



# Rotary Drilling Rig Types

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Course Name & Code: Petroleum Drilling Engineering I  
(PTR 316)

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Week #4/Lecture #4 (Theory)

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# Previous Lecture

- Drilling Methods
- Percussions Drilling
  1. Spring Pole Drilling
  2. Cable Tool Drilling
- Rotary Drilling

# Lecture Learning Outcomes

By the end of this lecture, you will be able to:

- List the well types according to different classifications.
- List and Differentiate between different rig types used in the Drilling Industry.

# Content

- Classification of Wells
  - A. Classification according to the well location.
  - B. Classification according to wellbore trajectory.
  - C. Classification according to the produced formation fluids.
  - D. Classification according to the purpose of the well.
- Drilling Rig Types

# Well Type Classifications

There are many different classifications of well types according to the following criteria:

- A. Classification according to the well location.
- B. Classification according to wellbore trajectory.
- C. Classification according to the produced formation fluids.
- D. Classification according to the purpose of the well.

# Well Type Classifications

## A) Classification according to the well location.

1. **Onshore wells:** wells that are placed in the land.
2. **Offshore wells:** wells that are placed in sea.



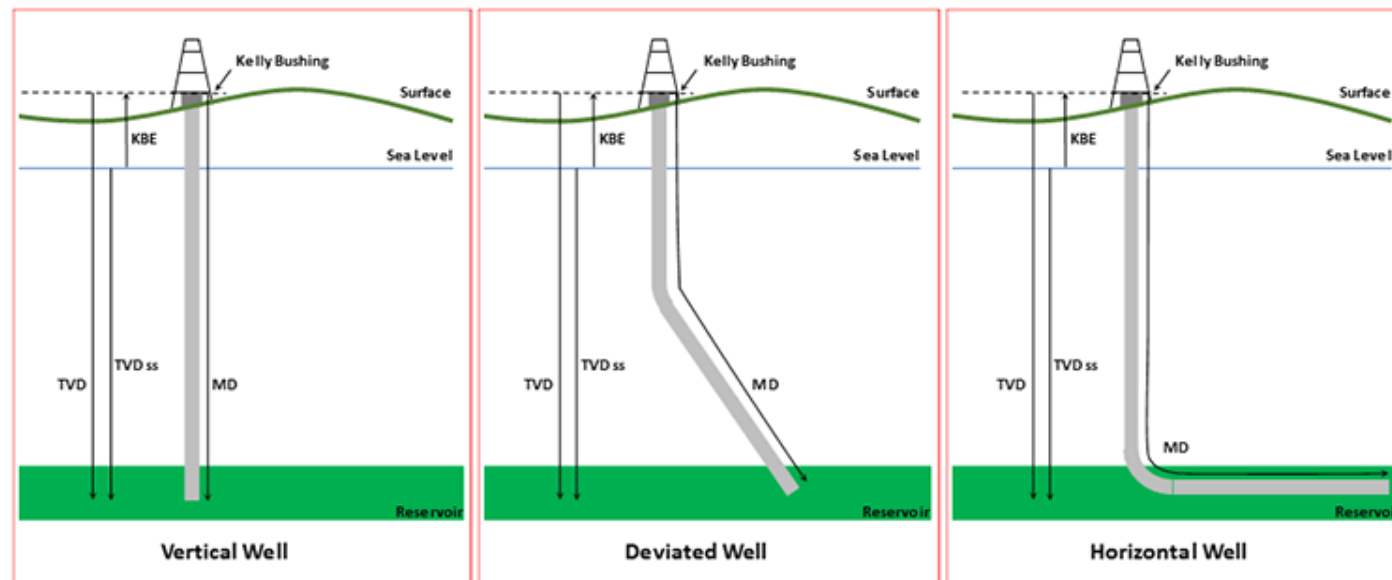
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# Well Type Classifications

## B) Classification according to the wellbore trajectory.

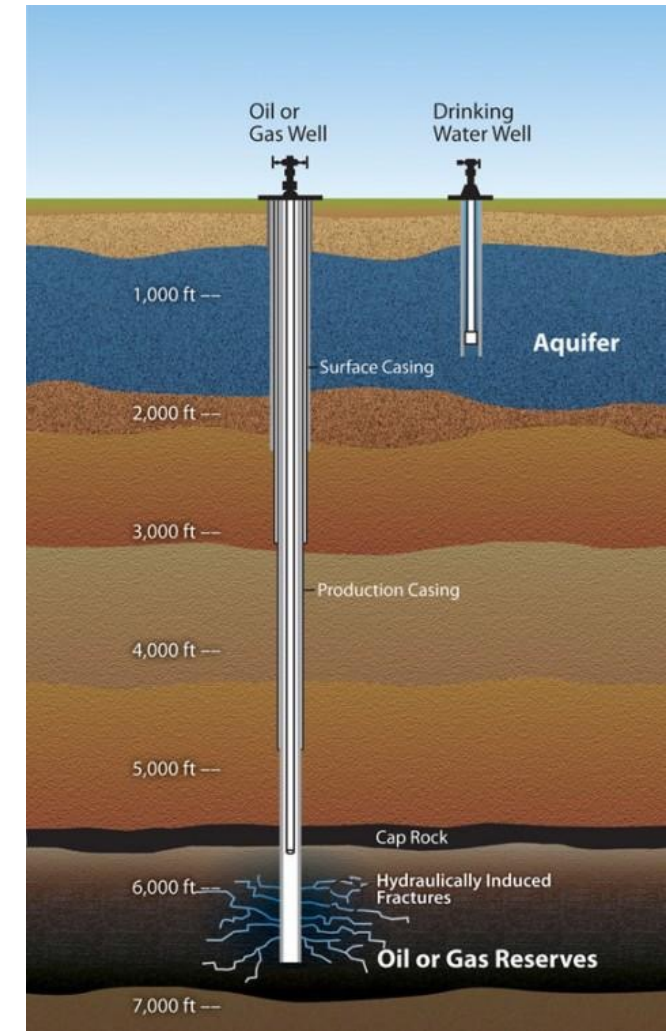
1. **Vertical wells:** wells that does not have an intentional departure or course deviation from the vertical.
2. **Directional wells:** wells that hit a particular subsurface target, typically located away from the surface location of the well.
3. **Horizontal wells:** are high-angle wells (with an inclination of generally greater than  $85^\circ$ ) drilled to enhance reservoir performance by placing a long wellbore section within the reservoir.



# Well Type Classifications

## C) Classification according to the produced fluids:

1. **Oil wells:** holes drilled in the earth from which crude oil is produced.
2. **Gas wells:** holes drilled in the earth from which gas is produced.
3. **Water wells:** holes drilled in the earth from which water is produced.

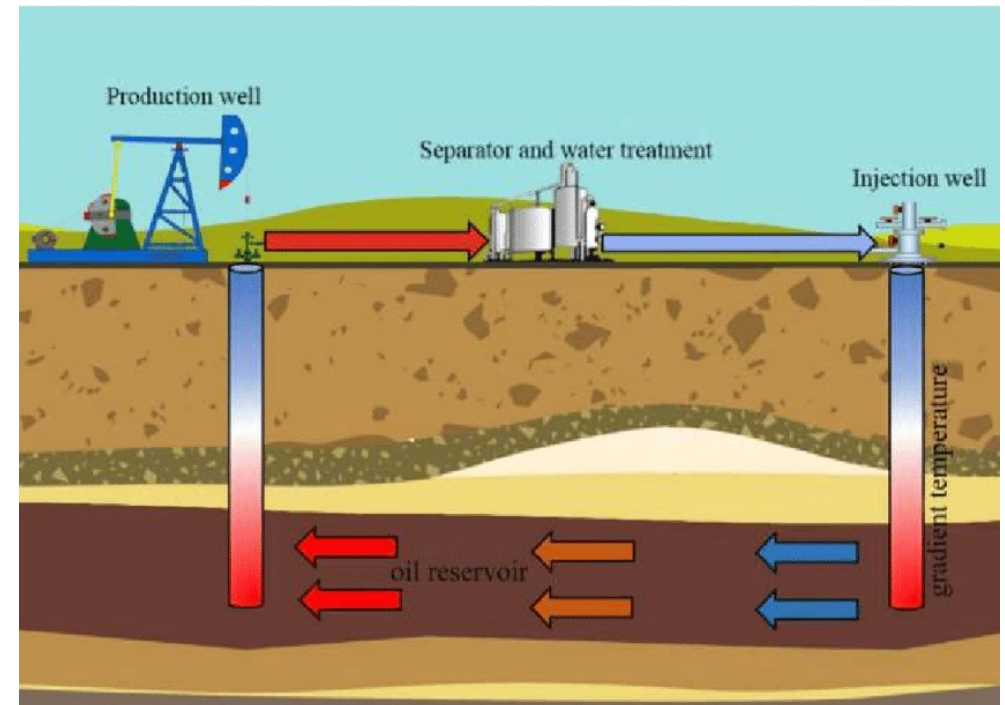




# Well Type Classifications

## D) Classification according to the propose of the well.

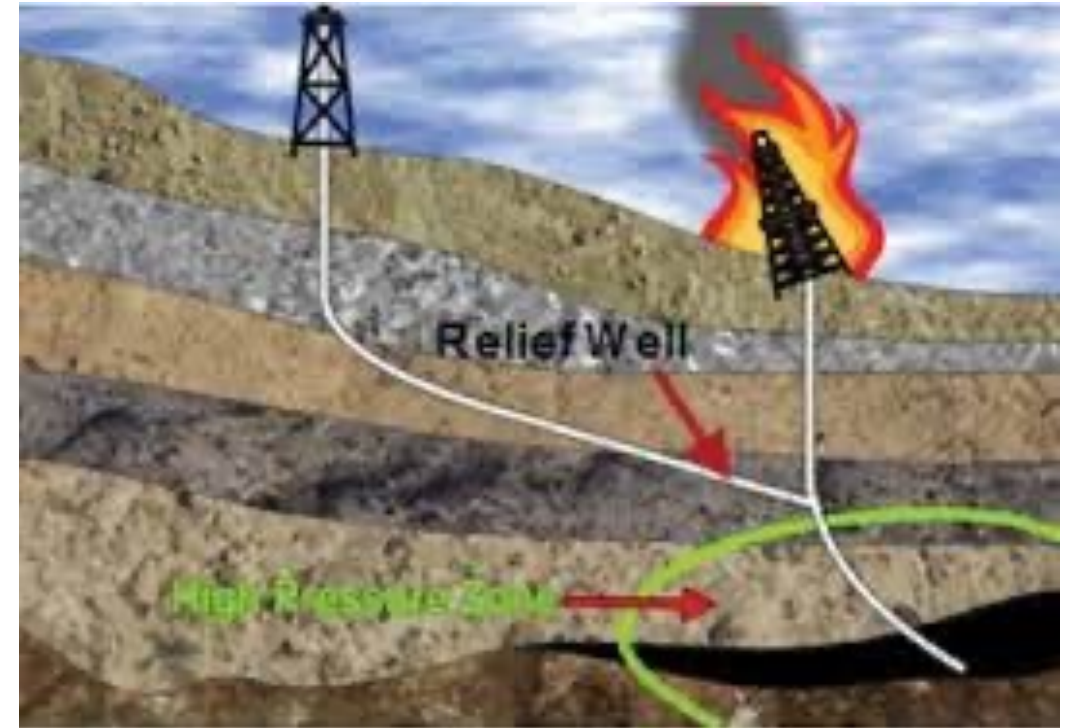
1. **Exploration wells:** wells drilled in an unproven area where no oil and gas production exists.
2. **Appraisal wells:** wells drilled in order to evaluate the characteristics of a field.
3. **Development wells:** wells drilled for the production of oil or gas from a field already proven by appraisal drilling.
4. **Injection wells:** wells that are used to inject water or gas back into the formation in order to maintain pressure, or to bring a field back under pressure.



# Well Type Classifications

## D) Classification according to the propose of the well, cont.

5. **Disposal wells:** wells drilled into a formation that is safe to receive and store waste fluid produced from other wells.
6. **Relief wells:** directionally drilled wells to intersect a well which is blowing out, thus enabling the blow out to be controlled



# Drilling Rig Types

- Drilling rig is a device used to **drill a hole**, **lower and cement** casing in the well, and provide a means to perform various **auxiliary functions** such as logging, stimulation and well testing.
- Before the rig can be selected, the **requirements** of the subject must be determined. **Total depth** is the first thing that comes to mind, but anticipated **hole sizes**, **hydraulic horsepower** requirements, **drillpipe and casing program**, and potential **hole problems** should be considered.
- The proper procedure for rig selection is to size or **design the various loads** that will be placed on the equipment and to select the **most cost-effective** rig that will satisfy these requirements.

# Drilling Rig Types

## Types of Rigs

### 1. Land Rigs: (Onshore)

#### A. Conventional rigs:

- Small land rigs
- Medium land rigs
- Large land rigs

#### B. Mobile rigs:

- Portable mast
- Jackknife derrick

### 2. Offshore Rigs:

#### A. Bottom supported rigs:

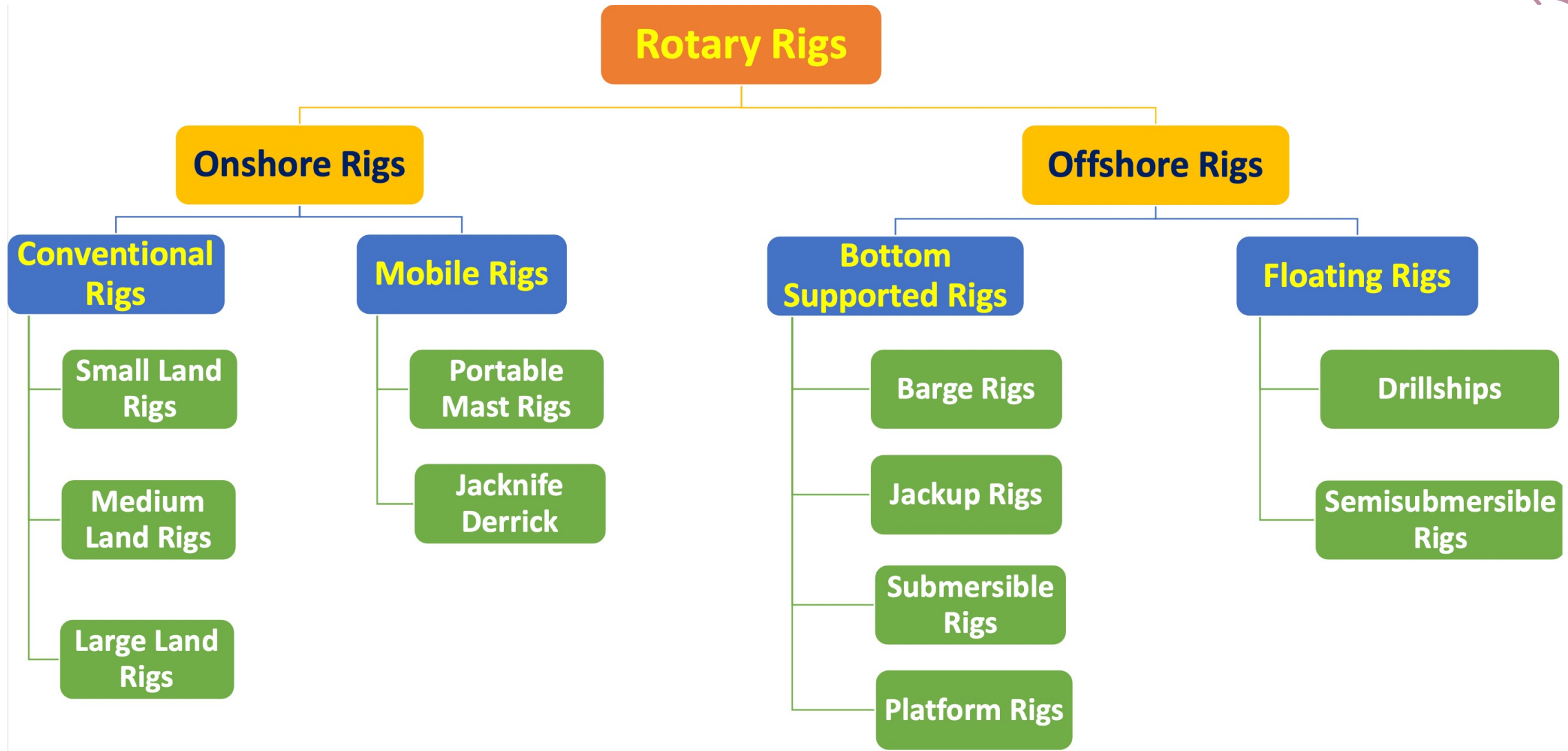
- Barge
- Jackup
- Submersible
- Platform

#### B. Floating rigs:

- Drillship
- Semi-submersible



# Drilling Rig Types





# Drilling Rig Types

## Onshore Rigs

### A. Conventional Rigs

- A conventional rig is considered usually as a component rig in which the key components are **so large** that they **cannot be transported** on a single truck bed.
- These rigs vary in depth rating from **6000 to 35000 ft.**
- Conventional rigs are the **largest land rigs** available for drilling and are sub-classified (based on their height) into:
  1. **Small Rigs (Light duty)**
  2. **Medium Rigs (Medium duty)**
  3. **Large Rigs (Heavy duty)**

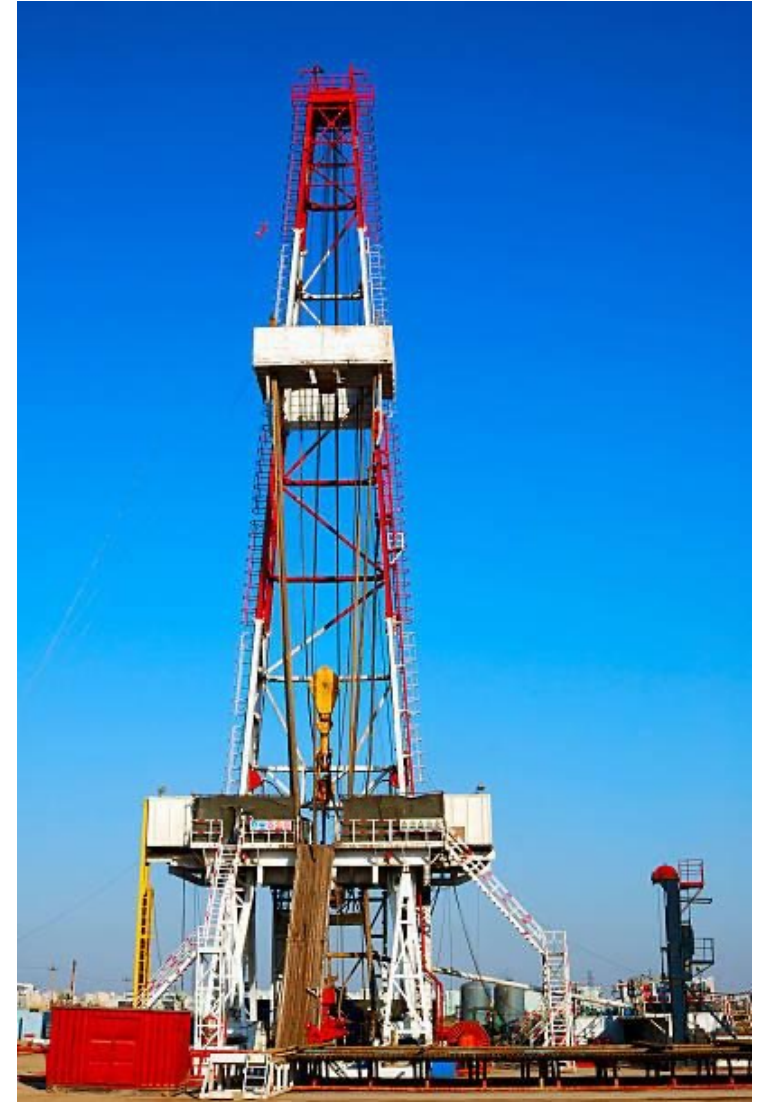
Maximum capabilities of the rigs are in the following ranges:

Derrick capacity = 2,000,000 lb

Pump horsepower = 3,000 hp

Pit volume = 300 – 1,500 bbl

Drillpipe size = 3 1/2 - 5 1/2 in.



# Drilling Rig Types

## B. Mobile Rigs

- Rigs that are usually considered to be a truck-mounted unit for movement purpose. Such as:

1. Jackknife Rig
2. Portable Mast

- The most mobile rig used is cantilevered mast, or **jackknife** derrick type.
- This type of rig allows the derrick to be assembled on the ground, and then raised to the vertical position using **power from the drawworks, or hoisting system**.
- A principle advantage of the portable rig is the **low rig-up and rig-down time** as well as **lower truck hire requirements**.



Jackknife Rig

# Drilling Rig Types

## B. Mobile Rigs, cont.

General capabilities for some portable rigs are as follows:

Maximum derrick capacity = 350,000 lb

Maximum pump flow rate = 6 – 8 bbl/min.

Pit volume = 150 bbl

Drillpipe size = 3 1/2 - 4 in.



Portable Mast



# Drilling Rig Types

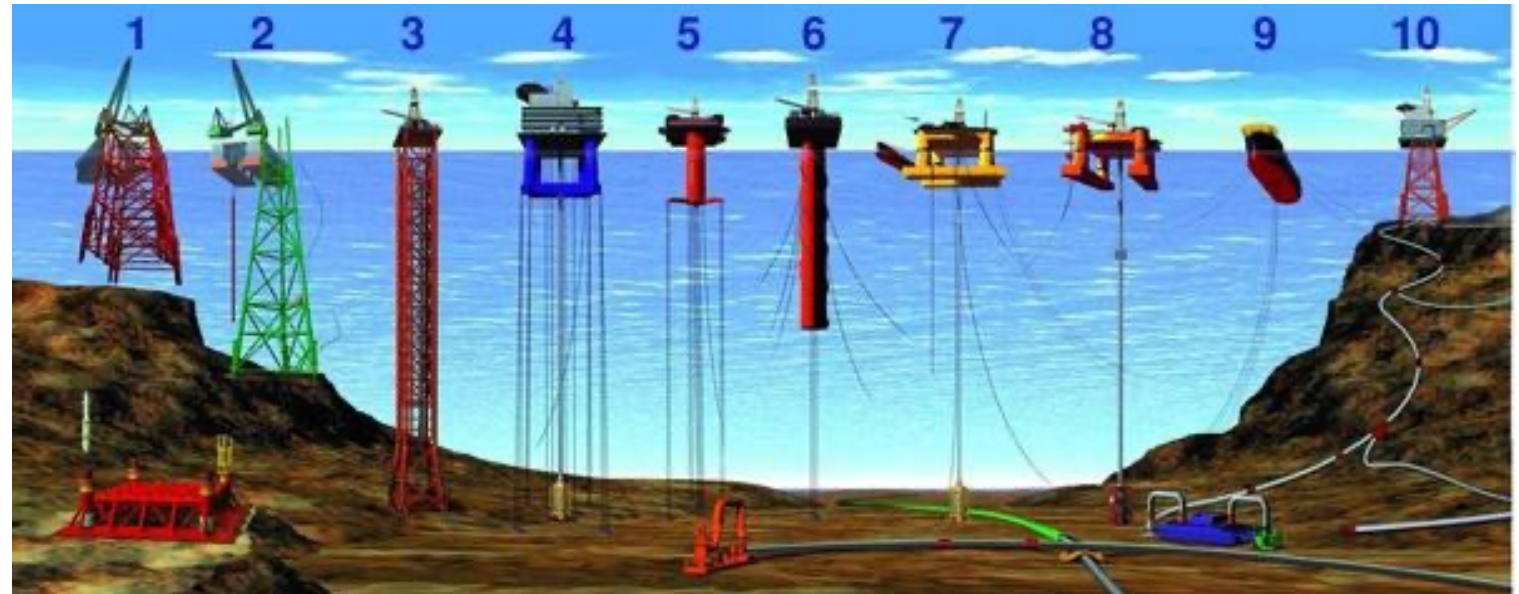
## Offshore Rigs

- Drilling for oil and gas offshore, in some instances hundreds of miles away from the nearest landmass, poses a number of different **challenges** over drilling onshore.
- The actual drilling mechanism used to drill into the sea floor is much the **same as** can be found on an onshore rig.
- However, with drilling at sea, the sea floor can sometimes be thousands of feet below sea level.
- Therefore, while with onshore drilling the ground provides a platform from which to drill, at sea an **artificial drilling platform must be constructed**.

# Drilling Rig Types

- In addition to the design criteria that are used in selecting an onshore rig, the following criteria should be considered during selecting an offshore rig:

- Distance from land.
- Water depth.
- Stability in rough weather.
- Duration of drilling program.



# Drilling Rig Types

## A. Bottom Supported Rigs

### 1. Posted Barge

- The barge is a shallow draft, flat-bottom vessel equipped as an offshore drilling unit, used primarily in **shallow water** depth (typically 8 – 20 ft) such as lakes, swamps, rivers, and canals.
- It can be **towed** to the location and then **ballasted** to rest on the bottom.
- Operating water depth and weather limit the areas for the drilling barge.
- A minimum water depth of 6 – 8 ft is required for vessel draft during transportation to the location.
- The upper range on the water depth can be extended to 30 – 40 ft if a shell mat or pad is built as a support for the barge.





# Drilling Rig Types

## 2. Jackup Rigs

- These rigs are similar to drilling barges, with one difference.
- Once a jack-up rig is towed to the drilling site, **three or four leg**' are lowered until they rest on the sea bottom.
- This allows the working platform to rest above the surface of the water, as opposed to a floating barge.
- These rigs are typically safer to operate than drilling barges, as their working **platform is elevated above the water level**.



# Drilling Rig Types

## 2. Jackup Rigs, cont.

- The jackup is towed to the location and spotted over the well site.
- During the towing process, the legs are up in the air and the barge floats on the water.
- Upon reaching its location, the legs are jacked down to contact the seafloor and the rig is raised into the air.
- When drilling is completed, the rig is lowered to the water level, the legs are raised, and the rig is towed to the next location.



# Drilling Rig Types

## 2. Jackup Rigs, cont.

- These rigs are typically designed for use in 13 – 25 ft minimum water depths and as much as 250 – 350 ft maximum water depths in some cases.
- The maximum operating depth is restricted in hurricane or **severe weather conditions**.
- For instance, a jackup designed for a 300 ft maximum operating depth may have upper limit of 200 ft operating depth in hurricane conditions.





# Drilling Rig Types

## 3. Submersible Rigs

- Submersible rigs, also suitable for **shallow water**, are like jack-up rigs in that they come in contact with the ocean or lake floor.
- These rigs consist of platforms with **two hulls** positioned on top of one another.
- The upper hull contains the living quarters for the crew, as well as the actual drilling platform.
- The lower hull works much like the outer hull in a **submarine** - when the platform is being moved from one place to another, the lower hull is **filled with air** - making the entire rig buoyant. When the rig is positioned over the drill site, the air is let out of the lower hull, and the rig **submerses** to the sea or lake floor.
- This type of rig has the advantage of mobility in the water, however once again its use is **limited to shallow water areas**.



# Drilling Rig Types

## 4. Platforms

- In some instances, when exploratory wells find commercially viable natural gas or petroleum deposits, it is economical to build a permanent platform from which well **completion, extraction, and production** can occur.
- These large, permanent platforms are **extremely expensive**, however, and generally require large expected hydrocarbon deposits to be economical to construct and usually up to 40 wells are drilled from one platform.



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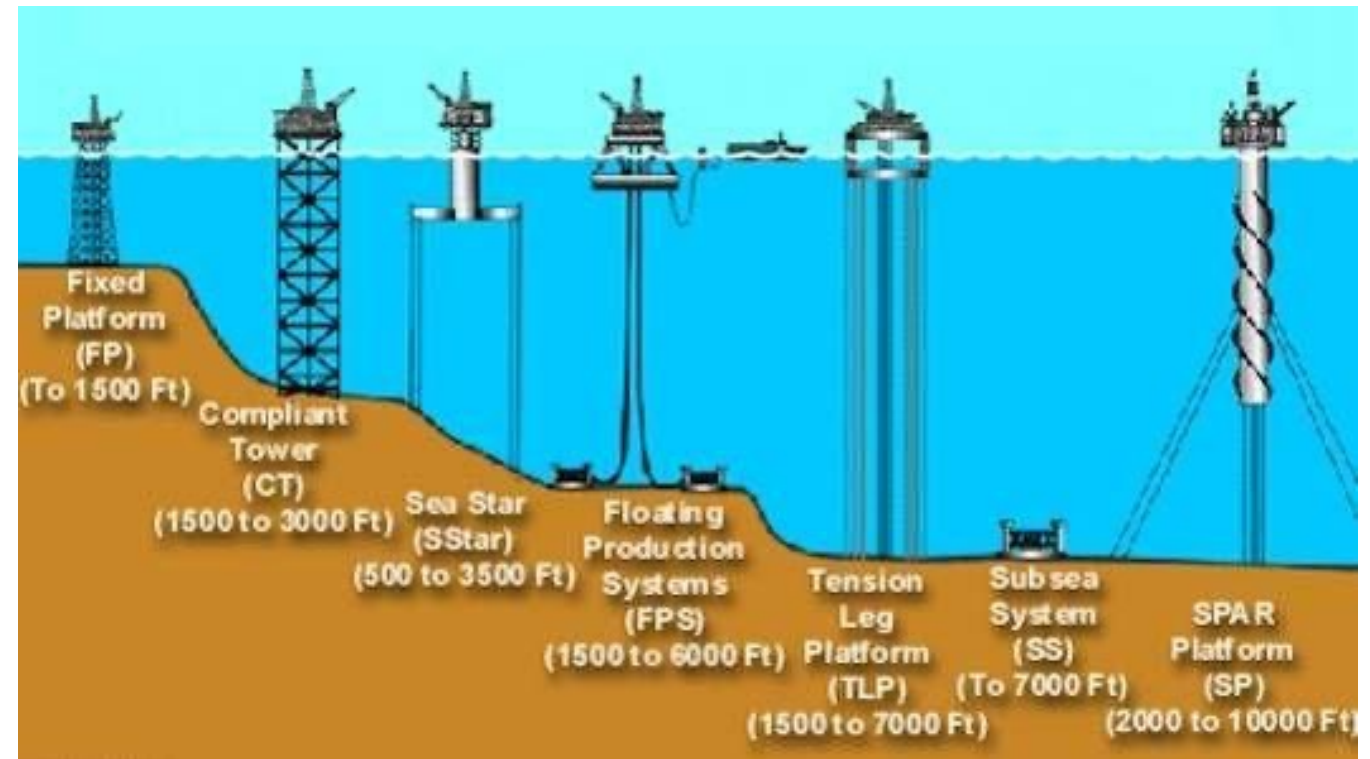


# Drilling Rig Types

## 4. Platforms, cont.

• There are a number of different types of permanent offshore platforms, each useful for a particular depth range:

- Fixed platforms
- Tension leg platforms
- Compliant towers
- Subsea system
- Seastar platforms
- Spar platforms
- Floating production system

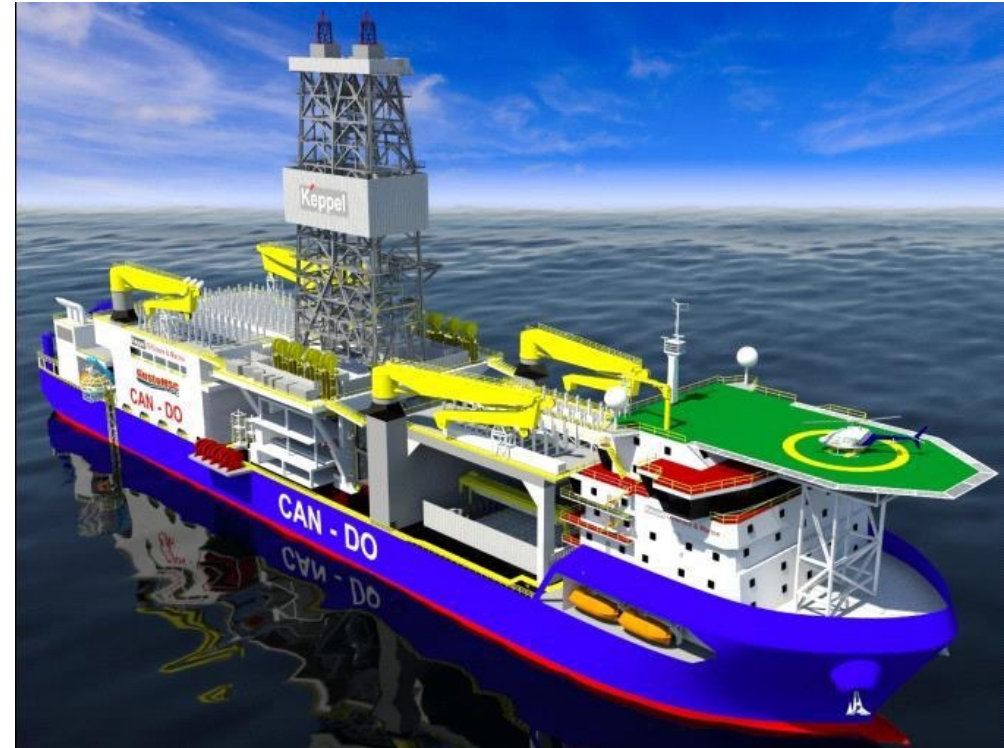


# Drilling Rig Types

## B. Floating Rigs

### 5. Drillships

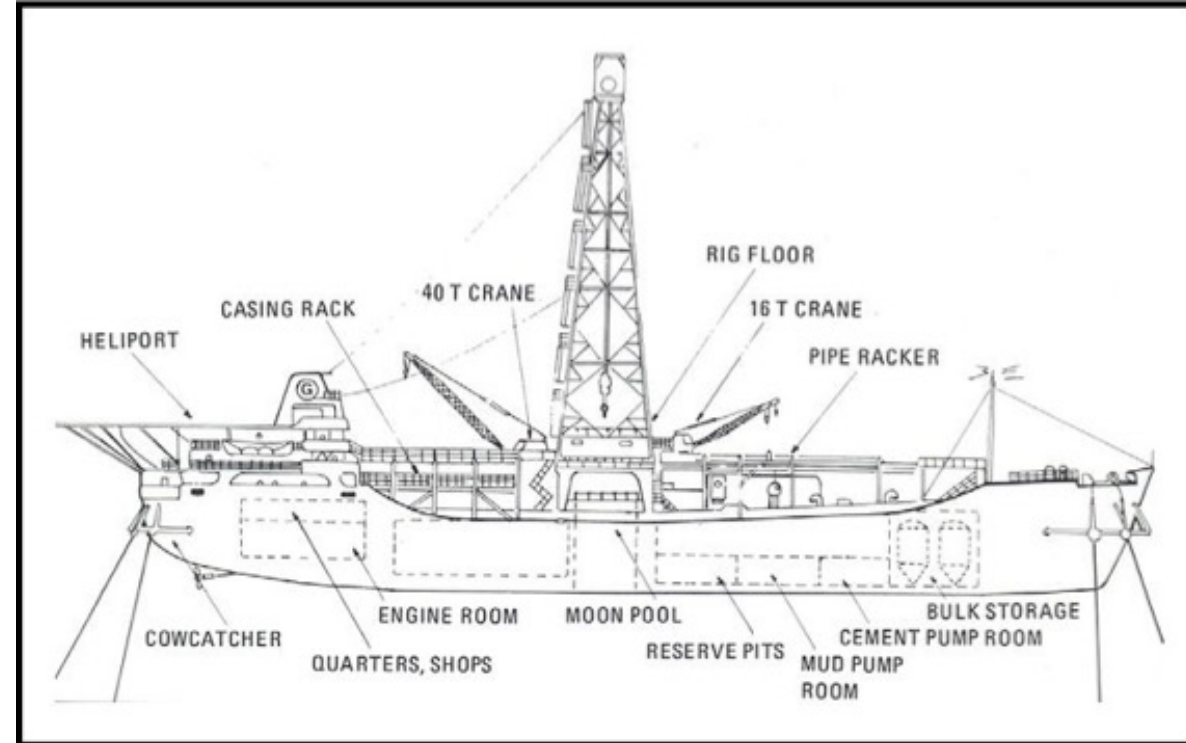
- Drillships are exactly as they sound, ships designed to carry out drilling operations.
- These boats are specially designed to carry drilling platforms out to deep-sea locations.
- A typical drillship will have, in addition to all of the equipment normally found on a large ocean ship, a **drilling platform** and **derrick** located on the middle of its deck.
- In addition, drillships contain a hole (or **moonpool**), extending right through the ship down through the hull, which allows for the drill string to extend through the boat down into the water.
- Drillships are often used to drill in **very deep water, which can often be turbulent.**



# Drilling Rig Types

## 5. Drillships, cont.

- Drillships use what is known as 'dynamic positioning' systems.
- Drillships are equipped with electric motors on the underside of the ship's hull, capable of propelling the ship in any direction.
- These motors are integrated into the ship's computer system, which uses satellite positioning technology, in conjunction with sensors located on the drilling template, to ensure that the ship is directly above the drill site at all times.



# Drilling Rig Types

## 6. Semisubmersible Rigs

- Semisubmersible rigs are the **most common type** of offshore drilling rigs, combining the advantages of submersible rigs with the ability to drill in **deep water**.
- A semisubmersible rig works on the **same principle** as a submersible rig through the inflating and deflating of its lower hull.
- The main difference with a semisubmersible rig, however, is that when the air is let out of the lower hull, the rig **does not submerge** to the sea floor. Instead, the rig is **partially submerged**, but still floats above the drill site.
- When drilling, the lower hull, **filled with water**, provides **stability** to the rig.





# Drilling Rig Types

## 6. Semisubmersible Rigs, cont.

- Semisubmersible rigs are held in place by huge **anchors**, each weighting upwards of 10 tons.
- These anchors, combined with the submerged portion of the rig, ensure that the platform is **stable and safe** enough to be used in **turbulent** offshore waters.
- Semisubmersible rigs can be used to drill in **much deeper** water than the rigs mentioned before.



# Next Lecture

In the next lecture on Sunday October 29th, 2023. At 11:00 in class 214 we will take the following topics:

- Drilling Companies
- Drilling Personnel
- Drilling Licenses

**End of Lecture**