Index

adiabatic cooling. See evaporative (adiabatic) cooling adjacency matrix, BIM design methods, 8 Adobe, 260, 262 Advanced Green Builder Demonstration (AGBD) structure, 227 advanced modeling, complementary software, 38-39 aerial surveys, site analysis, 65 Agruppo, 62, 123, 226, 231 air changes per hour (ACH), infiltration, 166-67 Allee, Ben, 238 alternative energy systems. See energy systems American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) climate standards, 135 massing analysis, standards, 93-99 passive cooling, 140, 147 passive heating, 159, 167-79 animations, solar geometry, 115-16, 142 annotation, complementary software, 49 Anwyl, James, 33, 153-57 ArchiCAD, 11, 32-33, 61 architects, 5-6, 7, 11-16. See also building professionals; collaboration architectural value scale, materials and waste. 239-40 Ashe Laughlin Studio, 123 ASHRAE. See American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) AutoCAD. See Revit azimuth, photovoltaics, 192, 193

badgir (wind tower), 137 Balcomb, Doug, 18 Bardagly, Paul, 23-28, 227 Bark Design Architects, 134 Barnes Gromatzk (Kosarek Architects, 215 basement, energy use, massing analysis, 94-95 basement wall, ground heat loss, 168-69 Battella Darby Creek Environmental Center, Columbus, Ohio, 145, 177–82 Beaux-Arts style, 1 Beck Architecture, 228 Bee Ranch, Navasota, Texas, case study, 144, 221-24 Bellino, Marianne, 272-74 Berg, Fred, 128-32 Bézier splines. See non-uniform rational Bézier splines (NURBS) Biosphere 2, Tucson, Arizona, 217 Bley Sleeping House Addition, 226 Bohmfalk, Gordon, 233 Borroughs, Jackson Clements, 133 Boston Society of Architects, xi Boulanger, Nadia, 7 Brooks, Gregory L., 30, 83, 86 Brunelleschi, 1 building envelope energy use, massing analysis, 91, 92 site analysis, 69-70 building hydrology. See hydrology building information models (BIMs) advantages of, xi-xii building professionals, 5-6, 7, 16 climate indexing, 19 collaboration, 249, 250

building information models (BIMs) (continued) cost containment, ix-x defined. 3-5 as design environment, x-xi design methods, 6-16 detailing, 11 line drawing, 11-16 parametric process, 7-11 energy efficiency, 19-21 high-performance architecture, 16-18 historical perspective, 1-3 hydrology, 21 overview, ix passive cooling, 139-40 passive heating, 159-60 photovoltaics, 185-86 site indexing, 18-19 software applications, 29-32 waste stream, 21-22 building professionals. See also collaboration building information models (BIMs), 5-6.7.16 collaboration, 249-50 Building Science Corporation, 235 buildingSMART. 11 Bullitt Foundation, 200-203 callouts, complementary software, 49 Cascadia Center for Sustainable Design and Construction, Seattle Washington, case study, 200-203 Center for Maximum Building Potential Systems (CMBPS), 227 cistern sizing, roof area optimization and, rainwater harvesting, 212-14 clarity, graphic communication, complementary software, 42 clash detection, BIM design methods, x-xi, 9, 17, 255 climate massing analysis, passive heating and cooling, 97-98 passive cooling, 135-39

passive heating, 160, 161, 170-74

rainwater harvesting, 210

climate change, cost containment, building information models (BIMs), ix-x climate indexing, BIM design, 19 code restrictions buildable envelope data, 69-70 plumbing fixture efficiency, 214-15, 216 site indexing, 19 windows, massing analysis, 96 collaboration, 249-74. See also building professionals BIM design methods, 249, 250 case study, Paisano Senior Housing, El Paso, Texas, 272-74 coordination functions, 264-66 DOE-2, 261-63 DWG format, 266-6 exported files, 251-58 gbXML, 263 imported backgrounds, 249-51 survey data, 250 Components, 250–51 industry foundation classes (IFC) format, 269–72 integrated project delivery (IPD), 267-69 PDF files, 258-61 rendering and visualization, 264 tabular data, 263-64 collectors, solar thermal energy systems, 193–97 ComCheck, 11, 20, 84, 90 complementary software, 38-49 advanced modeling, 38-39 annotation and callouts, 49 default settings, 43-45 detailing, 45-49 graphic communication, 42 hatches, fills, and shades, 43 information and scale, 43 line weight, 42-43, 44 massing models, 42 non-uniform rational Bézier splines (NURBS), 39-42 component-based cost analysis, massing analysis, 88-89 computer-assisted drafting (CAD) BIM compared, 16 historical perspective, 1

conductance, energy use, massing analysis, 92-95 construction firms, building information models (BIMs), 5 construction industry, materials and waste, 225 cooling degree days, solar geometry, 107, 108 cooling load, summer heat gain, passive cooling, 140 cooling tower, calculations for, 150 coordination functions, collaboration, 264-66 cost analysis building information models (BIMs), ix-x massing analysis, 87-89 materials and waste, 225-32 area calculations, 229 detailed takeoffs, 229-32 cost per linear foot, BIM design methods, 9 Court. Brian. 200-203 create, BIM software applications, 29 cross ventilation, passive cooling methods, 144-47 curtain walls, parameterized Hauer curtain wall, case study, 49-53 curtain wall tool, Revit, 34-35 curves, BIM design methods, 11 custom families. Revit. 34 cut-and-fill analysis, site analysis, 65-68

daylight, climate indexing, 19 daylight factor (DF), 119-21 daylighting, 116-32. See also solar geometry BIM workflow summary, 124-27 case study, Ross Street House, Madison, Wisconsin, 128-32 daylight factor (DF), 119-21 energy efficiency, 116-17, 118 light shelves, 121 ray traced renderings, 121-23 window-height to room-depth ratio, 117-19 default settings, complementary software, 43-45 design environment, building information models (BIMs), x-xi DesignGroup, 177-82 design software. See software design validation, high-performance architecture, 17

detailing BIM design methods, 11, 14–15 complementary software, 45-49 site analysis, 58 digital terrain model (DTM), 58 DNM Architect, 74–77 Dodge, Richard, 42, 49 DOE-2, collaboration, 261-63 doors BIM design methods, 11 line drawing, BIM design methods, 14 Dowhower, Justin Firuz, 10, 17, 20, 31, 71, 80, 126, 254 downspout, hydrology, 21 drainage analysis, site analysis, 68 dry-bulb temperature, 136, 161 DuPont, Stepher 194 DWG files, 62-65, 266-67

Ecotect 19, 123, 145 egress, windows, massing analysis, 96 elevation, photovoltaics, 192, 193 embed, BIM software applications, 30 Encina Ltd., 34 energy compliance, massing analysis, 90-91 energy efficiency BIM design, 19-21 cost containment, BIMs, ix-x, 10, 11 daylighting, 116-17, 118 massing analysis, 92-96 energy simulation, massing analysis, 91 energy systems, 183-203 case study, Cascadia Center for Sustainable Design and Construction, Seattle, Washington, 200-203 consumption statistics, 183-85 photovoltaics, 185-92 azimuth and elevation, 192 BIM model, 185-86 location, 190-92 sizing factors, 189-90 storage factors, 189 types of, 186-89 solar thermal, 192–97 collectors, 193-97

energy systems (*continued*) described, 192 storage, 197 types of, 192–93 wind turbines, 197–200 engineering files, collaboration, 251–58 envelope. *See* building envelope EQUA Simulation AB, 258 Eurobuild, 153–57 evaporative (adiabatic) cooling, passive cooling, 136–37, 148–50 exported files, collaboration, 251–58 extract, BIM software applications, 30–32

Farrell, Mischa, 260 Fazakas, György, 32 feasibility analysis, massing analysis, 87-89 field surveys, site analysis, 59-62 fills, complementary software, 43 float to surface/gravitate to mesh data, site analysis, 69 floor-area ratio (FAR) calculations, 19, 72 flow analysis, slope analysis and, hydrology, 208 Flying Fish Designs, 57 forensic process, BIM design methods, 7 Forest Stewardship Council (FSC), 21 framing, advanced, materials and waste, Franklin, Benjamin, 138 free-form modeling complementary software, 3 massing analysis, 81

Gardner, Wes, 32, 37, 82 Gauvain, Jan, 23–28 gbXML, collaboration, 263 geographic information system (GIS) data, site analysis, 65 GKZ, Inc., 256 glazing. See windows Gleick, Peter H., 206 Gomillion, Frank, 256 Google maps, 65 Government Services Agency (GSA), 8, 269 graphic communication, complementary software, 42 Graphisoft, 32, 262 gravitate to mesh/float to surface data, site analysis, 69 Green Building Studio, 19 ground, heat loss, 167–70 gutter, hydrology, 21, 220–21

Hadlow College Rural Regeneration Center, Kent, United Kingdom, case study, 153-57 handrails, line drawing, BIM design methods, 14 hatches, complementary software, 43 Hauer, Erwin, 34, 50 Hauer curtain wall, parameterized, case study, 49-53 heat gain auxiliary estimates roof ponds, 175-176 solar savings fraction estimation, 174–75 windows, 170-74 heating degree days passive heating, 170-71 splar geometry, 107, 108 beat loss, 162–70 ground, 167-70 infiltration, 166–67 roof assembly, 165-66 summarization of, 170, 171 walls, 162-65 windows, 163-65 high-performance architecture, 16-18 High School Project, Carlsbad, California, case study, 100-103 HOK, 4-5, 6, 134 Home Energy Efficient Design (HEED) program, 140 hot-dry climate, passive cooling, 136-37 hot-humid climate, passive cooling, 137-39 hot-temperate climate, passive cooling, 137 House in Sonoma, California, case study, 74-77 House in the Woods, Wisconsin, 160 Hughes, Thomas, 31 hydrology, 205-24 BIM design, 21 case study, Bee Ranch, Navasota, Texas, 221-24 flow and slope analysis, 208

gutter sizing, 220–21 plumbing fixture efficiency, 214–15, 216 rainwater harvesting, 209–14 climate, 210 load calculations, 210–12 roof area optimization and cistern sizing, 212–14 uses for, 209 runoff and impervious cover, 207–8 site design, 206–7 water consumption statistics, 205–6, 209, 210–12 wetland sizing, 215–20

imperial feet and inches measurements, surveyed contours, 63 impervious cover, runoff and, hydrology, 207-8 imported backgrounds, collaboration, 249-51 industry foundation classes (IFC) format, collaboration, 269-72 Industry Foundation Classes (IFCs), 11 infiltration, heat loss, 166-67 information, scale and, complementary software, 43 insulated concrete forms (ICFs), advanced framing, 232-37 insulation, energy use, massing analysis, 92-95 integrated project delivery (IPD), collaboration, 267-69 International Alliance for Interoperablity, 11 irrigation, hydrology, 211

Jackson, Mississippi Federal Courthouse, 255 Jamail Smith Construction Company, 233 Jansenson, Daniel, 45, 79, 126 Jones, Christopher Frederick, 134

Kenny, Gill, 217 Kerkythea, 123

landscaping, hydrology, 211 Lawrence, Mell, 71, 138, 184 Lazarus, Mary Ann, 134 LEED, xii, 243–44 Lévy, François, 23–28, 221–24 life cycle analysis, materials and waste, 239 Light, David, 49-53 lighting energy efficiency, 116-17, 118 viewsheds, site analysis, 73 light shelves, daylighting, 121 Limbacher & Godfrey Architects, 15, 48 line drawing, BIM design methods, 11–16 line weight, complementary software, 42-43, 44 Lining, John, 138 Lloyds of London building, 30 Loblolly House, Taylor's Island, Maryland, case study, 245-48 Loosemore, Mary, 137 Lower Colorado River Authority (LCRA) Redbud Center, 215 Lowry Park Zoo Animal Hospital Project, Tampa, Florida, 229 Lynes' formula, 120-21

MacLeamy, Patrick, 4-5, 6, 161 Margarido House, 244 Marlatt, David, 74–77 massing analysis, 79–103 case study, High School Project, Carlsbad, California, 100-103 complementary software, 42 cost and feasibility analysis, 87-89 energy compliance, 90-91 energy simulation, 91 energy use, 92-96 free-form modeling, 81 model creation, 79 passive heating and cooling, 89-99 perimeter/volume ratios, 83-85 SketchUp, 80-81 solar orientation, 95 Space objects, 81-83 thermal mass, 97 views, 85-87 materials and waste, 225–48 architectural value scale, 239-40 case study, Loblolly House, Taylor's Island, Maryland, 245-48 construction industry, 225 cost analysis, 225–32

materials and waste (continued) area calculations, 229 detailed takeoffs. 229-32 framing, 232-37 LEED material calculations, 243-44 life cycle analysis, 239 sheet materials, 237-39 target plots, 241-43 waste stream, BIM design, 21-22 Maxwell Render, 123 McConnell, Thomas, 215 McDonald Construction & Development LLC, 244 McMansion ordinance, 9, 70 measurements, surveyed contours, site analysis, 63 mechanical, electrical, and plumbing (MEP) systems energy simulation, massing analysis, 91 historical perspective, 1-3 Meridian Solar, Inc, 188 Michelangelo, 7 Microsoft Research Maps (MSR), 65 Miller Hull Partnership, 200-203 Minnesota, University of, 105 monocrystalline silicon photovoltaics, 186-89 Moonrise Ranch, Hill Country, Wimberly, Texas, case study, 23-28 Moore, Steven A., 4 Nance, Andrew, 226

National Renewable Energy Laboratory (NREL), 189–90 Nelson, Mark, 217–19 night flushing, passive cooling, thermal mass and, 137, 150–51 NIST report, 6, 8 NOAA Solar Calculator, 112 non-uniform rational Bézier splines (NURBS), 11 complementary software, 39–42 free-form modeling, 81

occupancy BIM design methods, 8 energy simulation, massing analysis, 91 massing analysis, passive heating and cooling, 97–98

Odell, Bill, 134 Oliver, Stephen, 233 onsite energy systems. See energy systems Oregon, University of, 112, 114 owners, building information models (BIMs), 5, 8 Paisano Senior Housing, El Paso, Texas, case study, 272-74 parameterized Hauer curtain wall, case study, 49-53 parametric design, high-performance architecture, 18 parametric process, BIM design methods, 7-11 Parkview El Milagro project, 256 passive cooling, 20-21, 133-57 BIM model, 139–40 case study, Hadlow College Rural Regeneration Center, Kent-United Kingdom, 153–57 climates, 135-39 evaporative (adiabatic) cooling, 148-50 massing analysis, 89-99 night flushing, thermal mass and, 150-51 roof ponds, 151–53 solar shading, 140-42 summer heat gain, 140 sustainable design, 133-35 ventilation, 142-48 passive heating, 159-82 BIM model, 159-60 case study, Battelle Darby Creek Environmental Center, Columbus, Ohio, 177-82 climates, 159, 161 guidelines, 160-62 heat gain, 170-77 auxiliary estimates, 174 roof ponds, 175-76 solar savings fraction estimation, 174-75 windows, 170-74 heat loss, 162-70 ground, 167-70 infiltration, 166-67 roof assembly, 165-66 summarization of, 170, 171 walls, 162-65 windows, 163-65 massing analysis, 89-99

Passive House Planning Package (PHPP), 160 Paulin, Edmond, 105 PDF files, collaboration, 258-61 performance design guidelines, building information models (BIMs), xii perimeter/volume ratios, massing analysis, 83-85 photovoltaics, 185–92. See also solar thermal energy systems azimuth and elevation, 192, 193 BIM model, 185-86 building systems and, 185 location, 190-92 sizing factors, 189-90 storage factors, 189 types of, 186-89 plumbing fixture efficiency, 214-15, 216 Plumbob LLC, 81, 244 polycrystalline silicon photovoltaics, 186-89 Project Vasari, 114 PVWatts tool, 191, 193 Pyrek, Adam, 122

quality, graphic communication, complementary software, 42 quantitative assessment, building information models (BIMs), xi

Radiance, 124-25 Ragsdale, Keith Guiton, 67 rainwater harvesting, 21, 209 climate, 210 load calculations, 210-12 roof area optimization and cistern sizing, 212-14 uses for, 209 Rancho Encino Residence, 62, 231 ray traced renderings, daylighting, 121-23 Reed, Mariko, 244 rendering, models for, collaboration, 264 renewable energy systems. See energy systems reports. See schedules and reports ResCheck, 11, 20, 84, 90 Revit Architecture, 8, 11, 33-35, 42, 43, 50-53, 61, 62, 70, 126, 127, 177-82 Reynolds, Eleanor, 86 Rhino modelers, 41

Richard, Carol, 128-32 Richard Wittschiebe Hand, 128-32 Roesling Nakamura Terada Architects, Inc., 100-103 roof area optimization, cistern sizing and, rainwater harvesting, 212-14 energy use, massing analysis, 92, 94 heat loss, passive heating, 165-66 hydrology, 21 roof ponds passive cooling, 151-53 passive heating, 175-76 room-depth to window-height ratio, daylighting, 117-19 Ross Street House, Madison, Wisconsin, case study, 128-32 round-tripping, high-performance architecture, runoff: impervious cover and, hydrology, 207–8 scale, information and, complementary software, 43 schedules and reports BIM. 4.5 energy simulation, massing analysis, 91 Schindler House (West Hollywood, California), 92 seasonal variation, solar geometry, 108-11, 115-16, 143 setbacks, solar rights and, site analysis, 70-72 shades and shading complementary software, 43 design, solar geometry, 106-7 passive cooling, solar exposure, 140-42 photovoltaics, 186 sheet materials, materials and waste, 237-39 silicon photovoltaics, 186-89 Simon, Albert, 2 site analysis, 55–77 aerial and topographical surveys, 65 buildable envelope data, 69-70 case study, House in Sonoma, California, 74-77 drainage analysis, 68 field surveys, 59-62 float to surface/gravitate to mesh data, 69

site analysis (continued) floor area ratio calculations, 72 geographic information system (GIS) data, 65 importance of, 55 model development, 57-59 site sections, 69 solar orientation, 106-7 solar rights and setbacks, 70-72 surveyed contours, 62-65 topographical analysis, 65-68 viewsheds, 72-73 site conditions BIM design methods, 7-8, 9 hydrology, 21, 206-7 site indexing, building information models (BIMs), 18-19 site sections, 69 sizing factors, photovoltaics, 189-90 SketchUp collaboration, 251 massing analysis, 80-81 site analysis, 61 Skripac, Brian, 177-82 slabs energy use, massing analysis, 94-95 ground heat loss, 167-68 slope analysis BIM design, 19 flow analysis and, hydrology, 208 Smith, Jamail, 233 Smith, Lane, 100-103 Socratic method, BIM design methods, 7-8 software, 29-53 ArchiCAD, 32-33 BIM applications, 29-32 case study, parameterized Hauer curtain wall, 49-53 complementary software, 38-49 advanced modeling, 38-39 annotation and callouts, 49 default settings, 43-45 detailing, 45-49 graphic communication, 42 hatches, fills, and shades, 43 information and scale, 43

line weight, 42-43, 44 massing models, 42 non-uniform rational Bézier splines (NURBS), 39-42 Revit. 33-35 Vectorworks, 35-38 solar exposure. See also daylighting BIM design methods, 9 climate indexing, 19 energy efficiency, 21 passive cooling, shading, 140-42 solar geometry, 105–16. See also daylighting animations and models, 115-16, 142 depiction of, 143 historical perspective, 105-6 massing analysis, 95 photovoltaics, 186 seasonal variation, 108-9 shade design, 106-7, 141-42 solar thermal energy systems, 194–97 static sun models, 109–15 solar heat gain coefficient (SHGC), windows, heat loss, 163-65 solar rights, setbacks and, site analysis, 70-72 solar savings fraction estimation, heat gain, 174–75 solar thermal energy systems, 192-97. See also photovoltaics collectors, 193-97 described, 192 storage factors, 197 types of, 192-93 Solibri Model Checker, 257 Sonoma, California, House, case study, 74–77 space, BIM design methods, 8-9 Spacehus dwelling, 35 Space objects, massing analysis, 81-83 stack ventilation, passive cooling, 137, 139, 147-48, 149 staffings, BIM, 6 static sun models, solar geometry, 109-15 storage factors photovoltaics, 189 solar thermal energy systems, 197

structural insulated panels (SIPs), advanced framing, 232–37 Studio Marquette, 57 Studio Mosaic, 23–28 subsidies, alternative energy systems, 185 summer heat gain, passive cooling, 140 sun chart projections, 112–15 surveyed contours, site analysis, 62–65 surveys. *See* field surveys sustainable design, 1–28 cost containment, BIM design, ix–x, xii passive cooling, 133–35 swamp coolers, 148–50 tabular data, collaboration, 263–64, 269

target plots, materials and waste, 241-43 Tartakov, Stanley, 23-28 taxation, alternative energy systems, 185 technology, societal influence of, 29, 31 TE Studio, 160 Texas Parks and Wildlife Department Headquarters Building, Austin, Texas, 233 thermal chimney, calculations for, 149 thermal mass massing analysis, 97 passive cooling, 137, 150-51 passive heating, 174-75 thermal performance, BIM design methods, 11 3D model components, collaboration, 250-51 3D PDF viewers, collaboration, 258-61 Timberlake, Kieran, 245-48 topographical analysis, 65-68 topographical surveys, 65 total building thermal conductivity, 20 Total Equivalent Temperature Differential method, 140 training, BIM, 6 triangular 3D polygons, site analysis, 58-60, 62 triangulated irregular network (TIN), 21, 58, 59 Trojan House, Melbourne, Australia, 133

U-factor BIM design methods, 9, 11 energy use, massing analysis, 92–95 heat loss

basement walls, 169, 171 walls, 162-65 massing analysis, 84-85 United States Department of Energy (DOE), 11, 20, 84.261-63 United States Environmental Protection Agency (EPA), 216 United States Government Services Agency (GSA), 81 Vectorworks, 8, 11, 14, 19, 34, 35-38, 41, 43, 61, 63, 68, 69-70, 82, 124-25, 142, 208, 237, 255, 257, 263 vegetation hydrology, 211 seasonal variation, solar geometry, 108–9 ventilation hot-dry climate, 136-37 hot-humid climate, 139 hot-temperate climate, 137 massing analysis, passive heating and cooling, 98 passive cooling methods, 142–48 views, massing analysis, 85-87 viewsheds, 19, 72–73 Viguier, Jean Paul, 32 visualization, models for, collaboration, 264 Vitruvius, 1 Vörösmarty tér 1 project, Budapest, Hungary, 32

walls

BIM design methods, 11 energy use, massing analysis, 94 heat loss, 162–65 line drawing, BIM design methods, 14 Ward, Greg, 121–22 Washington Park Custom House (West Standard Design Build), 36 waste. *See* materials and waste Wasterwater Garden (WWG) system, 217–19 waste stream, BIM design, 21–22 water. *See* hydrology; rainwater harvesting weather data, energy simulation, massing analysis, 91 Wells, Malcolm, 239–40 Wessel, Ralph, 34 West Standard Design Build, 36 wet-bulb temperature, 136-37 Whitsett, Dason, 4 Williams, Zane, 131 Wilson, Alex, 134 window-height to room-depth ratio, daylighting, 117-19 windows BIM design methods, 11 energy use, massing analysis, 95–96 heat gain, 170-74 heat loss, 163-65

winds climate indexing, 19 cross ventilation, passive cooling methods, 144-47 infiltration, heat loss, 166-67 wind tower (badgir), 137 wind turbine energy systems, 197-200 Winford, Mark, 23-28 Winford, Veronica, 57 Workshop8, 272-74

zoning, buildable envelope data, 69-70, 71

ok