Index

accidental flooding, 259, 308 accidental limit-state design, 257 active safeguards for fire and explosion, 485 collisions, 261 damaged vessel stability, 259 design principles and criteria, 257 considerations for ALS applications to ship-shaped offshore structures, 313 dropped objects, 277 fire and heat, 296 gas explosion and blast, 299 passive risk control for fire and explosion, 484 progressive collapse of heeled hulls, 308 risk control for collisions, 484 risk control for dropped objects, 485 accommodation, 16 design issues, 48 actions and action-effects analysis, 113, 150 action-effect analysis issues, 43 addition of new components, 454 age-related deterioration, 401 ALARP (as low as reasonably practicable), 471 allowable stress, 56 ALPS/HULL, 201, 309 ALPS/SPINE, 166 ALPS/ULSAP, 133, 168, 180 analytical methods, 159, 173 annualized corrosion rates, 374 Arco, 10 Association for Structural Improvement of the Shipbuilding Industry of Japan (ASIS), 274 ballast water deoxygenation, 393 beam-column type collapse, 171 Beaufort wind scale, 503 benign environmental areas, 10 biaxial compressive collapse, 171 Biggs method, 303 bottom-supported platforms, 2 bow slamming, 99 building material issues, 39 yield stress, 39 fracture toughness, 41

capacity, 65 characteristics value, 68 design capacity, 65 cargo handling systems, 324 cathodic protection, 391 Castellon, 10 chemical inhibitors, 395 classification societies, 78 classification society rules, 78 classing issues, 52 coating, 386 coating-life prediction, 390 selection criteria of coating material, 389 types of coating, 387 Cognac platform, 2 collisions, 261 energy absorption characteristics, 265 nonlinear finite-element modeling techniques, 265 practices for collision assessment, 263 prescriptive procedure, 263 risk control, 484 commissioning issues, 50 compressibility effects, 513 computational fluid dynamics (CFD) methods, 297 concrete gravity platform, 2 condition assessment of aged tanker structures, 450 condition assessment scheme, 408 emergency response services, 411 enhanced survey programme, 409 ship inspection report programme, 411 consequence analysis, 479 consequence rating, 473, 474 consequence severity, 473 construction issues, 49 contracting strategies, 32 conversion yard, 456 corrosion assessment and management, 356 ballast water deoxygenation, 393 cathodic prediction, 391 chemical inhibitors, 395 coating, 386 corrosion issues, 48 corrosion margin addition, 383

risk control, 483

532

Index

corrosion assessment and management (cont.) design issues, 48 risk control, 484 serviceability limit-state design, 145 corrosion margin addition, 383 corrosion models, 364 mechanical models, 366 phenomenological models, 379 corrosion rates, 374 corrosion wastage, 48 corrosion wastage examination, 402 corrosion wastage prediction, 364 effect of corrosion wastage on plate ultimate strength, 428 cost-benefit analysis, 470 Cowper-Symonds equation, 271 crack growth rate, 252 crack initiation, 251 crack propagation, 251 critical buckling strength, 57 critical buckling strength design (CBSD), 57 critical fracture strain, 267, 270 critical joints and details, 231 cross-stiffened plate structures, 132 currents, 91 Det Norske Veritas classification notes, 92 cyclic stress ranges, 221 damaged vessel stability, 259 decision-making recommendations, 471 decommissioning, 447, 456 cost issues, 460 decommissioning practices, 460 environmental issues, 459 regulatory framework, 457 safety and health issues, 459 technical feasibility issues, 458 demand, 65 characteristic value, 68 design demand, 65, 67 dented plates, 281 design capacity, 65 design criterion, 60 design demand, 65, 67 design principles, 55 for accidental limit-state design, 257 for environment, 77 for fatigue limit-state design, 218 for health, 77 for safety, 75 for serviceability limit-state design, 112 for stability, 74 for station-keeping, 74 for towing, 74 for ultimate limit-state design, 148 for vessel motions, 75 development drilling, 3 DNV PULS, 168

double-hull arrangements, 22 double sides, 22 double bottoms, 22 dropped objects, 277 risk control, 485 ultimate strength of dented plates, 281, 293 DYNA3D nonlinear dynamic finite-element simulations, 133 dynamic fracture strain, 272, 273 dynamic/impact-pressure actions, 9, 37, 45 dynamic load analysis, 43 dynamic material properties, 271 dynamic positioning systems, 5 dynamic yield stress (strength), 271, 272 effective width, 125 elastic buckling limits, 118 elastic deflection limits, 114 elastic plate buckling, 120 elastic stiffener flange buckling, 128 elastic stiffener web buckling, 123 elastic tripping of stiffener, 125 elevated deck, 327 environmental data, 83 metocean design parameters, 348 environmental phenomena, 82 design basis environmental conditions, 107 environmental severity factor (ESF), 151 equipment testing issues, 49 equivalent yield stress (strength), 116 event tree analysis (ETA), 478 exploration, 3 exploratory drilling, 3 export systems, 318, 350 design considerations, 352 design issues, 47 offloading system, 47 shuttle tankers, 351

fatal accident rate (FAR), 480 fatigue cracks, 404 effect of fatigue crack on plate ultimate strength, 431 fatigue crack examination, 404 fatigue crack propagation models, 250 fatigue damage accumulation, 225 fatigue damage calculations, 245 fatigue limit-state design, 217 design principles and criteria, 218 fatigue design issues, 44 fatigue safety factors, 44 fault tree analysis (FTA), 477 field development concepts, 4 field installation, 50 fire, 296 active risk control, 485 passive risk control, 484 practices for fire assessment, 297 first-order reliability methods (FORM), 66 fixed-type offshore structures, 2, 5

Index

533

floating-type offshore structures, 5 F-N curve, 480 fold length, 267 formal safety assessment, 464 FPSOs (floating, production, storage, and offloading systems), 3 FPSO project cost, 34 installation requirements, 28 major parts, 28 parameters driving the cost, 34 post-bid schedule, 39, 40 progress curve, 41 project management, 38 project management organization, 38 FPSO hull ultimate strength reliability, 433 frequency analysis, 476 frequency index, 472 frequency of occurrence or likelihood, 472 frequency rating, 473 front-end engineering, 31 front-end engineering and design (FEED), 33 Froude's scaling law, 511 Galerkin method, 161 gas compression facilities, 323 gas explosion, 299 active risk control, 485 passive risk control, 484 practices for gas explosion action analysis, 301 practices for gas explosion consequence analysis, 303 prescriptive methods, 301 probabilistic methods, 302 general arrangement, 16 general arrangement drawing, 26 general corrosion, 359 geometrical scaling factor, 513 global structural analysis, 230, 237 green water, 100 fundamentals, 100 measures for green-water risk mitigation, 102 practices for green-water assessment, 101 grooving, 361 gross cost, 470 gross yielding, 170 hazard identification, 465 heading control, 45 serviceability limit-state design, 139 heeled hulls, 308 high-cycle fatigue, 250 high-tensile-strength steel factor, 56

hot spot stress, 222, 238 finite-element analysis modeling, 241 hull structural scantling issues, 42 hydrodynamics model tests, 511

ice loads, 94 idealized structural unit method (ISUM), 185 ISUM beam-column element, 195

ISUM structural modeling, 187 test hull models under vertical bending, 201 Ifrikia, 10 impact-pressure actions, 9, 37, 45 green water, 100 slamming, 99 sloshing, 96 individual risk per annum (IRPA), 480 initial planning, 32 inspection, maintenance, and repair, 400 inspection and maintenance issues, 51 inspection practices, 423 maintenance and repair practices, 425 considerations for repair strategies, 439 repair strategies, 439 risk-based inspection, 411 risk-based maintenance, 416 risk control, 485 selected experience for repairs, 426 intact vessel stability, 134 international organizations, 78 international standards, 78 jacket-type offshore structures, 2 Johnson-Ostenfeld equation, 57 layout, 16 field layout, 17 risk control, 483 topsides layout, 18 limit-state criteria, 65 limit-state design (LSD), 56 limit states, 56 accidental limit states, 257 fatigue limit states, 217 limit-state design requirements, 36 risk control, 483 serviceability limit states, 111 ultimate limit states, 148 linear (knock-down factor) approach, 183 load-carrying capacity, 56 local buckling of stiffener web, 171 local structural analysis, 238 longitudinal strength, 23 low-cycle fatigue, 250 MAESTRO modeler, 25

ISUM plate element, 188

marginal fields, 5 marine corrosion mechanisms, 357 types of corrosion, 358 marine growth, 95 Marsden squares, 505 MaxWave project, 70 mechanical damage examination, 405 metocean design parameters, 83 midship section configuration, 25 three-dimensional midship configuration, 25 midship section drawing, 27 Miner sum, 220

534

Index

mooring systems, 318, 336 design considerations, 349 design issues, 47 DICAS mooring system, 349 mooring line vortex-induced resonance oscillation, 143 single-point moorings, 338 spread moorings, 337 mooring system selection, 348 turret moorings, 342 natural period of a rectangular plate, 131 net cost. 470 new build, 15 building cost, 15 nominal stress, 222 non-collinear environmental actions, 228 nonlinear finite-element methods, 166, 177 nonlinear governing differential equations of plates, 159 incremental forms, 164 nonlinear governing differential equations of stiffened panels, 174 incremental forms, 176 notch stress, 222 oil and water separation facilities, 319 orthotropic plates, 174 overall collapse, 170 owner requirements, 33 Paris-Erdogan law, 252 partial safety factors, 68 partial safety factor format, 67 performance requirements, 5 permanent set deflection limits, 128 phenomenological corrosion models, 379 pipeline infrastructure, 5, 350 pitting corrosion, 360 plate-induced failure, 178 plate-stiffener combination (PSC) model, 179 polar trading ship designs, 95 post-bid schedule, 39 sample schedule, 40 potential loss of life (PLL), 480 preassembled unit (PAU), 332 principal dimensions, 19 average principal dimensions of FPSOs, 19, 20 relationship between breadth and depth, 21 relationship between freeboard and depth, 21 relationship between length and depth, 20, 21 sample data, 24 probabilistic format, 65 probability of detection and sizing, 405 probability of sea states, 506 process facilities, 36 cargo handling systems, 324 design requirements, 36 gas compression facilities, 324 offshore/onshore processing options, 36

oil and water separation facilities, 319 optimum processing options, 4, 36 safeguard systems, 326 utility and support systems, 325 water injection facilities, 324 processing options, 4, 36 project management, 38 project management organization, 38 progressive hull collapse analysis, 185 heeled hulls, 308 pseudo-LSD approach, 59 Ramberg-Osgood model, 268 qualitative risk assessment, 472 quantitative risk assessment, 475 recommended practices, 78 regular wave theory selection diagram, 87 regulations, 78 regulations issues, 52 reliability index, 66 renewal thickness, 452 residual strength assessment, 453 response amplitude operators (RAOs), 221 return period, 103 reusability of existing machinery and equipment, 453 Reynold's scaling law, 511 risers, 6 flexible risers, 6 rigid risers, 6 risk, 463, 470 risk assessment, 463 qualitative risk assessment, 472 quantitative risk assessment, 475 risk-assessment requirements, 37 risk-based inspection (RBI), 411 risk-based maintenance (RBM), 416 risk-control options, 470 risk control during design, 482 risk control during operation, 484 risk corrective/preventive measures, 482 risk index, 472 safety factors, 68 safeguard systems, 326 safety, health, and environment, 75 scaling laws, 511 seakeeping analysis, 232 second order reliability methods (SORM), 66 SAFEDOR project, 463 self-contained systems, 2 semianalytical methods, 164, 173-175 semisubmersibles, 5 serviceability limit-state design, 111 actions and action-effects analysis, 113 corrosion wastage, 145 design principles and criteria, 112 elastic buckling limits, 118 elastic deflection limits, 114

intact vessel stability, 134

Index

535

mooring line vortex-induced resonance oscillation, 143 permanent set deflection limits, 128 vessel motion exceedance, 140 vessel station-keeping, 137 vessel weathervaning and heading control, 139 vibration and noise, 141 ship-shaped offshore units, 7, 13 shuttle tanker export, 351 tandem export, 352 side-by-side export, 353 CALM buoy, 353 simple beam theory, 150 Single Buoy Moorings, Inc., 9 site-specific metocean data, 35 slamming, 99 fundamentals, 99 measures for slamming risk mitigation, 100 practices for slamming assessment, 99 sloshing, 96 acceptance criterion, 98 fundamentals, 96 measures for sloshing risk mitigation, 99 practices for sloshing assessment, 96 Smith method, 186 S-N curves, 223 selection of S-N curves, 243 snow and icing, 93 ice loads, 94 mean ice thickness, 94 spar. 6 spectral analysis, 226, 227 stability, 74 intact stability criteria, 136 intact vessel stability, 134 station-keeping, 45 design principles, 74 design issues, 45 serviceability limit-state design, 137 stiffener-induced failure, 180 stiffened panel (SP) model, 179 storage capacity, 34 factors affecting the storage capacity, 34 stress concentration area, 241 stress concentration factor, 223 stress intensity factor, 252 stress ranges, 221 stress range transfer functions, 236 structural adequacy, 67 structural details, 231 structural mechanics model tests, 513 surface preparation, 386 surface tension effects, 512 swell scale, 504 tank design, 22 tanker conversion, 447, 448 tanker conversion option, 15

tension leg platform (TLP), 7-8 Terra Nova FPSO, 95 test hull models under vertical bending, 504 tether, 6 tensioning effect, 7 tether-mooring system, 6 vertical tethers, 7 tidal levels, 91 time-variant fatigue crack propagation models, 250 time-variant ultimate hull strength reliability, 438 topsides fabrication, 331 built-in grillage deck, 332 pre-assembled units (PAU), 332 topsides facilities, 3, 17, 318, 319 cargo handling systems, 324 design issues, 46 computer graphics, 320 gas compression facilities, 323 oil and water separation facilities, 319 safeguard systems, 326 topsides design issues, 46 utility and support systems, 325 water injection facilities, 324 topsides flooring, 330 topsides modules, 18 topsides supports, 327 multipoint support columns, 328 sliding/flexible support stools, 329 transverse girder supports, 330 topsides and their interfaces with hull, 327, 332 towing condition, 43 design principles, 74 towing issues, 50 trading tankers, 13 tripping of stiffener, 172 turret-mooring system, 342 buoyant turret, 346 clamped-riser turret, 345 disconnectable turret, 345 external turret, 344 internal turret, 344 ultimate hull girder strength interaction relationship, 183 ultimate hull strength reliability, 438 ultimate limit-state design, 148 actions and action-effects analysis, 150 design principles and criteria, 148 ultimate strength of plates, 153 ultimate strength of stiffened plate structures, 168 ultimate strength of vessel hulls, 182 ultimate strength of dented plates, 293 ultimate strength of plates, 153

ultimate strength of stiffened plate structures, 168 primary modes of overall failure, 170 ultimate strength of vessel hulls, 182 ultimate test hull models under vertical bending,

201

temperatures, 93 template, 2

536

Index

unified design requirements, 71 common structural rules (CSR), 71 minimum still-water bending moments, 73 minimum wave-induced bending moments, 73 utility and support systems, 325

vessel motions, 45 design issues, 45 design principles, 75 serviceability limit-state design, 140 vibration and noise, 141 vortex-shedding effects, 512

water depths, 91
water injection facilities, 324
waves, 84
American Petroleum Institute recommended practices, 86
Det Norske Veritas classification notes, 86
regular wave theory selection diagram, 87
UKOOA FPSO design guidance notes, 85 wave energy spectra, 105 directional wave spectra, 106 generalized Pierson-Moskowitz spectrum, 105 JONSWAP spectrum, 106 wave scale, 503 wave scatter diagrams, 14 weather routing, 14 weathervaning, 139 Weibull stress range scale distribution parameter, 247 welding connection types, 244 weld metal corrosion, 361 winds, 88 American Petroleum Institute recommended practices, 89 Det Norske Veritas classification notes, 89 UKOOA FPSO design guidance notes, 89 wind force, 89 wind tunnel test requirements, 514 working stress design (WSD), 56