, 284
as illumination, 37–38
interaction of materials and, 67–72
Kelly’s forms of lightplay, 10–13
layers of, 16–18
as material, 38–39
as particles, 39–41
as rays of vision, 38
resources, 45
and shadow, 13–14
task, 13
as a tool, 43
units for measuring, 246–247
as waves, 39–43
Light control, 105
Light deficiency, 283–284
Light emitting diodes (LEDs), 86–88
colored light from, 127–128
colors of, 104
descrating, 103–104
measuring life and output of, 89
organic, 89, 90
shapes, 92
Light emitting plasma (puck), 91
Lighting and Color Group, National
Institute for Standards and
Technology, 117
Lighting Certified (LC) credential, 4–5
Lighting controls, 139, 225–242
advanced features, 239–240
basic, 228–232
centralized systems, 235–236
commissioning, 242
control protocols, 237–239
dimmers, 228–232
dimming systems, 233–237
distributed systems, 236–237
documenting, 240–242
and electricity/electrical engineering, 225–227
intermediate, 232–235
large-scale systems, 235–237
need for, 227–228
photocells, 235
resources, 242–243
switches, 228
Lighting design, 7–34
aesthetic designs, 26–30
architecture in, 15–16
communicating ideas for, 17, 20–22
conceptual designs, 30–33
gathering relevant information for, 8–9
goal of, 7–8
layers of light in, 16–18
light in, 9–14
luminaires in, 14–15
phases of, 179–182
pragmatic designs, 22–25
process of, 7
resources, 34
Lighting designers, 1–5
luminaire information for, 161, 163
professional credentials, 4–5
resources, 5–6
scope of practice, 2–3
Lighting fixtures, see Luminaires
Lighting Industry Resource Council (LIRC), 210
Lighting plan, see Reflected ceiling plan (RCP)
Lighting power density (LPD), 268
Lighting & Sound America, 290
Lighting submittals, 182
Light level recommendations, 247–248, 284–285
Light loss factors (LLFs), 255–258
Light output, 104–105
Light pipes, 172, 174
Lightplay, 10–13
Light shelf, 175–176
Light therapy, 283–284
Light trespass, 267
Linear fluorescent lamps, 83
bases, 98
colored light from, 127, 129
describing, 102–103
shapes and sizes, 94, 95
Line (linear) sources, 15
LIRC (Lighting Industry Resource Council), 210
LLD (lamp lumen depreciation factor), 256
LLFs (light loss factors), 255–258
lm (lumen), 80, 246
Louvers:
luminaires, 143, 144
in sidelighting, 176
Low voltage lamps, 82, 83
LPD (lighting power density), 268
Lumens (lm), 80, 246
Lumen method (illuminance calculation), 253–259
Luminaires, 141–165
accessories, 154–156
components of, 142–144
cove lights, 151
custom, 161, 162
defined, 67
designations for, 188–189
downlights, 144–145
fluorescent strips, 151
information on and sales of, 161, 163–165
with LEDs, 104
in lighting design, 14–15
modifying, 161
mounting conditions, 154, 156–157
outdoor, 157–158
reading manufacturer’s literature on, 158–161
recessed adjustable or accent, 145, 146
Luminaires (continued)
resources, 165–166
selecting, 141
and shadows, 72–73
symbols for, 183, 185–188
theatrical, 152–154
track, 147–150
wall grazers, 147
wall washers, 145–147
Luminaire cut sheets, 158–161, 199–207
Luminaire dirt depreciation factor (LDD),
256–257
Luminaire schedule, 189, 199. See also
Fixture schedule
Luminance:
defined, 245
units for measuring, 246
Luminous ceilings:
detail drawings, 221–222
impressions from, 6, 65
Lux (lx), 247

M
Maintained illuminance, 255
Maintenance requirements, 105
MasterFormat, 209
Material(s):
diffusers, 69–70
interaction of light and, 67–72
light as, 38–39
reflectance of, 68
surface reflection and absorption,
71–72
transmittance of, 71
Matte surfaces, 68
Maxwell, James Clerk, 41, 43
Meanings, associated with color,
132–133
Measurement units, 246–247
Melatonin, 282
Mesopic vision, 51
Metal halide (MH) lamps, 84–85
Metamers, 104
Metamerism, 118–119
MH (metal halide) lamps, 84–85
Mies van der Rohe, Ludwig, 10
The Milkmaid (Vermeer), 42, 44
Mirrored louver systems, 176
MLO (Model Lighting Ordinance), 267
Mock-ups, 20, 22, 248
Model codes, 265–269
building codes, 266–267
energy codes, 267–269
Model Lighting Ordinance (MLO), 267
Mondo ARC, 289–290
Monet, Claude, 58
Mounting conditions (luminaires), 154,
156–157
Movement, as element of light, 10
MR lamps, 93, 94
Myopia, 50

N
Nadir, 249
National Association of Home Builders
(NAHB), 275
National Council on Qualifications for
the Lighting Professions (NCQLP),
4, 288
National Electrical Manufacturers
Association (NEMA), 100
National Electric Code (NEC, NFPA 70),
227, 265, 267
National Fire Protection Association
(NFPA), 265, 267
National Green Building Standard (NGBS),
275–276
National Institute for Standards and
Technology (NIST) Lighting and Color
Group, 117
NCQLP (National Council on Qualifications
for the Lighting Professions),
4, 288
NEC, see National Electric Code
NEMA (National Electrical Manufacturers Association), 100
Neon lamps, colored light from, 127
Newton, Sir Isaac, 40
NFPA (National Fire Protection Association), 265, 267
NFPA 70, see National Electric Code
NGBS (National Green Building Standard), 275–276
Nightingale, Florence, 281
NIST Lighting and Color Group, 117
Nizer, Louis, 141

O
Occumancy sensors, 231–232
OLEDs (organic light emitting diodes), 89, 90
Omnidirectional lamps, 91–93
Opaque, 70
Optics and Catoptics (Euclid), 38
Optiks (Sir Isaac Newton), 40
Organic light emitting diodes (OLEDs), 89, 90
Ott, John, 284
Outdoor luminaires, 157–158
Outlets, symbols for, 188
Overhead diffuse lighting, subjective impressions and, 61
Owner, preliminary design information from, 8

P
PAR lamps, 93, 94
PAR luminaires, theatrical, 153
Particles, light as, 39–41
Payback, 278
Pei, I. M., 10
Pendant luminaires, 154, 157, 187, 188
Perception, 57–58
of brightness, 54, 55, 130–132
colored light and, 130–132
relative vs. absolute, 54–55
schemas in, 58
Perceptual clarity, impressions of, 59–62
Perimeter lighting, subjective impressions and, 60
Photocells, 235
Photometrics, 245–262
amount of light required, 247–248
illuminance calculations, 248–262
resources, 262, 263
terms describing brightness, 245
units for measuring light, 246–247
Photometric files, 262
Photons, 41
Photopic vision, 51–53
P lamps, 92, 93
Planck, Max, 41, 44
Plane sources, 15
Planning, for daylighting, 168–170
PLASA, 117
Plastic color filters, 128
Play of brilliants, 11–13
Point method (illuminance calculation), 248–253
Point sources, 14
“Pop-up “roof monitors, 174
Porsche, Ferdinand A., 7
Power supplies, 227
Pragmatic designs, 22–25
criteria for, 23
multimedia conference room case study, 23–25
Presbyopia, 50
Primary colors, 122, 123
Primary light sources, 47
Privacy, impressions of, 64, 65
Professional credentials, 4–5
Professional Lighting Design, 290
Professional organizations, 3, 287–288
Programmed start electronic ballasts, 85, 86
Programming phase, 168, 179–180
Protocols, lighting control, 237–239
PS lamps, 92, 93
Psychology of light and vision, 57–65
  impressions, 58–65
  perception, 57–58
  resources, 66
Ptolemy, 38
Puck (light emitting plasma), 91
Pupil (eye), 48, 49
Purkinje effect/Purkinje shift, 53
Purkyne, Johannes Evangelista, 53

Q
Quality of light, 105
Quanta, 41

R
Rapid start electronic ballasts, 85
Rays of vision, light as, 38
RCP, see Reflected ceiling plan
RCR (room cavity ratio), 254–255
RDM (remote device management), 237–238
Recessed adjustable luminaires, 145, 146
Recessed luminaires, 154, 156
Recommended Practices (IES), 248
Reflectance:
  defined, 245
  units for measuring, 247
Reflected ceiling plan (RCP), 183–198
developing, 190–198
  symbols on, 186–189
Reflected glare, 73–75
Reflection, 67–68
  surface, 71–72
  and vision, 47, 48
Reflectors, 143, 144
Reflector factor (RF), 258
Refraction, 69, 70
Relaxation, impressions of, 64
Relays, 235
Remote device management (RDM), 237–238
REScheck, 270
Resistance (electrical), 227
Resistance dimming, 229
Retina, 48, 49
Return on investment (ROI), 278
Reverse phase dimming, 230
RF (reflector factor), 258
Ri (Special CRI), 116
R lamps, 93, 94
Rods (eye), 48–52
ROI (return on investment), 278
Romeo and Juliet (Shakespeare), 19
Roof monitors, 172, 174
Room cavity ratio (RCR), 254–255
RS232 protocol, 238

S
Saarinen, Eero, 10
SAD (Seasonal Affective Disorder), 283
Salespeople:
  as lighting designers, 2
  luminaire information from, 163–164
Scallops:
  detail drawings, 219–221
  spacing for, 210
Schemas, 58
Schematic design (SD) phase, 168, 180
SCN (suprachiasmatic nucleus), 281, 282
Sconces, symbols for, 187, 188
Scope of practice, 2–3
Scotopic vision, 51–53
SD (schematic design) phase, 168, 180
Seasonal Affective Disorder (SAD), 283
Secondary colors, 122–123
Secondary light sources, 47–48
Semi-direct distribution, 76
Semi-indirect distribution, 77
Semi-recessed luminaires, 154, 156
Semi-specular surfaces, 67, 68
Serotonin, 282
Shade (color), 123, 124
Shading strategies, 176, 177
<table>
<thead>
<tr>
<th>Page</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>319</td>
<td>Overview of Lighting Design and Applications</td>
</tr>
<tr>
<td></td>
<td>Shadows: and luminaires, 72–73</td>
</tr>
<tr>
<td></td>
<td>for variety and contrast, 13–14</td>
</tr>
<tr>
<td></td>
<td>Shakespeare, William, 19</td>
</tr>
<tr>
<td></td>
<td>Shielding angle, 75</td>
</tr>
<tr>
<td></td>
<td>Shop drawings, 182</td>
</tr>
<tr>
<td></td>
<td>Shutters, 176, 177</td>
</tr>
<tr>
<td></td>
<td>Sidelighting, 172, 174–176</td>
</tr>
<tr>
<td></td>
<td>Sight, see Vision</td>
</tr>
<tr>
<td></td>
<td>Sine wave dimming, 230, 231</td>
</tr>
<tr>
<td></td>
<td>Site visits, 182</td>
</tr>
<tr>
<td></td>
<td>Size of object, visual performance and, 53</td>
</tr>
<tr>
<td></td>
<td>Sketches, 20</td>
</tr>
<tr>
<td></td>
<td>Skin cancer, 284</td>
</tr>
<tr>
<td></td>
<td>Skin diseases, 283</td>
</tr>
<tr>
<td></td>
<td>Skyglow, 267</td>
</tr>
<tr>
<td></td>
<td>Skylights, 168, 172, 174</td>
</tr>
<tr>
<td></td>
<td>Sleep disorders, 285</td>
</tr>
<tr>
<td></td>
<td>Socket (luminaires), 143</td>
</tr>
<tr>
<td></td>
<td>Solar angles, 169–170</td>
</tr>
<tr>
<td></td>
<td>Solar heat gain, 171</td>
</tr>
<tr>
<td></td>
<td>Solid state lighting (SSL), 89, 90</td>
</tr>
<tr>
<td></td>
<td>Space-by-space method (LPD), 268</td>
</tr>
<tr>
<td></td>
<td>Spacing criteria, 190</td>
</tr>
<tr>
<td></td>
<td>Spaciousness, impressions of, 59–63, 65</td>
</tr>
<tr>
<td></td>
<td>Spatial complexity, impressions of, 59–62</td>
</tr>
<tr>
<td></td>
<td>SPD, see Spectral power distribution curve</td>
</tr>
<tr>
<td></td>
<td>Special CRI (Ri), 116</td>
</tr>
<tr>
<td></td>
<td>Specifications, 209–210</td>
</tr>
<tr>
<td></td>
<td>Spectral colors, 109</td>
</tr>
<tr>
<td></td>
<td>Spectral power distribution curve (SPD), 110, 113–115, 119</td>
</tr>
<tr>
<td></td>
<td>Specular surfaces, 67, 68</td>
</tr>
<tr>
<td></td>
<td>SSL (solid state lighting), 89, 90</td>
</tr>
<tr>
<td></td>
<td>Standards for Accessible Design, 267</td>
</tr>
<tr>
<td></td>
<td>Striplights, 153–154</td>
</tr>
<tr>
<td></td>
<td>Substitutions, 165</td>
</tr>
<tr>
<td></td>
<td>Subtractive mixing, 125, 126</td>
</tr>
<tr>
<td></td>
<td>Suprachiasmatic nucleus (SCN), 281, 282</td>
</tr>
<tr>
<td></td>
<td>Surface mount, 154, 157</td>
</tr>
<tr>
<td></td>
<td>Surface reflection and absorption, 71–72</td>
</tr>
<tr>
<td></td>
<td>Sustainability, 273–278</td>
</tr>
<tr>
<td></td>
<td>life-cycle cost analysis, 276–277</td>
</tr>
<tr>
<td></td>
<td>payback, 278</td>
</tr>
<tr>
<td></td>
<td>resources, 278–279</td>
</tr>
<tr>
<td></td>
<td>voluntary energy programs, 273–276</td>
</tr>
<tr>
<td></td>
<td>Swan, Sir Joseph, 79</td>
</tr>
<tr>
<td></td>
<td>Switches, 228</td>
</tr>
<tr>
<td></td>
<td>layout for, 240, 241</td>
</tr>
<tr>
<td></td>
<td>symbols for, 188</td>
</tr>
</tbody>
</table>

**T**

Table lamps, symbols for, 187, 188

Task lighting, 13

Theatrical luminaires, 152–154

Thoreau, Henry David, 57

Time of day events, 239

Tint, 123, 124

T lamps, 92, 93

Tone, 123, 124

Tool, light as, 43

Toplighting, 172–174

Track, 147

Track luminaires, 147–150, 186

Trade publications, 289–291

Transformers, 82, 83

Translucent, 70

Transmission, 70–71

Transparent, 70

A Treatise on Electricity and Magnetism (James Clerk Maxwell), 41

Treatise on Light (Christiaan Huygens), 39

Trichromatic theory of vision, 51

Tvis (visible light transmittance), 171

**U**

Ultraviolet (UV) light, 82, 83, 283, 284

U.S. Environmental Protection Agency, 275

United States Green Building Council (USGBC), 266–268, 273

Users:

benefits of daylighting for, 167–168

preliminary design information from, 8
USGBC (United States Green Building Council), 266–268, 273
UV light, see Ultraviolet light

V
V (volt), 225
Vacancy sensors, 231
Value (color), 123
Variety, light and shadows for, 13–14
Veiling reflections, 73–75
Vermeer, Johannes, 42, 44
VF (voltage to luminaire factor), 257
Viewing time, visual performance and, 53
Visible light transmittance (VT, Tvis), 171
Vision, 47–55. See also Psychology of light and vision
   aging eyes, 284–285
   brightness perception, 130–132
   color, 51–53
   colored light and, 130–132
   defined, 57
   eye, 48–51
   path of light, 47–48
   quality of, 247
   resources, 55–56
   visual performance, 53–55
Visual acuity, 47
Visual clarity, impressions of, 62, 63
Visual interest, created with light, 2–3
Visual Merchandising and Store Design (VMSD), 291
Visual performance, 53–55
Visual tasks, light for, 2
Vitamin D deficiency, 283
VMSD (Visual Merchandising and Store Design), 291
Volt (V), 225
Voltage to luminaire factor (VF), 257
Voluntary energy programs, 273–276
VT (visible light transmittance), 171

W
W (watt), 80
Walls, illuminating, 16, 17
Wall box dimmers, 228
Wall grazers, 147
Wall grazing:
   detail drawings, 212–213
   and subjective impressions, 61, 62
   for variety/contrast, 14
Wall washers, 145–147, 186–187
Wall washing, detail drawings for, 210–212
Warm colors, 124, 131
Watt (W), 80, 226
Waves, light as, 39–43
Wavelength, 39, 40
White light, 109
   color temperature, 109–113
   and visual system, 112
Windows, 174–176
A Work on Optics (Ptolemy), 38

Y
Young, Thomas, 37, 40–42, 51