

Index

A

Accessibility analysis, 257–258

Accessories:

for curtain walls and storefronts, 289

for doors, 248, 253, 254

as tertiary component, 71–72

for windows and skylights, 238, 240

Acoustic properties, 421–422

ADA compliance, 250, 257–258

Addition, creating solids by, 89

Air, properties of, 407

Alignment constraint, 34

Amperage, 331

Angle parameter, 26

Annotations, 6–7, 349–362

cross-reference, 354

as function of material, 102

graphics for, 353–355

information in, 356–361

level of detail in, 350

purpose of, 352

specialized, 352, 353

use of information in, 361–362

for windows and skylights, 239

Appearance. *See also* Rendering

of materials, 60, 101–102,

110–113

of moveable furnishings, 298

of spiral stairs, 272

Application information, 131–132

ARCAT.com, ix

ARCAT SpecWizard, 180

Architectural elements, graphics

of, ix

Archivision, 298

ArchVision, 338

Area dimensions, 398–399

Area parameter, 26

Artificial light, 317–318

As-built models, 185

Assemblies, *see* BIM assemblies

Attributes, 8–9, 23–27

component-specific, 122

in construction documentation, 30–32

for curtain walls and storefronts, 290–291

doors, 254–255

for fixtures and fittings, 302–304

for floors and ceilings, 224–227

instance, 148–149

MasterFormat categories for, 124

- Attributes (*continued*)
- of materials, 100–105
 - for model analysis and leveraging
 - of model, 29–30
 - project-level, 136
 - of roofs, 212–214
 - of site and landscape
 - components, 345
 - in specifications, 180–181
 - structural, 102–103
 - taxonomy for, 123
 - type, 148
 - for walls, 198–201
 - for windows and skylights, 240–243
- B**
- Ballasts, light, 313
- Base flashing, 207–208
- Basement slabs, 339, 340
- Basis of design, 184
- Bath fixtures and fittings, 293, 294, 296–297. *See also* Fixtures and fittings
- Bearing walls, *see* Walls
- Benches, 337, 338
- Bidding phase:
 - knowledge management in, 157
 - knowledge manager's involvement in, 161
- Bidirectional annotations, 353
- Bid review, 183–185
- BIM, *see* Building information management; Building information modeling
- BIM assemblies, 14, 62–64. *See also specific types, e.g.:* Walls
- in content hierarchy, 18–21
 - data and product information for, 20–21
 - details of, 67–68
 - graphics for, 19–20
 - layers of, 62
 - materials used within, 60
- BIM components, 59–74
- assemblies, 62–64
 - assigning attributes to, 8
 - contextual representation of, 77–79
 - details, 67–68
 - finding information on, 21–22
 - implementing, 68–72
 - information contained in, 72–73
 - materials, 60–62, 101
 - in multiples or arrays, 79
 - naming conventions for, 73–74
 - nested, 144–146
 - objects, 64–67
 - primary, 68–69
 - quality control procedures for, 143–146
 - representative vs. realistic modeling of, 86–89
 - secondary, 68–70
 - shared, 146
 - stand-alone, 64–65
 - tertiary, 68, 71–72
- BIM data, 121–139. *See also* Information
- accountability for
 - maintaining, 142
 - dimensional, 127–128
 - identification, 128–129
 - inside BIM materials, 100
 - installation/application, 131–132
 - management and maintenance, 133–134
 - merging into graphics, 150–151
 - methods of data entry, 134–136
 - organizing, 170–177
 - performance, 129–131
 - quality of, 141–142. *See also* Quality control
 - review of, 146–149
 - specification, 134
 - sustainability/usage, 132–133
 - types to add, 126–134
 - usage of, 136–139
- BIM-lite, 119
- BIM materials, 60–62, 99–113
- adding attributes into, 101–105
 - appearance and rendering of, 110–113
 - in constellations, 371–372
 - for curtain walls and storefronts, 289–290
 - data located in, 105–110
 - for doors, 253–254
 - for fixtures and fittings, 301–302
 - for floors and ceilings, 222–224
 - for lighting, 314–315
 - for roofs, 211–212
 - for site and landscape
 - components, 343–344
 - for walls, 192, 196–198
 - for windows and skylights, 238–240
- BIM objects, 14, 64–67
- in content hierarchy, 16–21
 - contextual representation of, 77–79
 - data and product information for, 20–21
 - dimensions of, 24, 95–97
 - graphic accuracy of, 70
 - graphics for, 20
 - hosted, 65
 - insertion or origin point of, 93–94
 - levels of detail for, 80–86
 - materials placed within, 62
 - reference lines and planes for, 93–95
 - representative vs. realistic, 86–89
 - solid modeling tools for, 89–93
 - sourcing product information from, 72
 - stand-alone, 64–65
 - tolerances for, 95, 97

- BIM projects:
 in content hierarchy, 21–22
 defined, 21
 as digital representations, xiv
- BIM “warehouse,” 100
- Bitmaps, 111
- Blended solids, 92–93
- Bollards, 341, 346
- Boolean (yes/no) parameter, 26, 35
- BSD SpecLink, 180
- Building, defined, viii
- Building codes, 130
 for roofs, 209, 214
 for stairs, 270
- Building information, defined, viii
- Building information management (BIM), viii
- Building information modeling (BIM), vii–xii. *See also specific topics*
- CAD vs., x–xi, 23
 defined, viii
 definitions used with, viii
 future of, xiv–xx
 and specifications, 30–32
 transition from CAD to, 8–13
 value proposition of, 11
 as whole-building design approach, 3–7
- Building Information Modeling Protocol Exhibit (AIA E202), 80
- Building modeling, viii
- Building products, x
- Bulbs, light, 313
- Bump maps, 111
- C**
- Cabinet constellations, 367–368, 378–379
- Cabinetry, 297, 302–304. *See also* Fixtures and fittings components of, 296 graphics for, 299–300 kitchen, 293–294 as secondary components, 69–70
- CAD, *see* Computer-aided design
- CAD-based projects, BIM projects vs., xiv
- Callouts, 349, 352
 for floors and ceilings, 220–221
 as function of material, 102
 for walls, 192
 for windows and skylights, 239
- Carpet, 227–228
- Casework, 69–70, 293. *See also* Fixtures and fittings
- Catalogs, creating, 150–151
- Cavity walls, 189, 191
- Ceilings, 218–220. *See also* Floors and ceilings
- Chandeliers, 310
- Chemical composition, properties of, 402
- Clash detection, x, 9, 10, 98. *See also* Interference checking
- Clearances, for lighting, 312–313
- Closers, door, 252–253
- Code compliance (roofs), 214
- Colors:
 for fixtures and furnishings, 302
 for floor assembly components, 223
 for glass, 254
 as instance attributes, 148
 for materials, 60
 for materials in assemblies, 100
 for materials in model view, 113
 for roof materials, 211–212
 for wall materials, 197
- Combustion properties, 417–418
- Comments, 129
- Communication identifications, 389
- Communication systems, properties of, 434–435
- Component ceilings, 220
- Component selection, 12. *See also* BIM components
- Compound floors, 218, 219
- Computer-aided design (CAD):
 BIM vs., x–xi, 23
 importing files, 115–119
 original concept of, 8
 transition to BIM from, 8–13
 working in BIM vs., 5
- Conditional statements, 35–36
- Connections (MEP), 324–325, 327–328
- Constellations, 363–381
 building, 364–373
 cabinet, 367–368, 378–379
 defined, 363
 door, 363–364, 367–368, 376–378
 door hardware, 365–366
 drawbacks with, 367
 materials in, 371–372
 quality control for, 373–375
 types of, 376–381
 use of, 367–368
 window, 380–381
- Constellation objects, 67
- Constraints, 33–35
- Construction documentation, using attributes in, 30–32
- Construction documents phase:
 knowledge management in, 156–157
 knowledge manager’s involvement in, 161
- Construction Entities by Form (OmniClass Table 12), 49
- Construction Entities by Function (OmniClass Table 11), 48–49
- Construction phase:
 clashes during, 9
 knowledge management in, 157–158

- Construction phase (*continued*)
 knowledge manager's involvement in, 162
- Construction Specifications Institute (CSI), 22. *See also* MasterFormat; UniFormat
- Content, ix, xiv–xv
 for clash detection, 98
 manufacturer-specific, 141
 ways of looking at, 59–60
- Content hierarchy, 15–22
 BIM assemblies, 18–21
 BIM objects, 16–21
 BIM projects, 21–22
 data and product information, 20–21
 graphics, 19–20
- Content libraries, downloading
 BIM content from, ix
- Contextual representation of objects, 77–79
- Contractors, ix–x, 138–139
- Corrugated panels, for curtain walls and storefronts, 286–287
- Cost estimation, 104
 for fixtures and fittings, 296
 preliminary, 155
 quantity takeoffs vs., 104–105
- Cost information, xi
- Cost properties, 392
- Cross-reference annotations, 354
- CSV files, 150–151
- Curtain, door, 251–252
- Curtain walls and storefronts, 277–292
 anatomy of, 278–281
 attributes, constraints, and equations, 290–291
 creating, 281–285
 doors in, 287–288
 examples, 291–292
 frame/mullions, 283–284
 glazing, 284–285
 graphics for, 283–289
 hardware/accessories, 289
 materials for, 289–290
 panels, 284–287
 as system components, 65, 66
- Curved stairs, 264
- D**
- Data:
 BIM, *see* BIM data
 product, 20, 141
 structural, 109
 up- and downstream usage of, 136–139
- Databases, 180
 creating specifications from, 181
 facility management, 166
- Data entry methods, 134–136
- Data management, ix, xi, 72–75
- Data sets, location of, 135
- Deliverables, 163–166
- Design changes, 157–158, 182
- Design development phase, 156
- Design phase, new documents for, 163
- Design process:
 knowledge management in, 153–156
 parametrics in, 27–29
 whole-building approach to, 3–7
- Design team, 153–154
- Detail(s), 67–68, 349–362
 in annotations, 350, 356–361
 in CAD files, 116–117
 consistent level of, 60
 creating, 349–353
 for door assemblies, 251–252
 for fixtures and fittings, 299
 graphics for, 353–355
 levels of, 87
 reference lines for, 95
 in section views, 350–353
 for site-based components, 337–338, 340–341
 three-dimensional, 351, 352
 in two dimensions, 350–351
 use of information, 361–362
- Detail drawings, 354–355
- Development models, 310
- Devices, MEP, 322
- Diffusers (HVAC), 331–332
- Digital owner's manual, 139, 165–166
- Dimensions, 95–97
 for doors, 248–249, 254–255
 as instance attributes, 148
 for stairs, 270
 for windows and skylights, 233, 240–242
- Dimensional constraints, 34–35
- Dimensional information, 127–128
- Dimension controls, 145
- Dimension parameter, 24–25, 35, 95–96
- Direct-to-fabrication exports, 132
- Disciplines (OmniClass Table 33), 53
- Documentation:
 completeness and accuracy of, 158–159
 construction documents phase, 156–157
 and knowledge management, 155
 new documents and deliverables, 163–166
- Doors, 245–261
 accessories, 253
 anatomy of, 245, 246
 attributes, constraints, and equations, 254–255
 creating, 245, 247–248
 in curtain walls, 281, 287–288
 door schedules, 256–257
 examples, 258–261
 frames, 251

- glazing, 251
 graphics for, 251–253
 hardware, 252–253
 as hosted objects, 65
 materials for, 253–254
 model analysis, 257–258
 performance criteria, 250–251
 size/dimensions, 248–249
 slab/leaf/curtain, 251–252
 use of information, 256–258
- Door constellations, 363–364, 367–368, 376–378
- Door hardware, 71
- Door hardware constellations, 363, 365–366
- Door hardware schedules, 365
- Door schedules, 256–257
- Downstream data usage, 138–139
- Drawing sheets, 178
- Driveways, 339. *See also* Site and landscape components
- Drop ceilings, 218, 222
- Durability properties, 415–417
- Dynamic analysis (lighting), 318, 319
- E**
- Egress analysis, 257
- Egress codes:
 doors, 250
 windows and skylights, 240
- Electrical and wiring systems, 321, 324, 333. *See also* Mechanical, electrical and plumbing (MEP) components
- Electrical fixtures, 303
- Electrical objects, 330–332
- Electrical system properties, 429–432
- Electricity, 331
- Elements (OmniClass Table 21), 50
- Energy codes (windows and skylights), 240
- Energy efficiency (doors), 250
- Energy modeling, for doors, 258
- Energy systems, properties of, 435–436
- Energy usage (lighting), 310
- Engineers, data usage by, 138
- Enumeration, 38–40
- Envelope, properties of, 418–420
- Environmental properties, 410
- Equality constraint, 33–34
- Equations, 35–36, 316
 curtain walls and storefronts, 290–291
 doors, 254–255
 fixtures and fittings, 302–304
 floors and ceilings, 226–227
 lighting/light fixtures, 316
 roofs, 214
 site and landscape components, 345
 stairs and railings, 272–273
 wall assemblies, 200–201
 windows and skylights, 243
- Equipment:
 defined, 322
 as tertiary component, 71–72
- Exit devices (doors), 252–253, 261
- Extruded blends, 93
- Extrusions, 89–90
- F**
- Fabric fences, 268
- Facility identification, 386–387
- Facility management databases, 166
- Facility managers, 162
- Facility services, 422–436
- Faucet fittings, 306
- Feasibility studies, 155
- Fences, 267, 268, 275, 339.
See also Site and landscape components
- Filenames, 74
- Filtering, 124
- Final assembly, quality control for, 150–151
- Finishes:
 for doors, 253–254
 for fixtures and fittings, 299, 301–302
 for floors, 219–220, 222, 223
 as instance attributes, 148
 for site-based components, 343
- Fire hydrants, 341
- Fireproofing, 98
- Fire protection systems, properties of, 423–424
- Fittings, *see* Fixtures and fittings
- Fixed furnishings, 69–70
- Fixtures and fittings, 293–306
 anatomy of, 293–295
 attributes and equations, 302–304
 creating, 295–299
 examples, 304–306
 graphics for, 299–301
 light fixtures, *see* Lighting/light fixtures
 materials and finishes for, 301–302
 MEP, 322
 as secondary components, 69–70
- Fixture units (plumbing), 329
- Flashing:
 for roofs, 206–209
 for windows and skylights, 232–233
- Floors and ceilings, 217–230
 anatomy of, 218–219
 attributes, constraints, and equations, 224–227
 creating, 219–221
 in early design stages, 4, 5
 examples, 229–230
 graphics for, 221–222
 layers of, 63–64
 materials for, 222–224

- Floors and ceilings (*continued*)
 as primary components, 68–69
 use of information, 227–228
- Fluorescent light fixtures, 308, 309
- Force, properties of, 408–409
- Formats, *see* Standards and formats
- Fountains, 341
- Frames:
 doors, 251
 windows and skylights, 231,
 234–236, 239
- Framed walls, 189, 190
- Framing:
 for curtain walls and storefronts,
 277–278, 281, 283–284,
 286, 292
 for floors, 221
 for roofs, 206
 for walls, 190
- Function properties, 412–413
- Furnishings:
 as fittings, 297–298
 moveable, 71–72, 298
 as secondary components, 69–70
 as tertiary component, 71–72
- G**
- Gases, properties of, 407
- General contractors:
 data usage by, 138, 139
 knowledge management role of,
 154–155
- Geographic locations, 389
- Glass:
 for curtain walls and storefronts,
 289
 for doors, 251, 254
 for windows and skylights, 232,
 235, 237–238, 240
- Glazing:
 for curtain walls and storefronts,
 280, 284–285
 for doors, 247, 251
 for windows and skylights, 235,
 237–238
- Graphics, 11–12
 accountability for
 maintaining, 142
 accuracy of, 70
 in BIM vs. CAD, x–xi
 for clash detection, 98
 for constellation host
 components, 368, 369
 in content hierarchy, 19–20
 for curtain walls and storefronts,
 283–289
 for doors, 251–253
 for fixtures and fittings, 298–301
 for floors and ceilings, 221–222
 information contained in, 24
 for lighting, 310–314
 merging data into, 150–151
 of models, ix
 quality control of, 143–146
 representative vs. realistic,
 86–89
 responsibility for, 179–180
 for roof coverings, 211
 for roofs, 210–211
 for site and landscape
 components, 340–343
 for walls, 194–196
 for windows and skylights, 232,
 234–238
- Grasses, 344, 347
- Grilles (windows), 238
- Guardrails, 269
- Gypsum board (ceilings), 218–219
- Gypsum wallboard, 190, 192, 193
- H**
- Hand dryers, 65, 97, 305
- Handrails, 269
- Hardware:
 for curtain walls and storefronts,
 286, 289
 for doors, 247, 248, 252–254,
 289
 for windows and skylights,
 232–233, 238, 240
- Hatch patterns, 111–113
 for floors, 223
 for walls, 194, 195
- Heating, ventilation, and air
 conditioning (HVAC), 321,
 324, 327, 335. *See also*
 Mechanical, electrical and
 plumbing (MEP) components
- Hierarchy:
 of MasterFormat, 41–44
 for organizing BIM data,
 171–177
 of UniFormat, 46–47
- Hinges, door, 253
- Host-based components, 326, 368
 dimensions with, 371
 graphics for, 368, 369
 insertion points for
 subcomponents, 370–371
 installing components, 372
- Hosted objects, 65
- HVAC, *see* Heating, ventilation,
 and air conditioning
- HVAC objects, 331–333
- HVAC systems, properties of,
 424–428
- Hyperlink parameters, 27
- I**
- Identification information, 128–129
- Identification properties, 383–389
- Image files, 110–111
 for metal finishes, 302
 for site-based components, 343
 for walls, 194
 for windows and skylights, 239
- Implementation, quality control for,
 151–152
- Importing CAD files, 115–119

- Incandescent light fixtures,
308, 309
- Index of refraction, 315
- Infill:
for curtain walls and storefronts,
278, 279, 283, 285
for railings, 265–268
- Information. *See also* BIM data
application, 131–132
contained in BIM components,
72–73
dimensional, 127–128
early addition of, 72–73
hierarchies of, 38–40. *See also*
Content hierarchy
identification, 128–129
inside BIM materials, 100,
105–110
installation, 131–132
leveraging, *see* Leveraging
information
limiting amount of, 105–106
maintenance, 133–134
management, 133–134
in models vs. specifications, 122
performance, 129–131
quality of, *see* Quality control
responsibility for, 180
specification, 134
standardization of, 37. *See also*
Standards and formats
sustainability, 132–133
usage, 132–133
- Information (OmniClass Table
36), 55
- Information management, ix,
8–9, 159
- Information modeling, viii
- Insertion points, for constellation
subcomponents, 370–371
- Installation information, 131–132
- Installation properties, 396–397
- Instance attributes, 148–149
- Insulation:
for floors and ceilings, 223, 224
in roof systems, 210
for wall assemblies, 196–198
- Integer parameter, 27, 35
- Integrated automation systems,
properties of, 428–429
- Integrated project delivery (IPD), 7,
154–155
- Interference checking, x, 98. *See also*
Clash detection
- J**
- Jambs, door, 248–249
- K**
- Keynoting, 356–357, 361
- Kickplates, 253
- Kitchen cabinetry, 293–294. *See also*
Fixtures and fittings
- Knobs, door, 252
- Knowledge management,
153–166
in bidding phase, 157
in construction documents phase,
156–157
in construction phase,
157–158
defined, 153
in design development
phase, 156
and documentation, 155
general contractors' role in,
154–155
and knowledge managers,
159–163
new documents and deliverables,
163–166
responsibility for, 159
in schematic design phase, 156
specifiers' role in, 153–154
- Knowledge managers, 154,
159–163
- L**
- Landings, stair, 264
- Landscaping, 338–339. *See also*
Site and landscape components
- Layers:
floor assemblies, 223
roofs, 211–212
wall assemblies, 195–197
- Leader, 352
- Leader heads, 354
- Leader lines, 354
- Leadership in Energy Efficient
Design (LEED), 103, 104,
132–133
- Leaf, door, 251–252
- LED lighting, 308
- LEED, *see* Leadership in Energy
Efficient Design
- Length parameter, 24–26
- Levels of development (LODs),
80–86, 88–89
100, 80, 81
200, 80, 82, 89
300, 82–86, 89
406, 83–85
500, 85, 88
- Levers, door, 252
- Leveraging information:
for doors, 256–258
for floors and ceilings, 227–228
for lighting, 316–319
for roofs, 214–215
for walls, 201–202
- Lifecycle information, 109
- Light, 307, 312
- Lighting/light fixtures, 307–320
anatomy of, 308–309
attributes and equations,
315–316
creating, 309–311
examples, 319–320
graphics for, 310–314
information for, 303

- Lighting/light fixtures (*continued*)
- lighting schedules, 316–317
 - lighting studies, 317–319
 - materials for, 314–315
 - use of information, 316–319
- Lighting schedules, 316–317
- Lighting studies, 317–319
- Lighting systems, properties of, 432–434
- Light sources, 312
- Light transmission, 233
- Liquids, properties of, 407
- Location(s), 17
- consistency of, 144, 145
 - of data sets, 135
 - of fixtures and furnishings, 298
 - in lighting studies, 318
- Location constraint, 34
- Location properties, 389–390
- Lockers, 300, 301
- LODs, *see* Levels of development
- Long-form specifications, 183
- Low-slope roofs, 205–206, 208–209, 215
- M**
- Magnetism, properties of, 410
- Maintenance information, 133–134, 258
- Management, defined, viii
- Management information, 133–134
- Manufacturers:
- construction details created by, 116
 - downloading BIM content from, ix
 - product attribute information from, 30
- Manufacturer properties, 393
- Manufacturing locations, 390
- Mass, properties of, 407–408
- MasterFormat, 38, 41–44, 124 for BIM, 169
- depth of information
- organization, 168
- evolution of, 46
- groups, subgroups, and divisions, 42–43
- in naming materials, 106, 107
- Table 22 – Work Results as, 50–51
- Materials. *See also* BIM materials
- as construction parameters, 24
 - properties of, 16, 55–56
- Materials (OmniClass Table 41), 55–56
- Material attributes, 24, 25
- Material controls, 145
- Mechanical, electrical and plumbing (MEP) components, 321–335
- anatomy of, 321–323
 - creating, 323–327
 - electrical objects, 330–331
 - examples, 333–335
 - graphics and connections, 327–333
 - HVAC objects, 331–333
 - plumbing objects, 328–330
- Mechanical elements, graphics of, ix
- MEP components, *see* Mechanical, electrical and plumbing components
- Mesh fences, 268
- Metal finishes, 302
- Models:
- analysis and leveraging of, 29–30
 - as-built, 185
 - Building Information Modeling Protocol Exhibit, 80
 - cost information in, xi
 - embedding performance data into, xiv
 - as part of construction contract, 141
 - phasing, x
 - product, x–xi
 - product information and formatting in, ix
 - updating, 6, 185
- Model analysis, 29–30, 257–258
- Model information, 122
- Modeling:
- defined, viii
 - representative, 86–89, 311
 - two- vs. three-dimensional, 3–7
- Model view, 113
- Moisture resistance, properties of, 420–421
- Money properties, 390–392
- Monolithic stairs, 264, 265
- Monolithic walls, 189–190, 192
- Moveable furnishings:
- adding, 298
 - as tertiary component, 71–72
- Mulled windows, 232
- Mullions, 278, 280, 283–285, 289
- Muntins, 232, 238, 247
- N**
- Naming conventions:
- for BIM components, 73–74
 - consistency of, 144, 145
 - for materials, 60–61, 106–108
 - standards and formats for, 40
- National CAD Standard, 106
- Natural light, 317
- Nested components, 144–146
- Nonparametric objects, 116, 119–120
- Nosing (stairs), 268, 270, 271
- Number parameter, 26, 35
- O**
- Objects. *See also* BIM objects
- constellation, 67
 - nonparametric, 116, 119–120
 - semi-parametric, 119–120

- Occupancy identifications, 387
- Office master, 180
- OmniClass, 40, 47–57
 benefits of, 168
 for BIM, 169–177
 Table 11 – Construction Entities by Function, 48–49
 Table 12 – Construction Entities by Form, 49
 Table 13 – Spaces by Function, 49–50
 Table 14 – Spaces by Form, 49–50
 Table 21 – Elements, 50
 Table 22 – Work Results, 50–51
 Table 23 – Products, 51
 Table 31 – Phases, 52
 Table 32 – Services, 52–53
 Table 33 – Disciplines, 53
 Table 34 – Organizational Roles, 53–54
 Table 35 – Tools, 54
 Table 36 – Information, 55
 Table 41 – Materials, 55–56
 Table 49 – Properties, 56–57, 383–436
- One-offs, 119. *See also*
 Nonparametric objects
- Online specification libraries, 180
- Openings. *See also* Doors;
 Windows and skylights
 in curtain walls, 281
 in early design stages, 4, 5
 as primary components, 68–69
 storefronts, 277
- Organizational Roles (OmniClass Table 34), 53–54
- Organizing BIM data, 170–177
- Orientation, 17
 of doors, 249
 in lighting studies, 318
 of windows and skylights, 233–234
- Outline specifications, 182, 183
- Overhead doors, 247, 261
- Owner's manual, digital, 139, 165–166
- P**
- Paint, 104
- Panels (curtain walls and storefronts), 278, 279, 284–287, 289–290, 292
- Panel wall systems, 285
- Parameters, 23–29
 conditional statements for, 35
 for constellations, 371
 constraining, 34–35
 defined, 23
 in nested components, 145
 in speeding up design process, 27–29
 types of, 25–27
- Partitions, 300–301, 304
- Patios, 339
- Paving, 339, 343
- Performance criteria (doors), 250–251
- Performance information, 129–131
 for curtain walls and storefronts, 290–291
 for doors, 255
 for materials/products, 109
 for roof materials, 212
 for windows and skylights, 233, 242–243
- Performance properties, 410–422
- Permeability, properties of, 420–421
- Phases (OmniClass Table 31), 52
- Phasing, project, x
- Photometry, 307, 315–316
- Physical performance (doors), 250
- Physical properties, 397–410
- Pipe penetrations (roofs), 206, 207
- Plans, 349
- Planters, 337, 338, 341
- Planting components, 338–339, 341. *See also* Site and landscape components
- Plug-ins, 9
- Plumbing and piping systems, 321–326, 334. *See also* Mechanical, electrical and plumbing (MEP) components
- Plumbing components, 297, 303. *See also* Fixtures and fittings
- Plumbing objects, 328–330
- Plumbing systems, properties of, 424
- Political/legal locations, 389–390
- Preliminary cost estimates, 155
- Preliminary project document, 155–156
- Pressure, properties of, 409–410
- Primary components, 68–69
- Process automation, specifications for, 177–178
- Products:
 researching, 13
 selecting, 179
- Products (OmniClass Table 23), 51, 106, 170
- Product data/information:
 for objects or assemblies, 20–21
 quality of, 141
- Product lifespan information, 110
- Product locations, 390
- Product models, x–xi
- Product properties, 393–395
- Profiles, 92, 278, 284
- Progress drawings, 356
- Projects. *See also* BIM projects
 BIM vs. CAD-based, xiv
 phasing, x
- Project delivery, 7, 154–155
- Project manual, 163

- Project phases:
 knowledge management during, 156–158
 levels of development for, 80–86
- Properties, 383–384
 of facility services, 422–436
 identification, 383–389
 location, 389–390
 in OmniClass Table 49, 384–436
 performance, 410–422
 physical, 397–410
 source, 393–397
 of time and money, 390–392
- Properties (OmniClass Table 49), 56–57, 383–436
 of facility services, 422–436
 identification, 383–389
 location, 389–390
 performance, 410–422
 physical, 397–410
 source, 393–397
 of time and money, 390–392
- Proprietary identifications, 389
- Push plates, 253
- Q**
- Quality control, 141–152
 for constellations, 373–375
 educating staff on, 152
 for final assembly, 150–151
 of graphics, 143–146
 for implementation, 151–152
 procedures for, 142–152
 and review of data, 146–149
- Quantity properties, 397
- Quantity takeoffs, 104–105, 201–202
- R**
- Railings, 65, 265–268. *See also* Stairs and railings
- Rain screens, 285
- Recessed lights, 310
- Reference lines, 93–95
- Reference planes, 93–94
 for constellations, 368, 369, 371
 to dimension sketches, 96
 named, 144, 145
- Reflectivity of materials, 314
- Refraction, index of, 315
- Registers (HVAC), 331–332
- Regulated content, properties of, 403
- Relational measurements, 399–400
- Rendering, 310
 of BIM materials, 110–115
 of fences, 268
 of floors and ceilings, 222–223
 of stairs, 271
 of walls, 194–196
 of wall surfaces, 193–196
- Repeating patterns:
 for floors and ceilings, 227–228
 for site-based components, 344
- Representative modeling, 86–89, 311
- Retaining walls, 339, 341–342
- Revision control, 129
- Revolutions, 90–91
- Ribbed panels, 286–287
- Risers (stairs), 263, 269, 270
- Roofs, 205–216
 anatomy of, 206–208
 attributes and equations, 212–214
 creating, 208–209
 in early design stages, 4, 5
 examples, 215–216
 graphics for, 210–211
 layers of, 63–64
 low-slope, 205–206, 208–209, 215
 materials for, 211–212
 as primary components, 68–69
 steep-slope, 207–209, 216
 use of information, 214–215
- Roof coverings, 209–211
- Roof flashing, 209
- Rough opening, 249
- R-value (walls), 193
- S**
- Safety and security systems, properties of, 435
- Sash (windows and skylights), 231, 234–235, 239
- Scalable models, 88–89
- Scale, in BIM vs. CAD files, 116
- Schedules:
 defined, 256
 door, 256–257
 lighting, 316–317
- Scheduling properties, 390–392
- Schematic design phase:
 knowledge management in, 156
 knowledge manager's involvement in, 160–161
- Secondary components, 68–70
- Section views:
 level of detail for, 350–353
 for walls, 193
- Semi-parametric objects, 119–120
- Services (OmniClass Table 32), 52–53
- Shading, for soils and grasses, 344
- Shape properties, 398
- Shared components, 146
- Sheathing:
 roofs, 210
 walls, 190, 192, 193
- Shelving, creating, 77–79
- Shipping properties, 396
- Shop drawings, 116
- Single dimensions, 398
- Site and landscape components, 337–347
 attributes and equations, 345
 from CAD files, 118
 creating, 337–340

- detail for, 337–338, 340–341
- examples, 346–347
- graphics for, 340–343
- materials for, 343–344
- site-based components, 340–342
- site improvements, 338
- topography, 342–343
- Size:
 - doors, 248–249
 - stairs, 270
- Size constraint, 34
- Sketches, 90
 - from CAD files, 118
 - dimensioning, 96
- SKU numbers, 126
- Skylights, *see* Windows and skylights
- Slab, door, 247, 251–252
- Slab floors, 218, 219, 221
- Sliding doors, 246
- Slope, floor/ceiling, 221
- Software plug-ins, 9
- Soils, 344
- Solid modeling tools, 89–93
- Sorting, 124
- Sound transmission classification (STC) ratings:
 - doors, 250–251
 - floor and ceiling assemblies, 228
- Source properties, 393–397
- Space identifications, 387
- Spaces by Form (OmniClass Table 14), 49–50
- Spaces by Function (OmniClass Table 13), 49–50
- Span, floor/ceiling, 221
- SpecAttic, 124, 125
- Specialty partitions, as secondary components, 69–70
- Specification(s), 122, 134, 167–186
 - and changes in BIM, 30–32
 - and changes to specifiers' workflow, 181–185
 - creating, 179–181
 - defined, 134
 - long-form, 183
 - organizing BIM data, 170–177
 - outline, 182, 183
 - for process automation, 177–178
 - specifiers' role in, 178–179
 - standards and formats for BIM, 168–170
 - structure of, 178
 - tabular, 157, 163–165
- Specification libraries, 180
- Specifiers:
 - changes to workflow of, 181–185
 - data usage by, 137–138
 - evolving role of, 178–179
 - knowledge management role of, 153–154
 - as knowledge managers, 161–163
 - responsibilities of, 167–168
- Spiral stairs, 264, 265, 269, 271–272, 274
- Square-foot cost estimation, 45, 104
- Stairs and railings, 263–275
 - anatomy of, 263–268
 - attributes and equations, 272–273
 - creating, 268–270
 - examples, 274–275
 - graphics for, 271–272
 - as secondary components, 69–70
 - use of information, 273
- Stand-alone components, 64–65
- Standards and formats, 37–57, 168–170
 - enumeration, 38–40
 - MasterFormat, 41–44
 - OmniClass, 47–57
 - purpose of, 37–40
 - for roof design, 209
 - taxonomy and naming conventions, 40
 - UniFormat, 45–47
- Standardization, in building constellations, 364
- Standardized taxonomy, 37–38, 40, 163
- Static analysis (lighting), 318–319
- STC ratings:
 - doors, 250–251
 - floor and ceiling assemblies, 228
- Steep-slope roofs, 207–209, 216
- Stock materials, 100
- Storage:
 - creating, 77–79
 - information for, 303–304
 - as secondary components, 69–70
- Storefronts, *see* Curtain walls and storefronts
- Strength properties, 413–415
- Stringers (stairs), 263, 268
- Structural attributes, 102–103
- Structural data, for materials, 109
- Structural elements, ix. *See also* Framing
- Structural loading, properties of, 406–407
- Subassembly floors, 219–220
- Subcontractors, data usage by, 138
- Subtraction, creating solids by, 89
- Surface (topography), 342
- Surface patterns:
 - for fences, 268
 - for materials, 60
 - for walls, 194
- Suspended acoustical ceiling tile, 222
- Suspended slab floors, 219
- Sustainability, properties of, 400–402
- Sustainability information, 132–133
- Sweeps, 91–92

- Sweets, ix
Swing doors, 246, 258–260
- T**
- Tabular specification, 157, 163–165
Taxonomy:
 for attributes, 123
 standardized, 37–38, 40, 163
TCNA (Tile Council of North America), 222
Telephone poles, 341
Temperature, properties of, 403–406
Templates, 100, 101
 for constellation
 subcomponents, 369
 for fixtures and fittings, 298–299
 for lighting, 312
Tertiary components, 68, 71–72
Testing properties, 410–411
Test standards, 129–130
Text, annotation, 354
Text parameter, 26
Thermal resistance (walls), 193
Third-party software plug-ins, 9
Thresholds (doors), 253
Tile Council of North America (TCNA), 222
Time properties, 390–392
Toilets, 294. *See also* Fixtures and fittings
Toilet partitions, 293, 304. *See also* Fixtures and fittings
Tolerances, 95, 97
Tolerance properties, 411–412
Tools (OmniClass Table 35), 54
Topography, 342–343. *See also* Site and landscape components
 from CAD files, 118
 creating, 337–340
Translucency, 314–315
Transparency, 314
Trash receptacles, 341, 346
Treads (stairs), 263, 268–270
Tree grates, 341
Tubs, 293, 296, 305
Type attributes, 148
- U**
- UniFormat, 38, 45–47
 for BIM, 169
 depth of information
 organization, 168
 evolution of, 46
Uniform Drawing Standard, 106
United States Green Building Council (USGBC), 103, 132
Updating models, 6, 185
Upstream data usage, 137–138
Usage information, 109, 132–133
Use properties, 412–413
USGBC (United States Green Building Council), 103, 132
- V**
- Value, in specifications, 180–181
Views, 6
Vision lites, *see* Glazing
Voltage, 331
Volume(s):
 in Properties Table, 399
 topography, 342
- W**
- Walls, 189–204. *See also* Curtain walls and storefronts
 anatomy of, 189–192
 attributes and equations for, 198–201
 creating, 192–194
 in early design stages, 4, 5
 examples, 203–204
 graphics for, 194–196
 layers of, 62–63
 materials for, 196–198
 as primary components, 68–69
 use of information, 201–202
Wall-mounted light fixtures, 309–310
Wall studs, 196
“Warehouse,” 100
Warranty properties, 395–396
Water components, 344
Waterproofing, 209–211
Wattage, 331
Weatherstripping:
 for doors, 248, 253
 for windows and skylights, 232–233
Weight attribute, 25
Windows and skylights, 231–244
 anatomy of, 231
 attributes, constraints, and equations, 240–243
 creating, 231–234
 examples, 243–244
 frame and sash, 234–236
 glazing, 235, 237–238
 graphics for, 234–238
 hardware and accessories, 238
 as hosted objects, 65
 materials for, 238–240
Window constellations, 380–381
Work Results (OmniClass Table 22), 50–51
Work results identifications, 387–388