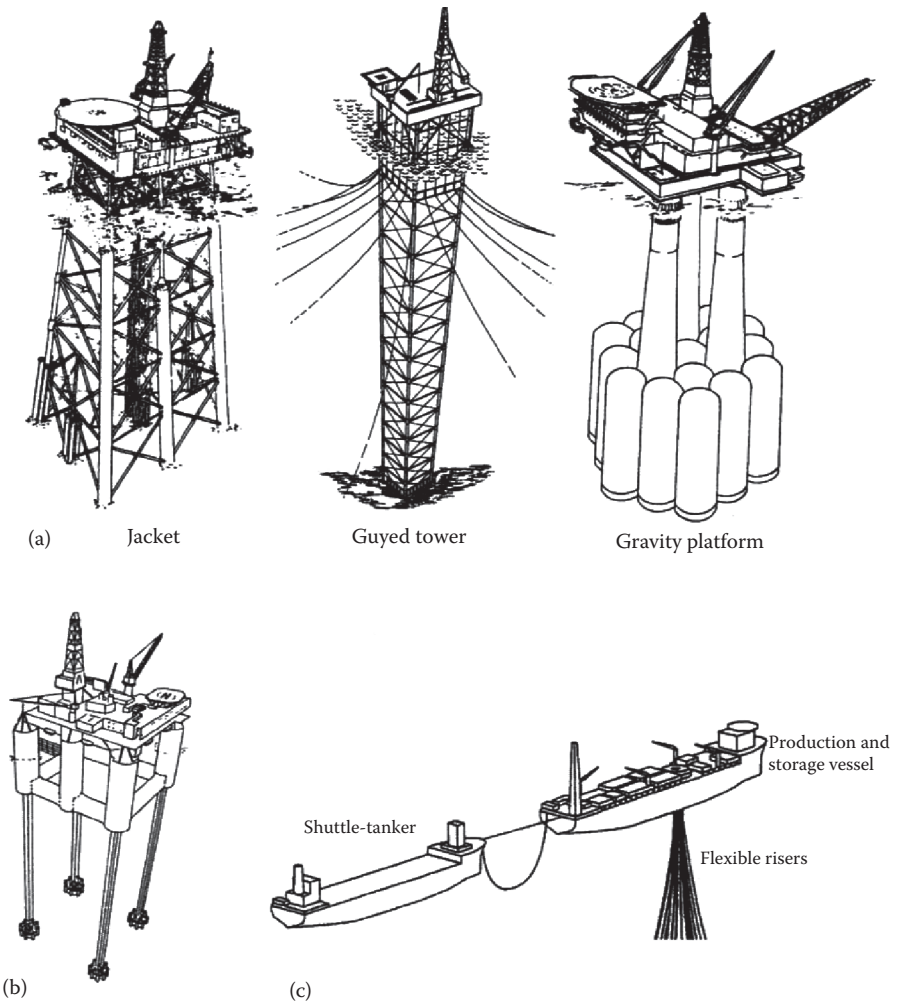


FIGURE 2.1 Types of offshore structures encountered in the ocean environment. (From T. Moan, Offshore structures (Chapter 7), in: *Modeling Complex Engineering Systems*, edited by R.E. Melchers and R. Hough, ASCE Press, Reston, VA, pp. 173 and 175, 2007. With permission.)

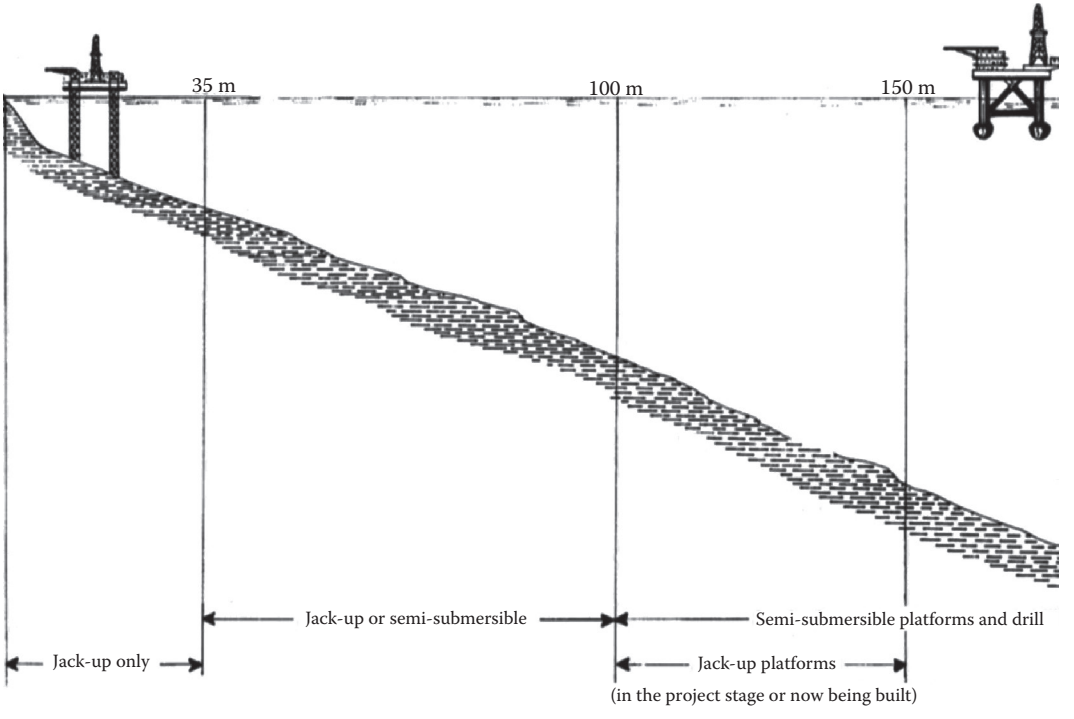
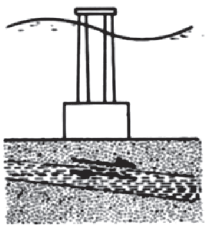
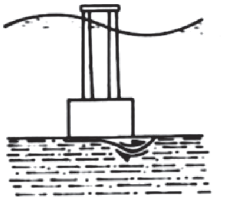


FIGURE 2.2 Common depths of water for jack-up platforms used in offshore exploration. (From P. Le Tirant, *Seabed Reconnaissance and Offshore Soil Mechanics*, Editions Technip 27, Paris, France, p. 400, 1979. With permission.)

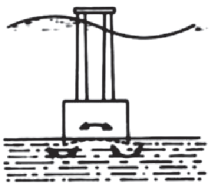
(a) Sliding of the structure along the soil



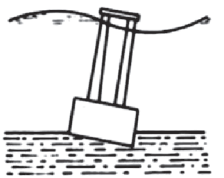
(b) Sliding of the foundation soil at the sand-clay interface



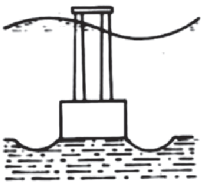
(c) Rupture of the foundation soil



(d) Rupture of the foundation through "rocking"



(e) Rupture of the foundation by liquefaction of the soil



(f) Instability of the foundation caused by scour

FIGURE 2.3 Various considerations made in the location of a gravity platform. (From P. Le Tirant, *Seabed Reconnaissance and Offshore Soil Mechanics*, Editions Technip 27, Paris, France, p. 347, 1979. With permission.)

FIGURE 2.4 Structural requisites: structure with adequate strength but excessive flexibility. (From A.J. McDonald, *Structure and Architecture*, Architectural Press, London, p. 20, 2001. With permission.)

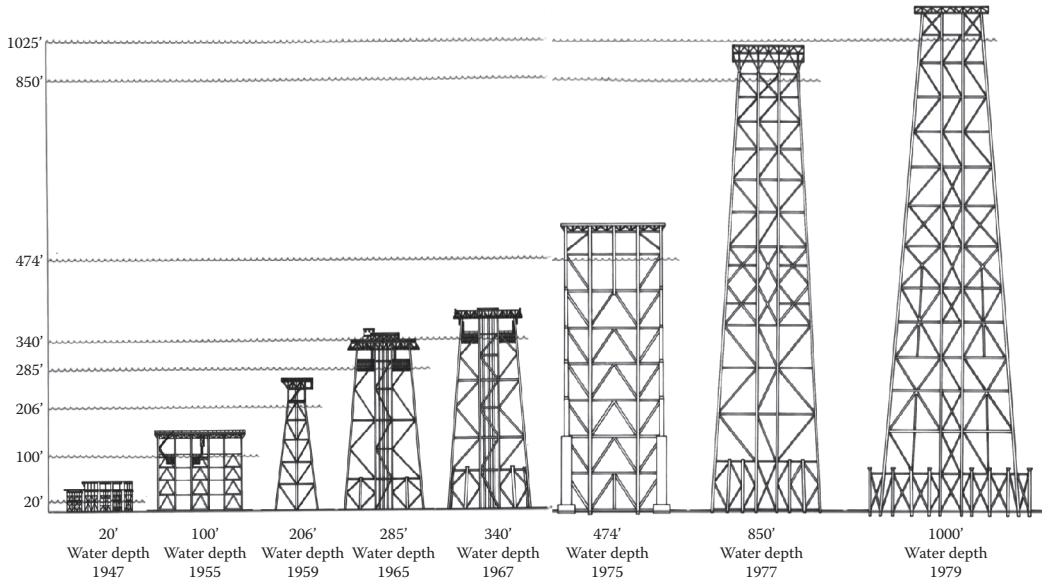


FIGURE 2.5 Evolution of jacket structures from their humble beginnings. (From Technical Brochure of McDermott Inc., *The Story of Oil and Gas*, p. 21, 1981. With permission.)

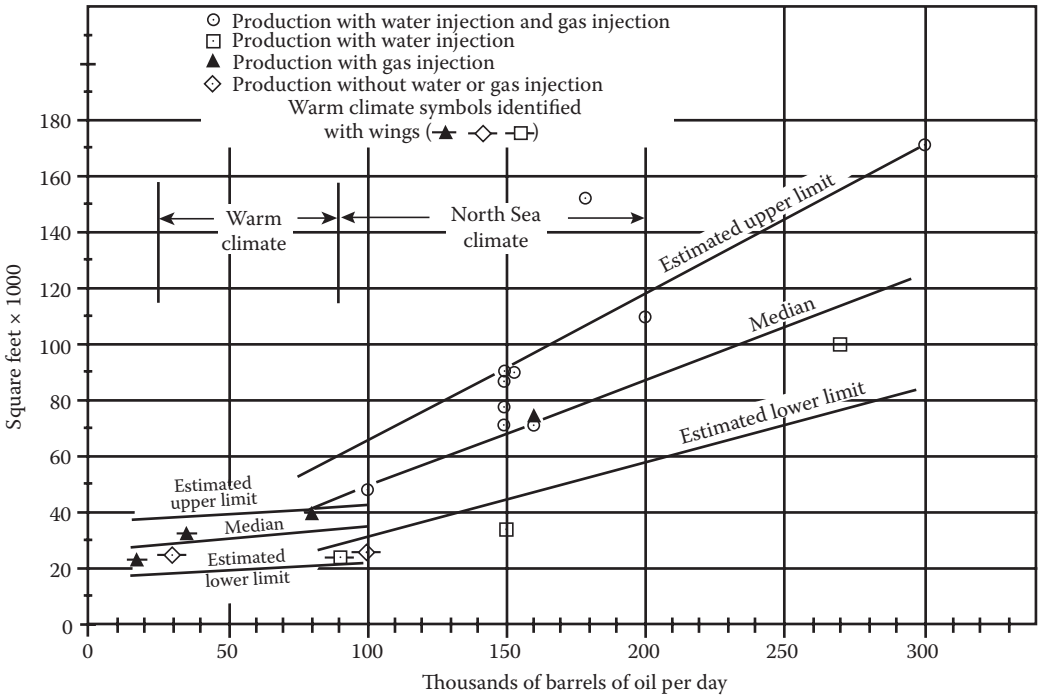


FIGURE 2.6 Platform topside area as a function of oil production rate. (From S.L. Landes, Operational loadings, in: *Planning and Design of Fixed Offshore Platforms*, edited by B. McClelland and M.D. Reifel, Van Nostrand Reinhold Company, New York, pp. 27–45, 1986. With permission.)

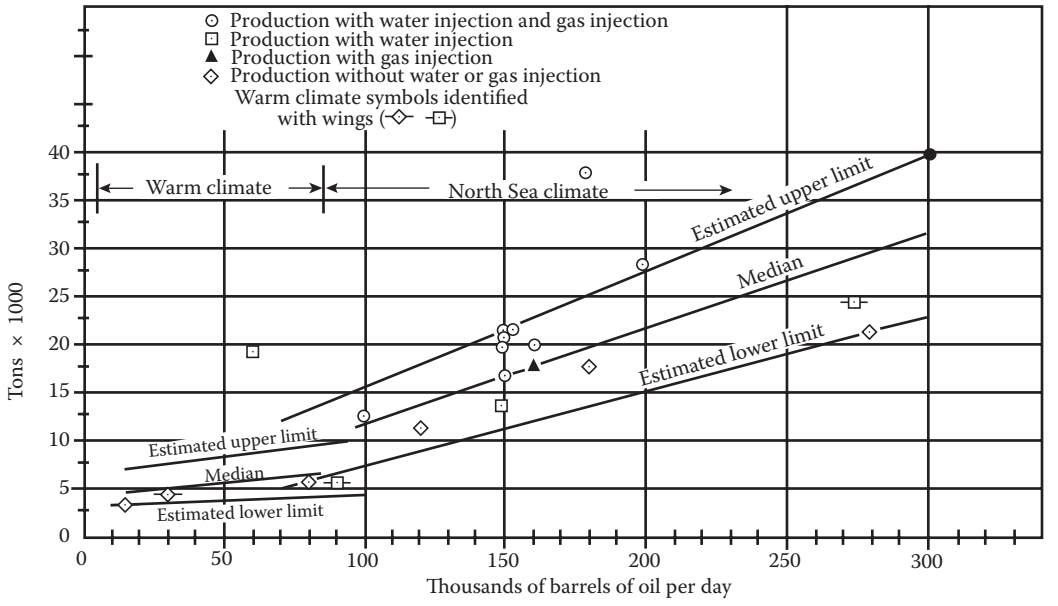


FIGURE 2.7 Platform dry weight as a function of oil production rate. (From S.L. Landes, Operational loadings, in: *Planning and Design of Fixed Offshore Platforms*, edited by B. McClelland and M.D. Reifel, Van Nostrand Reinhold Company, New York, pp. 27–45, 1986. With permission.)

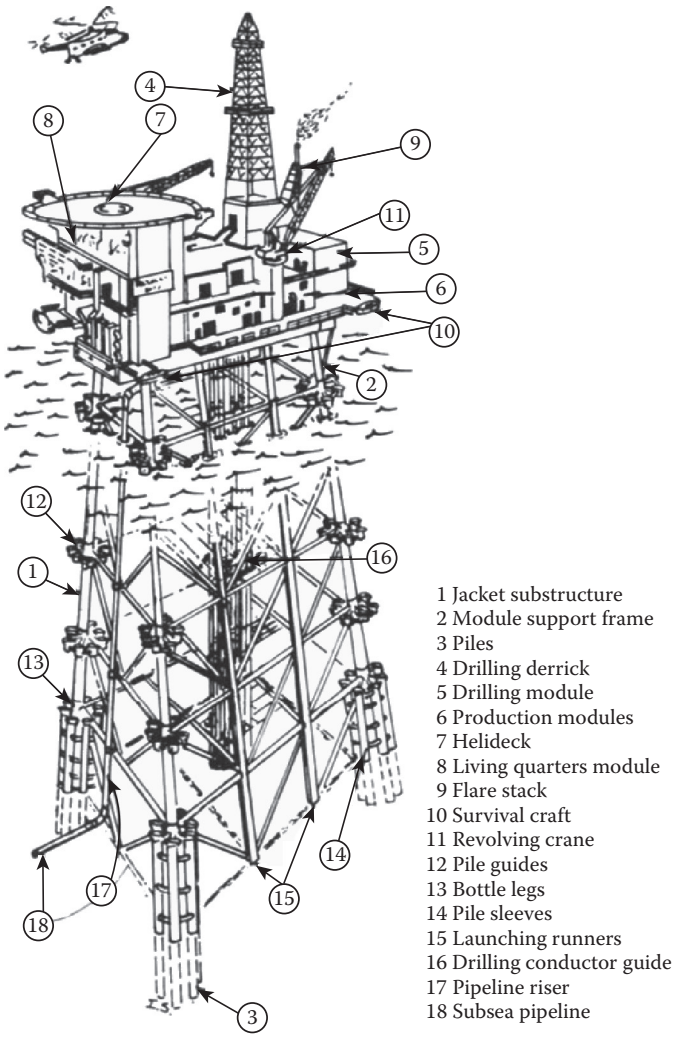


FIGURE 2.8 Components of a steel-piled self-contained drilling and production platform. (From J.G. Timar, *Lectures on Offshore Engineering*, Institute of Building Technology and Structural Engineering, Aalborg University Centre, Aalborg, Denmark, 1978. With permission.)

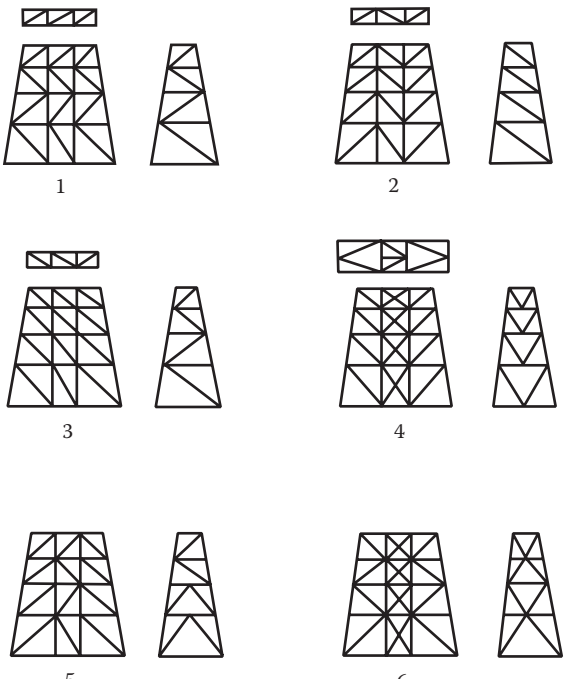


FIGURE 2.9 Typical jacket framing plans. (From W.J. Graff, *Introduction to Offshore Structures*, Gulf Publishing Company, Houston, TX, p. 111, 1981. With permission.)

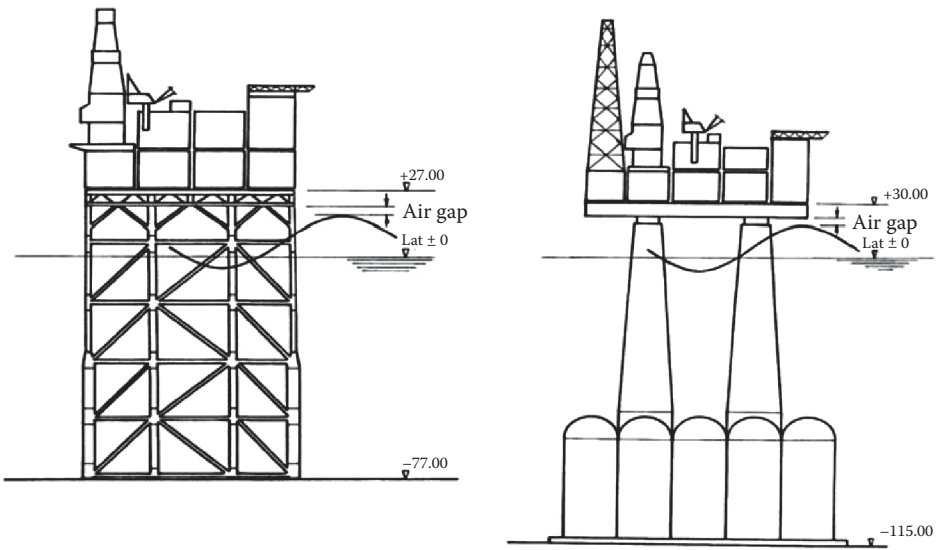


FIGURE 2.10 Modular deck assembled over a fixed jacket and a gravity platform. (From J.W. Bunce, The integrity of platform superstructures—Background to new API RP2A recommendations, in: *Platform Superstructures—Design and Construction*, edited by L.F. Boswell, Granada, London, p. 69, 1984. With permission.)

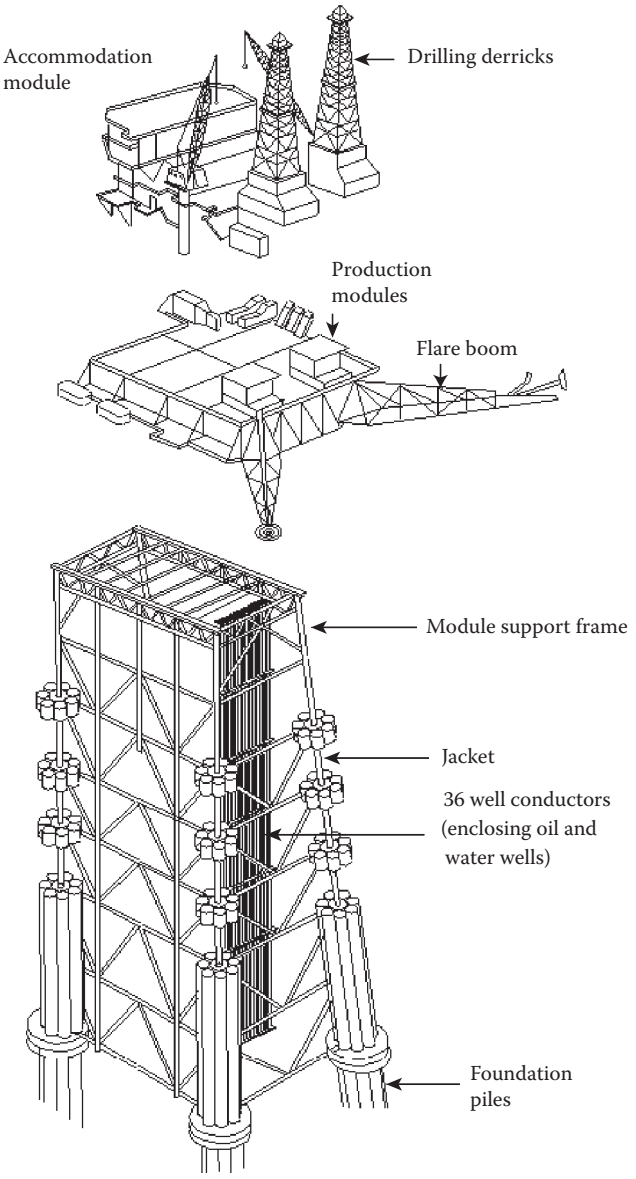


FIGURE 2.11 Modular assembly of jacket platform components with launch girders. (From ESDEP [The European Steel Design Education Program] Lecture Series, *Offshore Structures*, Lecture 15A.1. Available at http://www.esdep.org/members/master/wg15a/l0100.htm, 1993. With permission.)

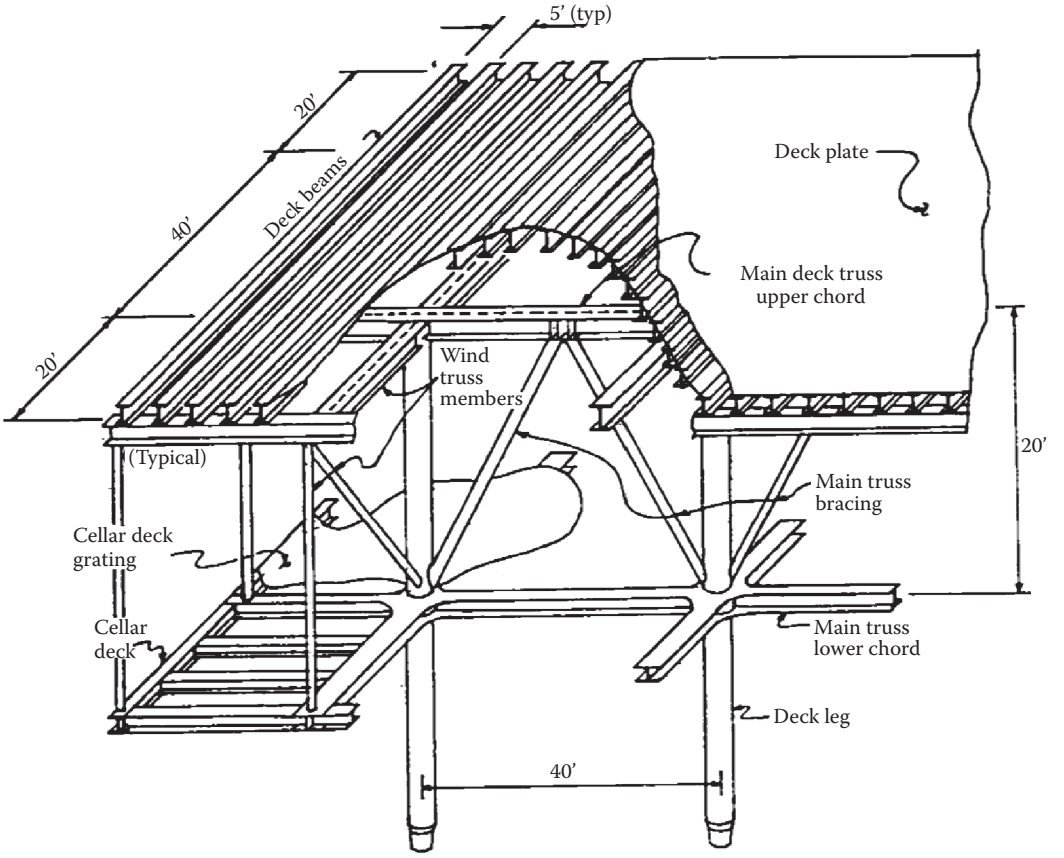


FIGURE 2.12 Cutaway view of the deck structure. (From W.J. Graff, *Introduction to Offshore Structures: Design Fabrication and Installation*, Gulf Publishing Company, Houston, TX, p. 219, 1981. With permission.)

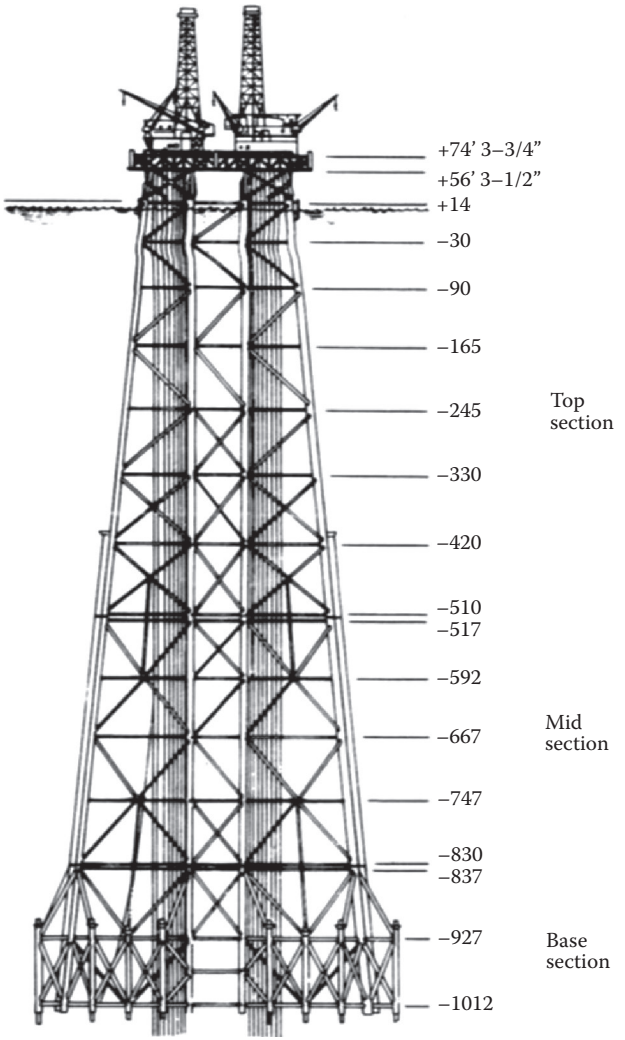


FIGURE 2.13 Assembled components of the Cognac platform located in the Mississippi Canyon, Gulf of Mexico, at a water depth of 1026.0 ft. (From W.J. Graff, *Introduction to Offshore Structures*, Gulf Publishing Company, Houston, TX, p. 49, 1981. With permission.)

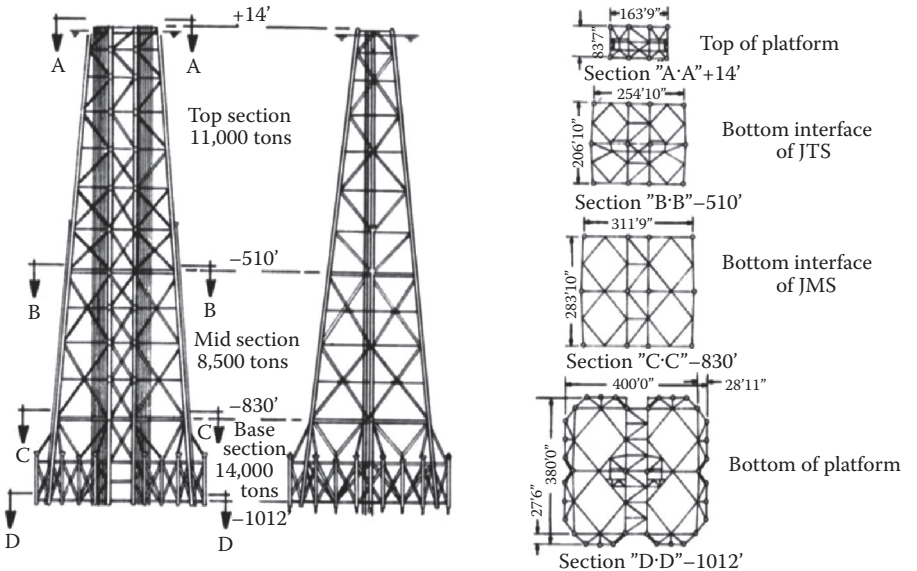


FIGURE 2.14 Constituent Subcomponents of the Jacket Structure. (From W.J. Graff, *Introduction to Offshore Structures*, Gulf Publishing Company, Houston, TX, p. 56, 1983. With permission.)

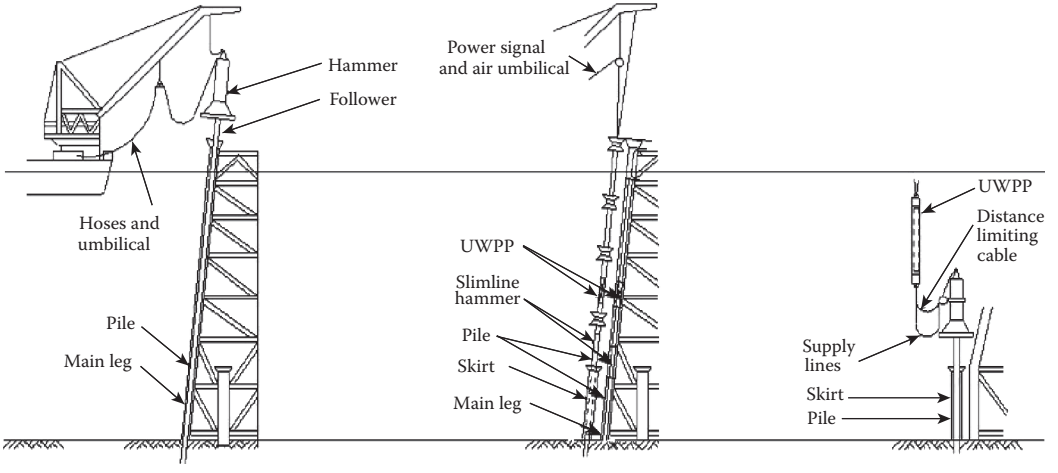
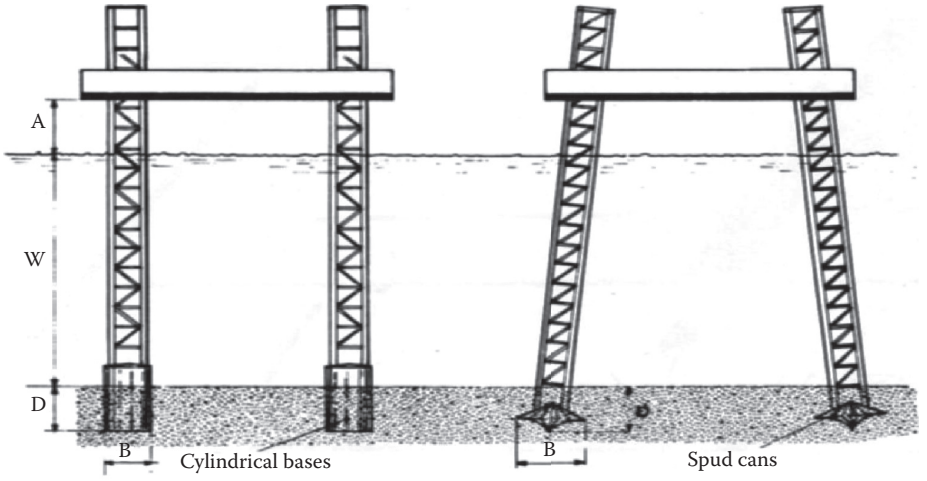
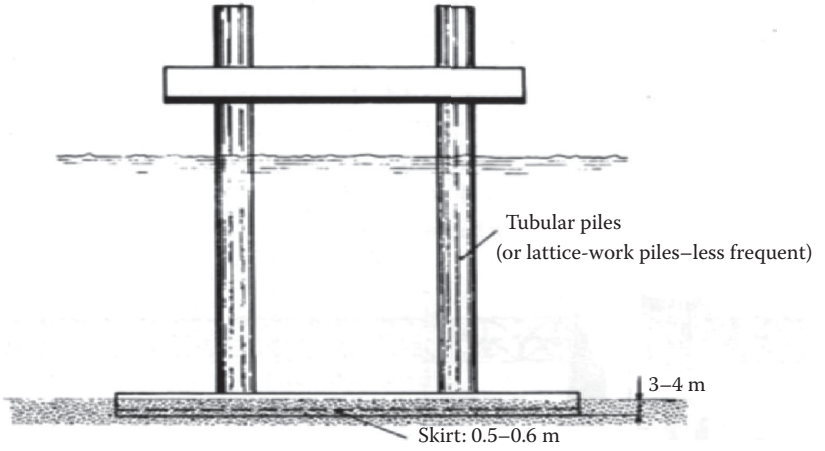


FIGURE 2.15 Conventional and New Pile Driving Technologies Utilized in Offshore Jacket Structures. (From ESDEP [The European Steel Design Education Program], Lecture Series, *Offshore Structures*, Lecture 15A.1. Available at http://www.esdep.org/members/master/wg15a/l0100.htm, 1993. With permission.)



(a) Jack-up platforms with bases or spud cans



(b) Mat-supported jack-up platforms

FIGURE 2.16 Types of jack-up platforms used in offshore exploration. (From P. Le Tirant, *Seabed Reconnaissance and Offshore Soil Mechanics*, Editions Technip 27, Paris, France, p. 401, 1979. With permission.)

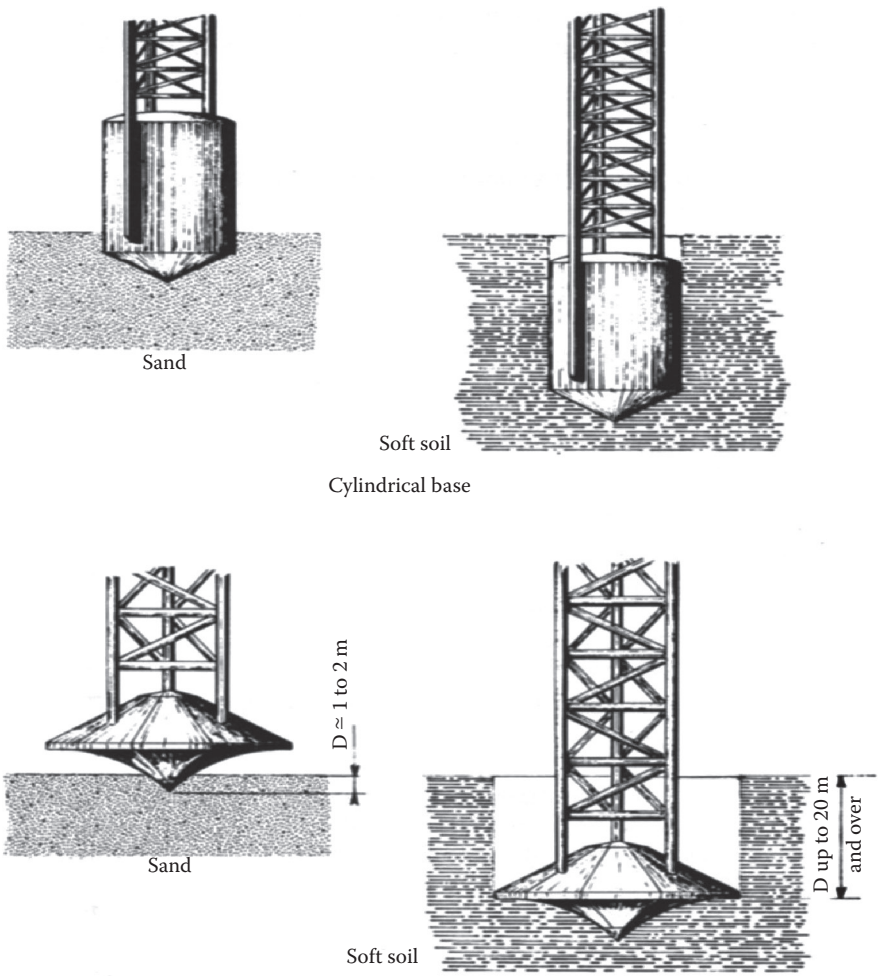


FIGURE 2.17 Types of bases used in jack-up platforms for seabed penetration. (From P. Le Tirant, *Seabed Reconnaissance and Offshore Soil Mechanics*, Editions Technip 27, Paris, France, p. 437, 1979. With permission.)

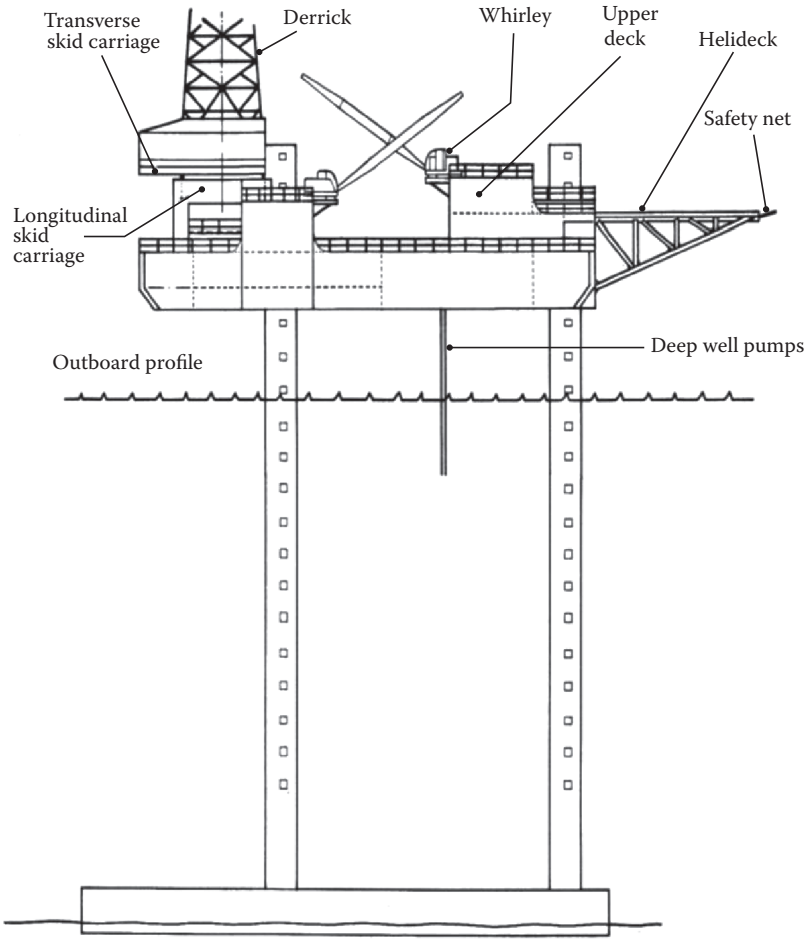


FIGURE 2.18 Elevation of a mat-supported jack-up platform. (From Bethlehem Steel Corporation, Jack-up designs for drilling, production and storage, *Technical Brochure*, p. 5, 1975. With permission.)

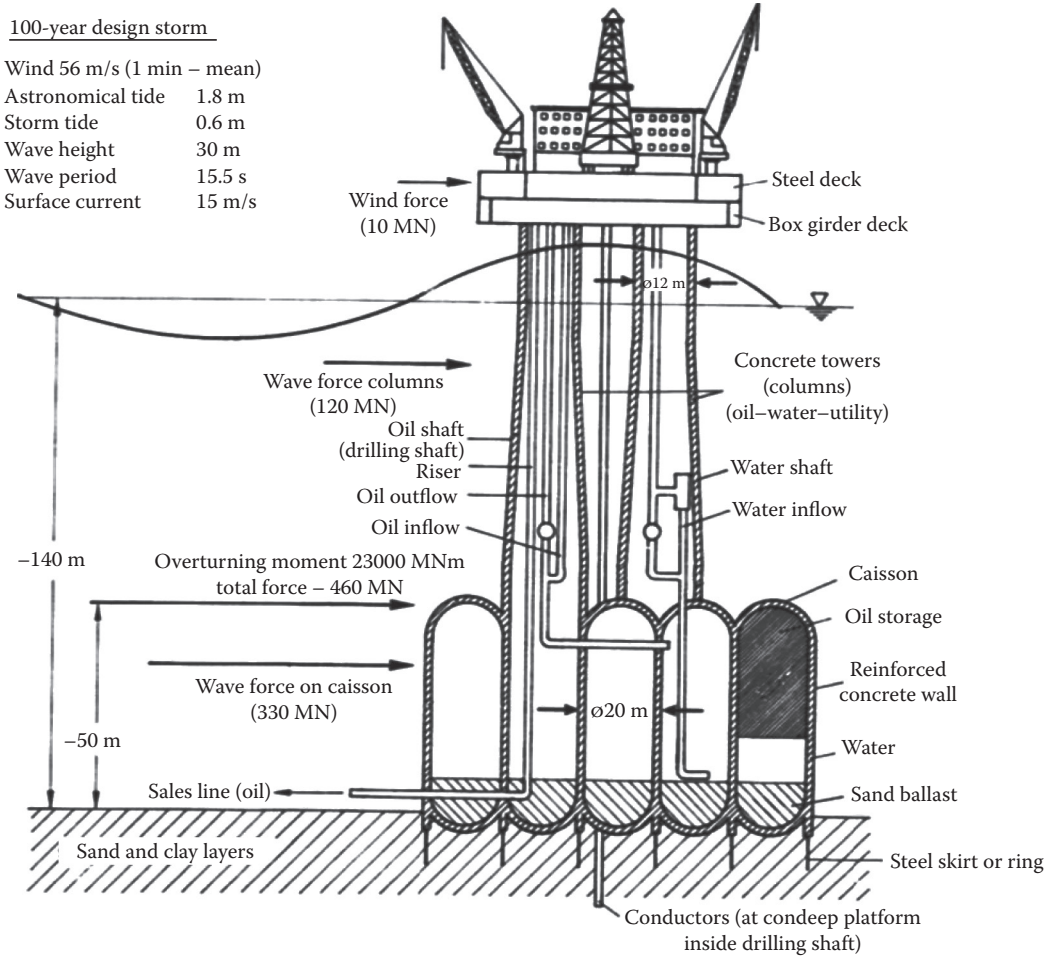
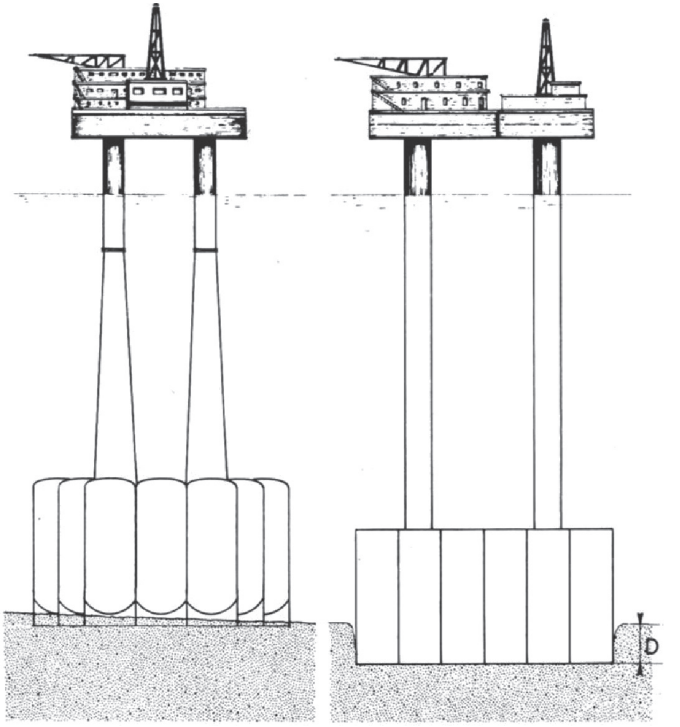


FIGURE 2.21 Cross section of the gravity platform Brent B and D. (With kind permission from Springer Science+Business Media: *Offshore Structures: Conceptual Design and Hydromechanics*, Volume I, 1992, p. 66. G. Clauss, E. Lehmann, and C. Ostergaard.)



(a) Stiff soil
Irregularities < 0.5 m
Gradient < 1%

(b) Soft soil
Base penetrates metres into soil

FIGURE 2.22 Penetration of the skirt into soil (stiff and soft) in a gravity platform. (From P. Le Tirant, *Seabed Reconnaissance and Offshore Soil Mechanics*, Editions Technip 27, Paris, France, p. 437, 1979. With permission.)

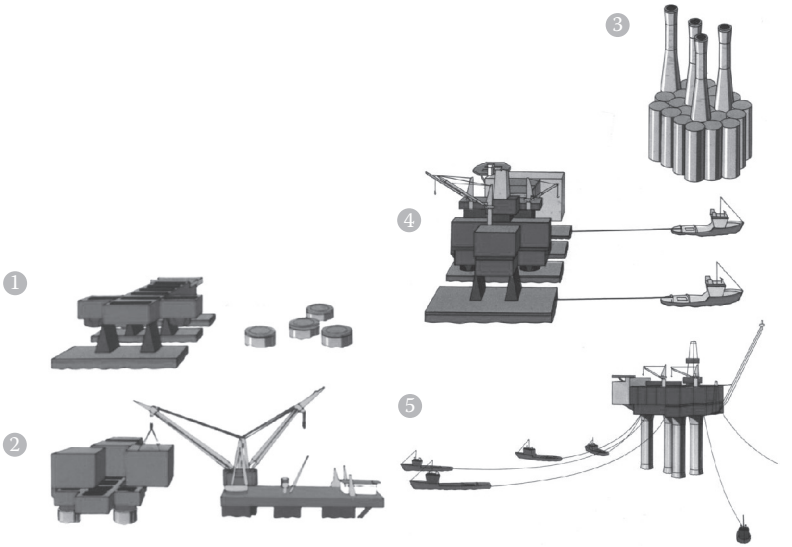


FIGURE 2.23 Components of an offshore gravity platform: (1) modular support frame ; (2) modules loaded and fixed on support frame; (3) floating gravity-based structure; (4) transportation barge towed to the deepwater site; (5) assembled gravity platform structure is towed to the final location for installation. (From Technical Brochure of Statoil, Aker and Norwegian Contractors, *Gullfaks A Gravity Platform*, pp. 3–4, 1986. With permission.)

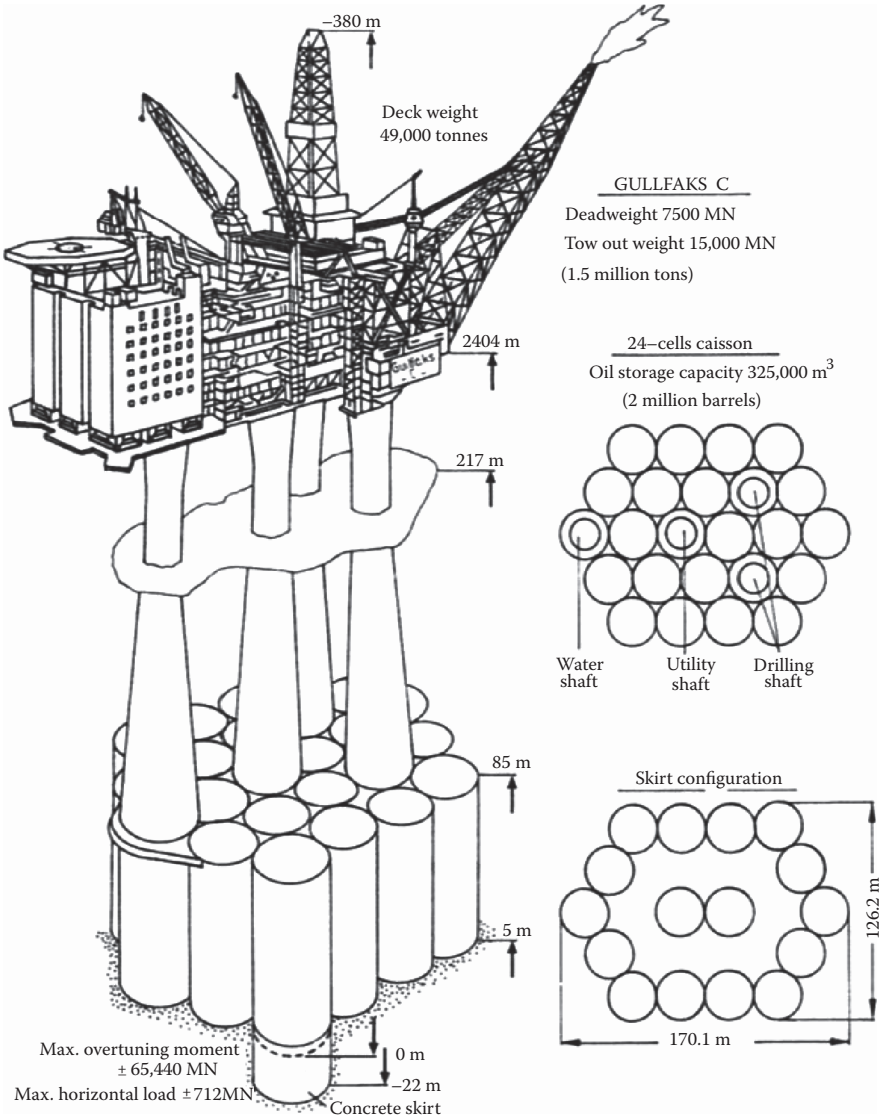


FIGURE 2.24 Assembled structural components on the gravity platform: Gullfaks C. (With kind permission from Springer Science+Business Media: *Offshore Structures: Conceptual Design and Hydromechanics*, Volume I, 1992, p. 67. G. Clauss, E. Lehmann, and C. Ostergaard.)

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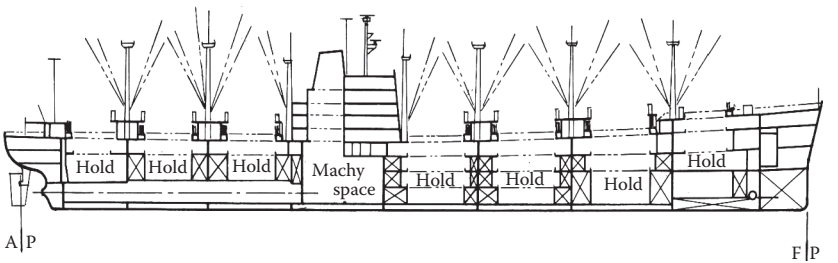

Length overall	184.4 m (605.0 ft.)
Length between perpendiculars	177.5 m (582.5 ft.)
Beam, molded	25.0 m (82.0 ft.)
Depth to main deck at side, molded	14.0 m (46.0 ft.)
Draft, full load (scantling), molded	10.7 m (35.0 ft.)
Light ship	9,787 t
Passengers, crew effects and stores	60 t
Fuel oil	3,596 t
Fresh water	608 t
Refrigerated cargo	218 t
Liquid cargo	2,377 t
General cargo	15,349 t
Total deadweight	22,208 t
Displacement, full load (scantling) draft	31,995 t
Cargo volume, bale	30,645 m^3 (1,082,207 $ft.^3$)
Refrigerated volume, net	618 m^3 (21,839 $ft.^3$)
Containers in hold	325
Containers on deck	84
Passenger accommodation	12
Crew accommodation	41
Shaft horsepower, ABS	24,000
Speed, knots	20.8
Propeller 4 blades, diam	6.7 (22.0 ft.)
Propelling machinery, cross compound, double reduction geared turbine	

FIGURE 2.25 Typical general arrangement in a large cargo ship. (From R.E. Taggart, *Ship Design and Construction*, SNAME, New York, pp. 137–138, 1980. With permission.)

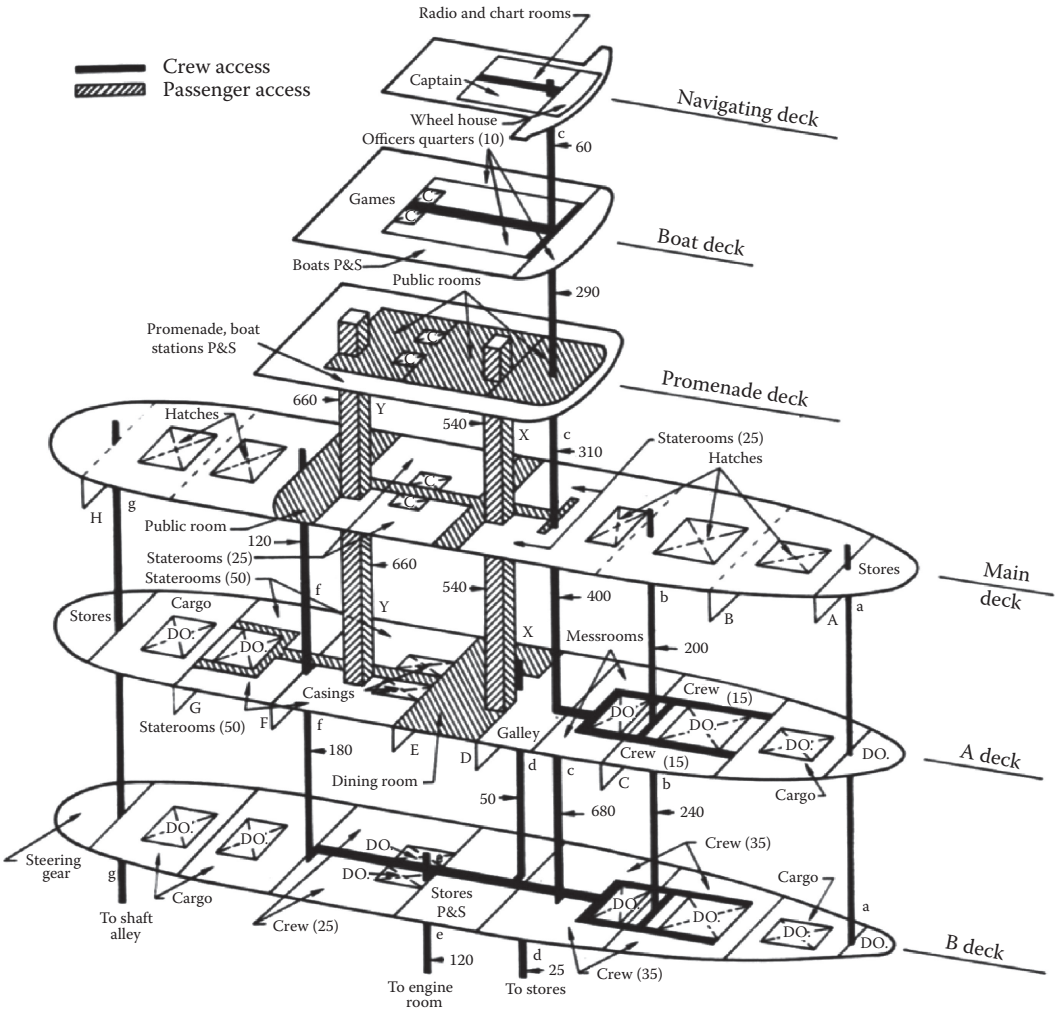

FIGURE 2.26 Details of decks in a general cargo ship. (From R.E. Taggart, *Ship Design and Construction*, SNAME, New York, p. 131, 1980. With permission.)

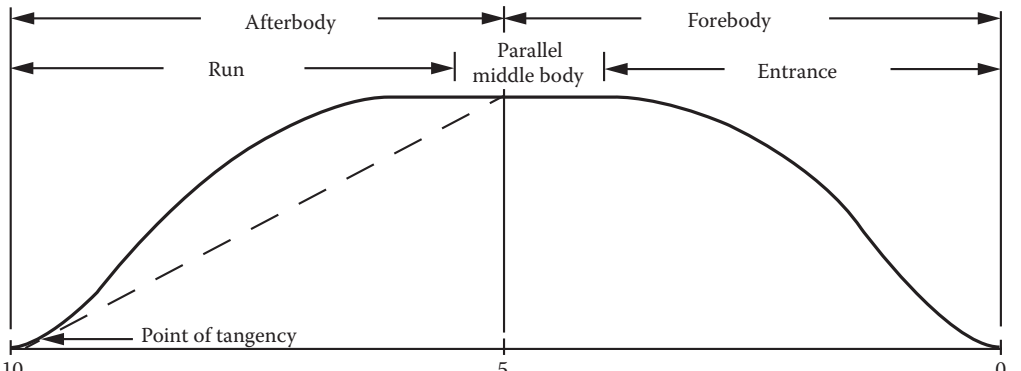

FIGURE 2.27 Geometry of longitudinal vertical section area curve. (From E.V. Lewis, *Principles of Naval Architecture*, SNAME, New York, p. 4, 1989. With permission.)

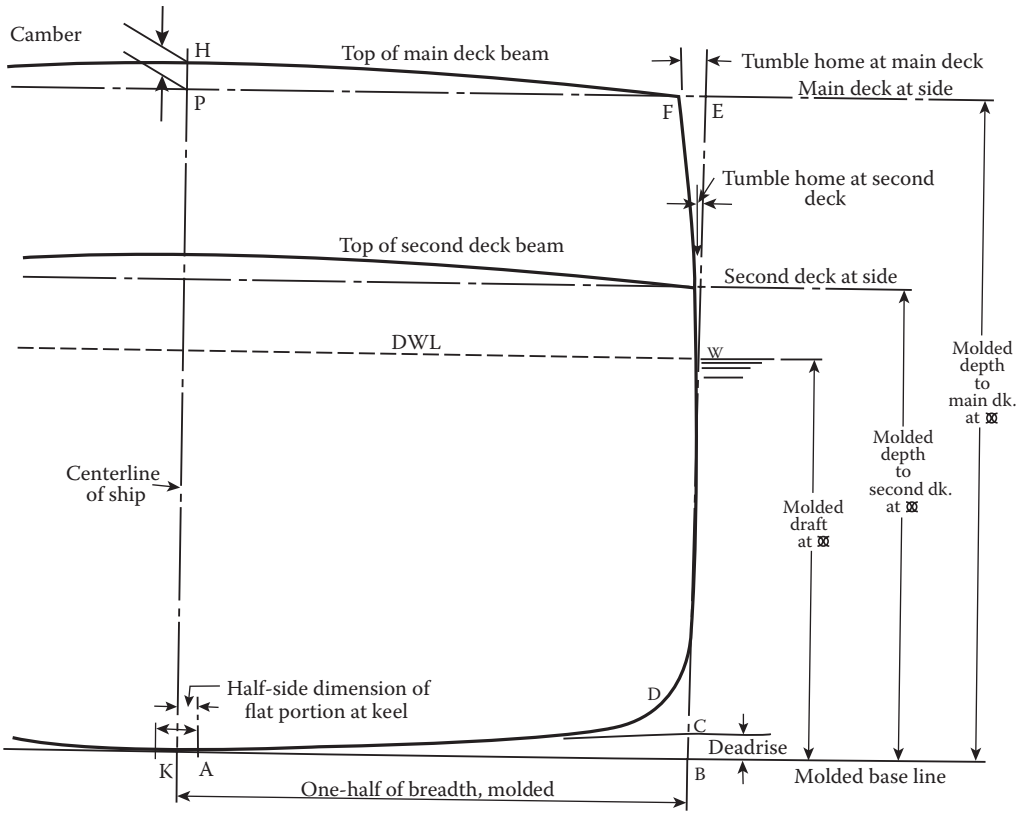

FIGURE 2.28 Molded form of a mid-ship section in a typical ship structure. (From E.V. Lewis, *Principles of Naval Architecture*, SNAME, New York, p. 5, 1989. With permission.)

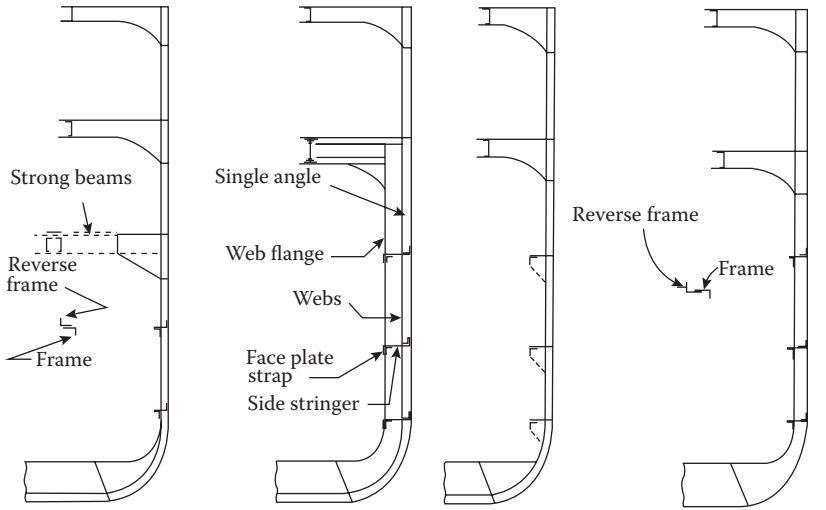

FIGURE 2.29 Different types of ship frames. (From R.E. Taggart, *Ship Design and Construction*, SNAME, New York, p. 212, 1980. With permission.)

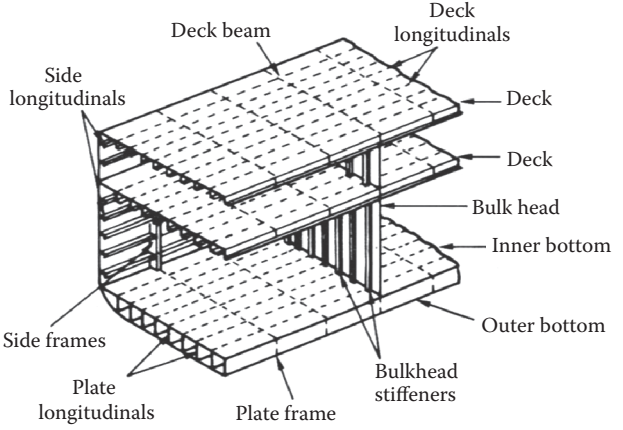

FIGURE 2.30 Cut-away section of one side of a typical ship structure with double bottom. (From N. Morgan, Marine technology reference book, in: *Ships and Advanced Marine Vehicles*, Butterworths, London, p. 3.43, 1990. With permision.)

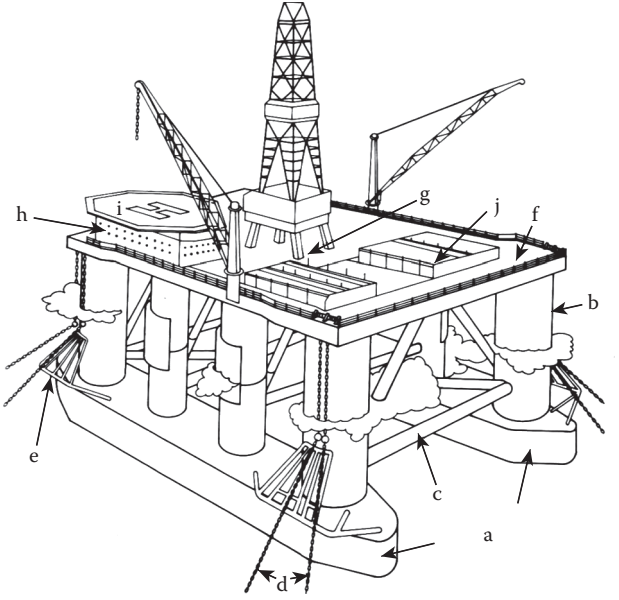

FIGURE 2.31 Components of a semi-submersible structure: (a) submerged pontoon; (b) surface piercing columns; (c) bracing members; (d) mooring line; (e) anchor rack; (f) deck; (g) moonpool; (h) accommodation; (i) helicopter pad; and (j) drill pipe. (From N. Morgan, Marine technology reference book, in: *Ships and Advanced Marine Vehicles*, Butterworths, London, 1990.)

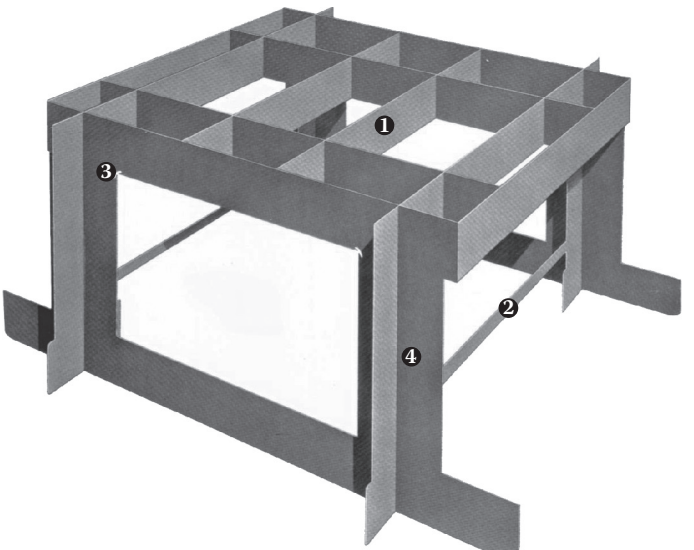

FIGURE 2.32 The skeleton of a production semi-submersible: (1) rigid box structure of the continuous bulkhead; (2) bracing; (3) stress-reducing joint; (4) column bulkheads. (From Technical Brochure of Gotaverken Arendal, Sweden, *Balmoral*, GVA 5000 Floating Production Unit, p. 3, 1988. With permission.)

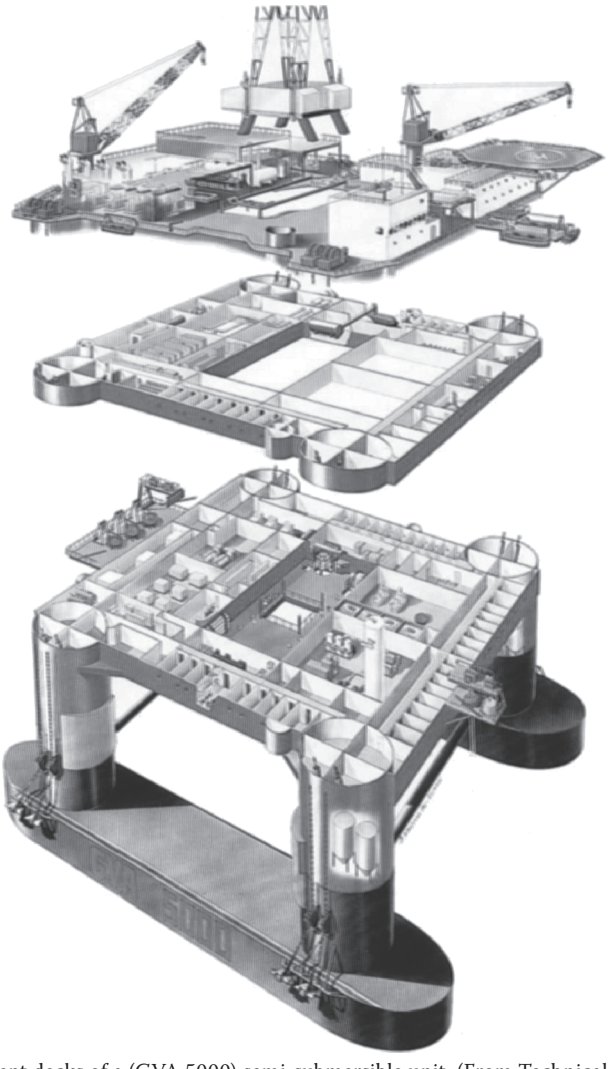

FIGURE 2.33 Component decks of a (GVA 5000) semi-submersible unit. (From Technical Brochure of Gotaverken Arendal, Sweden, *Balmoral*, GVA 5000 Floating Production Unit, p. 3, 1988. With permission.)

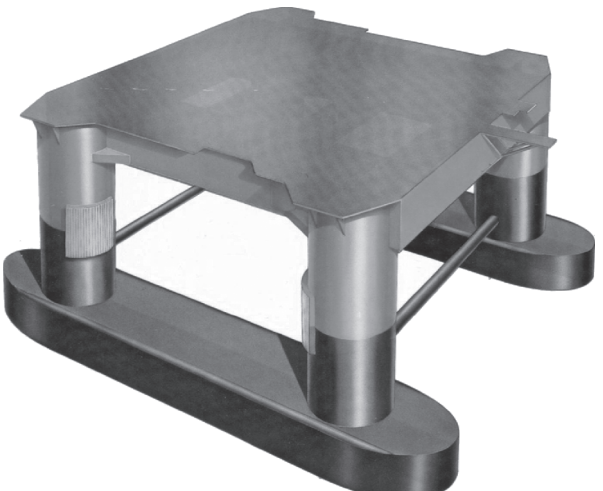

FIGURE 2.34 The production semi-submersible platform: main deck and steel shell. (From Technical Brochure of Gotaverken Arendal, Sweden, *GVA Are Leaders on Floaters*, 22 pp., 1986. With permission.)

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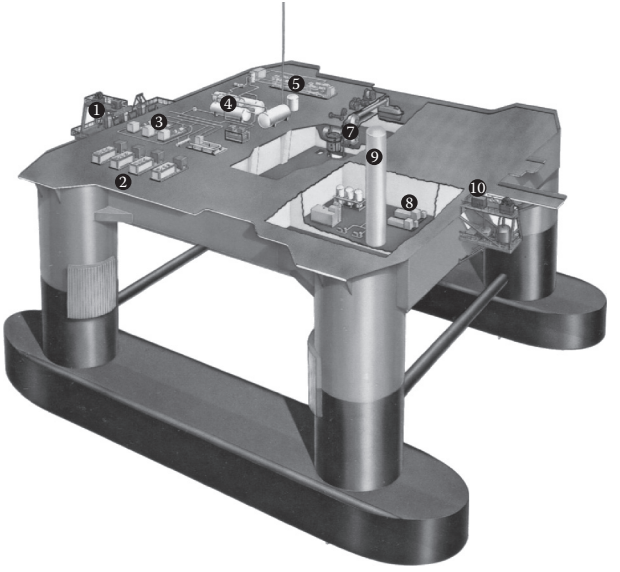

FIGURE 2.35 Processing and diving units in the semi-submersible: (1) risers for oil and gas; (2) gas turbines for power generation; (3) crude oil export pumps; (4) separators; (5) gas treatment and compression plants; (6) flare (omitted due to size limitation); (7) saturation diving system; (8); water injection room; (9) de-aerator; and (10) risers for water injection. (From Technical Brochure of Gotaverken Arendal, Sweden, *GVA Are Leaders on Floaters*, 22 pp., 1986. With permission.)

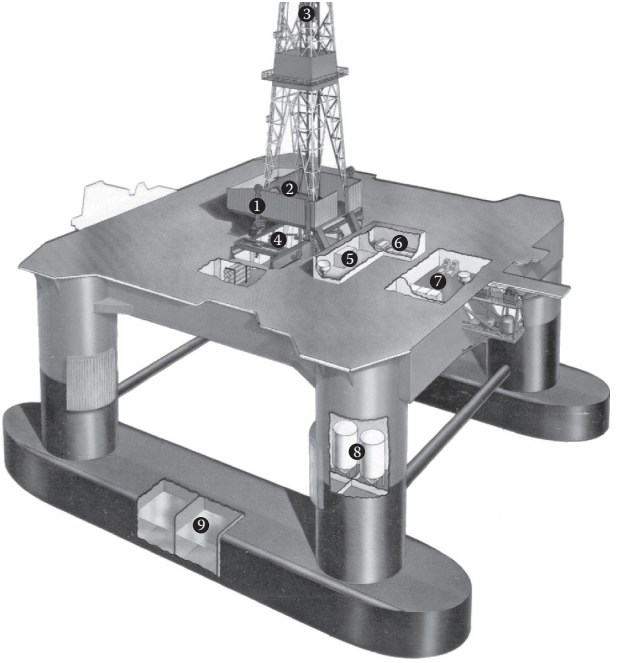

FIGURE 2.36 Drilling units of the production semi-submersible: (1) four riser tensioners; (2) drill floor; (3) heave compensators; (4) BOP and LMR package handling area; (5) cement unit room; (6) shale shaker room; (7) mud pump room; (8) bulk tanks; (9) drill water tanks. (From Technical Brochure of Gotaverken Arendal, Sweden, *GVA Are Leaders on Floaters*, 22 pp., 1986. With permission.)

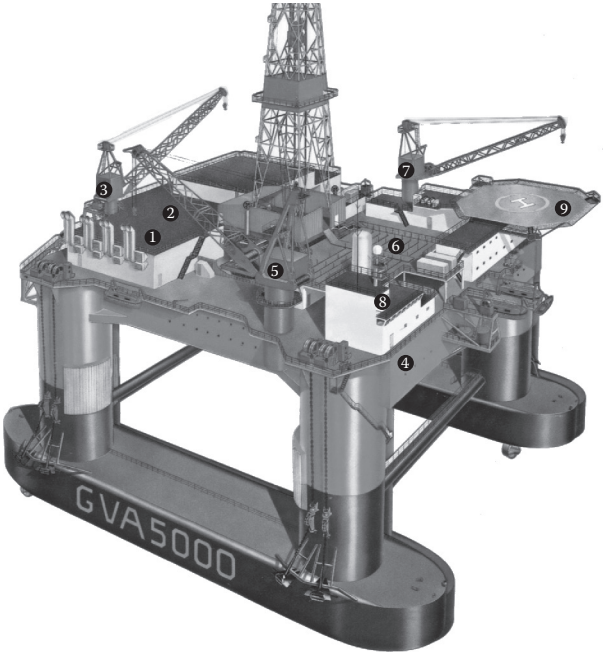

FIGURE 2.37 The exterior of the production semi-submersible: (1) gas turbine house; (2) process plant; (3) 10-ton crane; (4) accommodation module; (5) 75-ton crane; (6) pipe rack deck; (7) 25-ton crane; (8) communication tower; (9) helideck. (From Technical Brochure of Gotaverken Arendal, Sweden, *GVA Are Leaders on Floaters*, 22 pp., 1986. With permission.)

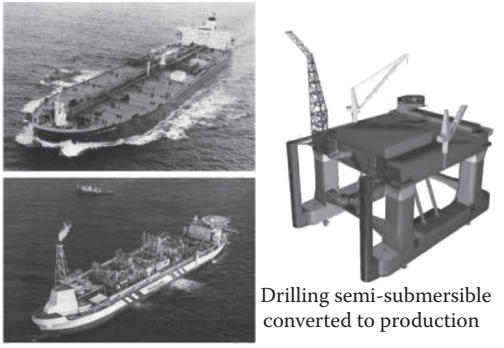

FIGURE 2.38 Conversion of platforms from drilling to production units. (From T. Moan, Offshore structures (Chapter 7), in: *Modeling Complex Engineering Systems*, edited by R.E. Melchers and R. Hough, ASCE Press, Reston, VA, pp. 173 and 175, 2007. With permission.)

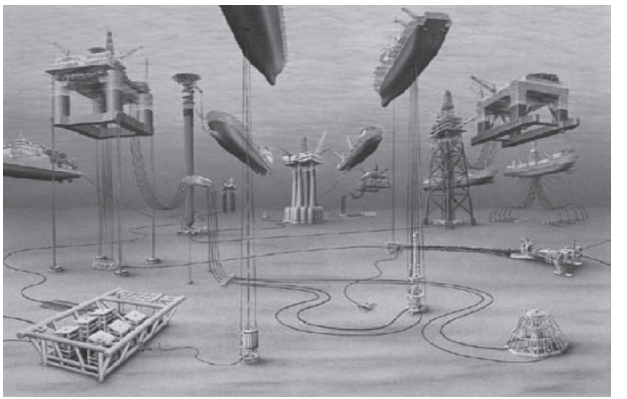

FIGURE 2.39 Sub-sea structures and equipment associated with offshore structures. (From T. Moan, Offshore structures (Chapter 7), in: *Modeling Complex Engineering Systems*, edited by R.E. Melchers and R. Hough, ASCE Press, Reston, VA, pp. 173 and 175, 2007. With permission.)

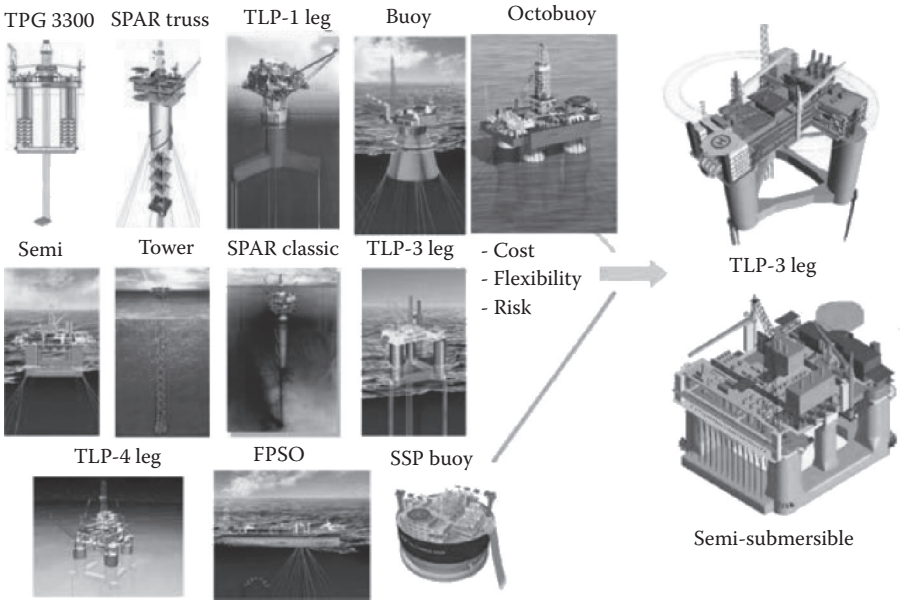

FIGURE 2.40 Sub-sea structures and equipment associated with offshore structures. (From T. Moan, Offshore structures (Chapter 7), in: *Modeling Complex Engineering Systems*, edited by R.E. Melchers and R. Hough, ASCE Press, Reston, VA, pp. 173 and 175, 2007. With permission.)

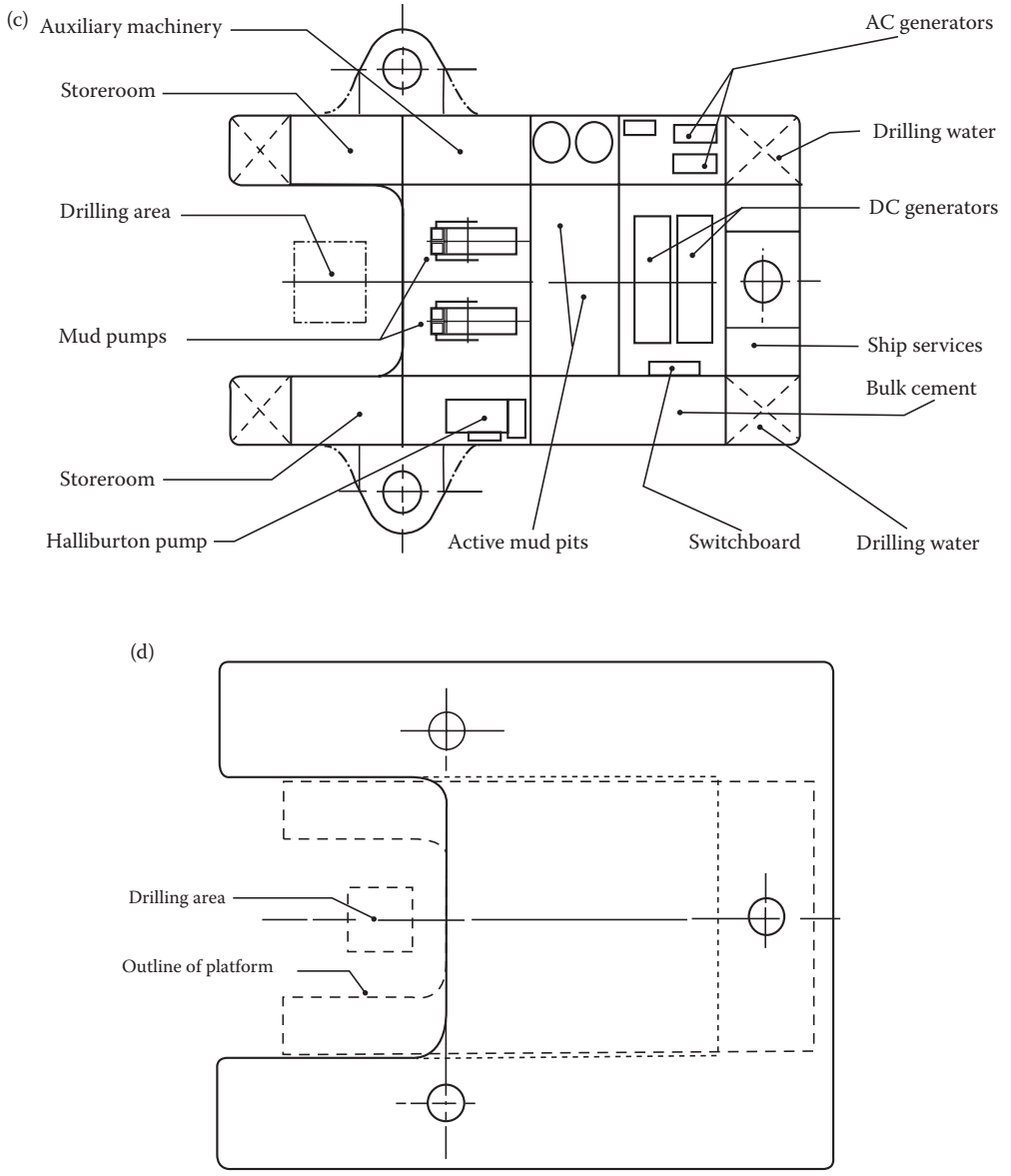

FIGURE 2.19 (Continued) Structural details of a jack-up platform (a) skid unit and upper deck; (b) main deck; (c) lower deck; and (d) mat and drilling platform. (From Bethlehem Steel Corporation, Jack-up designs for drilling, production and storage, *Technical Brochure*, pp. 4 and 5, 1975. With permission.)

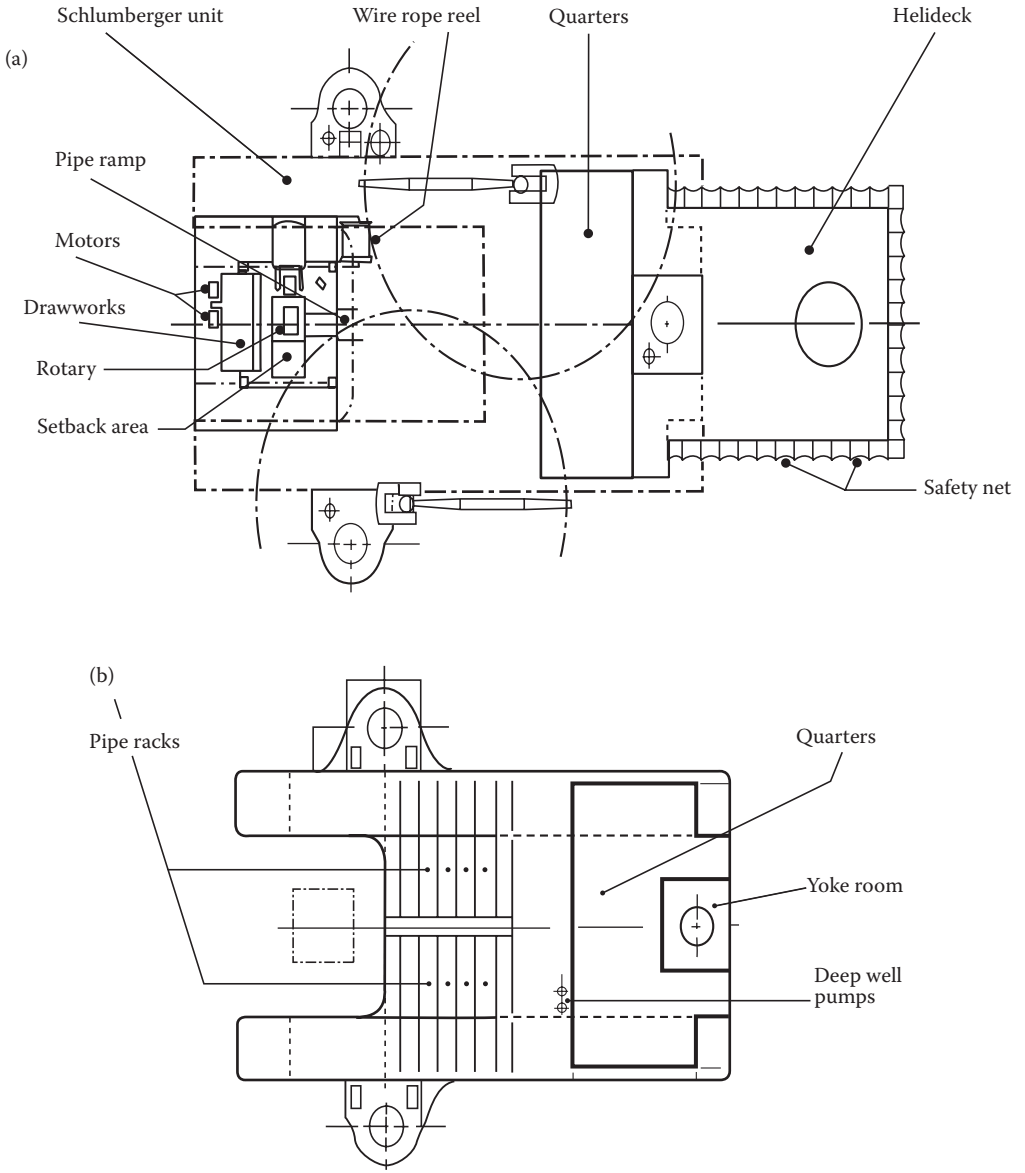

FIGURE 2.19 Structural details of a jack-up platform (a) skid unit and upper deck; (b) main deck; (c) lower deck; and (d) mat and drilling platform. (From Bethlehem Steel Corporation, Jack-up designs for drilling, production and storage, *Technical Brochure*, pp. 4 and 5, 1975. With permission.)

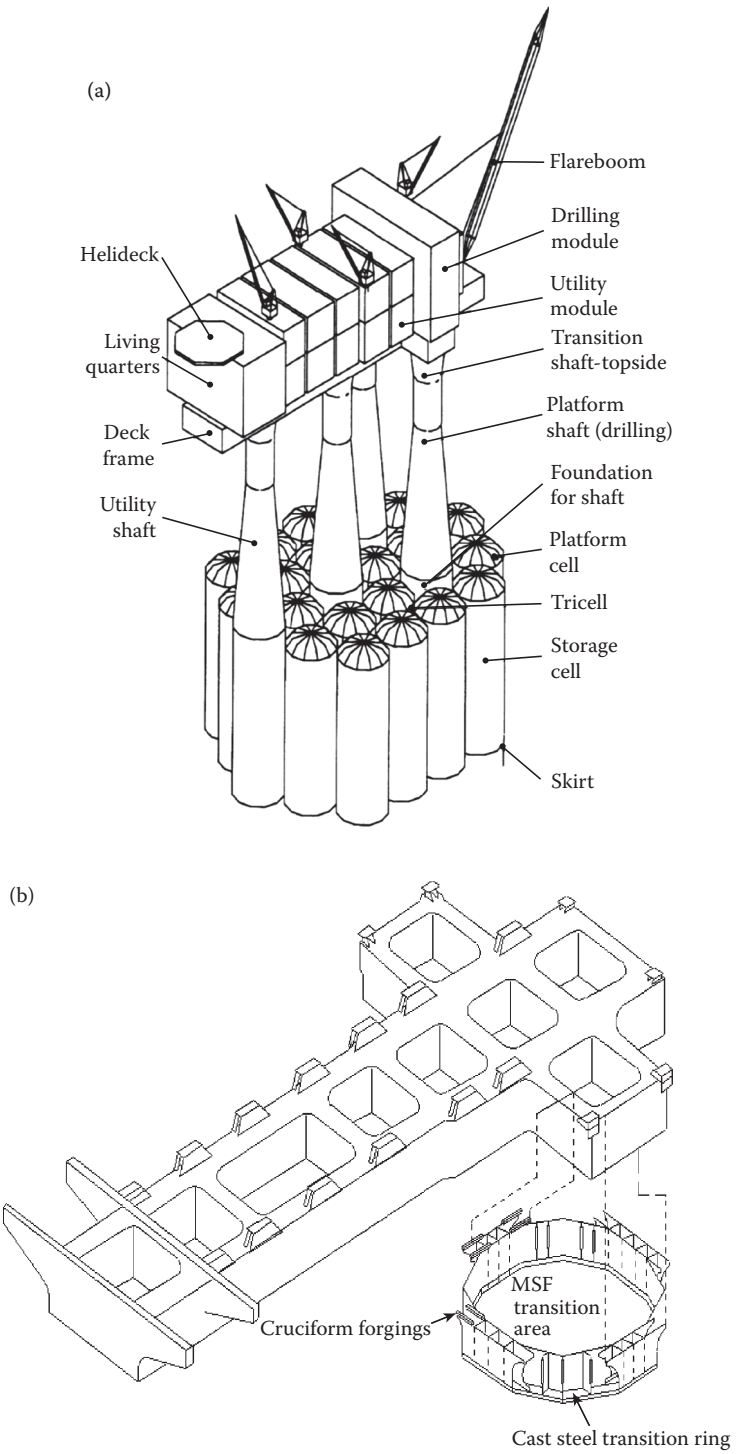

FIGURE 2.20 (a) Components of a typical condeep gravity platform. (From T. Holland et al., *Design of Offshore Concrete Structures*, Spon Press, London, p. 18, 2000. With permission.) (b) Module support (or deck) frame (MSF) for a gravity platform. (From ESDEP [The European Steel Design Education Program] Lecture Series, *Offshore Structures*, Lecture 15A.1. Available at http://www.esdep.org/members/master/wg15a/l0100.htm, 1993. With permission.)