Index

ALHO Systembau GmbH, 82 alloy steel, 56 arc cutting, 59 Asahi Kasei, 170–71 Atterbury, Grosvenor, 26 automated bending, 61-62 automated construction, 98-100 automated forging, 61-62 automated off-site cabling, 52-54 automotive industry Japanese large-scale prefabrication influenced by, 101–02 One-Piece Flow manufacturing in, 222 Volkswagen production strategies, 138-41 BCM. See building component manufacturing Bessemer process, 55 BIM. See Building Information Modelling Bodenkisesel Media House, 32-33 bolt and nut systems, 60 Bramah, Joseph, 58 brick and ceramic construction, 8-25. See also brickwork automated processes for, 12-20 classification of elements and products, 9-10 emerging technologies for, 22-24 end-effectors in, 12-20 history of, 8-9 industrial customization in, 12 popular use of, 9 "programmed wall" robotics in, 24 recycling strategies after, 24-25 techniques in, 8-9 bricks calcium silicate, 9 components of, 8-9 extruded, 9 fly ash, 9 manufacturing methods, 10-12 off-site manufacturing of, 11 on-site manufacturing of, 11 recycling strategies for, 24-25

steel reinforced, 24-25 brickwork, 11-12 automated plants, 20-22 component manufacturing classification of, 11-12 ERP solutions, 20-22 factory layouts for, 20-22 horizontal manufacturing, 11-12 manufacturing place classification of, 11 masonry robots for, 14-18 mortar providing elements in, 14 Multistone machines for, 19 off-site manufacturing for, 18-19 on-site manufacturing for, 12-18 Rimaten system, 18 with ROCCO, 15-18 with SMAS, 18 vertical manufacturing, 12 Broad Group, 91 Brodie, John Alexander, 26 building component manufacturing (BCM). See also specific building components analysis framework for, 4, 5 defined, 1 manufacturing strategies for, 2-4 Building Information Modelling (BIM), 97-98 in physical service strategies, 209 for Sekisui Heim, 131-32 for Toyota Home, 131-32 building module manufacturing, 66-71 history of, 66-67 OEM and, 66 for plumbing modules, 68-71 with prefabricated subsystems, 67-68 CAD/CAM systems. See computer aided design/computed aided manufacturing systems CADOLTO GmbH & Co. KG, 83 calcium silicate bricks, 9 Caledonian Building Systems Limited, 87 cataphoresis, 62

More information

234

Index

CEMBUREAU, 27-28 cement production, 27 in China, 27–28 ceramic construction. See brick and ceramic construction ceramic fiber reinforced ceramics (CFRCs), manufacturing methods for, 11 ceramic matrix composites (CMCs), 9, 11 ceramics components of, 8-9 manufacturing methods, 10-12 porcelain and, 9 recycling strategies for, 24-25 CFRCs. See ceramic fiber reinforced ceramics CFT concrete. See concrete fulfilling tubular concrete China cement production in, 27-28 construction companies in, 89-90 large-scale building manufacturing in, 89-91, 92 CLT. See cross-laminated timber CMCs. See ceramic matrix composites (CMCs) computer aided design/computer aided manufacturing (CAD/CAM) systems, for wood construction, 47-48 Computer Aided Facility Management, 211 concrete construction, 25-43. See also precast concrete architectural and engineering function of, 30 automated production equipment for, 33-35 Bodenkisesel Media House, 32-33 with CFT concrete, 41 classification of, 28-30 curing chambers in, 35 emerging techniques in, 36-41 end-effectors in, 33, 34-35 factory production layouts for, 36 geometry and complexity of, 29-30 history of, 26-27 industrial customization of, 32-33 Laing O'Rourke and, 84-86 lunar pad development, 41 Metabolism movement in, 26 moulding systems in, 33 Neuer Zollhof project and, 32 with optical fibres, 41-42 pallets in, 33 prefabrication techniques, 26-27 recycling strategies with, 43 robotic shuttering systems, 33 transport and storage systems for, 35 by Vanke, 90-91 volumetric structures of, 29 concrete fulfilling tubular (CFT) concrete, 41 concrete production, 27-28 cement and, 27

construction robotics, i construction robots, 36, 47-48 COR-TEN steel, 56, 60 cross-laminated timber (CLT), 46 Daiwa House, 159-62, 209-10, 219-22. See also robot oriented design, in Japanese prefabrication industry disaster management strategies, 211-16 drawing exchange format (DXF) file formats, 47 Durrer, Robert, 55 DWG file formats, 47 DXF file formats. See drawing exchange format file formats Eco Serve Network, 43 electrical discharge machining (EDM), 59 end of life strategies. See also recycling strategies for steel construction, 63-65 end-effectors in brick construction, 12-20 in concrete construction, 33, 34-35 in on-site manufacturing, 14 in steel construction, 61-62 in wood construction, 49-51 enterprise resource planning (ERP) solutions, 20-22 HAPPS influenced by, 111 Sekisui Heim and, 111 Eska, 43 extruded bricks, 9 extrusion process, in steel construction, 58 factory layout design for brickwork, 20-22 OEM and, 136 for Sekisui Heim, 135-38, 141 for Toyota Home, 135-38 finger joints, 47 fly ash bricks, 9 Ford, Henry, 136 frame precast systems, for precast concrete structures, 30 galvanization, 59-60 Gehry, Frank O., 32 Germany construction companies in, 82, 83 large-scale building manufacturing in, 73-83 off-site manufacturing in, 75, 78-80, 81 on-site manufacturing in, 76, 81 steel construction in, 76-83 wood construction in, 73-74, 75, 76 glued laminated timber, 46 Halbou, Alphonse, 58 HAPPS. See Heim Automated Parts Pickup System Hebel House Homes. See Asahi Kasei

More information

Index

235

Heim Automated Parts Pickup System (HAPPS), 48-49 ERP solutions influenced by, 111 Himmelheber, Max, 46 horizontal brickwork manufacturing, 11-12 Industry Foundation Classes (IFC) file format, 47 - 48insulation process application robot (IPAR), 36-37 Japan, large-scale prefabrication in, 110-11. See also robot oriented design, in Japanese prefabrication industry specific companies advanced product systems in, 208-11 analysis of selected companies, 148-49 automotive industry and, 101-02 BIM management in, 97-98, 209 chemical industry and, 101-02 co-adaptations in, 117 cultural and local influences on, 99-101 development of, 94-96 digital services in, 210-11 in disaster management strategies, 211-16 drivers for, 103-04 earthquake resistance technology in, 214 electronics industry and, 101-02 evolution of, 207-23 future production projections for, 96-98 history of, 93-96 industry strategy for, 94-96 Karakuri technology diffusion mechanisms in, 98 - 100One-Piece Flow manufacturing and, 222 overview of companies, 94-95, 96 physical services in, 209-10 PREMOS Home, 104-07 production peaks for, 93, 96-97, 98 as prototype for future manufacturing systems, 222-23 repair services as part of, 214-15 reverse innovation in, 222-23 robotized production in, 110-11 for short-term shelters, post-disaster, 212 SMAS in, 18 for temporary housing, 212 timeline of evolution for, 112 TPS and, 100, 109-10 value chains as result of, 216-22 Volkswagen production strategy influenced by, 138-41 zero-waste factories in, 222-23 joints, in wood construction, 47 Kanban system, 110, 131 Karakuri technology diffusion mechanisms, 98-100 in TPS, 100

Kurokawa, Kisho, 26

Lahyer balancer and handling device, 13-14 Laing O'Rourke, 84-86 Lambot Jean-Louis 26 laminated strand lumber (LSL), 46 large panel systems, for precast concrete structures, 30 large-scale building manufacturing. See also Japan, large-scale prefabrication in in China, 89-91, 92 in Germany, 73-83 history of, 72-73 in Spain, 88-89 in UK, 82-87 large-scale prefabrication (LSP). See also Japan, large-scale prefabrication in analysis framework for, 4, 5 defined, 1-2 manufacturing strategies for, 2-4 laser cutting technique, 59 LaserCUSING process, 63 LiTraCon, 42 LSL. See laminated strand lumber LSP. See large-scale prefabrication lunar pad development concrete, 41 Maekawa, Kunio, 99, 104-07 manufacturing, 4, 5. See also building component manufacturing; large-scale prefabrication May, Ernst, 26 medium density fibreboards (MDF), 46 Metabolism movement, 26 Misawa Homes, 171-73, 201-06. See also robot oriented design, in Japanese prefabrication industry Mitsui Home, 174-76 mobile formwork, 30-31 production methods for precast concrete, 31 modular wood unit manufacturing, 48-49 Muji House, 181-84 Multistone machines, 19 Neuer Zollhof project, 32 non-alloy steel, 56 OEM. See original equipment manufacturing off-site manufacturing of bricks, 11 for brickwork, 18-19 component materials in, 4 in Germany, 75, 78-80, 81 robot oriented design in, 119-21 steel construction and, 4 in UK, 82-83

in UK, 82–83 Ohno, Kazuhiko, 107 Ohno, Taichi, 110, 131 One Star Group, 90 One-Piece Flow manufacturing, 222 Ono, Kaoru, 104

Kleusberg GmbH & Co. KG, 82

Kingspan, 86-87

More information

236

Index

on-site manufacturing of bricks, 11 for brickwork, 12-18 end-effectors in, 14 in Germany, 76, 81 Lahyer balancer and handling device in, 13-14 robot oriented design in, 119-21 Steinherr Assistance System in, 12-13 optical fibres, concrete construction with, 41-42 oriented strand board (OSB), 46 original equipment manufacturing (OEM) building module manufacturing and, 66 factory layout design and, 136 IT structure for, 52 models for, 1-4 in robot oriented design, 121 OSB. See oriented strand board Pana Home, 162-65, 216-22. See also robot oriented design, in Japanese prefabrication industry panelized wood construction, 75 particle board, 46 performance multiplication effect (PME), 126-28 Phaeton. See Volkswagen, production strategies for plasma arc cutters, 59 plastic wood, 46 plumbing modules, 68-71 plywood, 46 PME. See performance multiplication effect polymer optical fiber (POF) sensors, 36 porcelain, 9 precast concrete, 26-27 components of, 29 formwork methods for, 30-31 manufacturing methods for, 30-32 mobile formwork production methods for, 31 product classification for, 28-30 shortline production methods for, 31 stationary long line production methods for, 31 structure classification for, 30 prefabrication construction. See concrete construction; Japan, large-scale prefabrication in; large-scale building manufacturing; large-scale prefabrication; steel construction; wood construction PREMOS Home, 104-07 "programmed wall" robotics, 24 R&D. See research and design recycling strategies after brick and ceramic construction, 24-25 after concrete construction, 43 with steel construction, 64-65 after wood construction, 54 research and design (R&D), 125-26 Rimaten system, 18 riveting, 60

Robot Construction System for Computer Integrated Construction (ROCCO), 15-18 robot oriented design, in Japanese prefabrication industry, 116-28 assembly in, 118-19 complementarity in, 116-17 conceptual development of, 116 customer integration flexibility in, 123-25 flexibility in, 138-41 innovation strategies in, 125-26 linkage of systems in, 122 logistics in, 117-18 manufacturing process in, 128-29 modular coordination in, 121 OEM-like integration structures in, 121 off-line configuration in, 122-23 in off-site manufacturing, 119-21 in on-site manufacturing, 119-21 organizational analysis for, 136, 137 platform strategies in, 121-22 PME in, 126-28 production process in, 129-47 R&D capability in, 125-26 same-parts strategies in, 121-22 types of prefabrication, 129, 130 robotic shuttering systems, 33 ROCCO. See Robot Construction System for Computer Integrated Construction Safdie, Moshe, 26 Sakamura, Ken, 209-10 Sanyo Homes Corporation, 165-68 Sekisui Heim, 96-98, 185. See also robot oriented design, in Japanese prefabrication industry BIM system, 131-32 Computer Aided Facility Management and, 211 digital services, 210-11 ERP systems, 111 factory layout design for, 135-38, 141 line-based production and assembly by, 132-34 M1 building systems, 107 modular factories for, 142-44 on-site deployment of, 134 physical services with, 209-10 production processes in, 129-47 reorganization services with, 209 TPS and, 222 two-U home models, 206-07 Sekisui House, 97, 149-55. See also robot oriented design, in Japanese prefabrication industry TPS and, 222 shortline production methods, for precast concrete, 31 slab column systems, for precast concrete structures, 30 Solid Material Assembly System (SMAS), 18 Spain construction companies in, 88 large-scale building manufacturing in, 88-89

More information

Index

237

stainless steel, 56 stationary long line production methods, for precast concrete, 31 stationary single formwork, 30-31 steel construction, 54-65 by ALHO Systembau GmbH, 82 arc cutting in, 59 automated forging in, 61-62 automated measuring and maintenance in, 64 automated processes in, 61-62 by Broad Group, 91 by CADOLTO GmbH & Co. KG, 83 cataphoresis in, 62 EDM in, 59 element assembly in, 60 element bending processes in, 58-59 element production before, 57-60 element protection processes in, 59-60, 62 emerging techniques in, 63 end of life strategies for, 63-65 end-effectors in, 61-62 extrusion process in, 58 factory production layouts for, 62-63 in Germany, 76-83 by Kleusberg GmbH & Co. KG, 82 laser cutting technique in, 59 LaserCUSING process in, 63 machining processes in, 58-59 off-site manufacturing and, 4 by One Star Group, 90 robotic component assembly in, 62 scrap recycling with, 64-65 steel polishing, 59-60 steel production alloy, 56 with basic oxygen furnaces, 55 Bessemer process in, 55 construction elements in, shape as influence on, 56-57 COR-TEN steel, 56, 60 with electric arc furnaces, 55 European Standard EN 10020 classification, 56 history of, 54-55 industrial customization of, 60-61 non-alloy, 56 product classification in, 55-57 product lifecycle management in, 61 stainless, 56 techniques of, 54-55 types and uses, 56 WSA figures for, 55 steel reinforced bricks, 24-25 Steinherr Assistance System, 12-13 Tama Home, 176-79

Tange, Kenzo, 26 Terrapin, 87 Thonet, Michael, 47 3D CNC technology, 49 3D concrete printing (3DCP), 37–39 timber frame wood construction. 44 timber panel wood construction, 44 timber prefabrication. See wood construction Toyota Home, 198-201. See also robot oriented design, in Japanese prefabrication industry BIM system, 131-32 factory layout design for, 135-38 line-based production and assembly by, 132-34 on-site deployment of, 134 personal assistance technologies in, 209-10 physical services with, 209-10 production processes of, 129-47 reorganization services with, 209 TPS and, 222 Toyota Production System (TPS). See also robot oriented design, in Japanese prefabrication industry Kanban system and, 131 Karakuri technology diffusion mechanisms in, 100 organizational culture towards, 109-10 Toyota Home and, 222

(UK) construction companies in, 84–87 large-scale building manufacturing in, 82–87 off-site manufacturing in, 82–83

Vanke, 90–91 vertical brickwork manufacturing, 12 Volkswagen, production strategies for, 138-41 weathering steel. See COR-TEN steel wood construction, 43-54 automated off-site cabling in, 52-54 automated processes in, 49-51 automated sequencing in, 53 with CAD/CAM systems, 47-48 with DWG file formats, 47 with DXF file formats, 47 emerging techniques in, 52-54 end-effectors in, 49-51 from engineered wood, 46 factory production layouts in, 52-53 finger joints in, 47 in Germany, 73-74, 75, 76 history of, 43-44 with IFC file format, 47-48 industrial customization in, 47-49 with logs, 44 manufacturing methods with, 46-47 in modular wood unit manufacturing, 48-49 multilevel automated joining in, 48 panelized, 75 product classification in, 44-46 production figures for, 44 recycling processes after, 54 shipping and, 53 from solid wood, 45-46

238

Index

wood construction (*cont.*) techniques of, 43–44 with 3D CNC technology, 49 timber frame, 44 timber panel, 44 timber prefabrication and, multilevel integration in, 49 wood-framing methods in, 48 World Steel Association (WSA), 55

Yamaguchi, Kentaro, 24–25 Yorkon, 85–86

zero-waste factories, 222-23