MOSUL UNIVERSITY
PETROLEUM & MINING ENGINEERING COLLEGE
3RD STAGE

Well Drilling Engineering

Drilling Rigs

Lec.1

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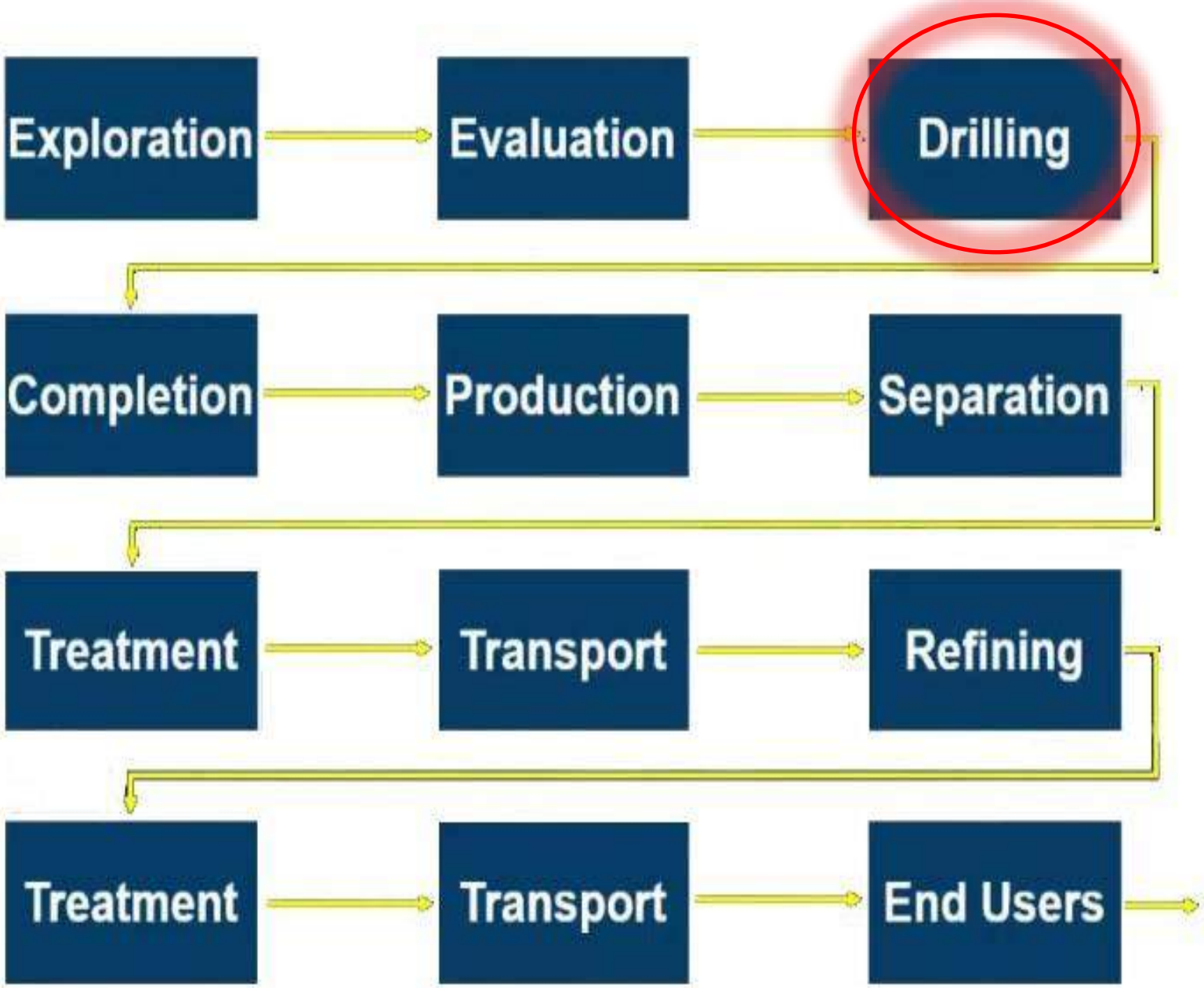
What is mean the Drilling?

- Drilling is a mechanical technique for drilling and penetrating rock (Rock Formation) to reach places where hydrocarbons (oil & natural gas) are collected.

- Drilling can be considered as the second stage of oil production after exploration to reach the stage of oil production.


Exploration
Evaluation
Drilling
Completion
Production
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Refining
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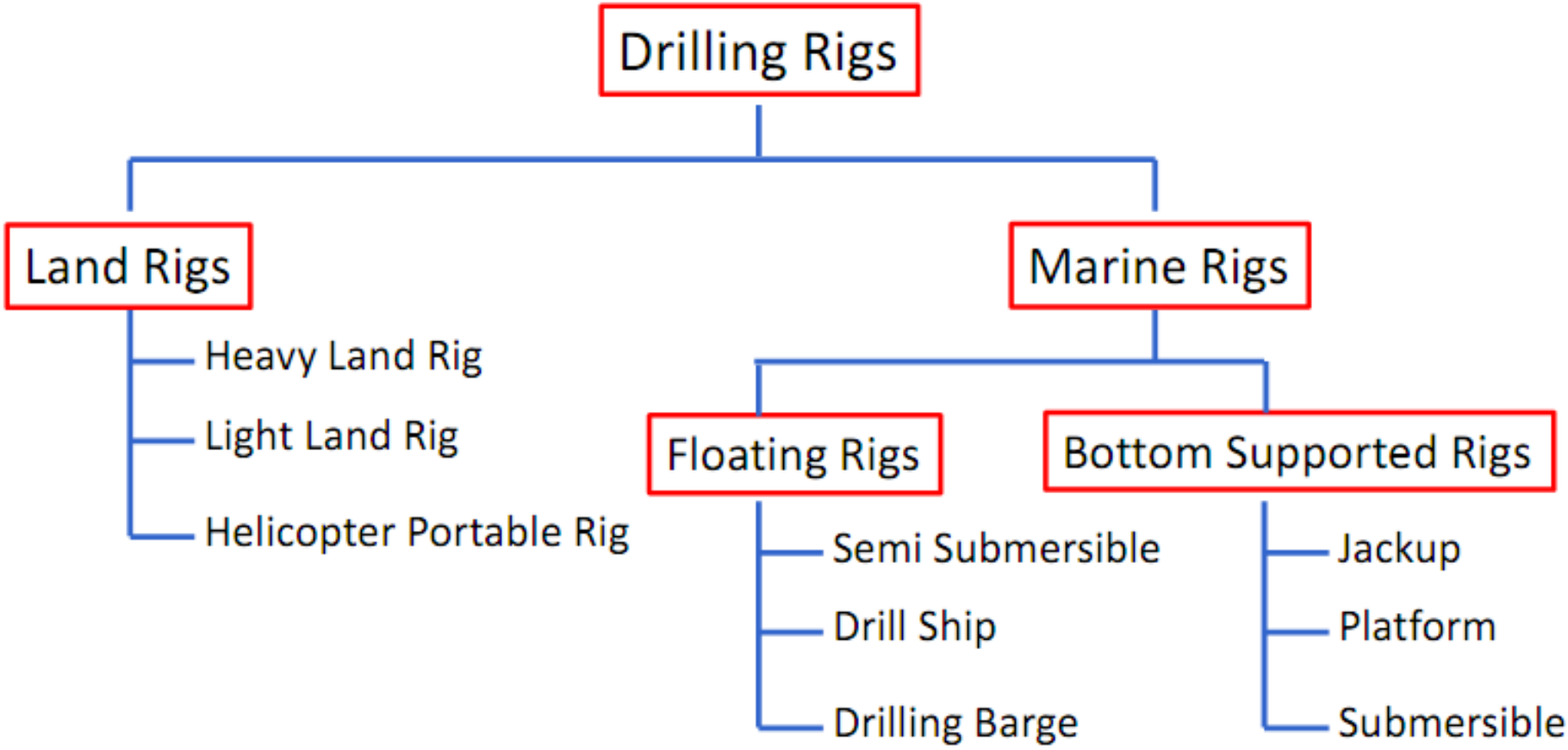
End Users

Type of Drilling Rigs



A typical classification of rotary drilling rigs

Types of Oil Rigs

1– Land Rigs

The sequence of operations is as follows when a land well is drilled:

1- Prepare location before rig arrives.

2- Dig cellar

3- Install conductor pipe

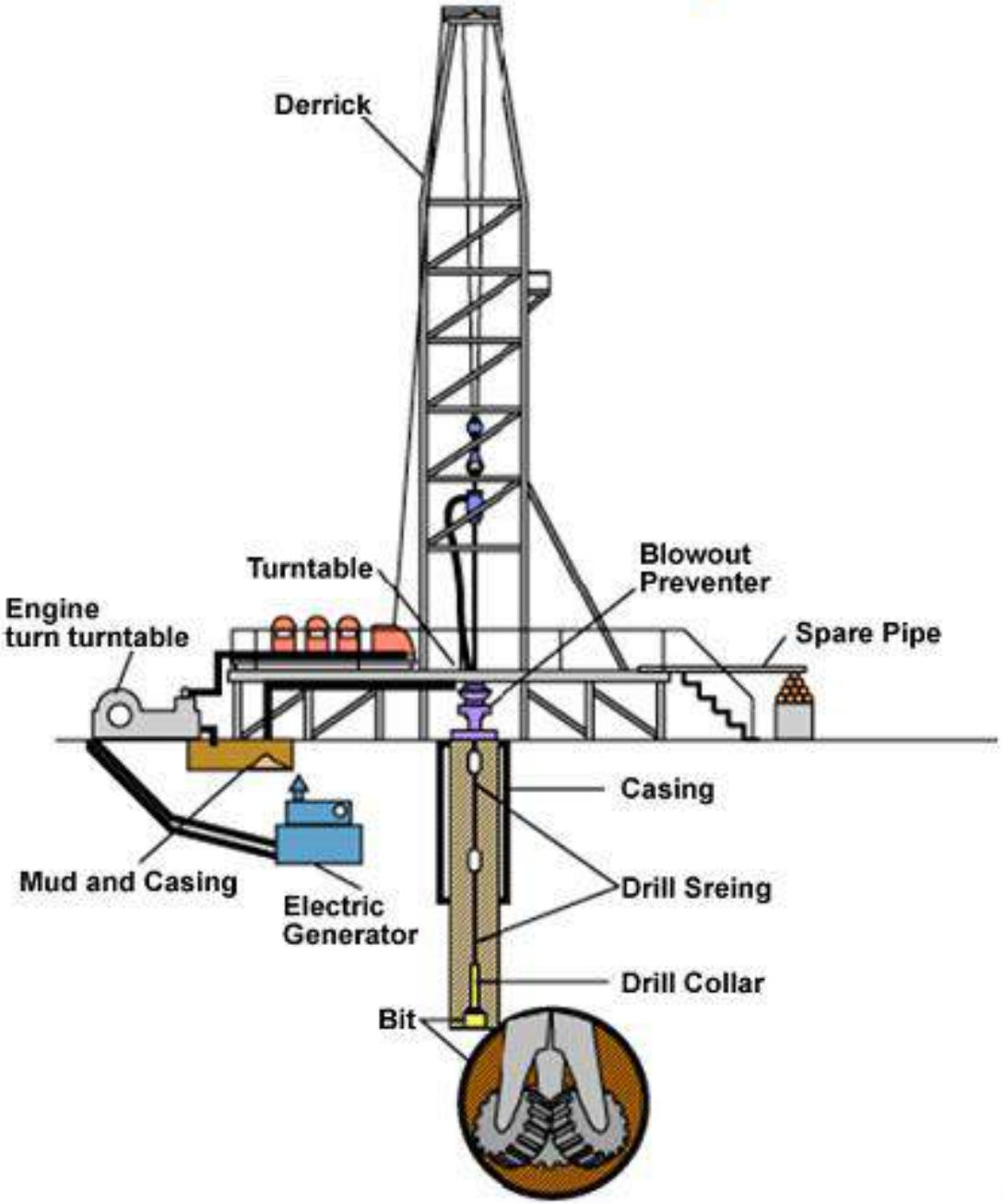
4- Prepare support pad for rig, camp, etc

5- Build roads, fencing, dig pits

6- Sometimes drill water well.

7- Move rig on to location, rig up and prepare to start drilling.

Rotary Drilling



Rotary Drilling Process

- Rotary table rotates the drill string
- Downward force applied to the bit
- Cuttings are lifted to the surface by circulating a fluid down the drill string

➢ **Main Component Parts of a Rotary Rig are:-**

1. Power System
2. Hoisting System
3. Fluid Circulating System
4. Rotary System
5. Well Control System
6. Well Monitoring System

2- Marine Drilling Rigs (*Offshore)*

Two main types:

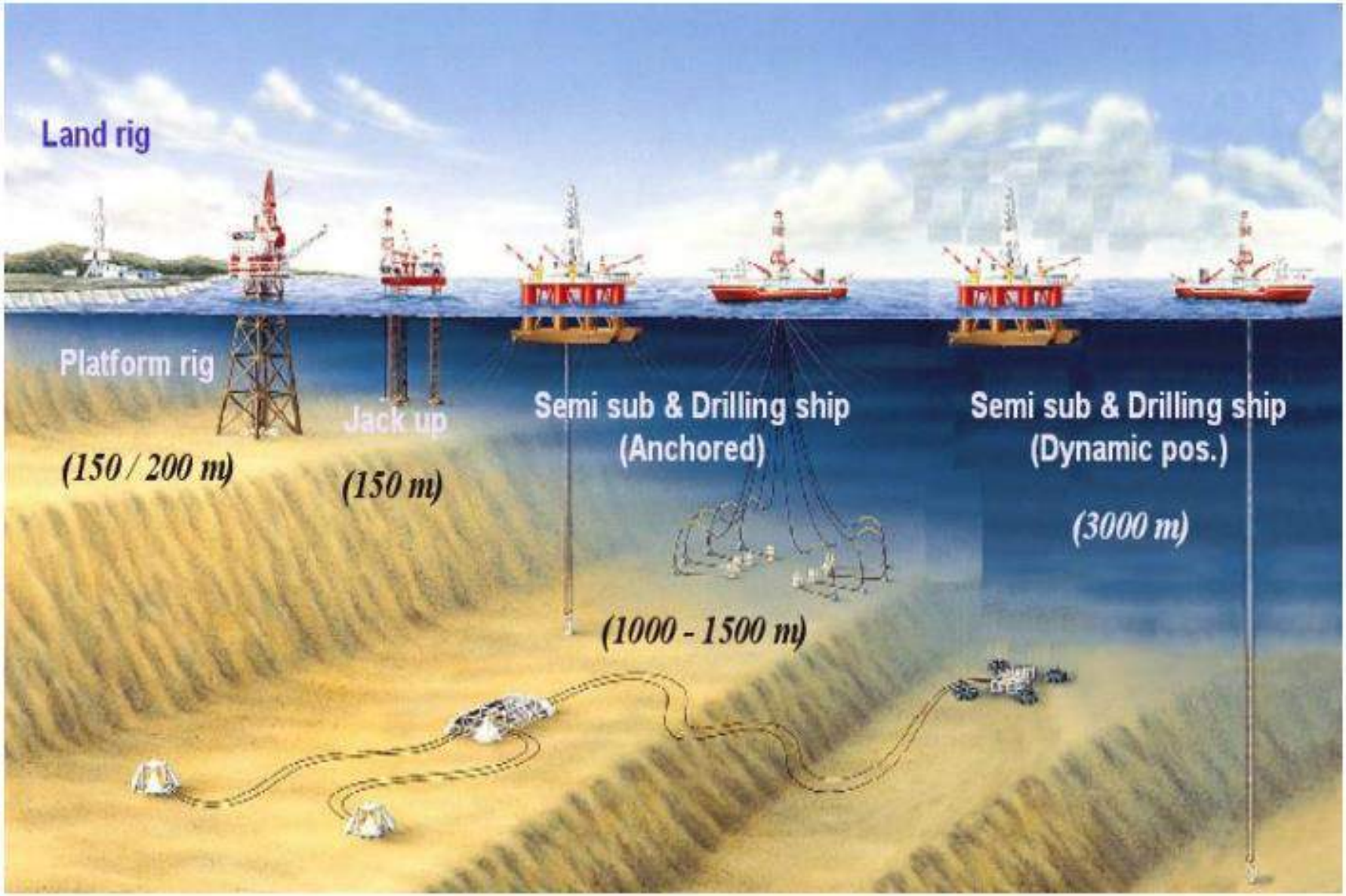
1- floating

2- bottom-supported unit

➡ ***Floating unit*** include: semisubmersible (bottle-type, column stabilized), barge rig and drill ship.

➡ ***Bottom-supported unit*** include: submersible (posted barges, bottle-type submersibles, arctic submersibles), jackups and platforms.

Marine (offshore) Rig

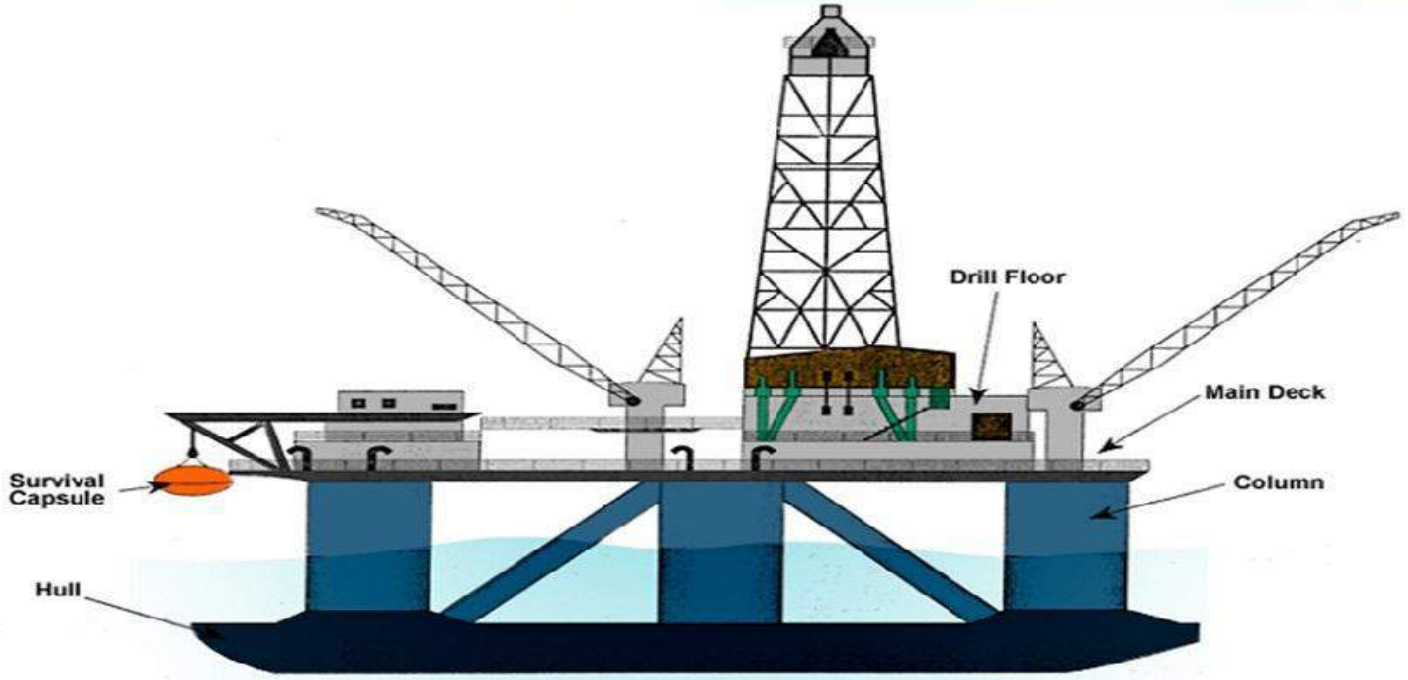


Floating Rig

- **SEMI-SUBMERSIBLE**
- **This floating drilling unit has columns when flooded with seawater, cause the structure submerge to a predetermined depth.**
- **Although it is moved by wave action, it sits low with a large part of its structure under water combined with eight huge mooring anchors, make it a very stable installation.**
- **This type of rig drills a hole in the seabed then it moves to the next location.**
- **With advancing technology some semi submersibles can drill in water depths over five thousand feet.**

Floating rig

Semi Submersible Rig



DRILL SHIP

- As the name suggests this is a ship shaped drilling vessel.
- Unlike the semi-submersible and the Jack up, it does not require tugboats to tow it to location.
- Although they are not as stable as semi submersibles they also drill in very deep waters.

DRILLING BARGE

It is found in swamps, ponds and shallow waters and reaches a depth of 20 or 30 meters.

Floating rig

Drilling barge

Bottom supported Rig

Jack up

- This is a mobile drilling rig, different from the semi-submersible. Instead of floating over its drilling location the Jackup has long leg structures, which it lowers to and into the seabed raising the rig out of the water.
- The obvious limitation with this type of installation is the depth of water it can operate in.
- The maximum being five hundred feet.

jack up

Submersible

Bottom supported

Submersible Rig

Platforms

- This immobile structure can be built from concrete or steel and rests on the seabed.
- When oil or gas is located a platform may be constructed to drill further wells at that site and also to produce the hydrocarbon.

Steel Jacket platform

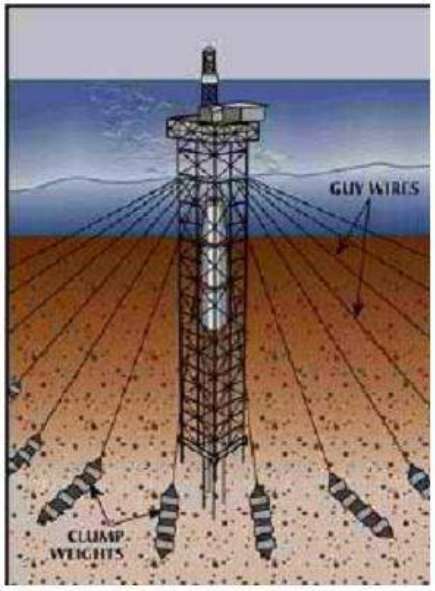
- Most common type of platform.
- Consist of the jacket, a tall vertical section made of tubular steel members.
- Supported by piles driven into the seabed.
- Additional sections on top of the jacket provide space for drilling rig, crew quarters, and other equipment's.

Concrete Gravity

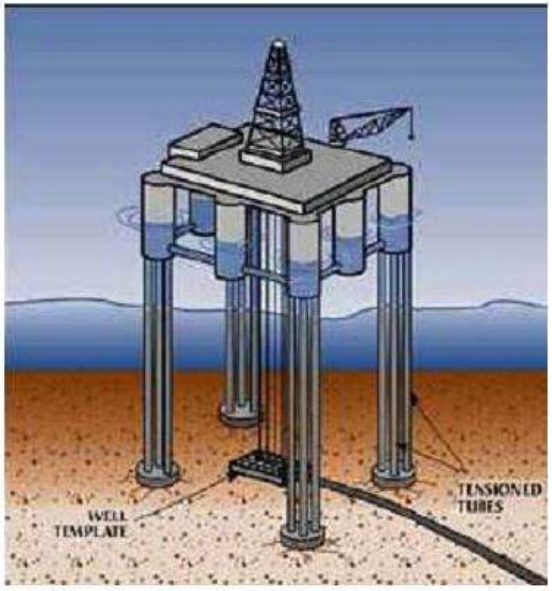
- Build from steel reinforced concrete.
- Tall caissons, or column are the dominant feature of this platform.
- Sometime, special concrete cylinder are fixed at the base of the caissons on the sea floor to store crude oil.

Compliant platform

- Using rigid platform in water much over 1000 feet depth is not practical – very much expensive to build.
- In deep water, most companies use compliant platform, which contain fewer steel parts and are lighter than rigid steel-jacket
- Guyed-tower platform and tension-leg platform.



Guyed tower platform



Tension Leg Platform (TLP)

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Land Rig (*Onshore*)

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Land Rig (*Onshore*)

- Cantilever mast – most common arrangement
- Portable mast – usually mounted on trucks that incorporate the hoisting machinery, engines and derrick as a single unit.

Conventional rig

Onshore

portable drilling rigs

Onshore

Main component parts of a Rotary Rig are:

1. Hoisting system.
2. Rotary system.
3. Tubular and tubular Handling Equipment.
4. Fluid circulating system.
5. Power system.
6. Well control system BOP's
7. Well Monitoring system.

1. Hoisting System

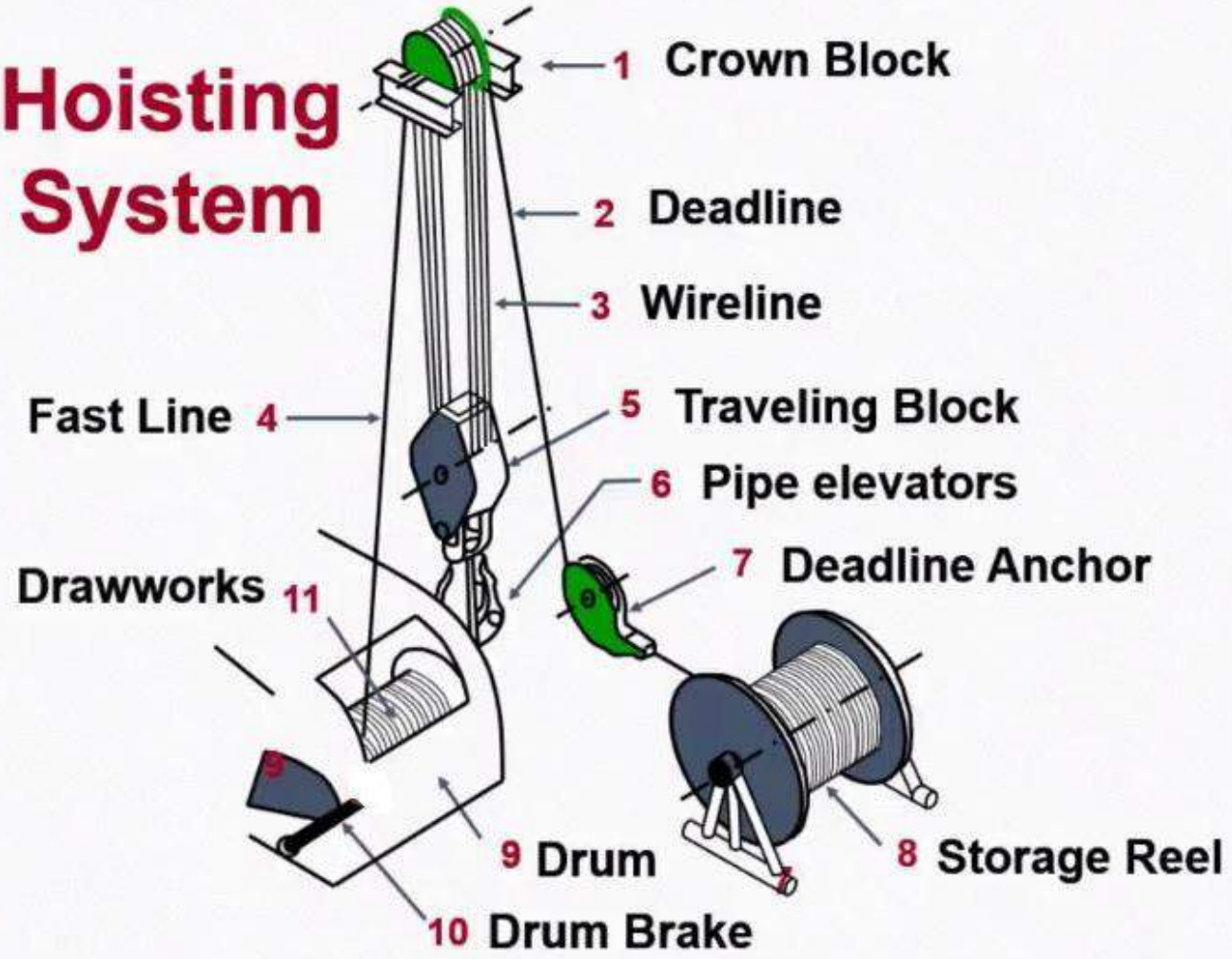
Function

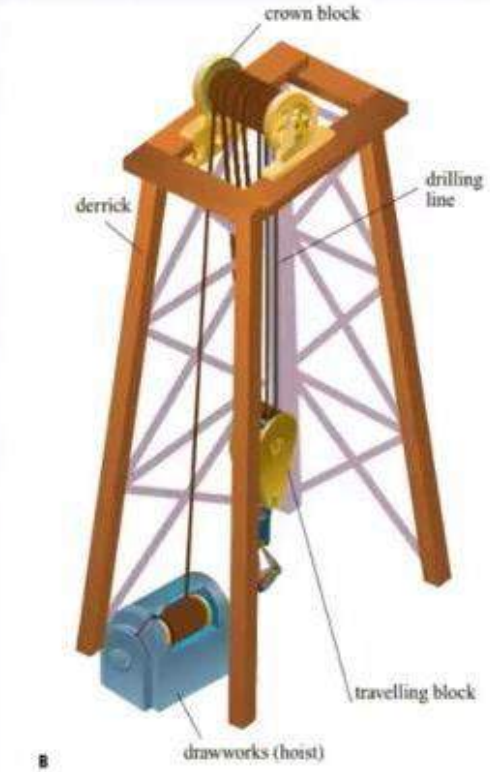
The hoisting system is the set of equipment necessary to lower or raise drill strings, casing string and other subsurface equipment into or out of hole.

Principal Components:

I. Derrick and substructure
II. Crown block
III. Travelling block
IV. Draw works
V. Drilling line

Hoisting System





1. Substructure

- The substructure is the supporting base for the derrick, the draw works and the rotary table, and constitutes the working floor for operations, or drilling floor, being elevated with respect to ground level. The substructure is a reticular structure of steel beams, that can easily be dismantled, and rests on concrete foundations or on a base of wooden planks around the cellar.
- Its height varies from a few meters up to 10 m in the largest rigs

2. Derrick

- The derrick is an open-framework structure of steel beams, whose function is to hold the ensemble of sheaves at its top, known as the crown block, on which all of the items of equipment operated in the well or on the drilling floor are suspended.

- the height of the derrick must be such as to permit the vertical movement of the travelling block for a distance greater than the equivalent of one stand. For example, to handle a stand of 3 drill pipes (about 27 m long) the derrick has to be about 40 m high. The derrick is designed to resist the loads tripped in and out of the well in the operating phases, which induce both static and dynamic stresses.

- Every derrick has a rated load capacity, defined by API (American Petroleum Institute) standards, which establish the maximum hook load

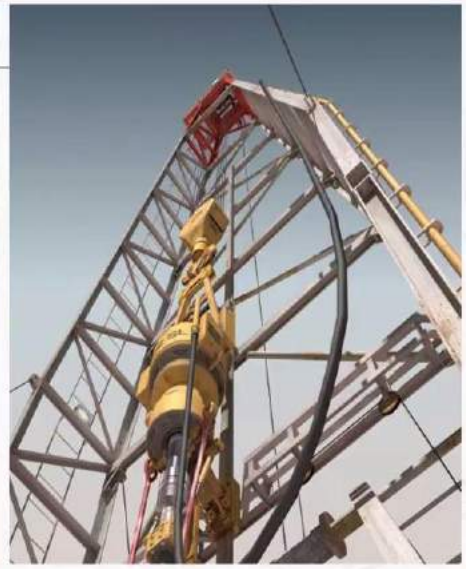
Derrick

1 Conventional derrick

2 Mast

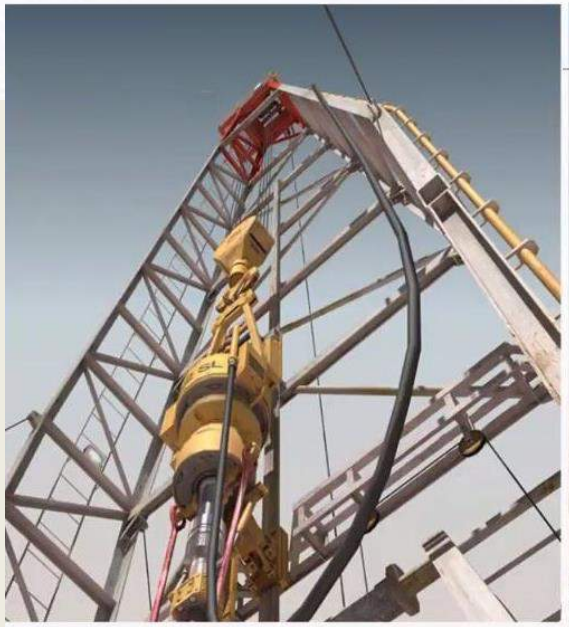
3. Crown block

- An assembly of sheaves mounted on beams at the top of the derrick/mast and over which the drilling line is reeved.
- The crown block bears the load applied at the hook and its function is to reduce the wire rope tension required to pull the tubular material used to drill the well. It at the top of the rig consists of a set of sheaves (usually from 3 to 7) supported by a framework of steel beams.



4. travelling block

- consists of another set of sheaves (one fewer than for the crown block), mounted on an axis connected to the hook.
- The number of sheaves in the crown and travelling block is chosen on the basis of the rated capacity of the tower and the rate of pulling, which is inversely proportional to the number of lines of wire rope connecting the travelling block and the crown block



5. Hook

- The high-capacity J-shaped equipment used to hang various other equipment, particularly the swivel and Kelly, the elevator bails or top drive units. The hook is attached to the bottom of the traveling block and provides a way to pick up heavy loads with the traveling block. The hook is either locked (the normal condition) or free to rotate, so that it may be mated or decoupled with items positioned around the rig floor, not limited to a single direction.

6. Draw works

- The drawworks is the machine that transmits the power to operate the equipment in the well. The basic components of the drawworks are an engine, one or more drums containing a steel cable, and the brakes

- The main brake is a strongly-built, band brake, used to stop the drill string as it is being lowered, or to release it slowly during drilling.

- Normally a hydraulic brake and an electromagnetic brake are used, although these cannot stop the hoisting drum completely and they cannot be used alone.


LDW750K

Learning Objectives

Hoisting system:

- **Identify the names of each of the component parts of the hoisting system and state its purpose.**