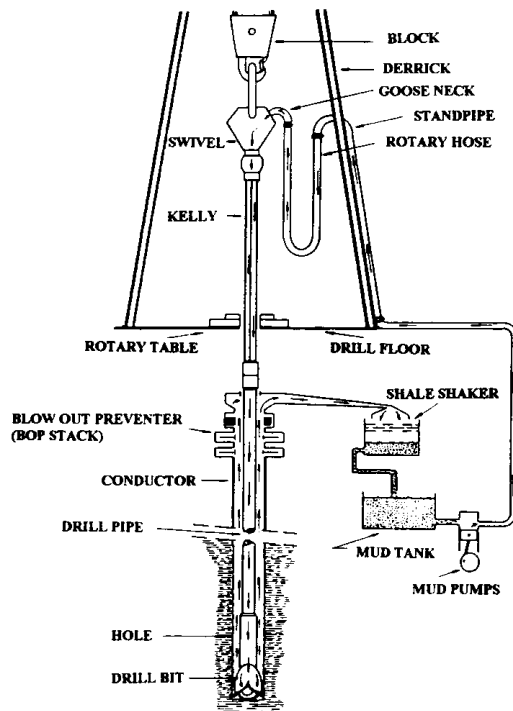


Offshore Structures



Offshore Drilling Equipment

The drill string is lowered through a conduit (riser). The drill string consists of a drill bit, drill collar and drill pipe. Drill pipe sections are added at the surface as the well deepens. The drill passes through a system of safety valves called a Blowout Preventer (BOP) stack which contains the pressures in the well to prevent a blowout (escape of pressure into the annular casing between the casing and the drill pipe or into the hole).

Drilling fluid (mud) is pumped into the drill pipe from the surface and flows through small holes in the drill bit. The mud collects rock cuttings and flows up the annulus between the drill pipe and the casing where the rock is strained out and the mud is recirculated. The weight of the mud exerts a pressure on the rock and keeps the well under control.

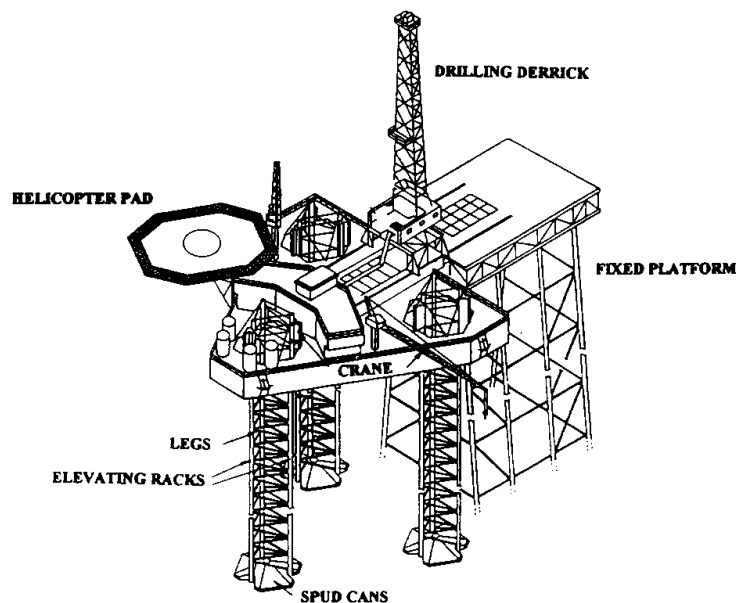
Jack-Up Drilling Rig

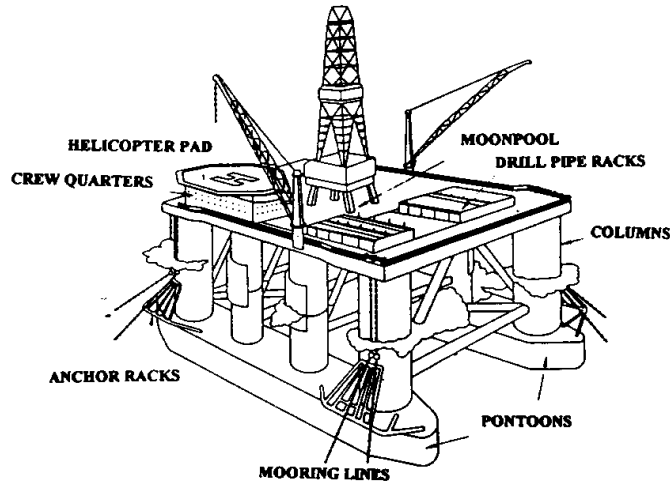
Design: primarily exploratory drilling; similar to a barge with movable legs, the rig is towed to the site and legs are jacked down, engaging the seafloor and raising the platform.

Depth: shallow... 90 - 140 m

Advantages: (1) mobile, (2) stable when elevated, (3) low cost & efficient

Disadvantages: (1) depends on weather windows for placement, (2) restricted to shallow areas, (3) seafloor scour, (4) blowout can cause collapse of platform due to soil fluidization





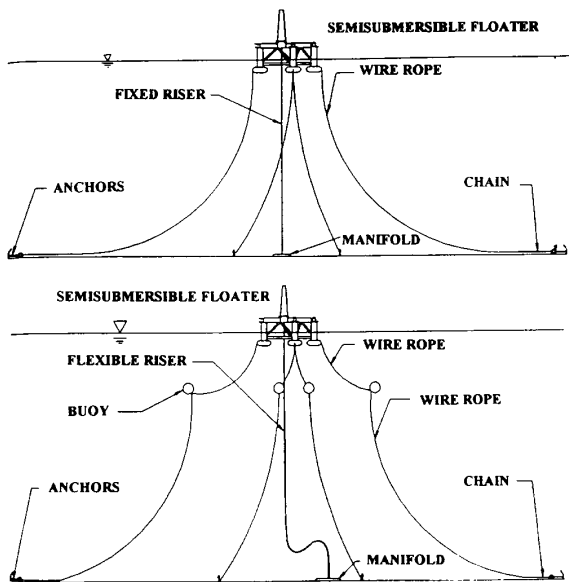
Semisubmersible

Design: exploratory and production; floating structure; towed to the site, ballasted and moored (anchored); large vertical columns connected to large pontoons, the columns support the deck structure and equipment

Depth: shallow to medium... 90 - 1000 m

Advantages: (1) mobile with high transit speed (~10 kts), (2) stable - minimal response to wave action, (3) large deck area.

Disadvantages: (1) high initial & operating costs, (2) limited deck load (low reserve buoyancy), (3) structural fatigue, (4) expensive to move large distances, (5) limited dry-docking facilities available, (6) difficult to handle mooring systems and land BOP stack & riser in rough seas



wind/waves reducing their effect

Floating Production System (FPS)

Design: small field production; semisubmersible or converted drill ship moored using a catenary mooring system or dynamic positioning; may have flexible or rigid tensioned risers; quick disconnects.

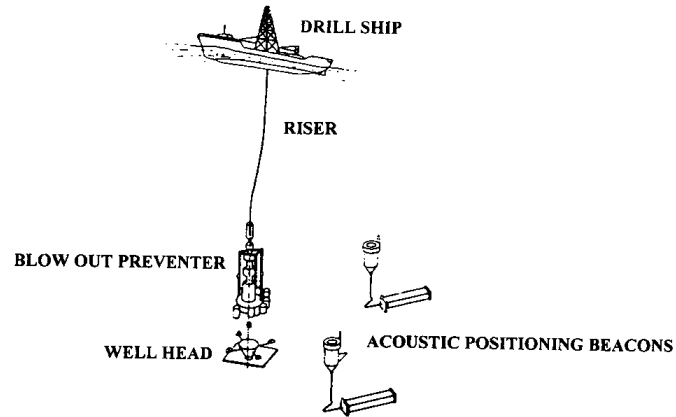
Depth: shallow... 70-250 m

Advantages: (1) low cost (small), (2) mobile & reusable, (3) reduced lead time, (4) quick disconnect capability (good in iceberg prone areas), (5) little infrastructure required, (6) Turret Mooring System enables FPS (converted ship type) to head into the

Disadvantages: (1) limited to small fields, (2) low deck load capacity, (3) damage to risers due to motion, (4) poor stability in rough seas, (5) little oil storage capabilities

Drill Ship

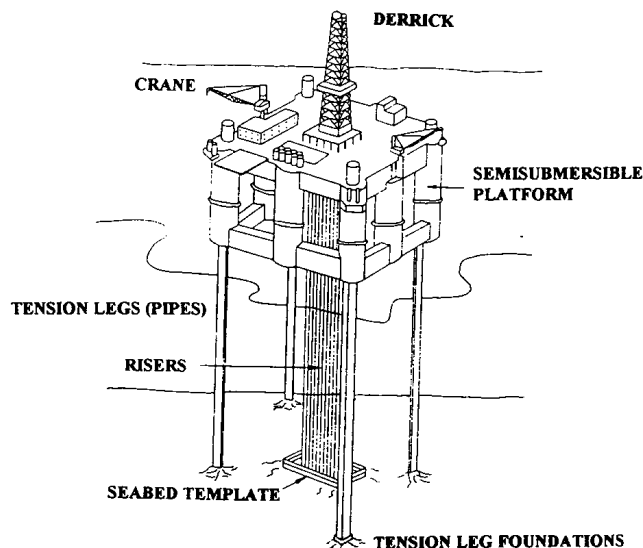
Design: exploratory; ship hull adapted to accommodate drilling equipment, drilling derrick amidships with a “moonpool” opening located below the derrick, flexible risers with disconnects; self-propelled, utilize a dynamic positioning system to maintain ship above the drilling location (computer controlled thrusters, environmental sensors, position determining equipment). Turret Mooring System enables ship to head into the wind/waves reducing their effect



Depth: deep... 2500 m or greater

Advantages: (1) mobile with high speed transit (up to 16 kts), (2) deck load and total load greater than jack-up and semisubmersibles, (3) reduced transoceanic transit times (able to pass through Suez and Panama Canals), (4) low mobilization cost, (5) low initial & operating cost, (6) superior seaworthiness and survival capability

Disadvantages: (1) poor stability in rough seas, (2) minimum deck area, (3) low freeboard (4) difficult to handle mooring systems and land BOP stack & riser in rough seas



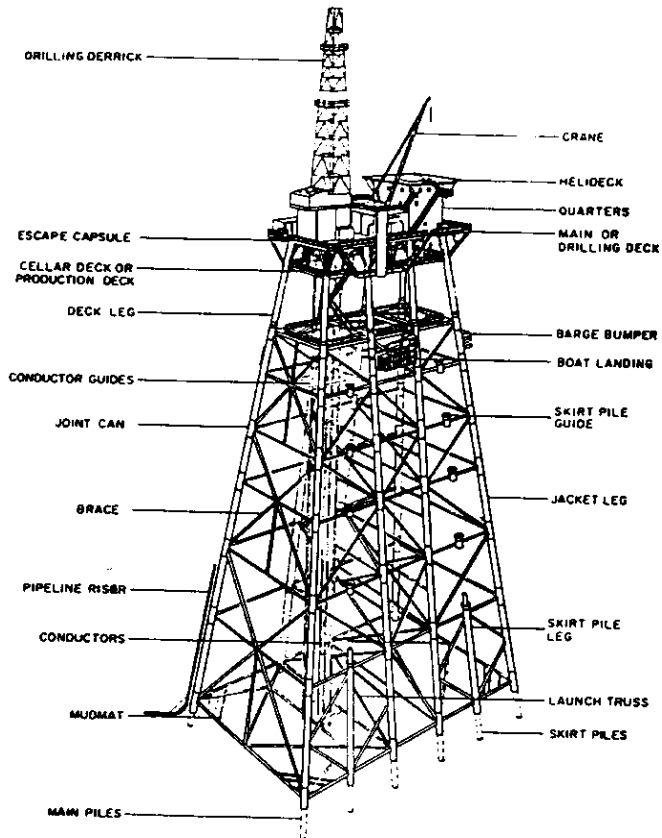
Tension Leg Platform

Design: production; semisubmersible tethered to seafloor with vertical anchor lines (cables or pipes) maintained in tension by the excess buoyancy of the platform

Depth: shallow to deep... 120 - 1500 m

Advantages: (1) mobile & reusable, (2) stable - minimal vertical motion, (3) low cost increase with depth increase, (4) deep water capability, (5) low maintenance cost

Disadvantages: (1) high initial cost, (2) high subsea cost, (3) fatigue of tension legs, (4) difficult maintenance of subsea systems, (5) little or no storage



Fixed Jacketed Structure

Design: production; steel framed tubular structure attached to sea bed with piles which are driven into the seafloor (legs act as a guiding device or “jacket” for the piles); constructed in sections and transported to the site; design lifetime of 10-25 years.

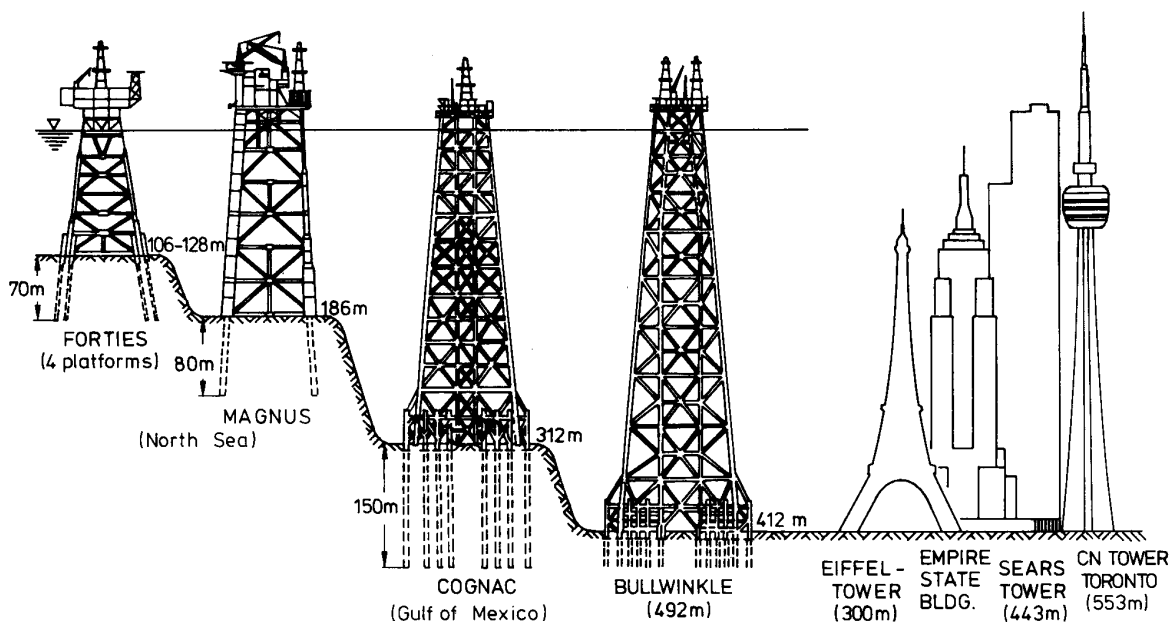
Depth: shallow... 500 m or less

Advantages: (1) support large deck loads, (2) may be constructed in sections & transported, (3) large field, long term production (supports a large number of wells), (4) piles result in good stability, (5) little effect from seafloor scour

Disadvantages: (1) costs increase exponentially with depth, (2) high initial & maintenance costs, (3) not

reusable, (4) steel structural members subject to corrosion

Comparison of Fixed Jacketed Structures



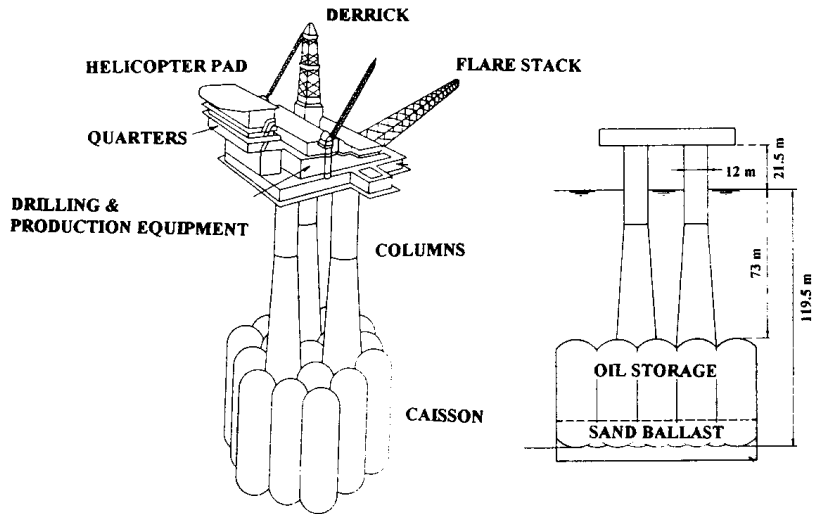
Gravity Structure

Design: production; large reinforced concrete bottom mounted structure which uses its weight to resist environmental loads, not attached to the bottom with piles

Depth: medium... up to 350 m

Advantages: (1) support large deck loads, (2) possible reuse, (3) construction and testing may be completed before floating and towing to site, (4) large field, long term production (supports a large number of wells), (5) may have large storage capacity, (6) more tolerant to overloading & sea water exposure than steel jacketed platforms

Disadvantages: (1) cost increases exponentially with depth, (2) foundation settlement, (3) subject to seafloor scour, (4) may require more steel than steel jacket structures



Guyed Tower

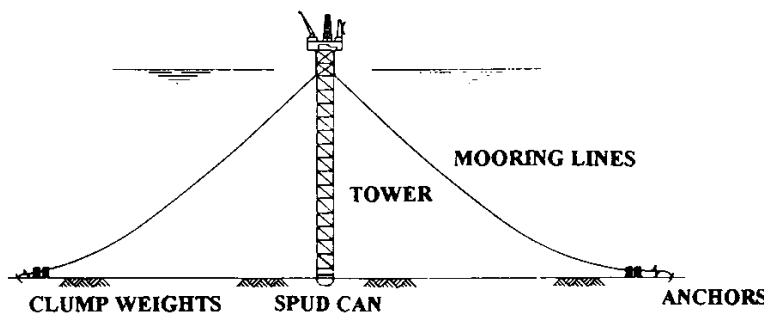
Design: small field production; slender truss-steel structure supported by a "spud-can" foundation and held upright by multiple wire or chain guy lines which are held in place by clump weights and anchor piles; clump

weights may rise off the seafloor in extreme conditions and provide added restoring force.

Depth: medium... 200-600 m

Advantages: (1) low cost (lower than steel jacket), (2) good stability - guy lines and clump weights give added restoring force, (3) possible reuse

Disadvantages: (1) high maintenance costs, (2) small fields only, (3) cost increases exponentially with depth, (4) difficult mooring



Articulated Tower & Single Anchor Leg Mooring Systems

Design: small fields; crude oil is moved up the tower and transferred to a tethered tanker for processing and storage, shuttle tanker transports receives processed oil and transports it to shore or pipeline is used.

Depth: shallow... less than 200 m (buoy may be used in deep water)

Advantages: (1) low cost, (2) large restoring moments due to high center of buoyancy, (3) risers are protected by tower, (4) buoy system may be used in deep water

Disadvantages: (1) shallow water only - greater oscillations as depth increases, (2) cannot operate in bad weather, (3) limited to small fields, (4) fatigue of universal joint (single point failure), (5) riser not protected by buoy

