Introduction to well drilling

Rig Components

Well Drilling

Land rig classification

onshore drilling rigs fall into four groups:

1. Light rigs, down to 2,000 m
2. Medium rigs, to 4,000 m
3. Heavy rigs, to 6,000 m
4. Ultra-heavy rigs for greater depths

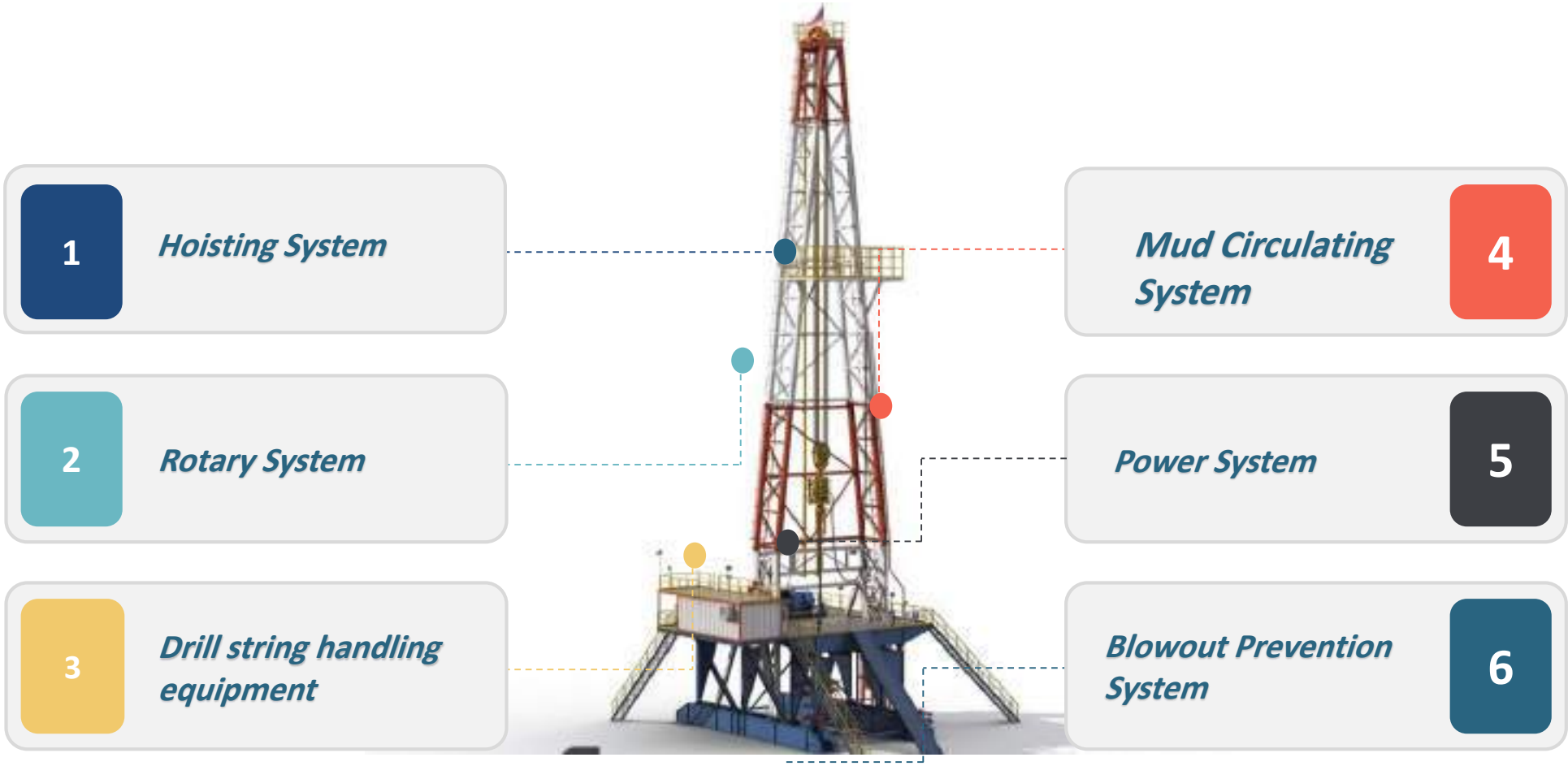
Increasing capacity is matched by increasing both maximum hook load capacity and derrick strength.

Land rig classification

Another criterion for classification is the power installed on the rig, which for oil well drilling is in the range of at least 10 HP every 100 feet in depth

1. Light rigs, up to 650 HP
2. medium rigs, up to 1,300 HP
3. heavy rigs, up to 2,000 HP
4. ultra-heavy rigs, 3,000 HP and more.

Main Rig systems components




Eng. Elsayed Amer

1 crown block
2 mast
3 monkey board
4 traveling block
5 hook
6 swivel
7 elevators
8 kelly
9 kelly bushing
10 master bushing
11 mousehole
12 rathole
13 drawworks
14 weight indicator
15 driller's console
16 doghouse
17 rotary hose
18 accumulator unit
19 catwalk
20 pipe ramp
21 pipe rack
22 substructure
23 mud return line
24 shale shaker
25 choke manifold
26 mud gas separator
27 degasser
28 reserve pit
29 mud pits
30 desander
31 desilter
32 mud pumps
33 mud discharge lines
34 bulk mud components storage
35 mud house
36 water tank
37 fuel storage
38 engines and generators
39 drilling line

1. Hoisting System

Rig components

Eng. Elsayed Amer

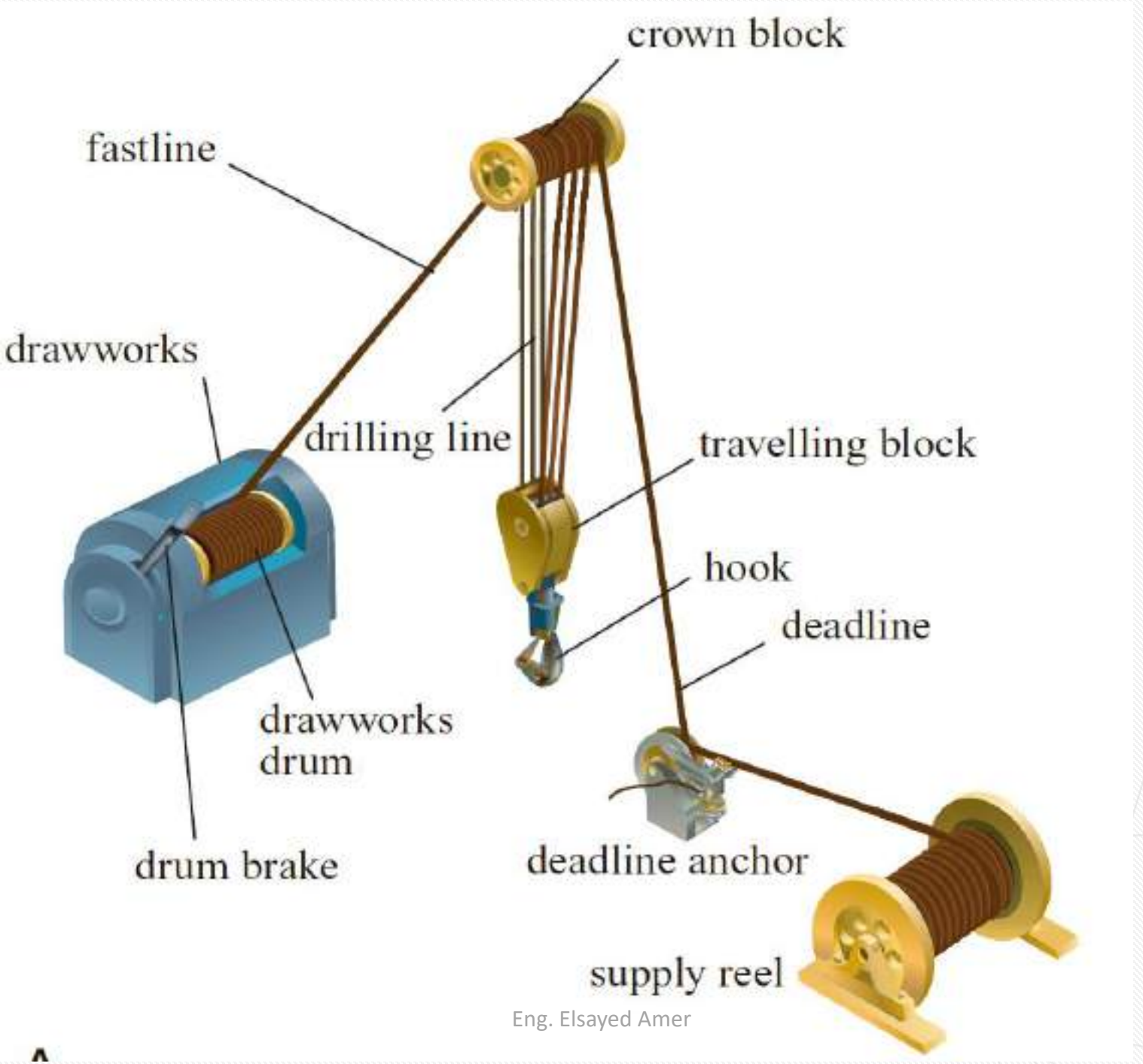
1. Hoisting System

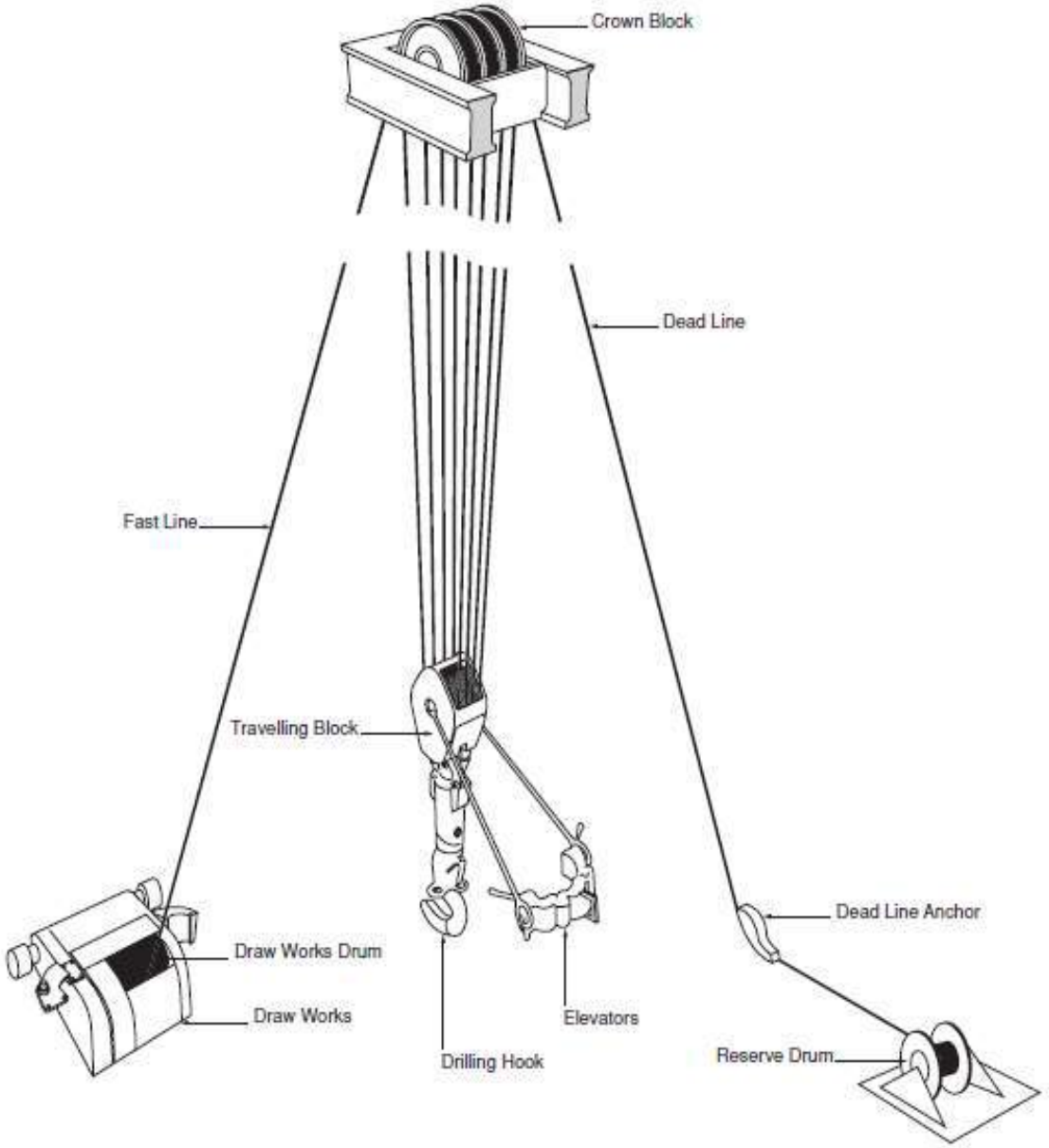
Function

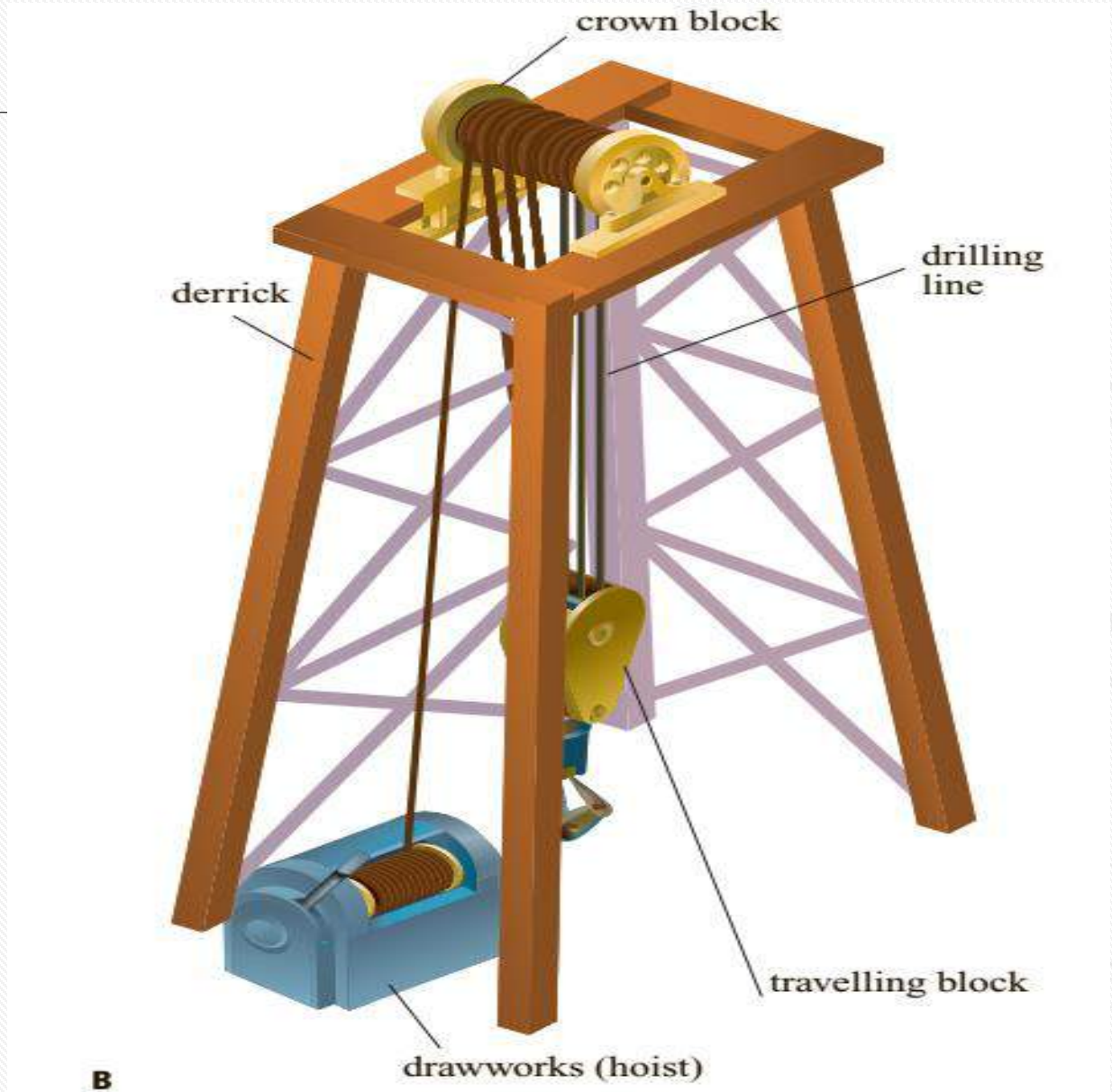
The hoisting system is the set of equipment necessary to lower or raise drill strings, casing string and other subsurface equipment into or out of hole.

Principal Components:

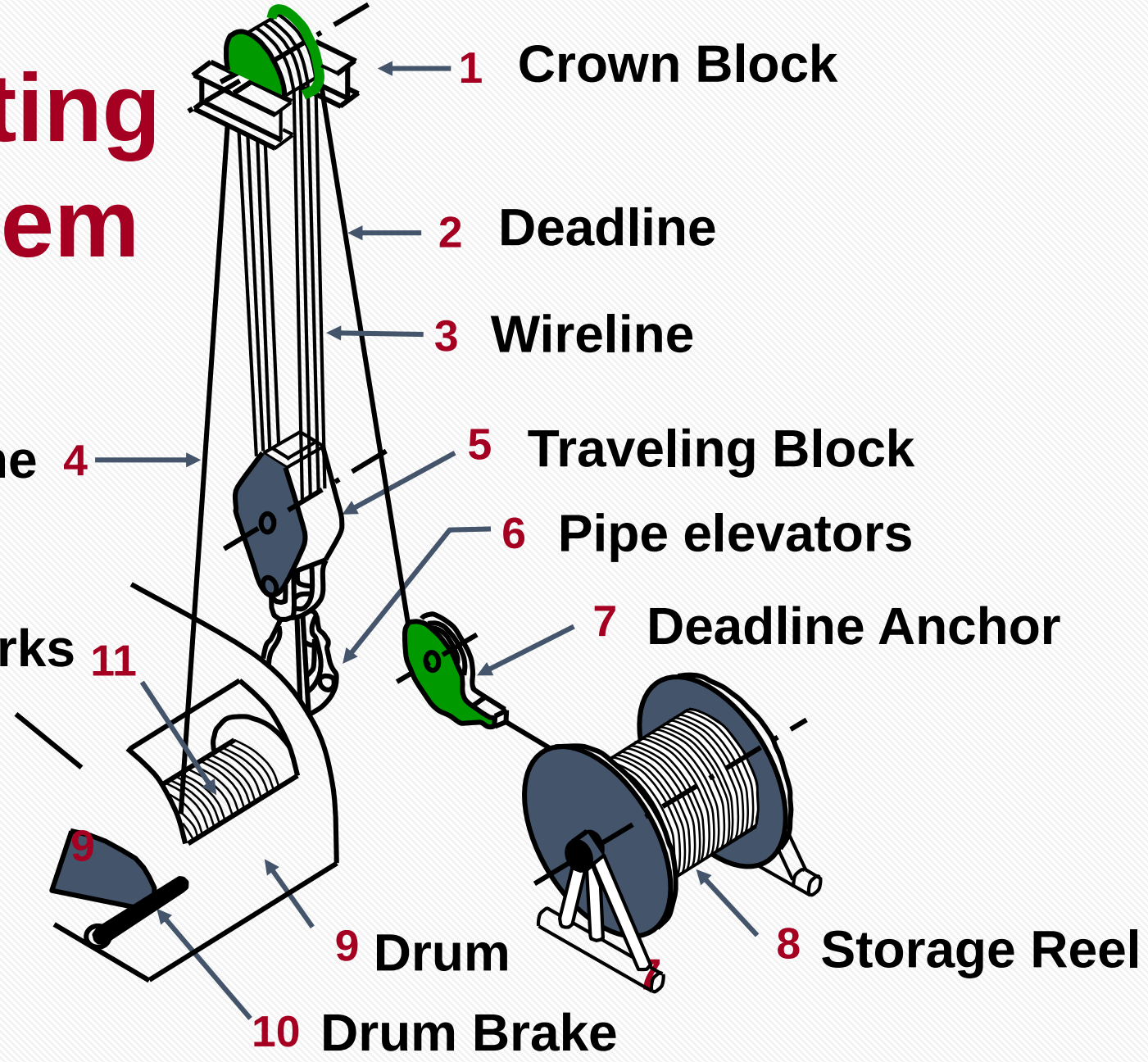
I. Derrick and substructure
II. Crown block
III. Travelling block
IV. Draw works
V. Drilling line

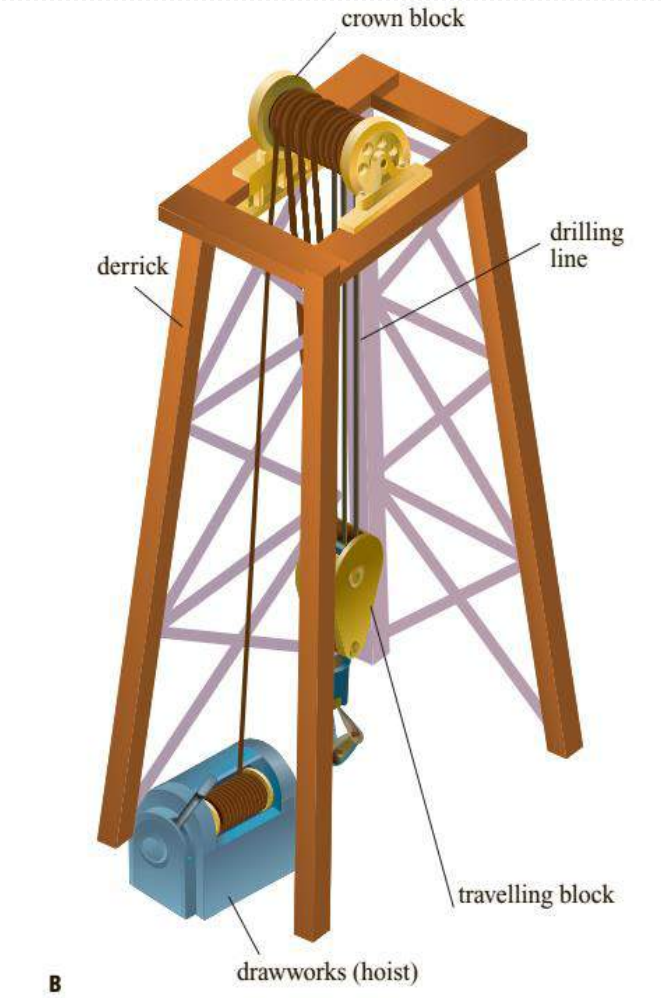

crown block
fastline
drawworks
drilling line
travelling block
hook
deadline
drawworks drum
drum brake
deadline anchor
supply reel


Crown Block
Dead Line
Fast Line
Travelling Block
Draw Works Drum
Draw Works
Drilling Hook
Elevators
Dead Line Anchor
Reserve Drum


crown block
drilling line
derrick
travelling block
drawworks (hoist)
B

Hoisting System





1. 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

1. Hoisting System

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

1. Hoisting System

Derrick

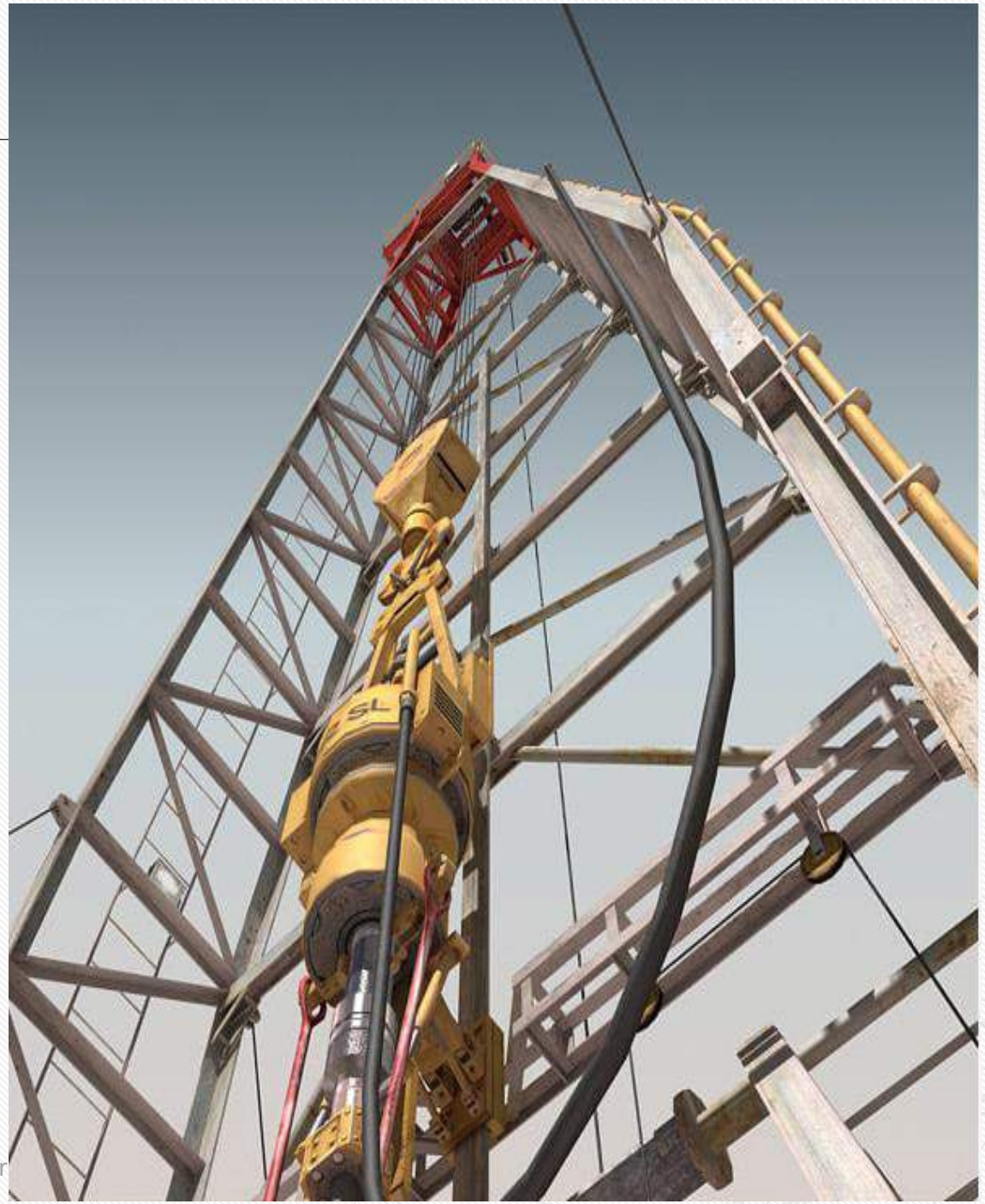
1 Conventional derrick

2 Mast

1. Hoisting System

3. Crown block

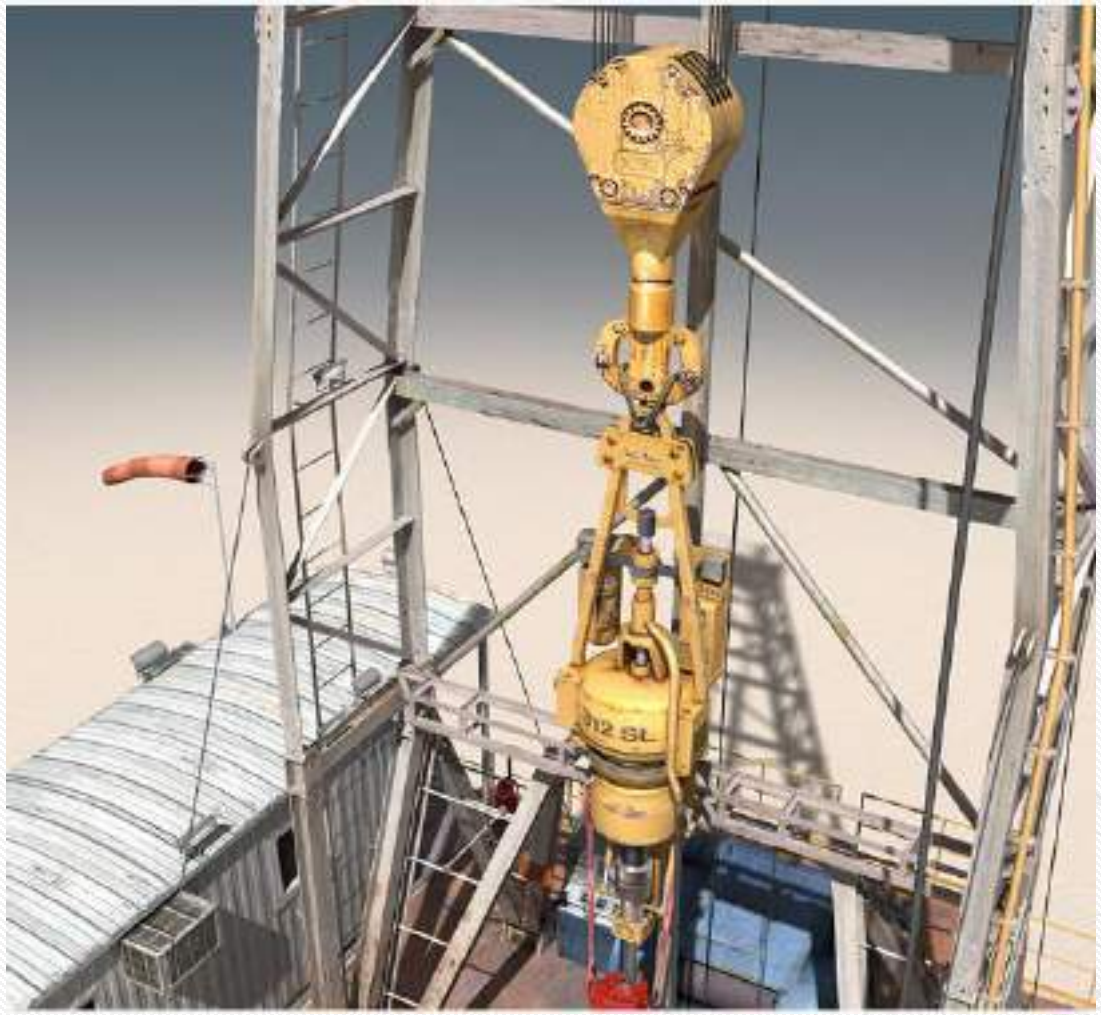
- An assembly of sheaves mounted on beams at the top of the derrick/mast and over which the drilling line is reeved.
- The crown block bears the load applied at the hook and its function is to reduce the wire rope tension required to pull the tubular material used to drill the well. It at the top of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

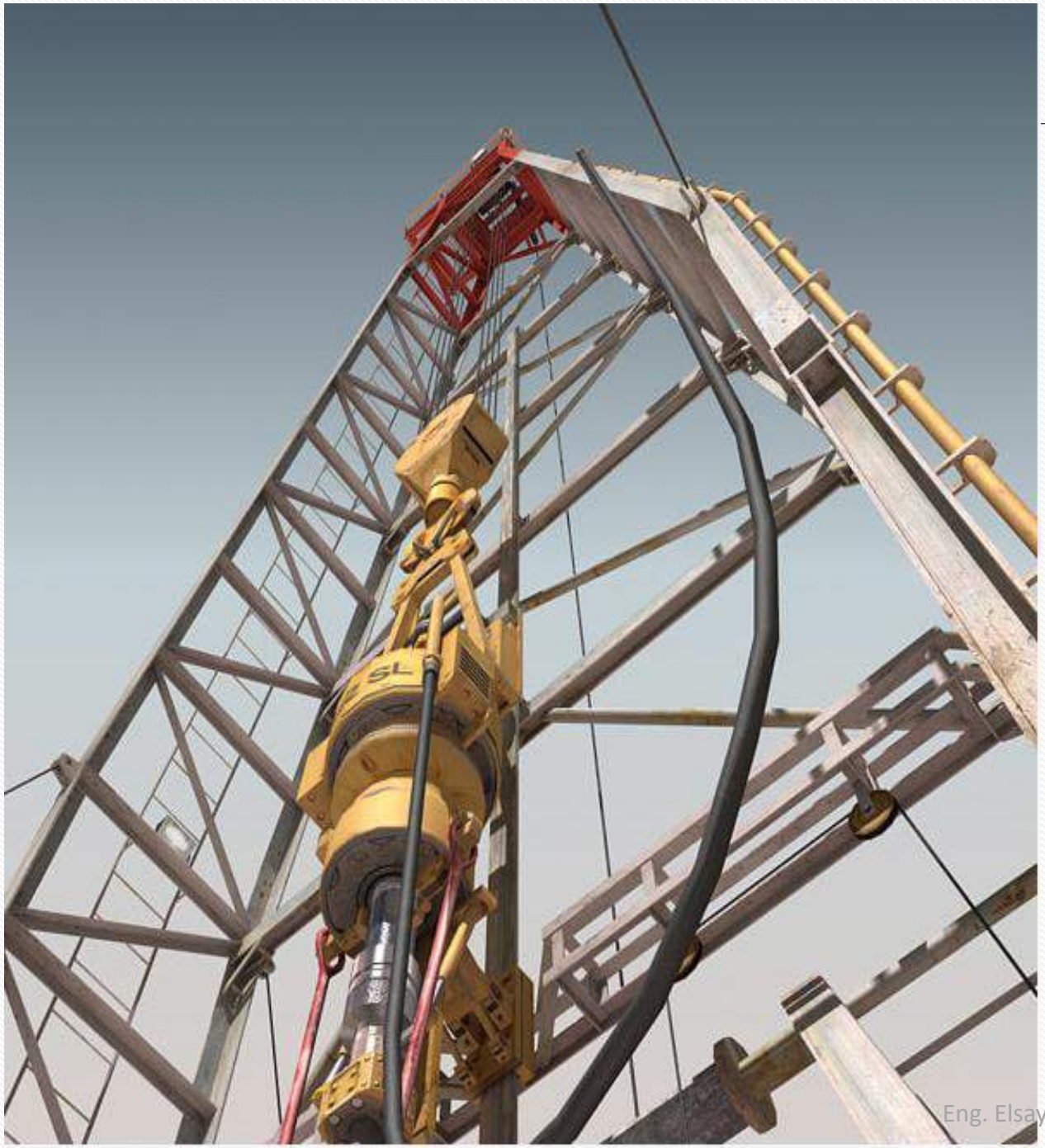


1. Hoisting System

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





1. Hoisting System

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.

1. Hoisting System

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
LeTourneau
TECHNOLOGIES

Typical Drawworks Data

Rating Imput Power, HP	1000	1500	2000
Max. Fastline Pull, lbs	61,820	76,435	109,030
Dia. Of Drill Line	1¼	1 3/8	1 ½
Drum Size, in (Dia. X width)	25.20 X 44.84	26.97 X 44.80	30.31 X 53.58

DRAWORKS RATED POWER HP (kW)	HOOK LOAD CAPACITY (tons)	
	CONVENTIONAL RIGS	MOBILE RIGS
150 (110)		60
200 (147)		75
250 (184)		80
300 (220)		90-100
500 (368)		125
700 (515)	180	180
1000 (735)	220	220
1500 (1100)	360	
2000 (1470)	500	
3000 (2200)	750	
4000 (2940)	1000	
5000 (3728)	1500	

1. Hoisting System

7. Drilling Line

- The drilling line contained in the hoist drums consists of helically-wound steel-wire strands around a plastic, vegetable fiber or steel core.
- The first end of the drilling line (fast line) is wound around the hoist drum, after which it passes alternately over the sheaves of the travelling block and of the crown block, while the other end (dead line) is anchored to an element of the substructure.
- The tension of the line is measured on this anchorage, and this makes it possible to calculate the weight of the equipment suspended from the hook (e.g. drill string, casing, etc.). Through being wound around the drum and over the block sheaves, the line is subject to wear and tear, to weakening of the wires (due to local overheating) and to fatigue due to cyclical variations of tension in the winding over the sheaves and the drum.

1. Hoisting System

7. Drilling Line

- One method of assessing the state of wear and tear of the drilling line is visual inspection, but this is uncommon because of the uncertainty involved, the practical difficulties and the time required.
- slipping and cutoff, is performed when a given value of the work carried out by the line has been reached.

1. Hoisting System

7. Drilling Line

Types of Wire Rope Lay

Right Lang Lay

Left Lang Lay

Right Regular Lay

Left Regular Lay

Nominal Breaking strength of 6 x 19 I.W.R.C (Independant Wire Rope Core) Blockline (lbs)			
Nominal Diameter	Ton-miles between cuts	Improved Plowed Steel	Extra Improved Plowed Steel
1"	8	89,800	103,400
1 1/8"	12	113,000	130,000
1 1/4"	16	138,800	159,800
1 3/8"	20	167,000	192,000
1 1/2"	24	197,800	228,000

1. Hoisting System

7. Drilling Line

Type of Wire Rope Construction

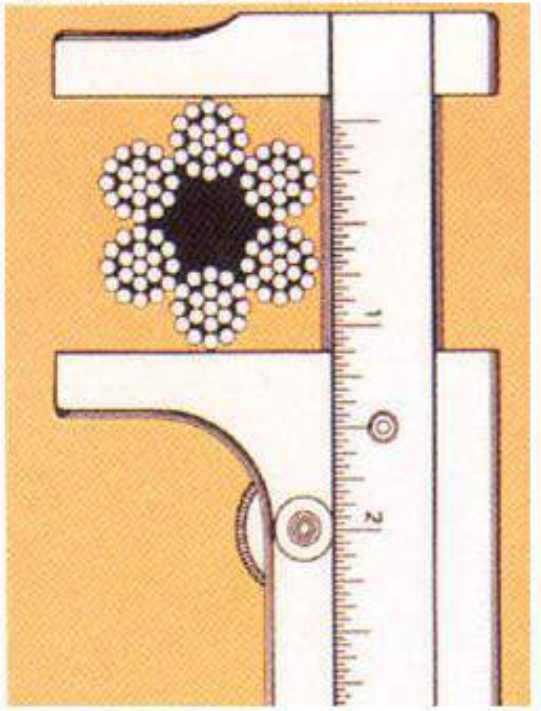
Shallow:	**1” to 1-1/8” diameter**
Deep:	**1-1/4” to 2” diameter**
Contruction:	**6 x 19 S or 6 x 21 S or 6 x 25 FW, RRL, IPS or EIP, IWRC**

Measurement of a Diameter

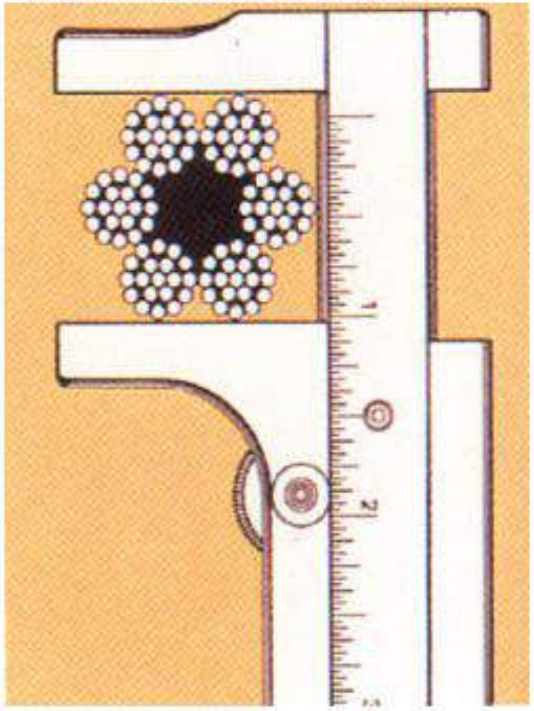
The measurement of the diameter shall be carried out by means of a vernier calliper as shown in Figure at any two or more points or more directions within the same cross-section distant not less than 1.5 m from the rope end.

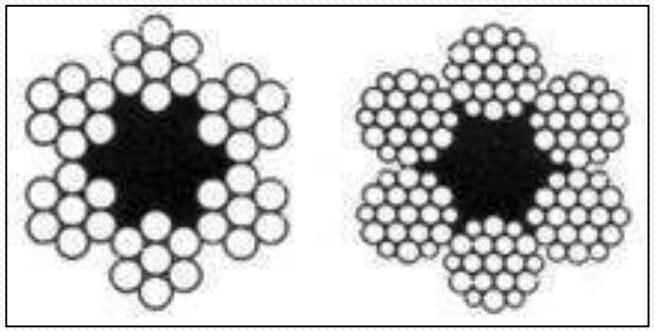
The mean value of these measurement is considered as the rope diameter.

Correct way to measure the diameter of wire rope



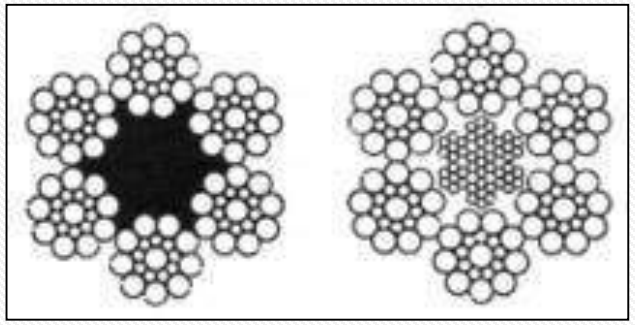
Incorrect way to measure the diameter of wire rope





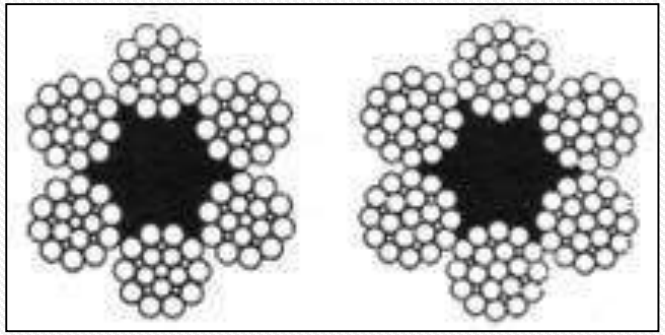
6 X 7 with fiber core

6 X 19W with fiber core



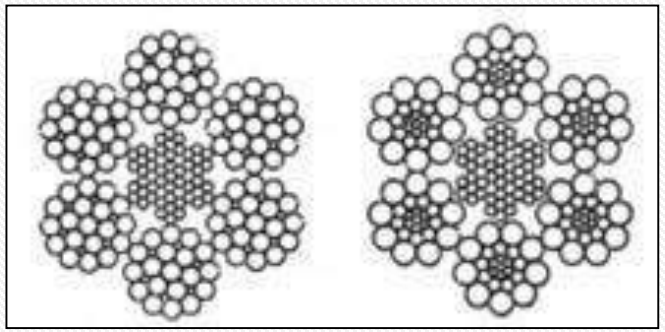
6 X 19S with fiber core

6 X 19 with IWR core



6 X 21 Filler Wire with fiber core

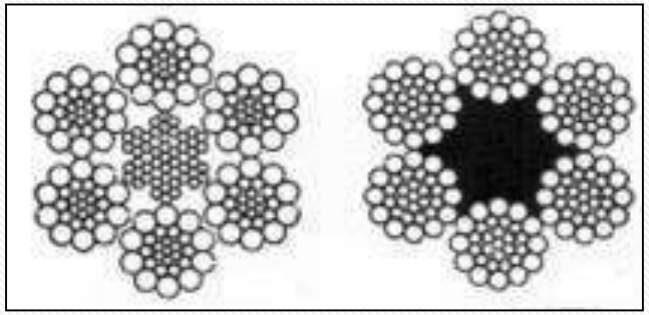
6 X 25 Filler Wire with fiber core



6 X 25 Filler Wire with IWR core

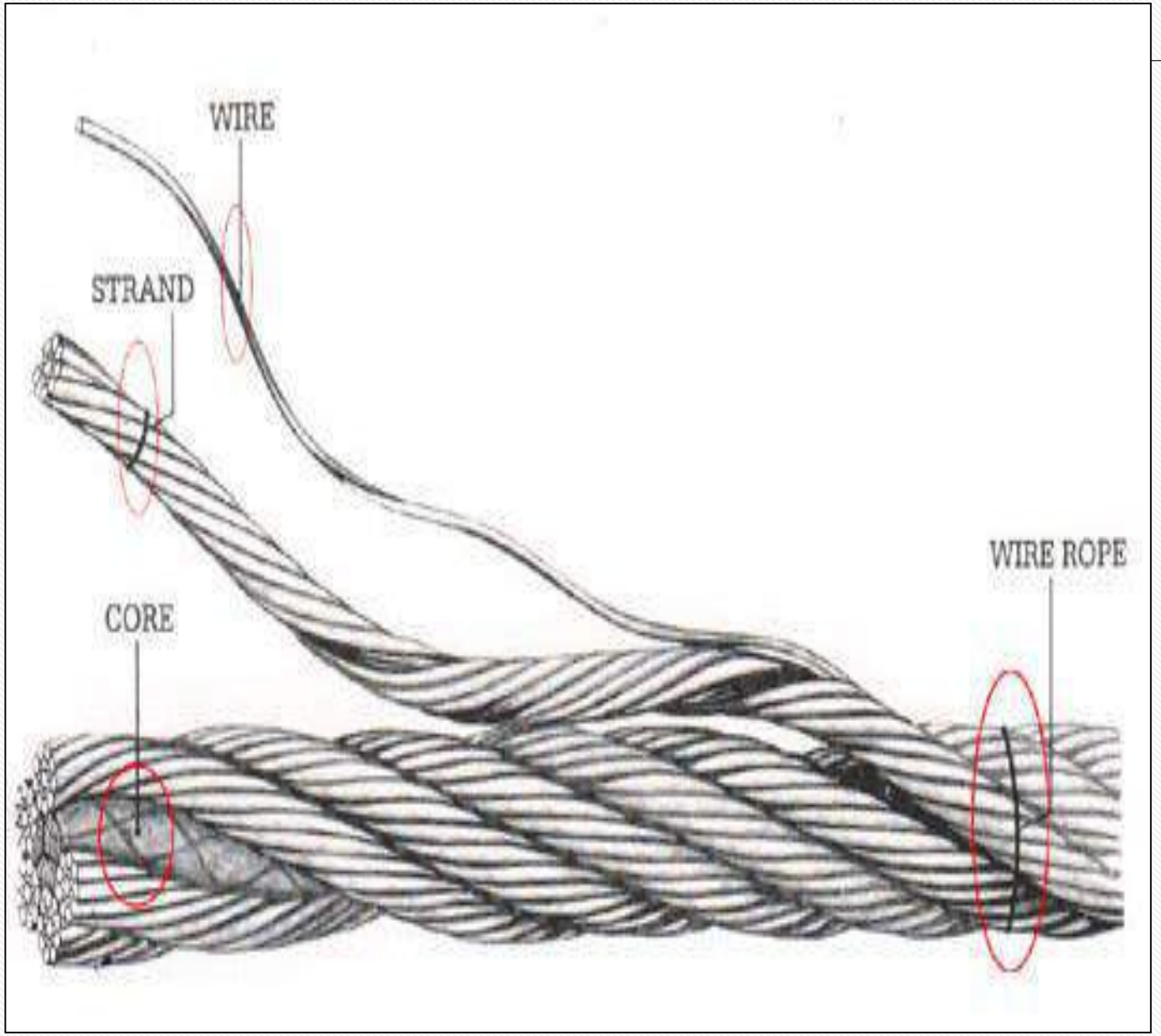
6 X 25 Seal with IWR core

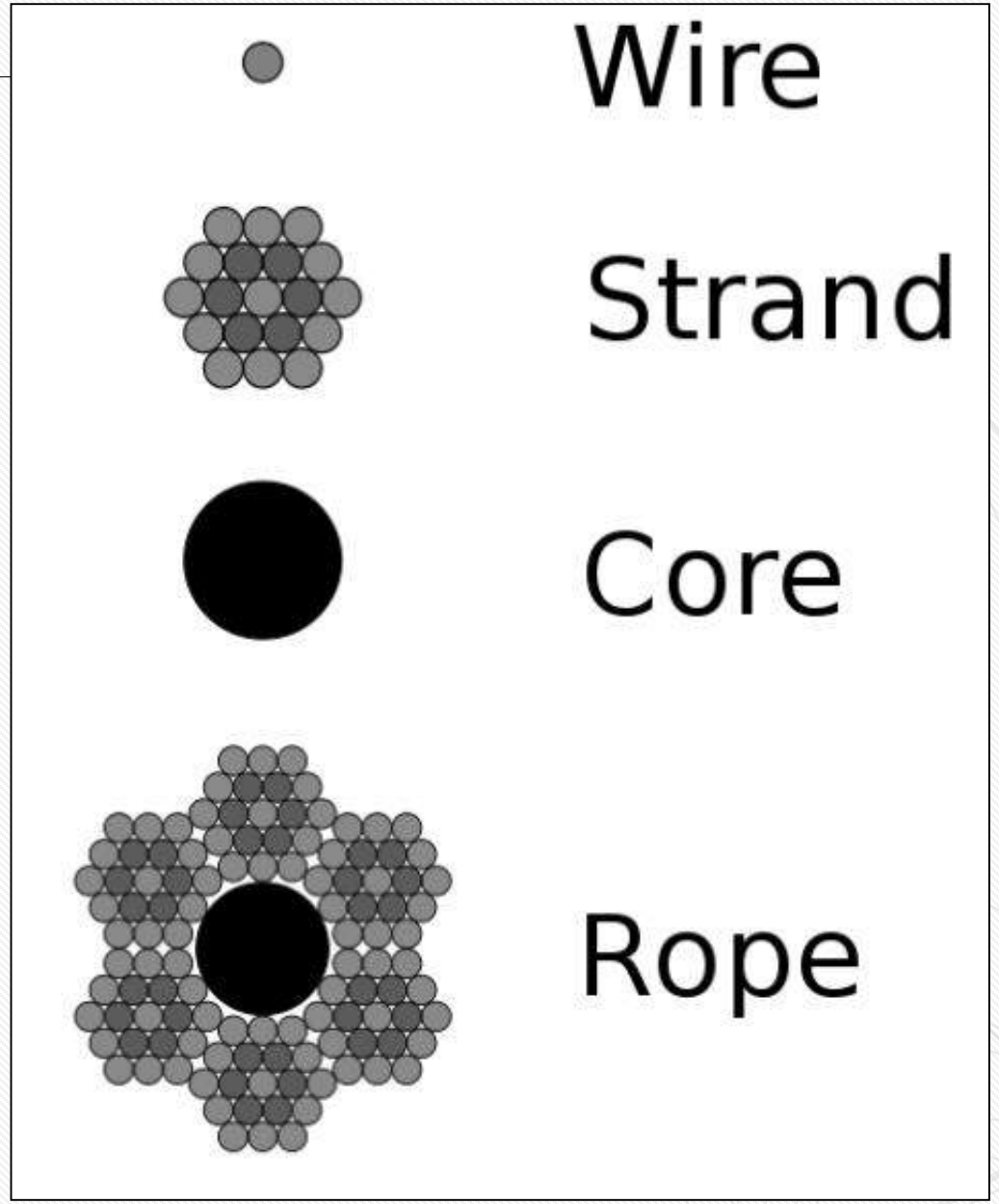
6 X 27 Seal with IWR core



6 X 31 Seal with IWR core

IWR = Independent Wire Rope


WIRE
STRAND
WIRE ROPE
CORE


Wire
Strand
Core
Rope

1. Hoisting System

8. cathead

- The cathead is used to lift heavy objects and to pull on the tongs when making up the drill pipe

1. Hoisting System

9. air hoist

- An air hoist or tugger is a safer way to lift heavy objects

1. Hoisting System

10. Drill line spool

The drilling line is stored on a spool
Periodically, some of the drilling line is cut off at the drawworks and additional line is pulled off the spool to replace the cut line

1. Hoisting System

10. Deal line anchor

The “dead line” is anchored in the substructure

The anchor is on the spool side

2. Rotating System

Rig components

Eng. Elsayed Amer

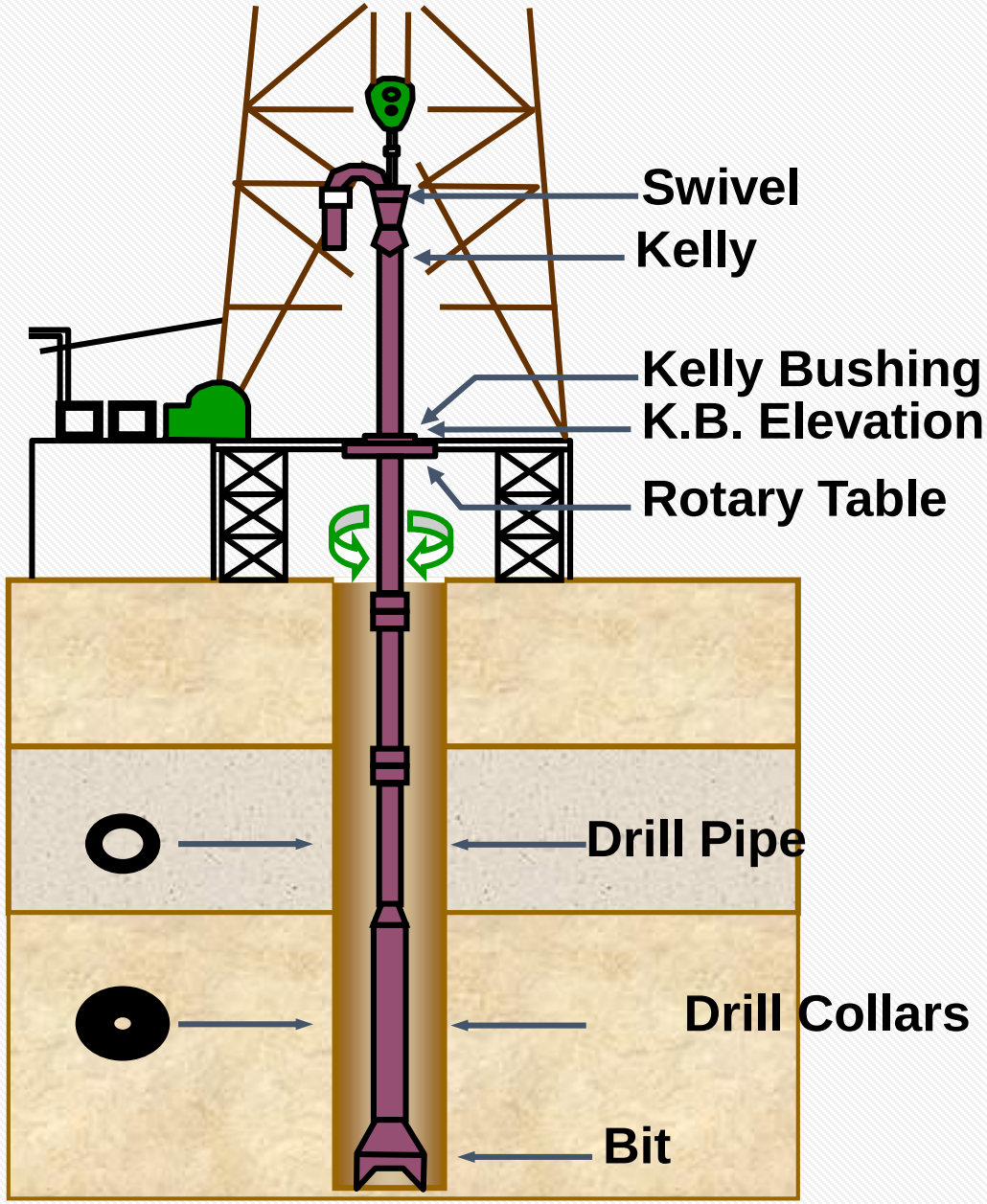
2. Rotary System

Function

The system of rotation is intended to cause the drill string to rotate.

Principal Components:

1. The rotary table
2. Kelly or Top Drive
3. Kelly Bushing
4. Master Bushing


Swivel
Kelly
Kelly Bushing
K.B. Elevation
Rotary Table
Drill Pipe
Drill Collars
Bit

2. Rotary System

1. Top drive

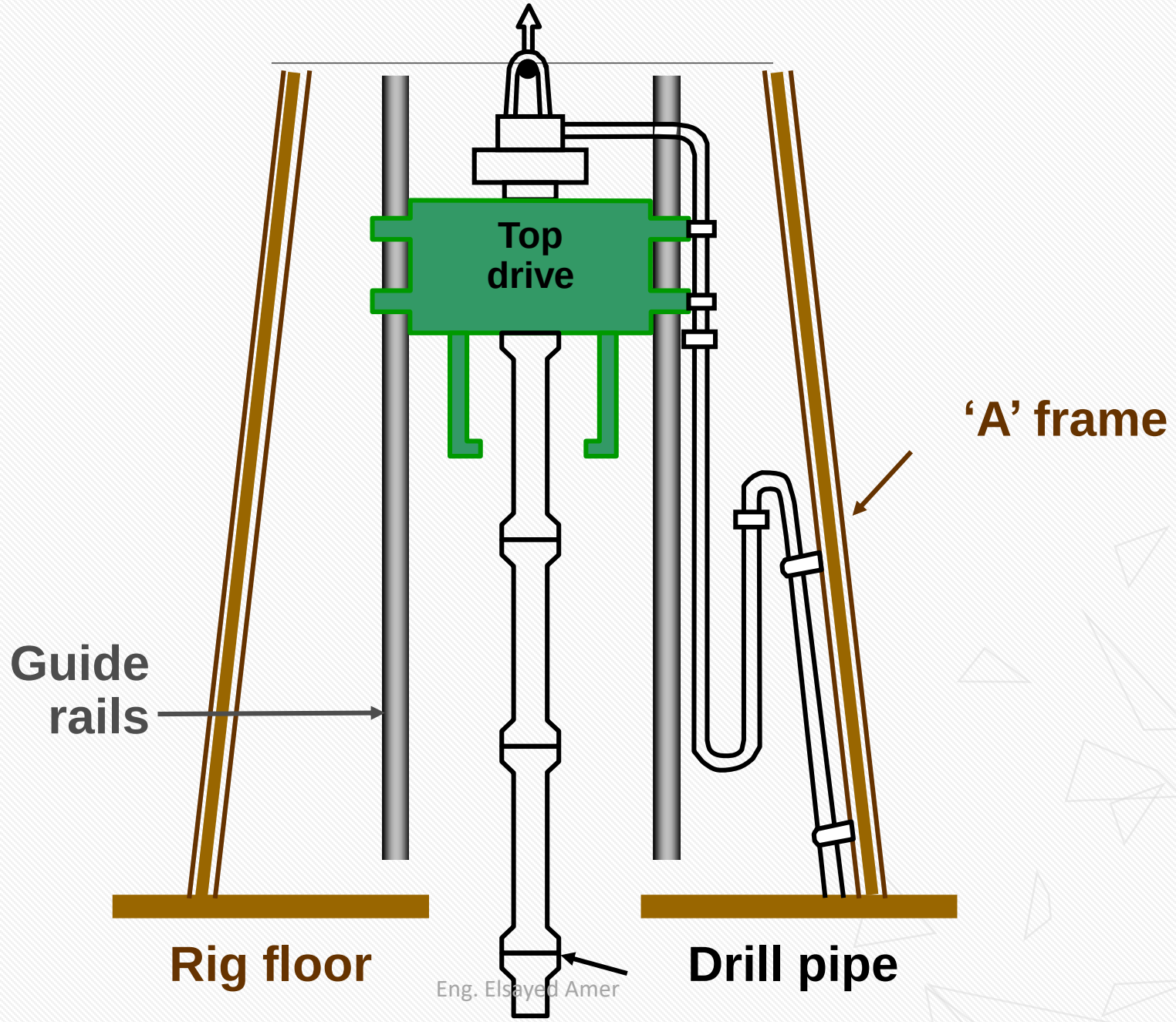
- The top drive is a relatively recent piece of equipment, introduced towards the mid-1980s, grouping together in a single unit the equipment for connecting the drill pipes, rotation of the drill string and circulation of the fluid
- The top drive unit is suspended from the hook and is guided by two vertical rails fixed to the derrick, which provide the reactive torque necessary to prevent the rotation of the whole complex and to allow free vertical movement.

2. Rotary System

1. Top drive

the use of the top drive instead of the rotary table offers numerous advantages, including:

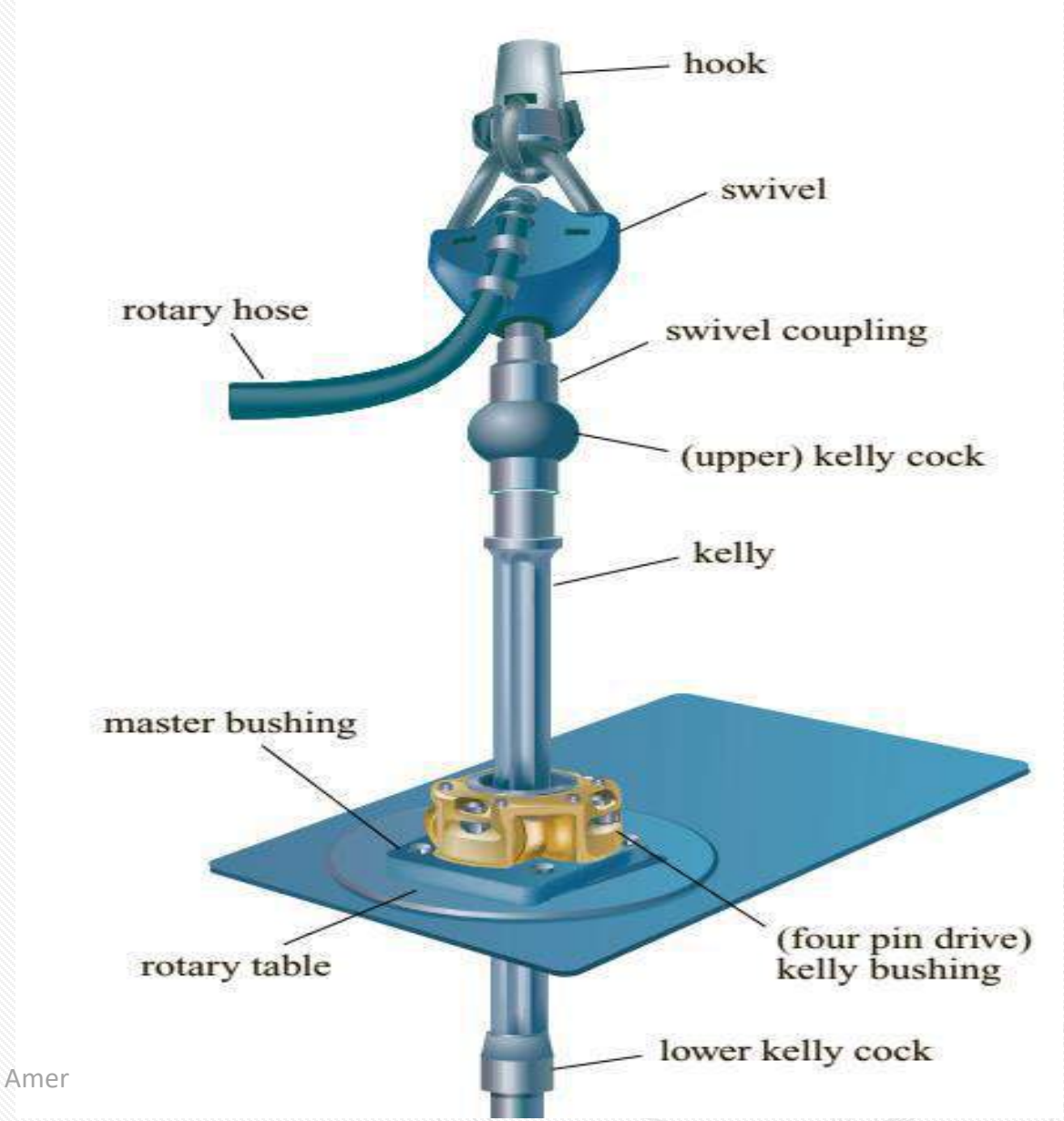
1. possibility of ‘drilling by stands’ (adding the pipes by stands, and not individually), allowing greater control of drilling.
2. the reduction of the time required to connect the pipes, with less risk of accidents for drilling operators
3. the possibility of performing the trip-out operation while circulating mud and rotating the string (*back reaming*), impossible with the rotary table and useful for preventing the drill string from becoming stuck
4. the possibility of obtaining longer cores, as intermediate connections are eliminated.



2. Rotary System

2. swivel

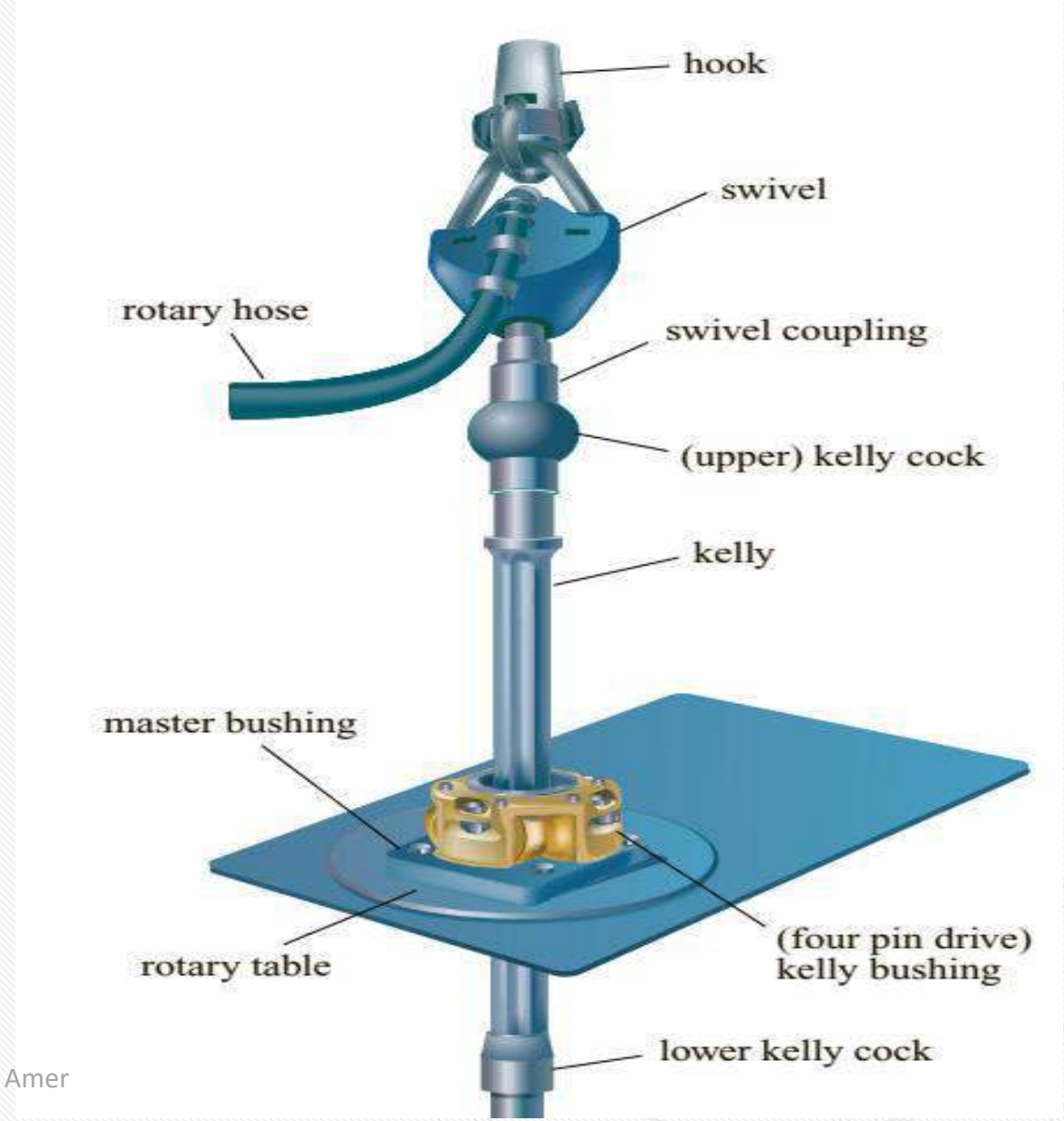
- The rotary tool that is hung from the hook of the traveling block to suspend the drillstring and permit it to rotate freely.
- It also provide connection for the rotary hose and provide passageway for the flow of drilling fluid into the drill stem.

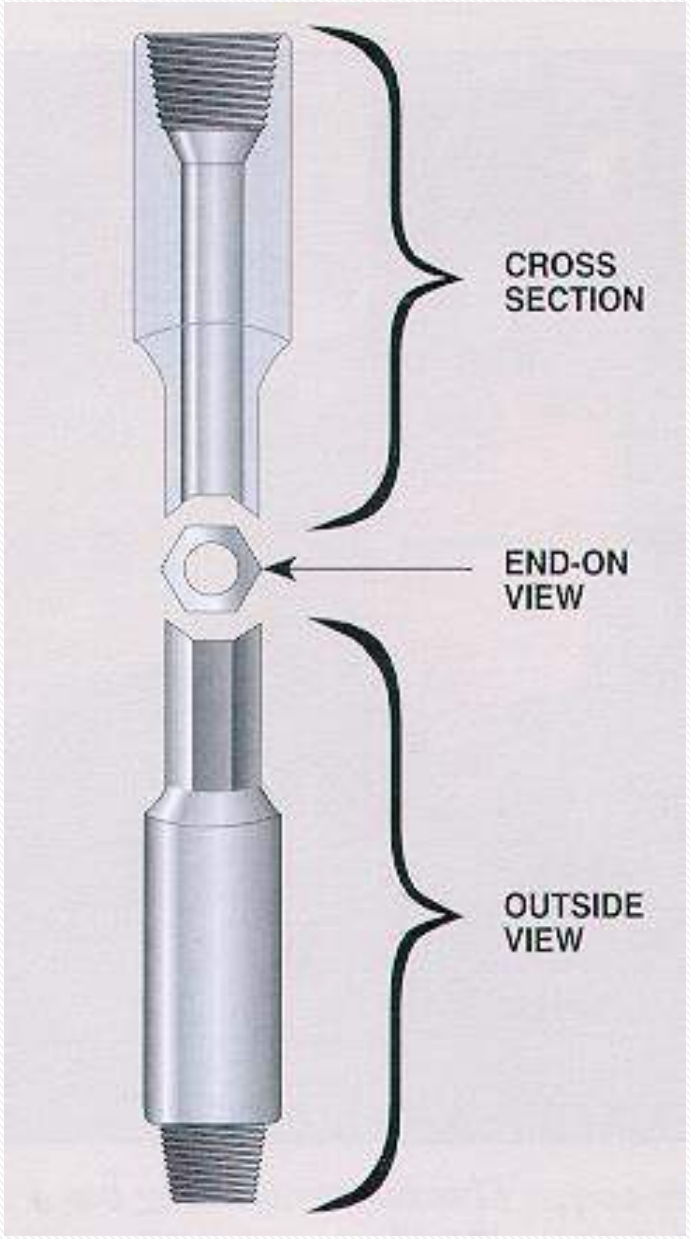


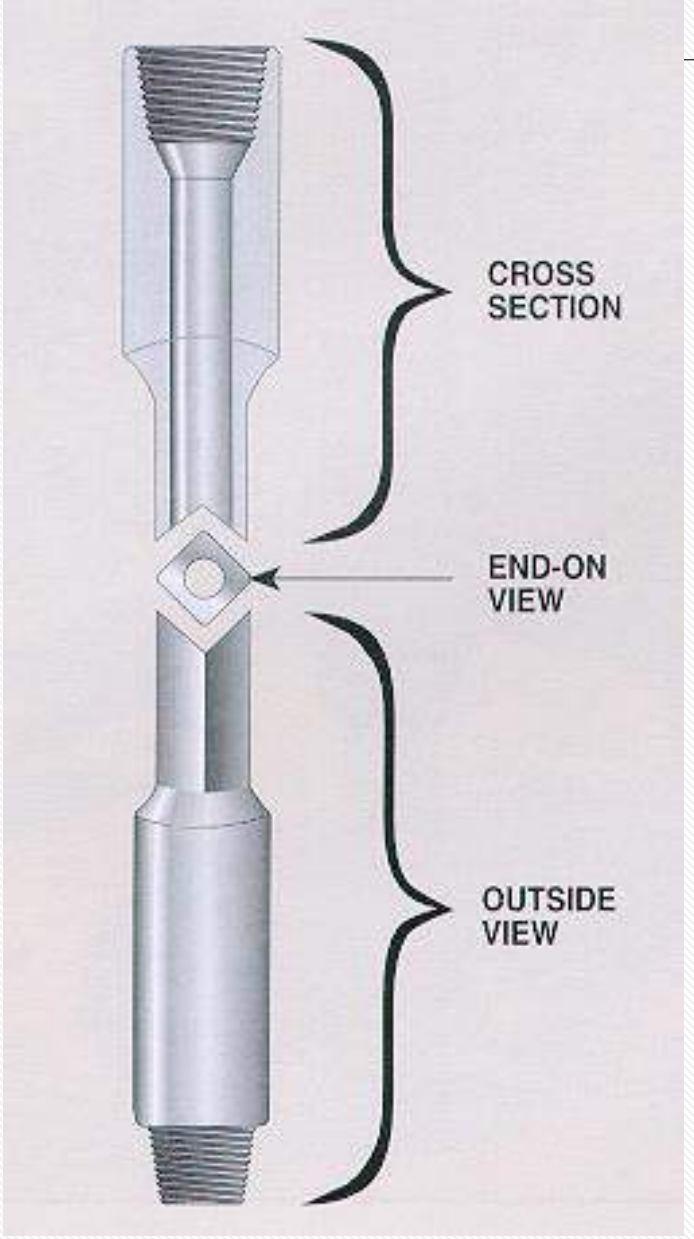
2. Rotary System

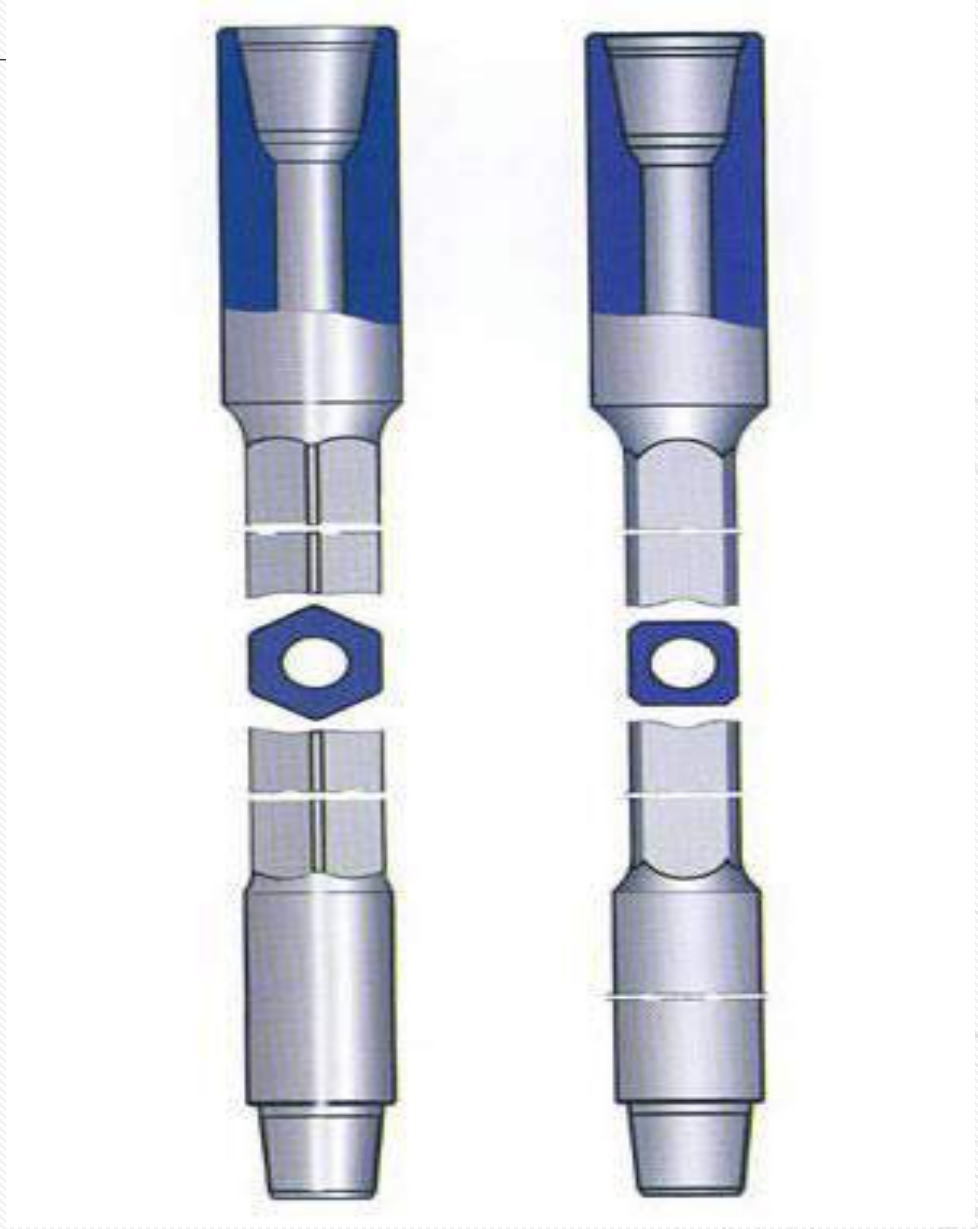
3. Kelly

- The Kelly is a pipe of square or hexagonal section that transmits the motion of the rotary table to the drill string.
- It receives this motion from the Kelly bushing, to which it is joined through a sliding coupling, so that it can move vertically.




CROSS SECTION
END-ON VIEW
OUTSIDE VIEW


CROSS SECTION
END-ON VIEW
OUTSIDE VIEW



2. Rotary System

4. Kelly Bushing

A device that when fitted to master bushing transmits torque to the Kelly and simultaneously permits vertical movement of the Kelly to make hole.

Type HDP

Heavy Duty fits 23” through 49-1/2” Rotary Table

Type HDS

Heavy Duty for Square Drive Rotary Tables

Type MDS

Medium Duty for Square Rotary Table

2. Rotary System

5. Master Bushing

A device that fits into the rotary table to accommodate the slips and drive the kelly bushing so that the rotating motion of the rotary table can be transmitted to the Kelly.

Type MSPC

Fits 20-1/2” to 27-1/2” Rotary Tables

Type MPCH

Fits 37-1/2” to 49-1/2” Rotary Tables

Type MSPC

Fits 17-1/2” to 27-1/2” Rotary Tables

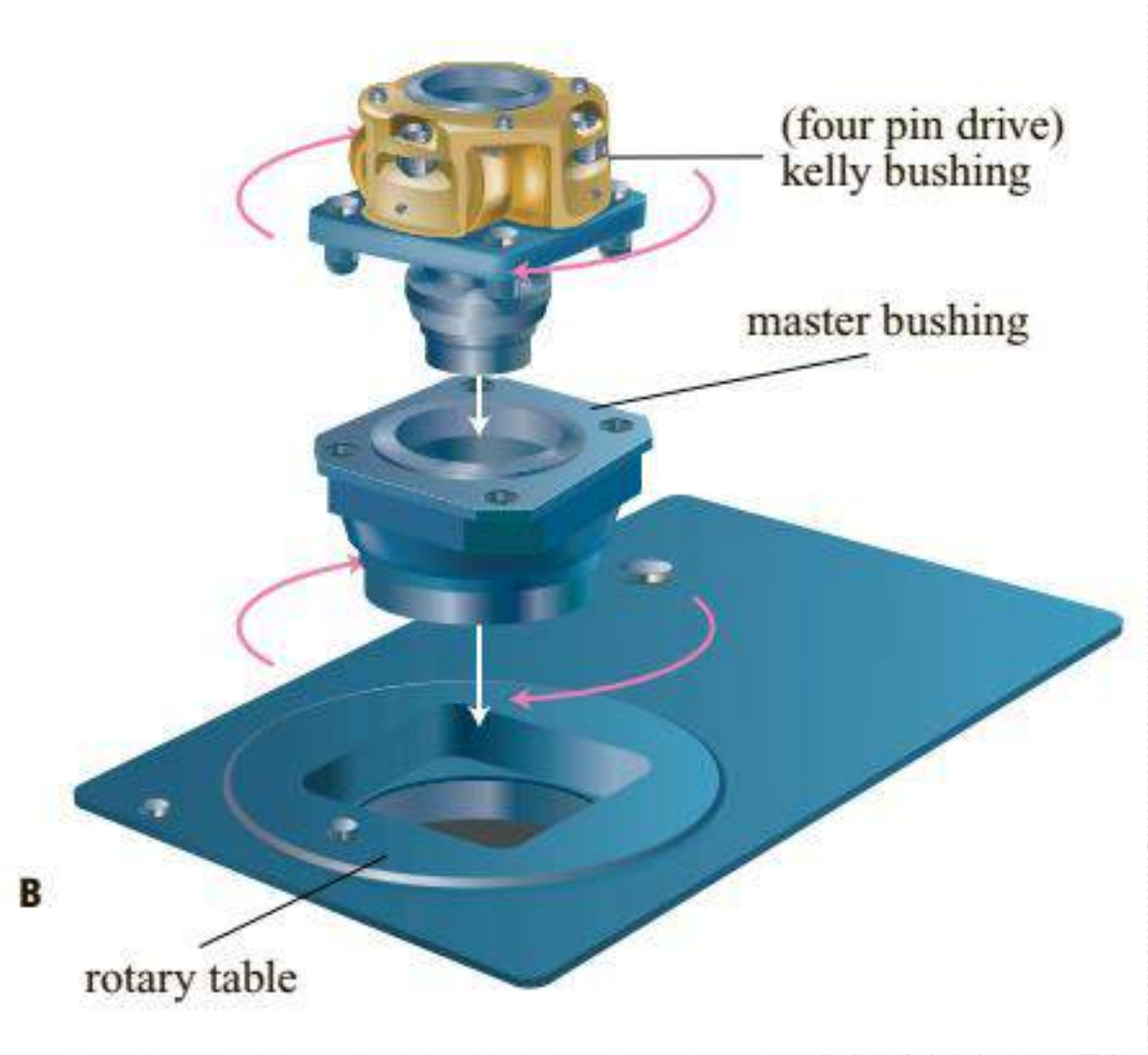
Type MBSS

Fits 17-1/2” to 27-1/2” Rotary Tables

2. Rotary System

6. Rotary table

- The rotary table makes the drill string rotate and supports its weight during operations or during the connection of a new drill pipe, when it cannot be borne by the hook



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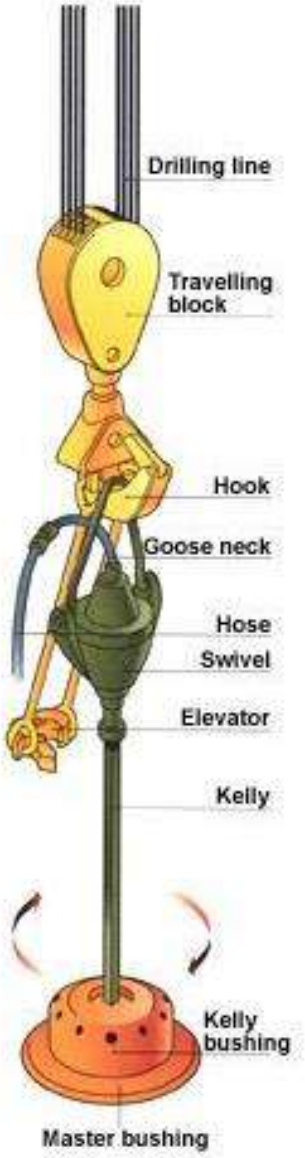
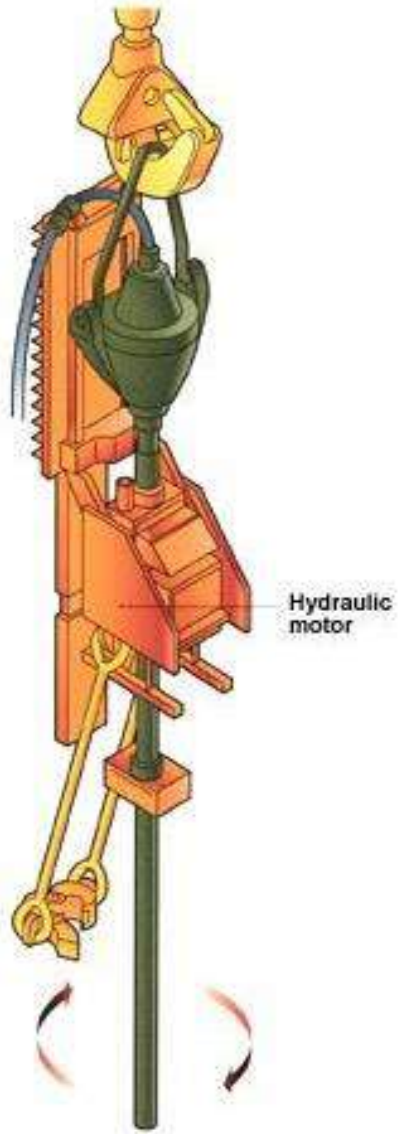


Rotary Table drive Drilling



Top Drive Drilling

3. Tubular and Tubular Handling Equipment

Rig component

Eng. Elsayed Amer

- Drill string

The drill string is an assemblage of hollow pipes of circular section, extending from the surface to the bottom of the hole. It has three functions:

- ❖ it takes the drilling bit to the bottom of the hole, while transmitting its rotation and its vertical load to it.
- ❖ It permits the circulation of the drilling fluid to the bottom of the hole.
- ❖ it guides and controls the trajectory of the hole.

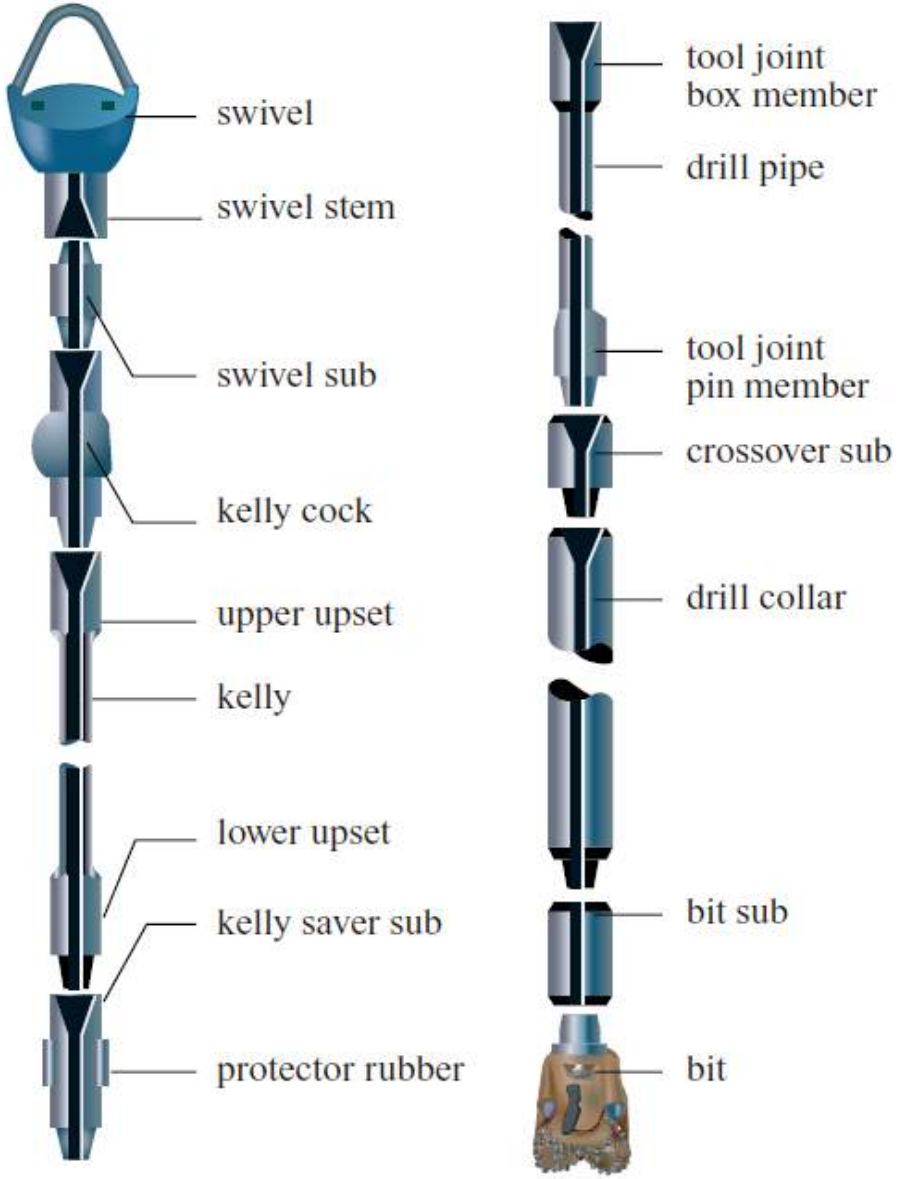


Fig. 11. Main components of drill string.

- Drill string

a) Drill Pipe

- The drill pipes are hollow steel pipes of various types, with two tool joints welded at their ends.
- They are standardized according to API standards and classified on the basis of their length (usually about 9 m), their outside diameter, their linear weight and their steel grade.
- The most common drill pipes are the following: 3.50" (13.30 lb/ft), 4.50'' (16.60 lb/ft) and 5" (19.50 lb/ft),

- Drill string

a) Drill Pipe

- Drill string

a) Drill Pipe

TENSILE REQUIREMENTS

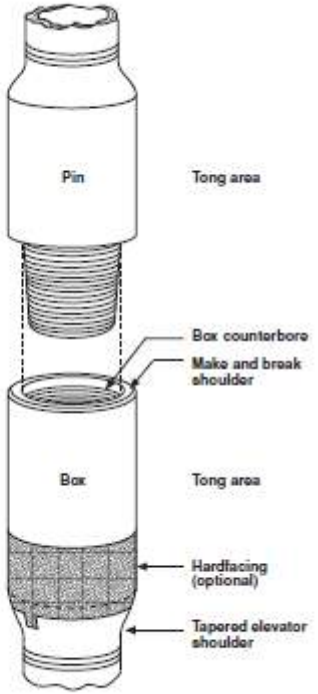
GRADE	YIELD STRENGTH		TENSILE STRENGTH
	MIN. PSI	MAX. PSI	MINIMUM PSI
D*	55,000	—	95,000
E	75,000	105,000	100,000
X-95	95,000	125,000	105,000
G-105	105,000	135,000	115,000
S-135	135,000	165,000	145,000

RANGE LENGHTS

	RANGE 1 (ft.)	RANGE 2 (ft.)	RANGE 3 (ft.)
TOTAL RANGE LENGTH, INCLUDES.....	16-22	27-30	38-45
RANGE LENGTH FOR 95% OR MORE OF CARLOAD:			
PERMISSIBLE LENGTH, MINIMUM.....	20	—	—
PERMISSIBLE VARIATION, MAXIMUM.....	2	—	—
RANGE LENGTH FOR 90% OR MORE OF CARLOAD:			
PERMISSIBLE LENGTH, MINIMUM.....	—	27	38
PERMISSIBLE VARIATION, MAXIMUM.....	—	2	3

TOLERANCES

DRILL PIPE SIZE (in.)	DIMENSION	TOLERANCE (in.)
2.375 - 3.500	O.D.**	+ 3/32, - 1/32
4 - 5		+ 7/64, - 0.75% O.D.
5.500 - 6.625		+ 1/8, - 0.75% O.D.
ALL SIZES	WALL THICKNESS	- 12.5%
	I.D.	GOVERNED BY O.D. TOLERANCES
	ECCENTRICITY: O.D.	.093 MAX. (TOTAL INDICATOR READING)
	ECCENTRICITY: I.D.	1/16 MAX. (1/8" TOTAL INDICATOR READING)
	OVALITY (ON UPSET)	.093 MAXIMUM



Drill string

a) Drill Pipe

API Range	Length (ft)
1	18-22
2	27-30
3	38-45

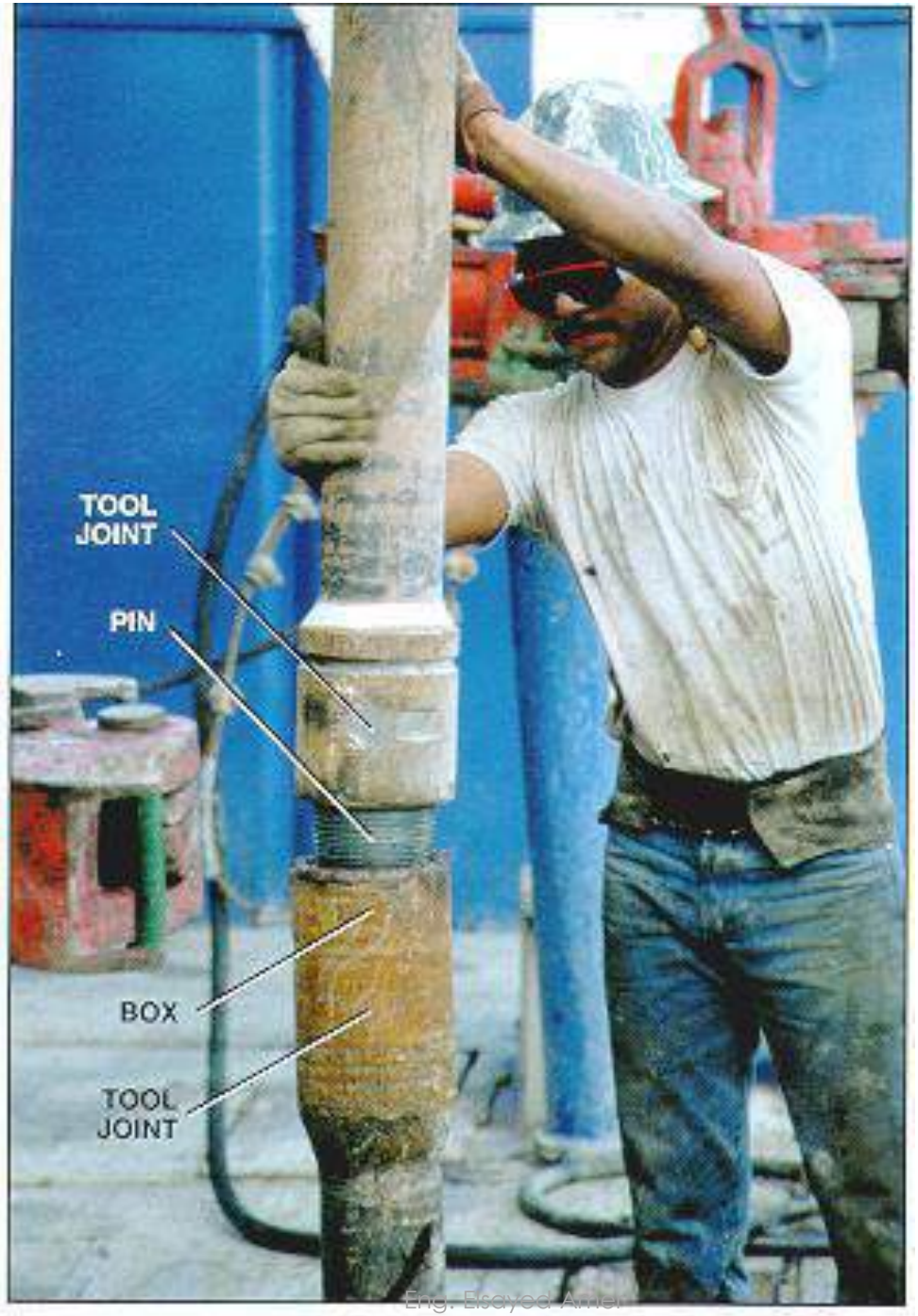
Table 1 Drillpipe Lengths

Size(OD) (inches)	Weight (lb/ft)	ID (inches)
$2^{3}/_{8}$	6.65	1.815
$2^{7}/_{8}$	10.40	2.151
$3^{1}/_{2}$	9.50	2.992
$3^{1}/_{2}$	13.30	2.764
5	15.50	4.602
5	16.25	4.408
5	19.50	4.276
$5^{1}/_{2}$	25.60	4.000
$5^{1}/_{2}$	21.90	4.776
$5^{1}/_{2}$	24.70	4.670

Table 2 Dimensions of Drillpipe

API Grade	Minimum Yield Stress (psi)	Minimum Tensile Stress (psi)	Yield Stress / Tensile Stress ratio
D	55,000	95,000	0.58
E	75,000	100,000	0.75
X	95,000	105,000	0.70
G	105,000	115,000	0.91
S	135,000	145,000	0.93

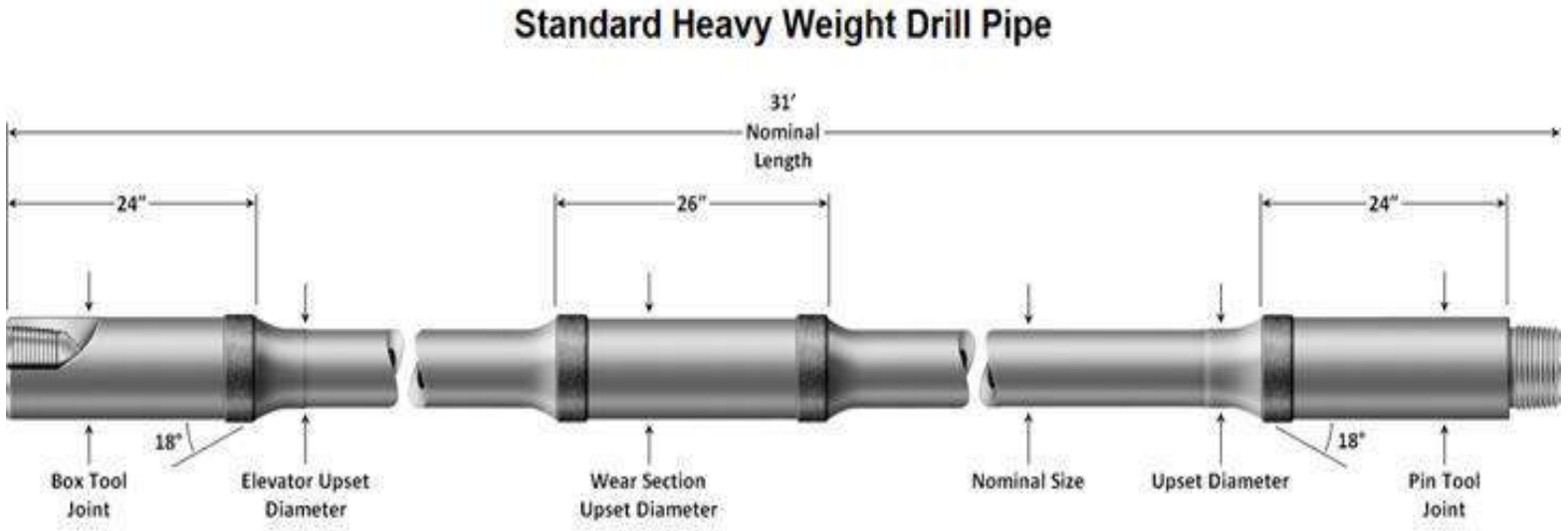
Table 3 Drillpipe Material Grades

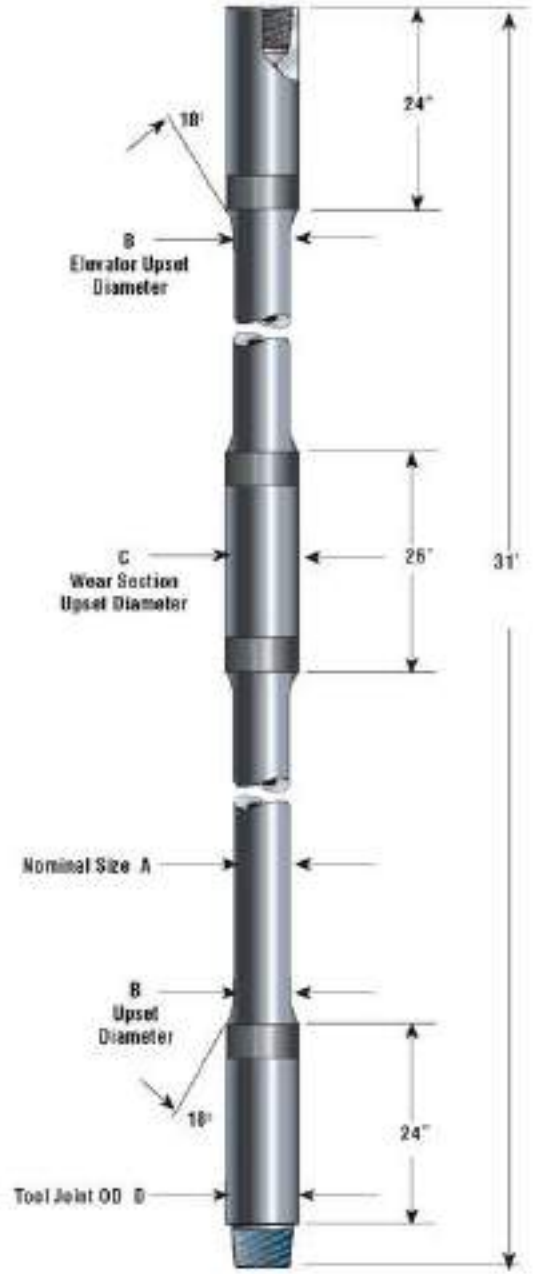


- Drill string

b) Heavy Weight Drill pipe

❖ To avoid the danger of breaks in the drill string, a short stretch of intermediate heavy-wall or heavy-weight drill pipes is inserted.

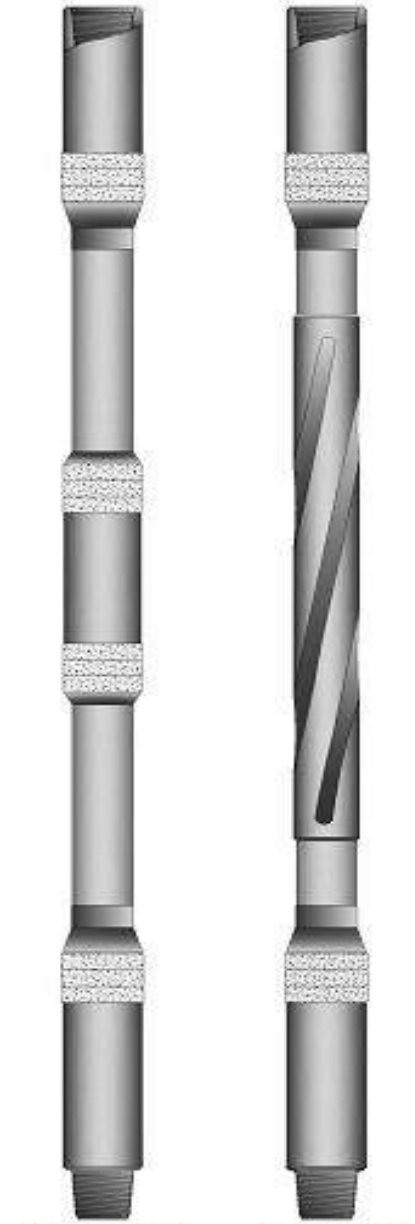


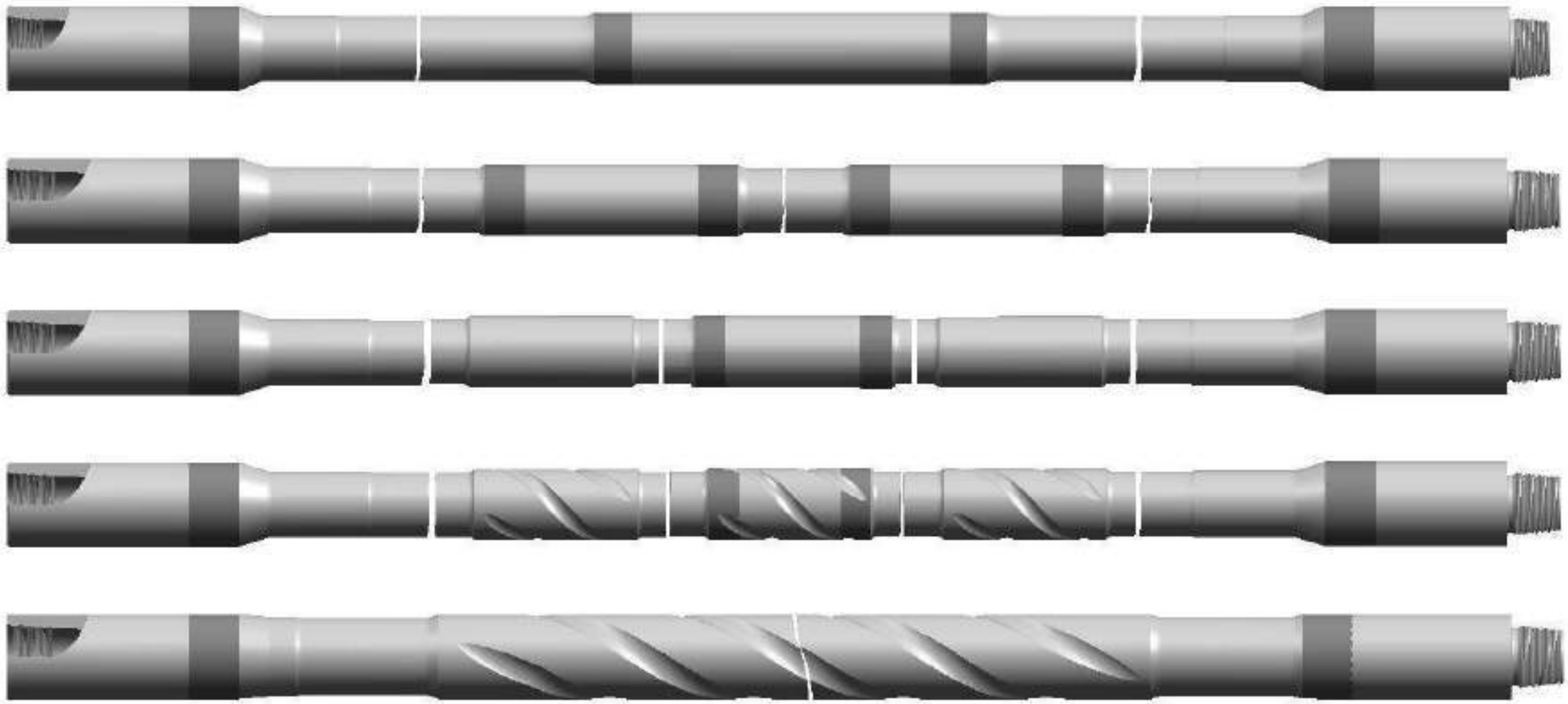


- Drill string

b) Heavy Weight Drill pipe

- Similar in appearance to a drill pipe, HWDP has the following different dimensional characteristics; the tube wall is heavier about 1”thick in most sizes, the tool joints are longer, and the tube section has a larger diameter at mid length to protect the pipe from wear.

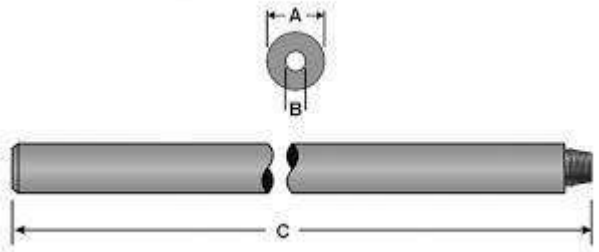


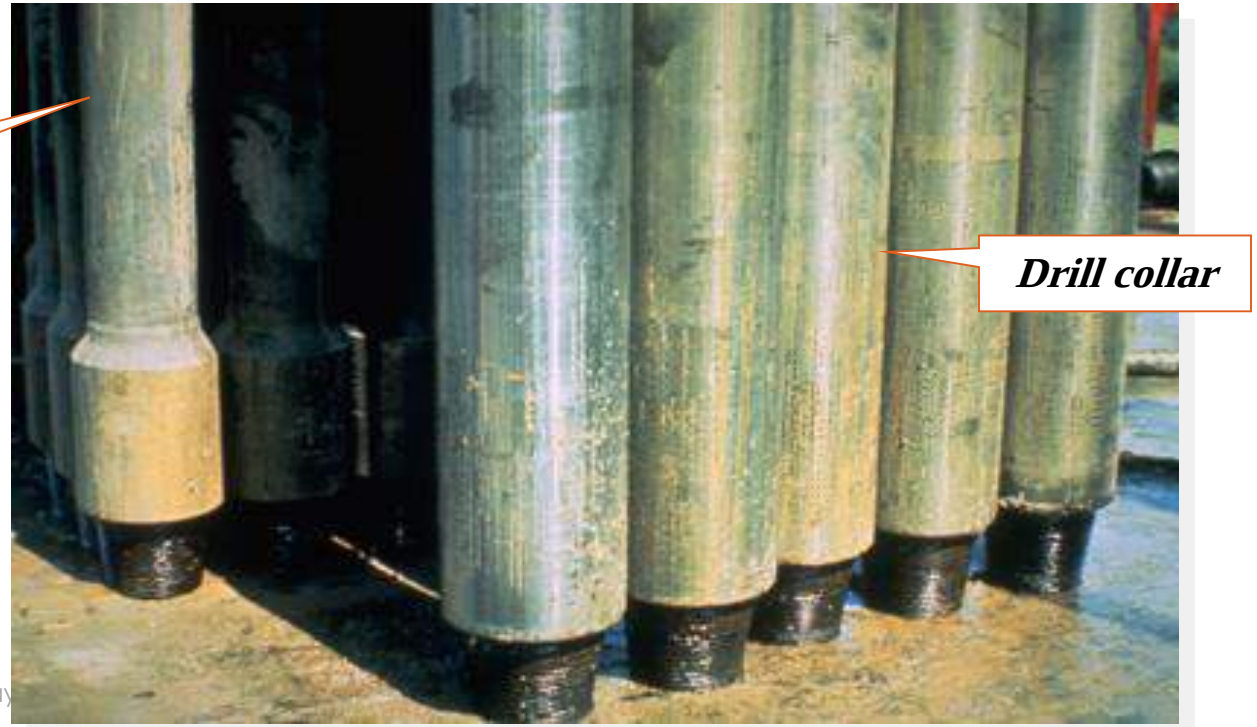


- Drill string

C) Drill Collar

- The heavy, thick-walled tube steel, used between the drill pipe and the bit in the drill stem to provide pendulum effect to the drill stem and to provide weight on bit.





An 8" OD drill collar weighs 150 lbs/ft or 4500 lbs each

- Drill string

C) Drill Collar

The drill collars have a thick wall, are made out of solid steel bars, rounded externally, bored on the inside and with threaded ends directly on the body, with threading analogous to that used for ordinary pipes.
The drill collars are 9 to 13 m in length and their outside diameter is between 3.125" and 14".
They are also standardized (API), with the most common diameters being 9.50", 8" and 6.50".
Drill collars made of nonmagnetic steel also exist, and are used in directional drilling so as not to influence the sensors that measure
the earth’s magnetic field.
They are manufactured with stainless steels (alloys of K-Monel type) or with chrome-manganese steel alloys.

- Drill string

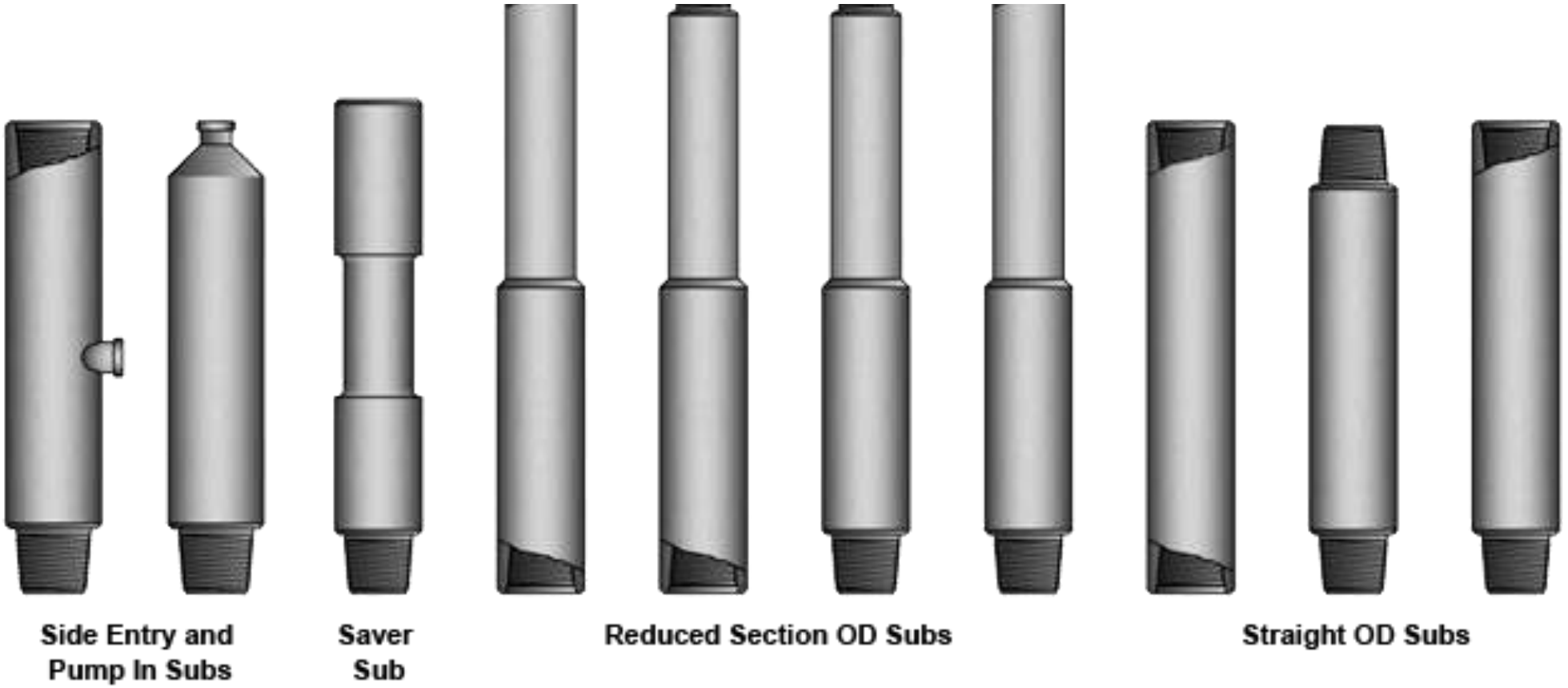
D) Sub

- A short, threaded piece of pipe used to adapt parts of the drilling string that cannot otherwise be screwed together because of difference in thread size or design.
- These consist of:

1. **Bit Sub**
2. **Crossover Sub**
3. **Kelly Saver Sub**
4. **Lifting Sub**
5. **Bent Sub**

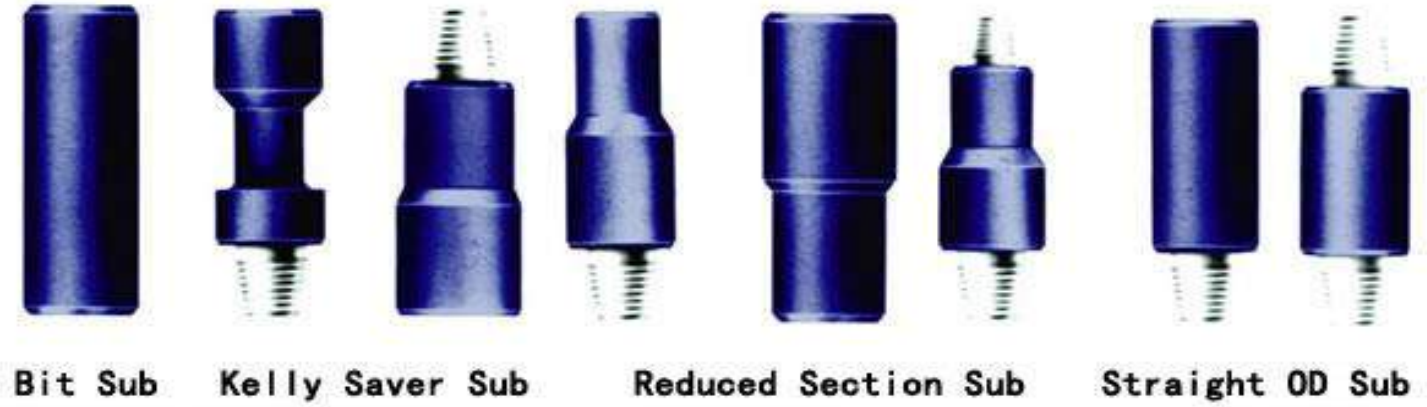
- Drill string

D) Sub



- Drill string

D) Sub



- Drill string

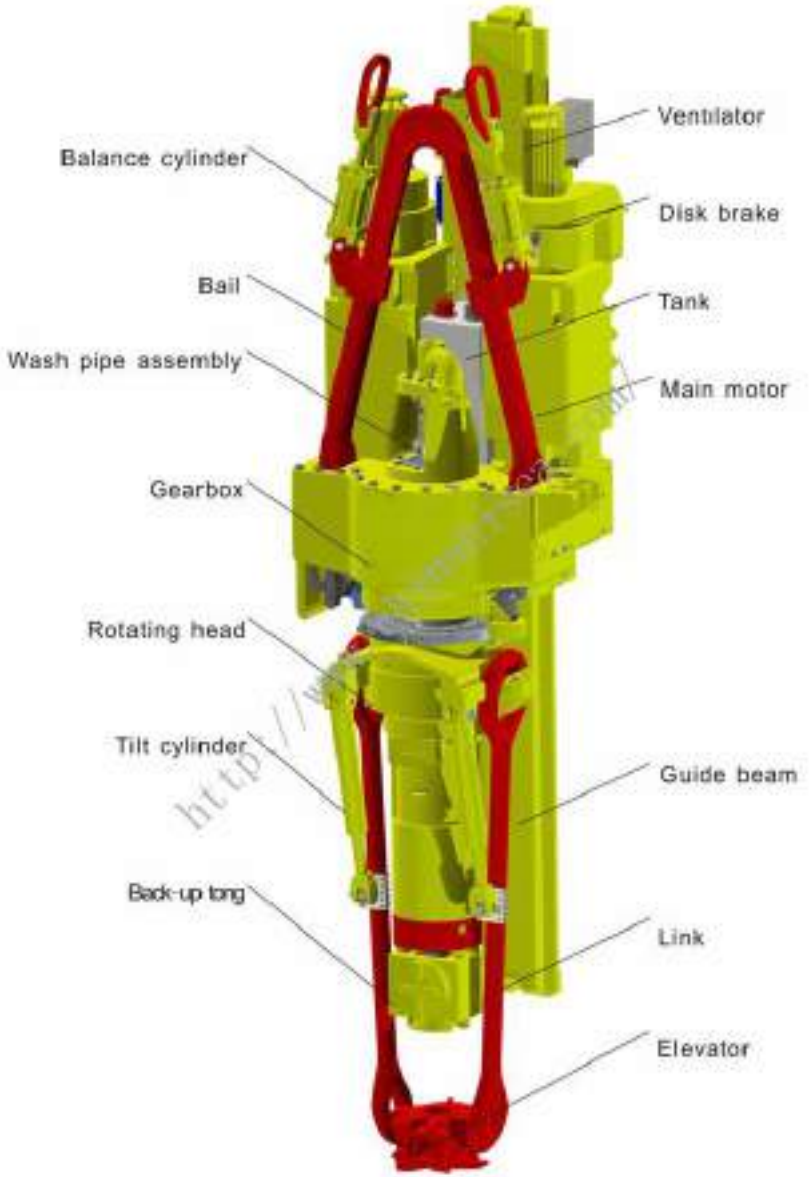
Tubular Handling Equipment

Equipment used to move, make and break connection, suspend tubular on the rig. These include the following:

1. Elevator Links
2. Elevator
3. Lifting Subs
4. Lifting Plug
5. Tugger/Winch
6. Slips
7. Safety Clamp
8. Tongs
9. Kelly Spinner
10. Drillpipe Spinner
11. Iron Roughneck
12. Bit Breaker

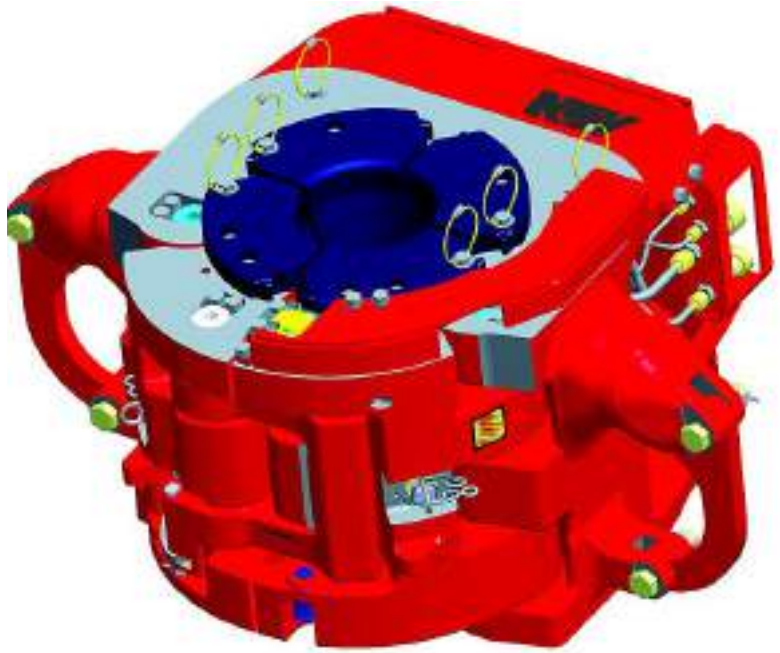
1. Elevator Links

Equipment attached onto the Traveling Block in order to suspend the Elevators.



2. Elevator

Clamps that grip a stand of casing, tubing, drillpipe or drill collars so that the stand or joint can be raised from or lowered into the hole opening of the rotary table.



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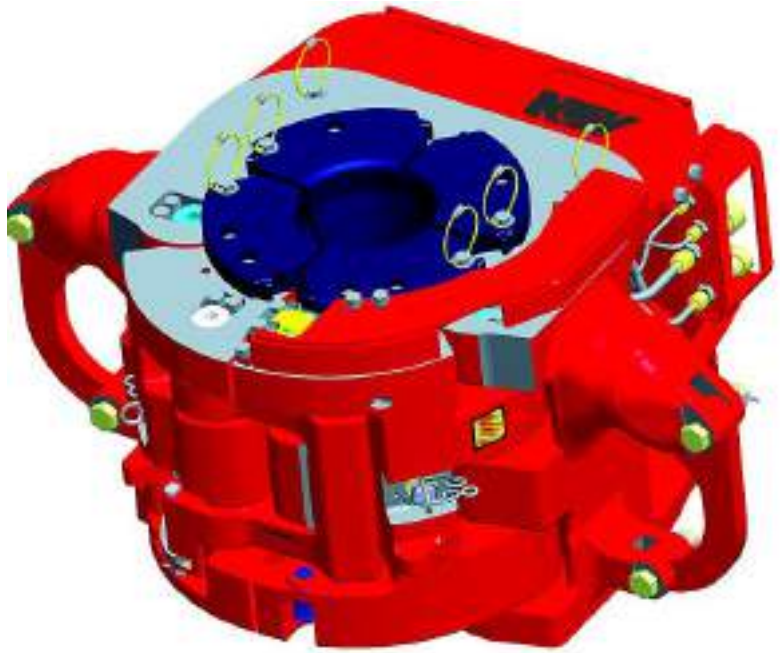
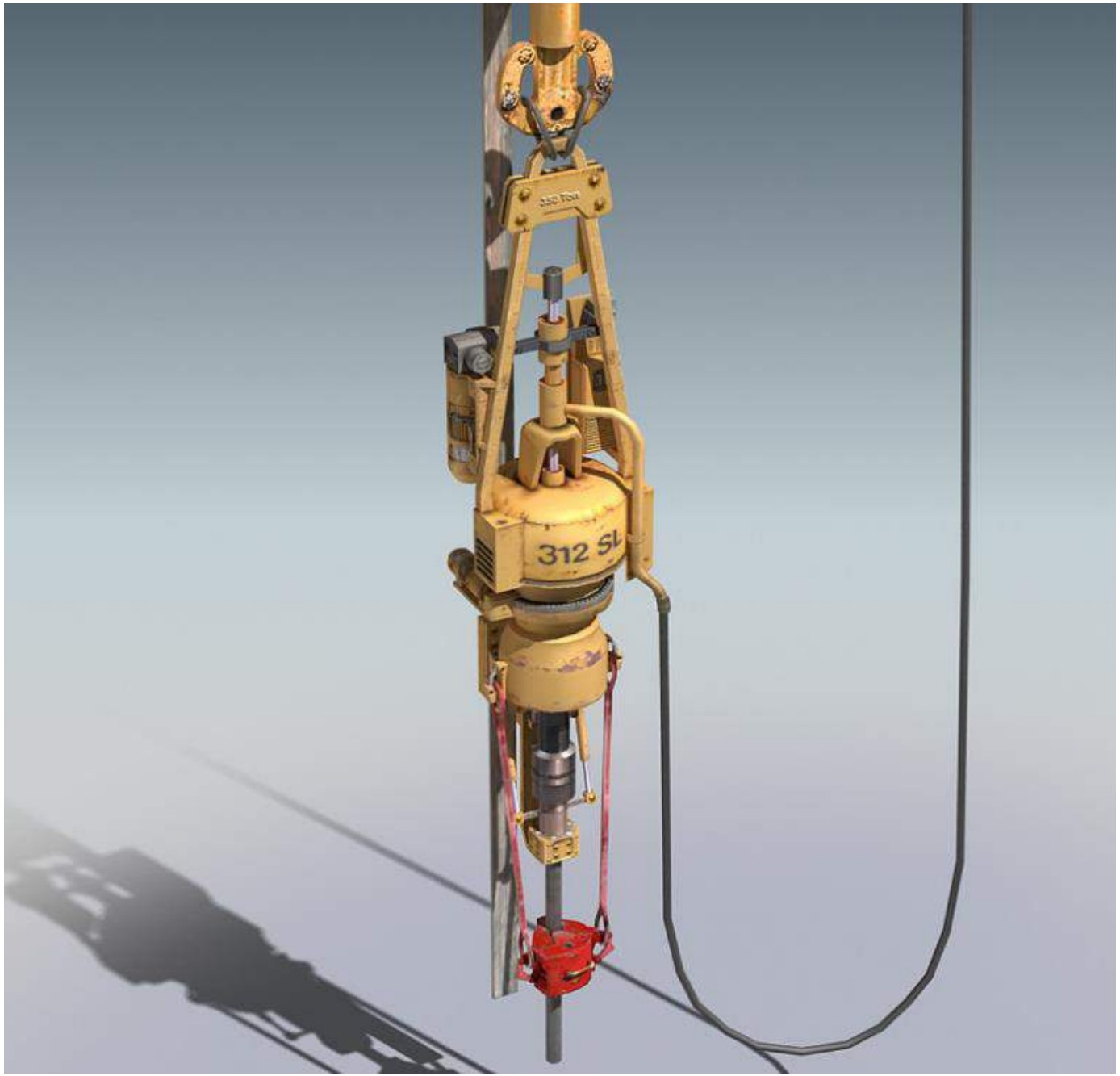



312 SL

2. Slips

Slips for hanging the string on rotary table:
A, drill pipe suspended inside the rotary table; B, close-up of pipe-slips

2. Slips

Drill collar Slips

Drill Pipe Slips

2. Slips

Casing slips

3. Safety clamp

The are used on tubular above the slips to prevent dropping the string should the slips fail to hold.

3. Safety clamp

The are used on tubular above the slips to prevent dropping the string should the slips fail to hold.

4. Rig tong

Used to make up and brake down drill string.

Make up Tong

Breakout Tong

4. Rig tong

Used to make up and brake down drill string.

5. Drillpipe Spinner

A pneumatically operated device usually suspended on the rig floor used to make fast connections and spin off of drill pipes.

5. Drillpipe Spinner

A pneumatically operated device usually suspended on the rig floor used to make fast connections and spin off of drill pipes.

6. Bit breaker

A device that is placed on top of the rotary table to enable the bit to be made up to drill string.

4. Mud Circulation System

Rig components

Eng. Elsayed Amer

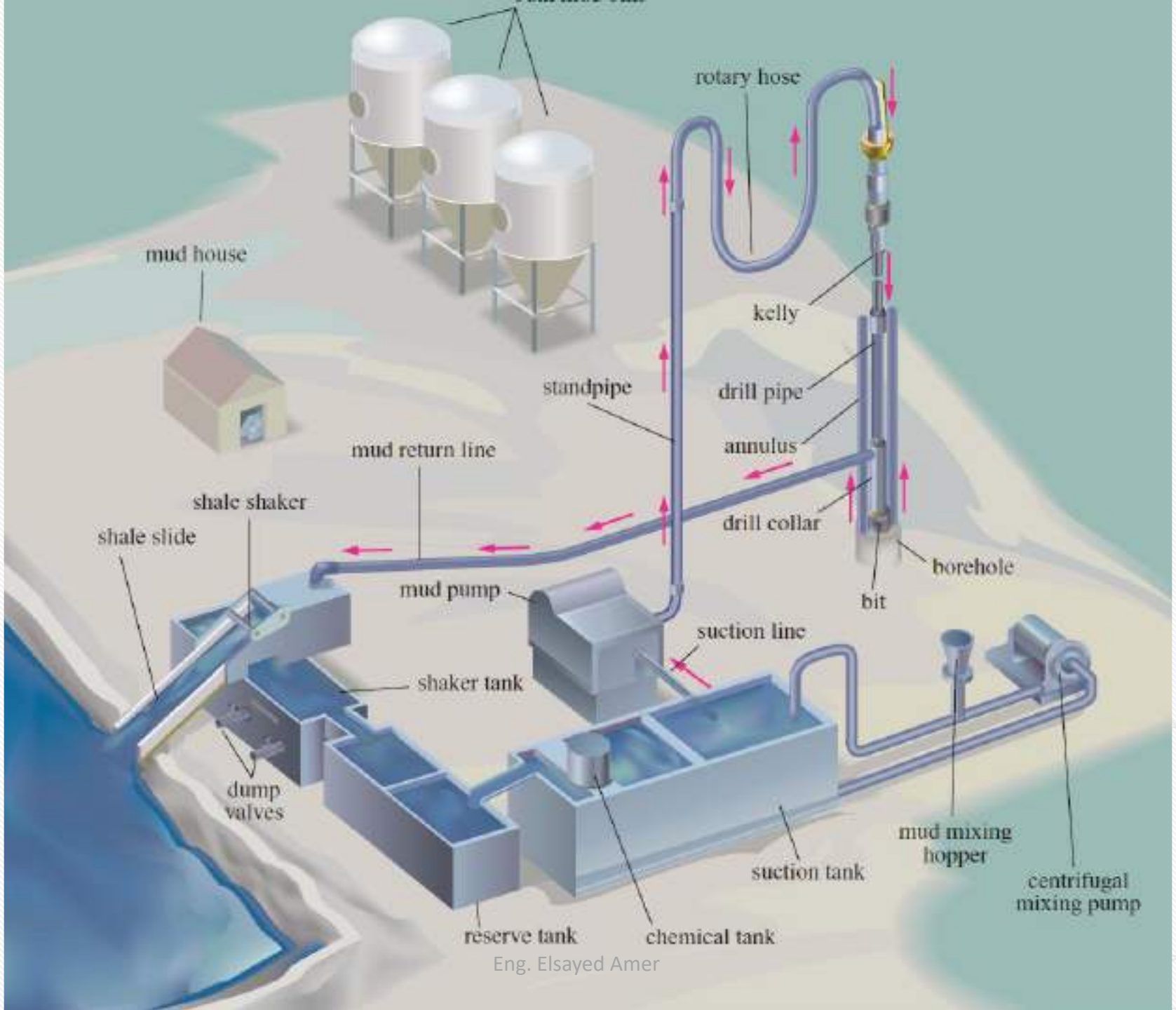
3. Mud Circulation System

Function

A major function of the fluid circulating system is to remove the rock cuttings from the hole as the drilling progresses

Principal Components:

1. Mud Pump
2. Pump Manifold
3. Standpipe
4. Swivel
5. Drillstring
6. Annulus
7. Return Line
8. Shale Shaker
9. Desander
10. Desilter
11. Degasser
12. Mud Pit


rotary hose
mud house
kelly
standpipe
drill pipe
annulus
mud return line
shale shaker
shale slide
drill collar
borehole
mud pump
bit
suction line
shaker tank
dump valves
mud mixing hopper
suction tank
centrifugal mixing pump
reserve tank
chemical tank

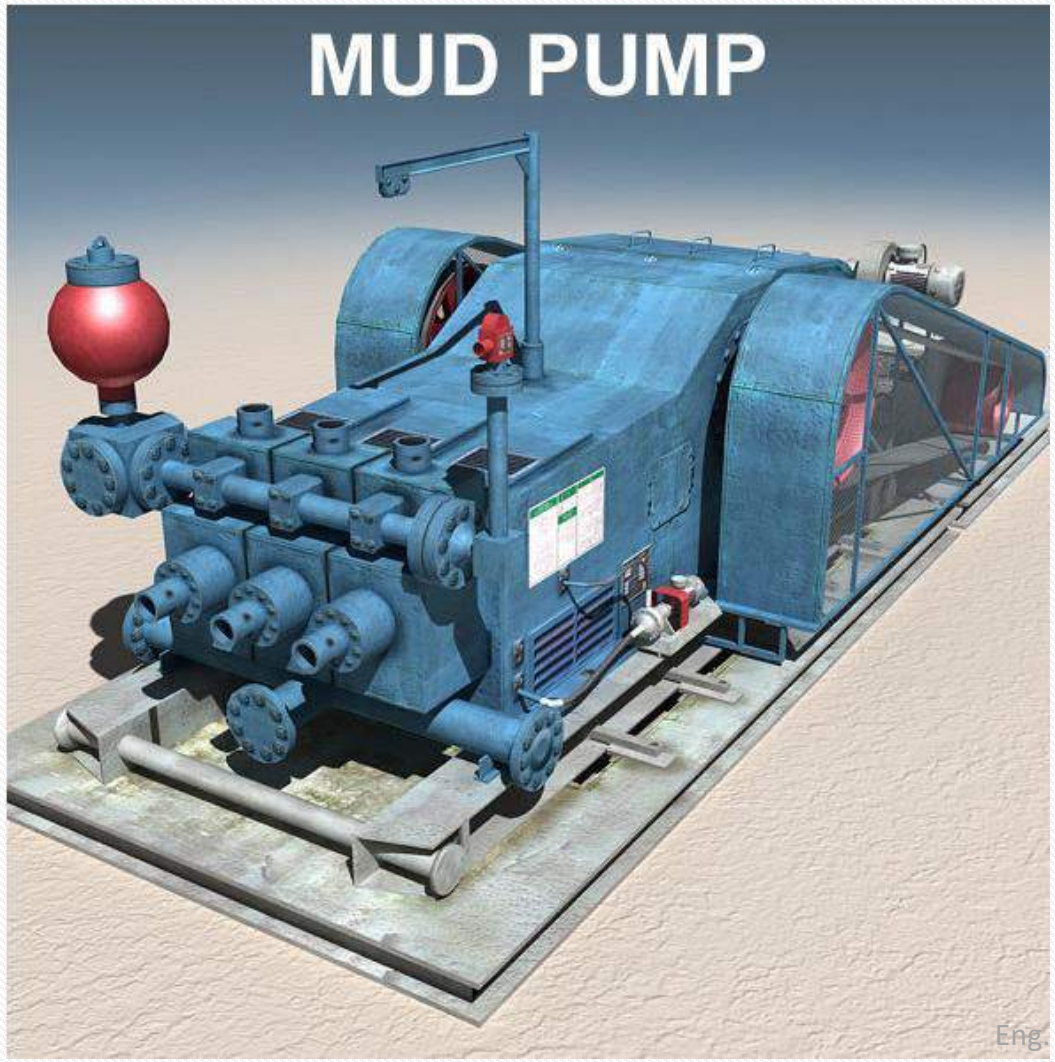
4. Mud Circulation System

1. Mud pumps

- A large, high-pressure reciprocating pump used to circulated the mud on a drilling rig.
- with 2 or 3 pistons (duplex or triplex pumps), may be single – or dual acting, and receive their power from an electric motor independent from other uses.

4. Mud Circulation System

1. Mud pumps



4. Mud Circulation System

1. Mud pumps


DANGER
HARD HAT
AREA

4. Mud Circulation System

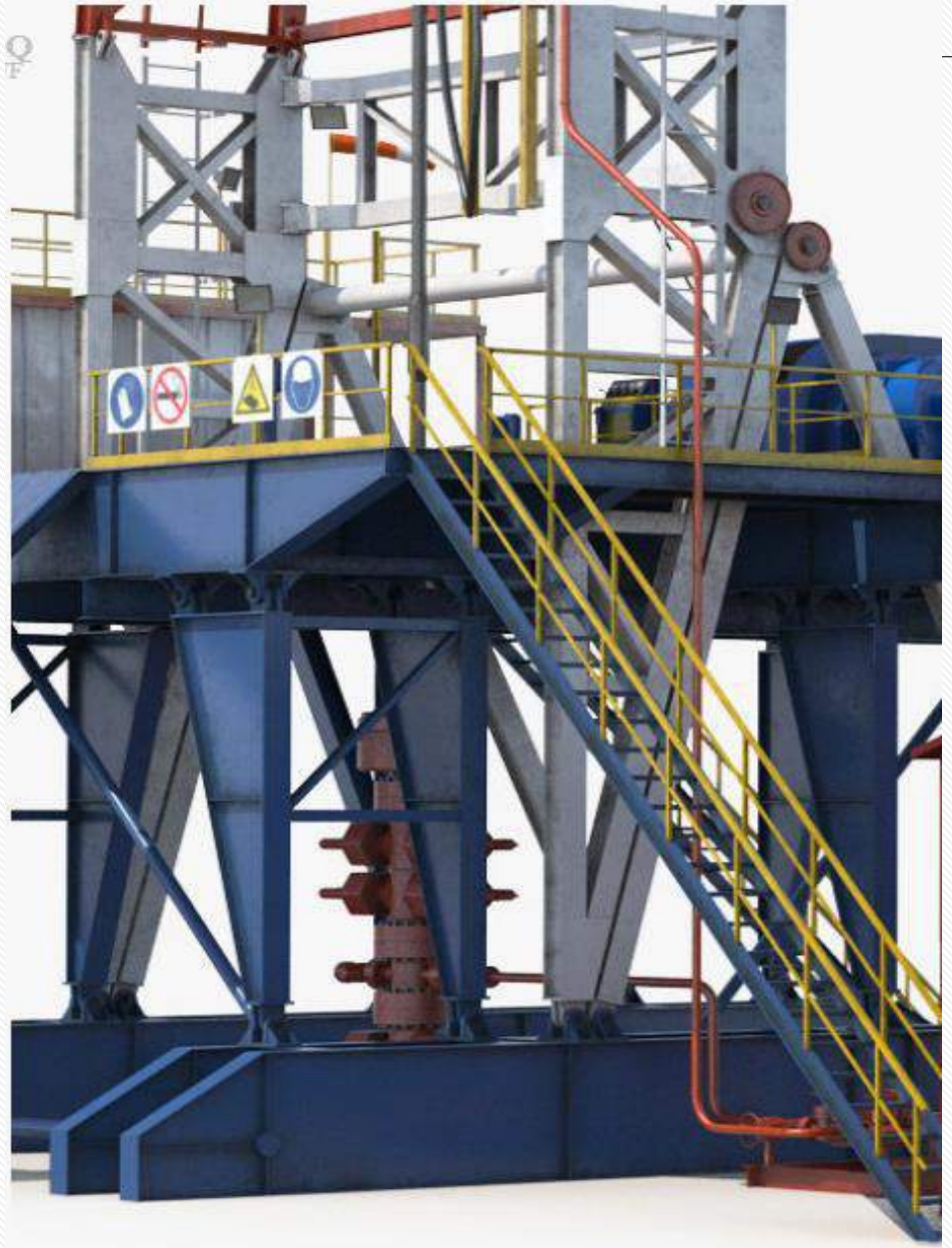
2. Stand pipe manifold

- Divert Mud flow to kill lines in case of kill or lost circulation

4. Mud Circulation System

3. Stand Pipe

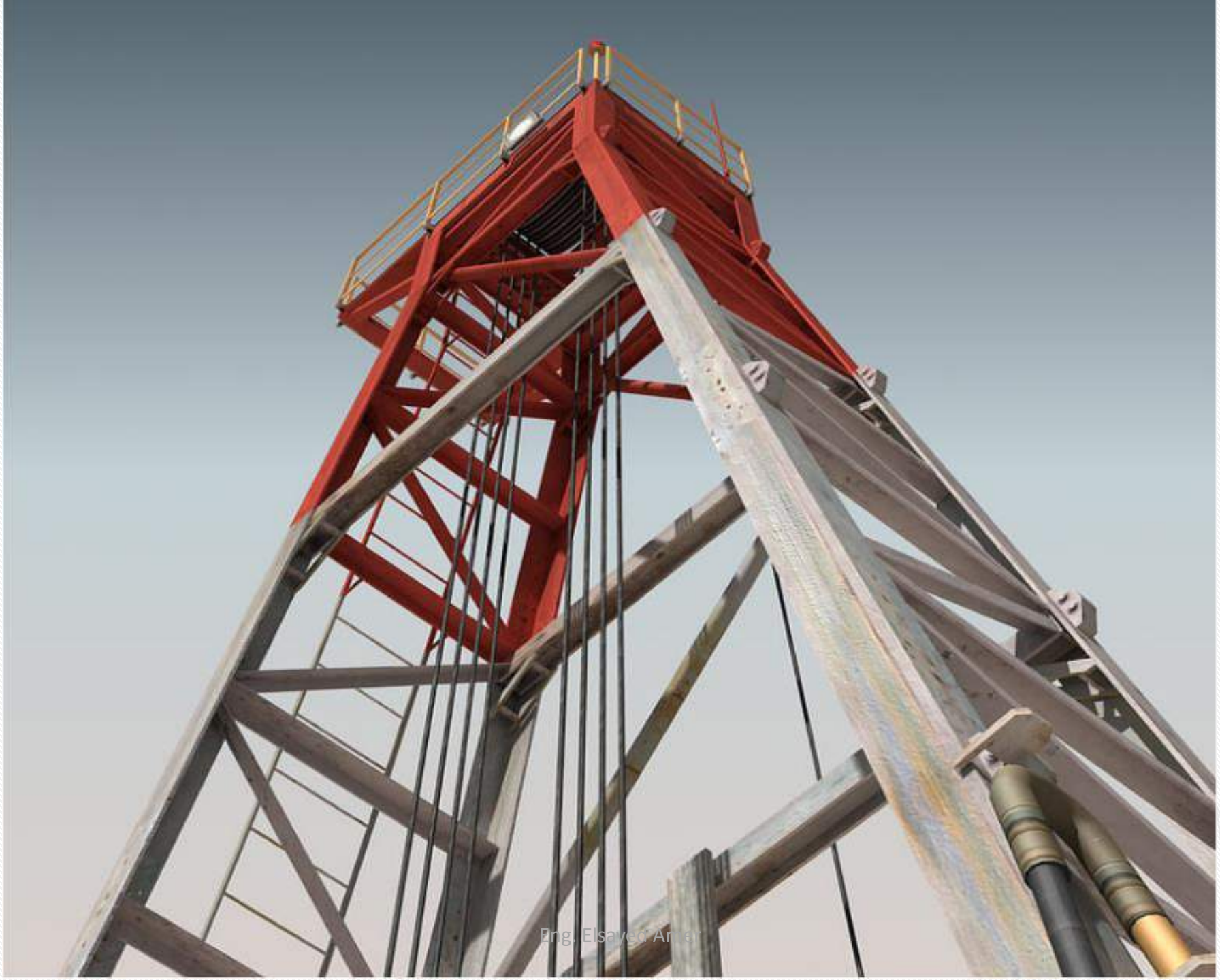
The vertical pipe rising along the side of the Derrick or Mast, which joins mud pump manifold to the rotary hose.



4. Mud Circulation System

6. Rotary hose

- A large-diameter (3- to 5-in. inside diameter), high-pressure flexible line used to connect the standpipe to the swivel. This flexible piping arrangement permits the kelly (and, in turn, the drillstring and bit) to be raised or lowered while drilling fluid is pumped through the drillstring. The simultaneous lowering of the drillstring while pumping fluid is critical to the drilling operation.


Eng. Elsayed Anwar

4. Mud Circulation System

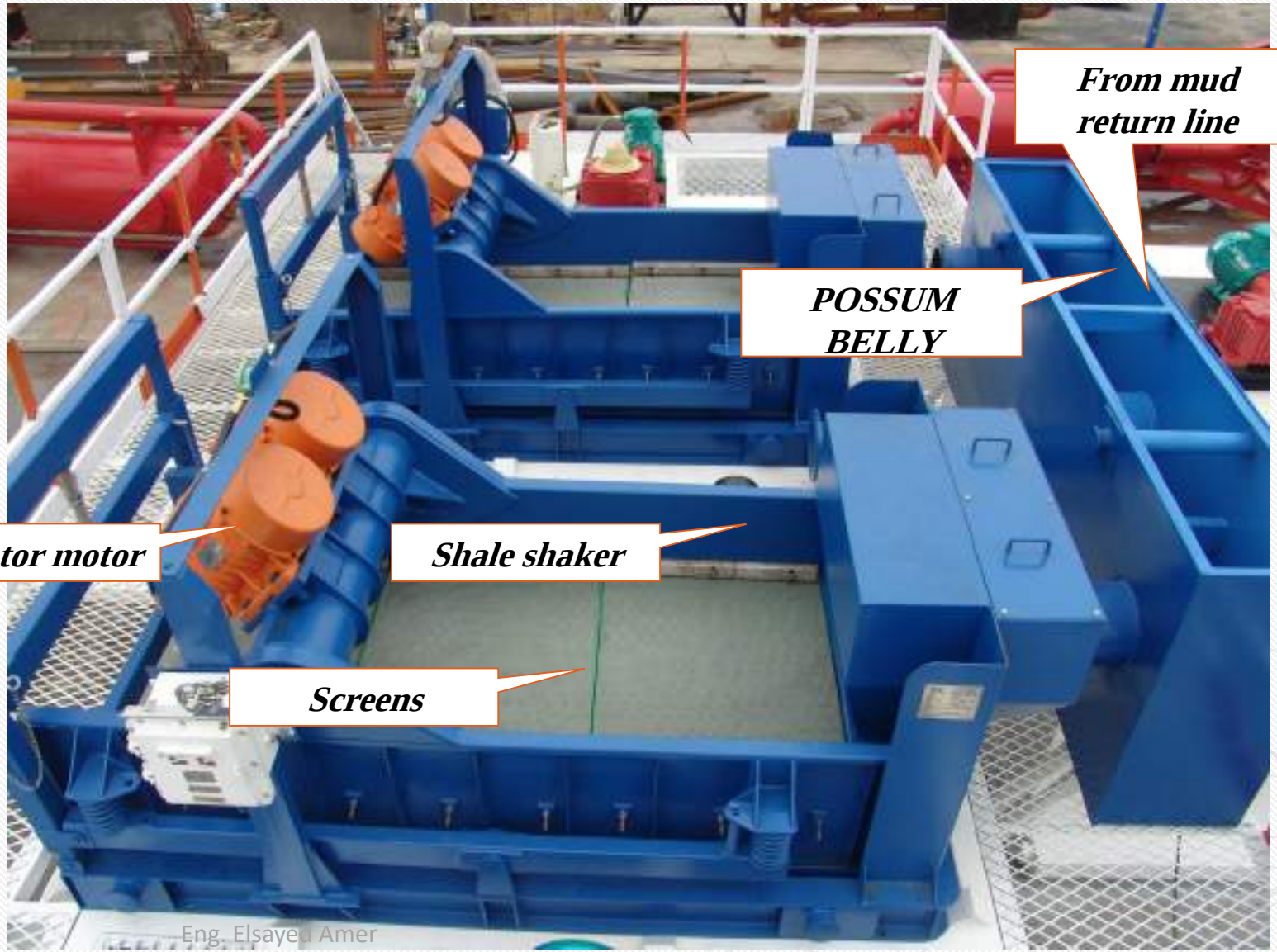
7. Mud return

The passageway of the drilling fluid as it comes out of the well.

4. Mud Circulation System

8. Shale Shaker

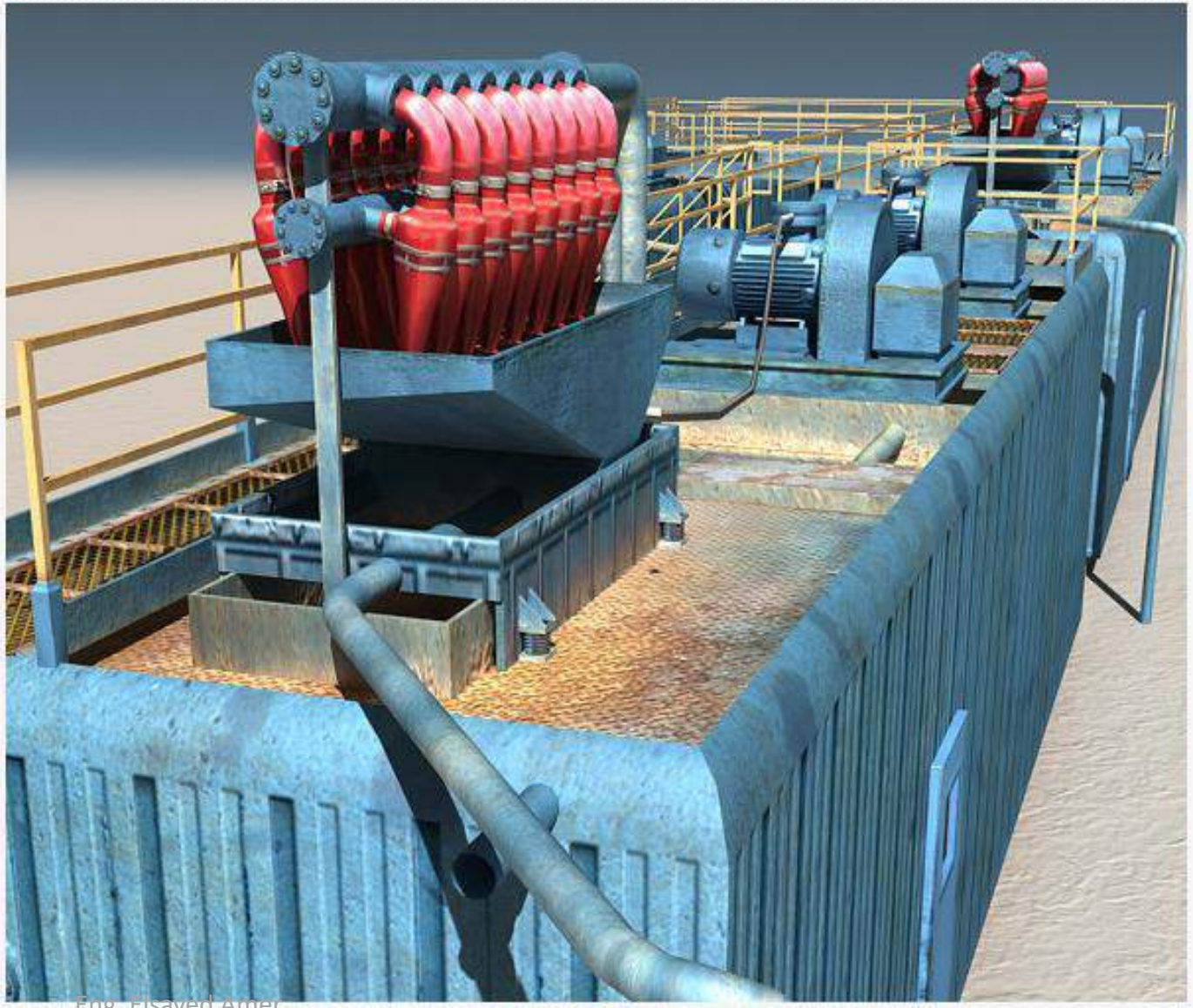
An equipment the uses a vibrating screen to remove cuttings from the circulating fluid in rotary drilling operations.



4. Mud Circulation System

9. Desander

A centrifugal device for removing sand from the drilling fluid to prevent abrasion of the pumps.

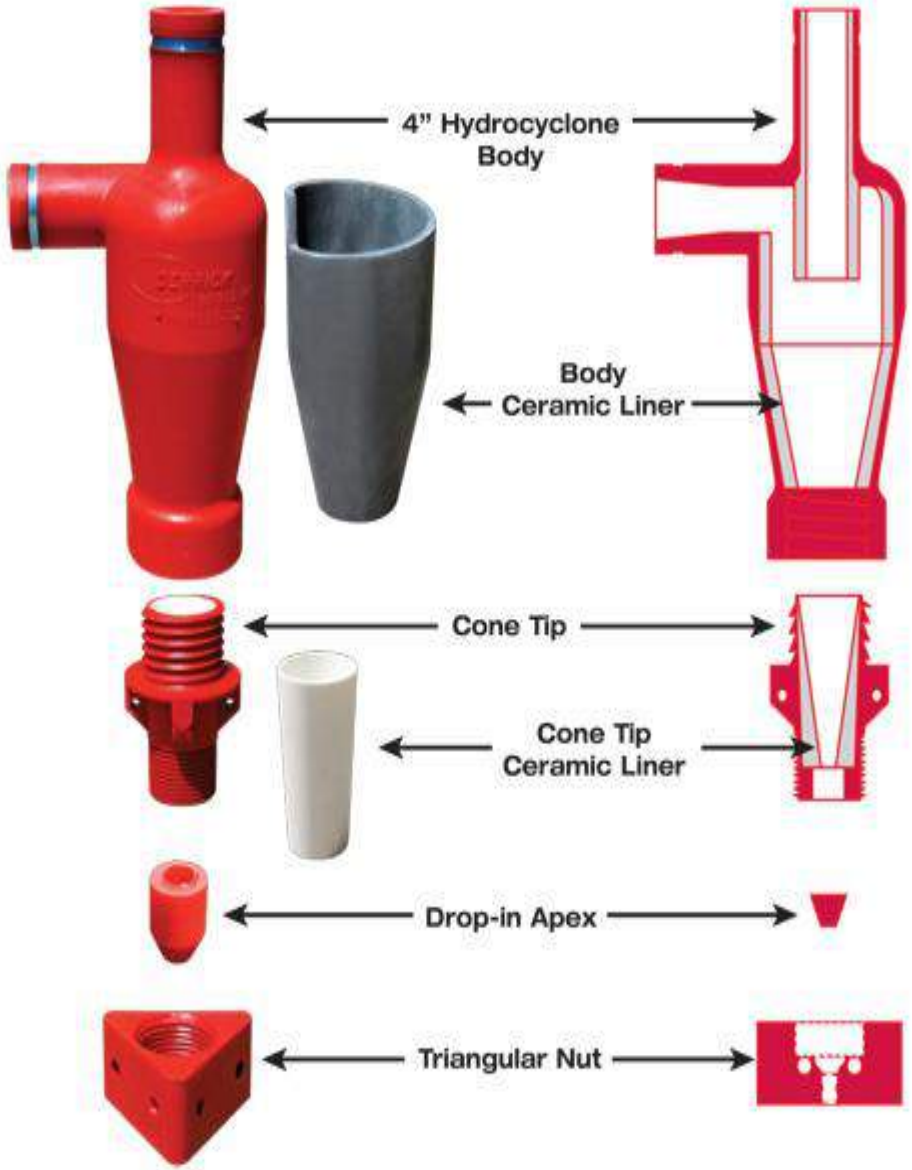


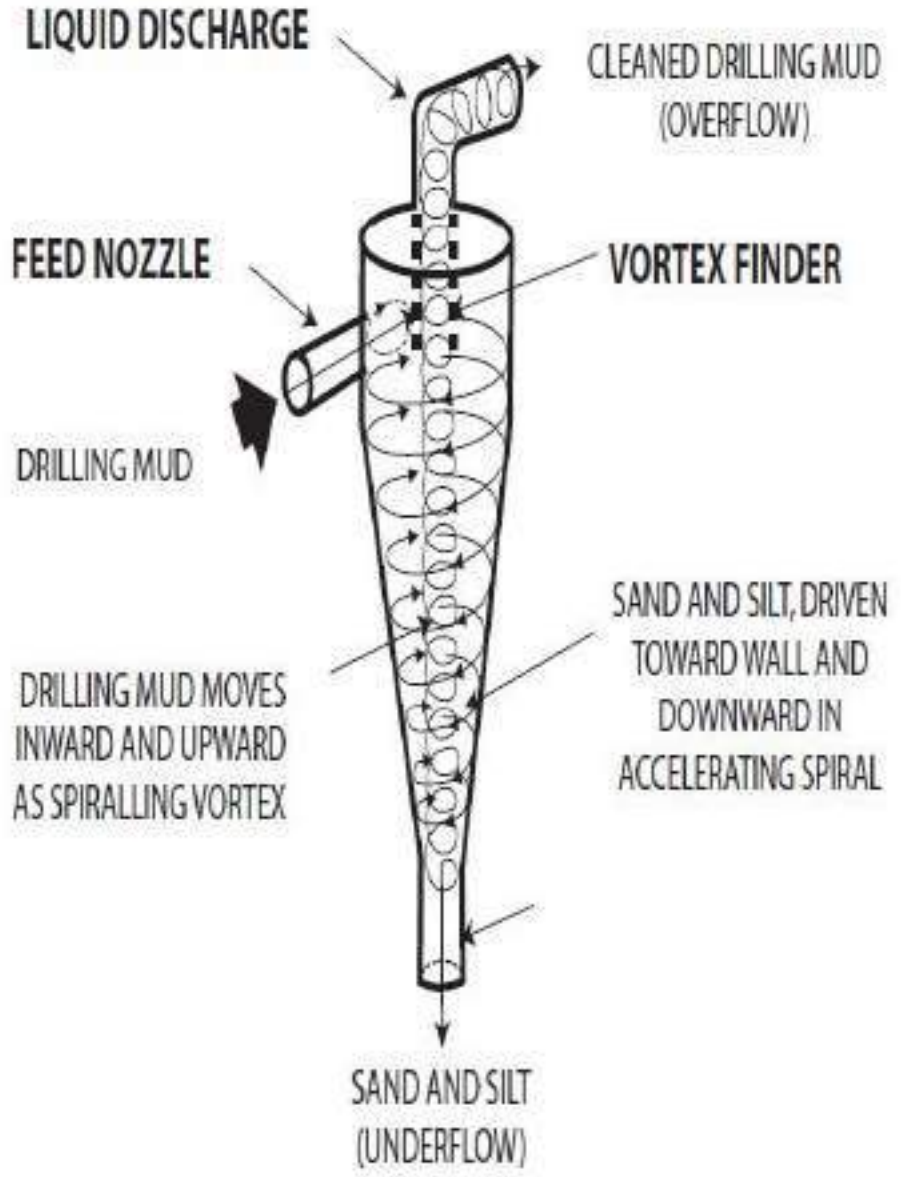
4. Mud Circulation System

10. Desilter

Also a centrifugal device for removing free particles of silt from the drilling fluid to keep the amount of solids in the fluid at the lowest possible point.

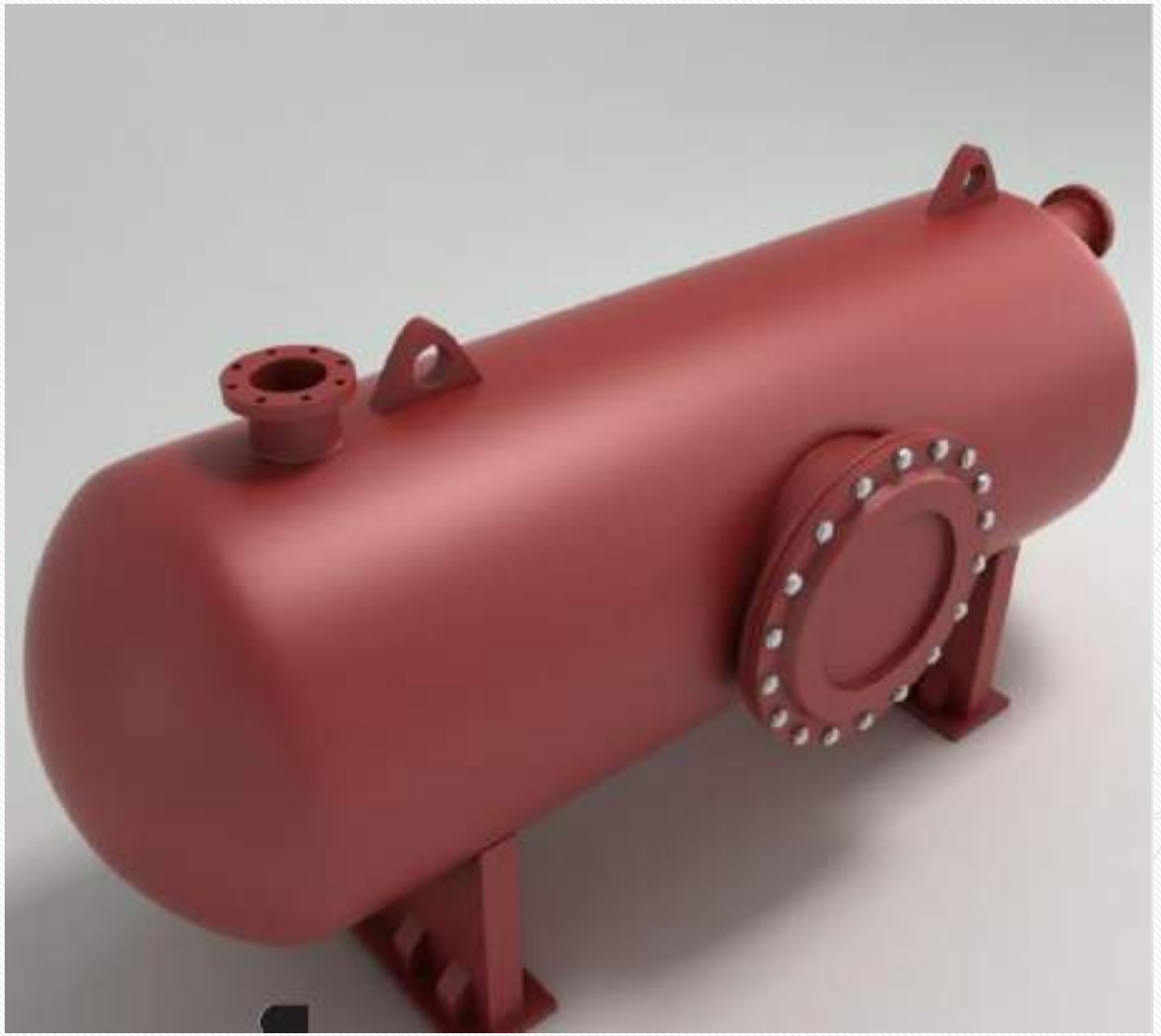

Eng. Elsayed Amer


4" Hydrocyclone Body
Body Ceramic Liner
Cone Tip
Cone Tip Ceramic Liner
Drop-in Apex
Triangular Nut


LIQUID DISCHARGE
CLEANED DRILLING MUD (OVERFLOW)
FEED NOZZLE
VORTEX FINDER
DRILLING MUD
DRILLING MUD MOVES INWARD AND UPWARD AS SPIRALLING VORTEX
SAND AND SILT, DRIVEN TOWARD WALL AND DOWNWARD IN ACCELERATING SPIRAL
SAND AND SILT (UNDERFLOW)

4. Mud Circulation System

10. Degasser



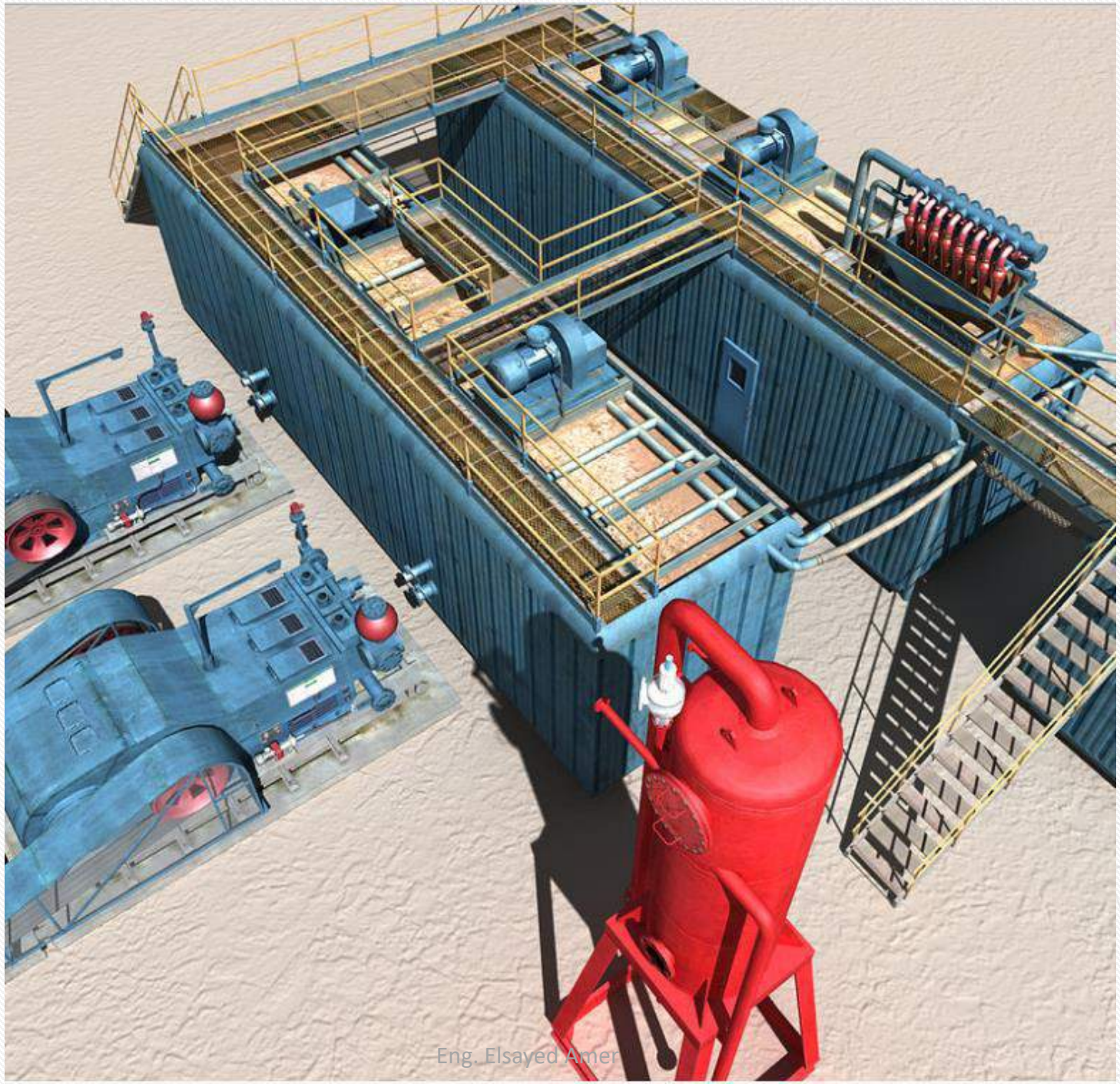
4. Mud Circulation System

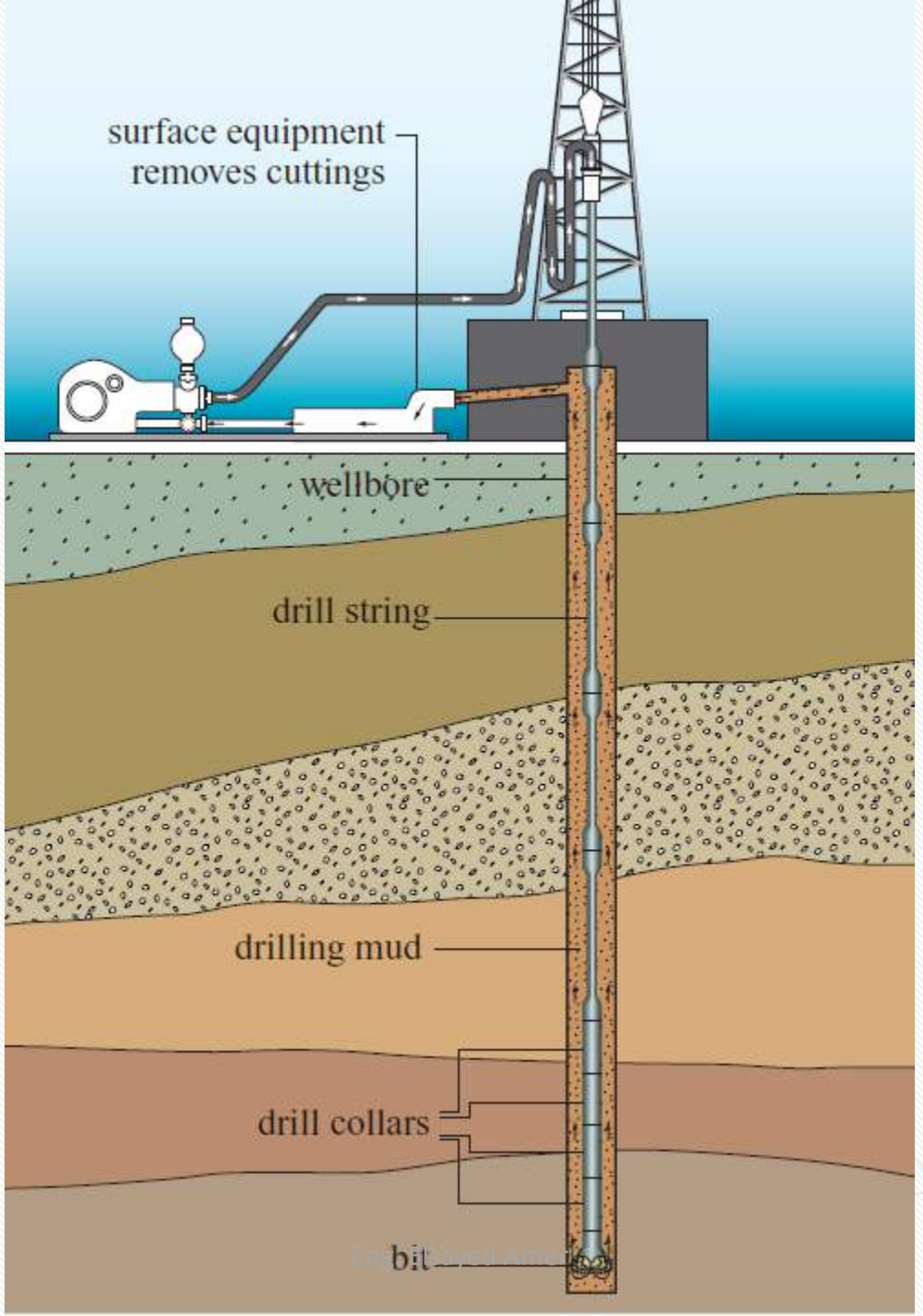
11. Mud Gas Separator

4. Mud Circulation System

12.Reserve Pit

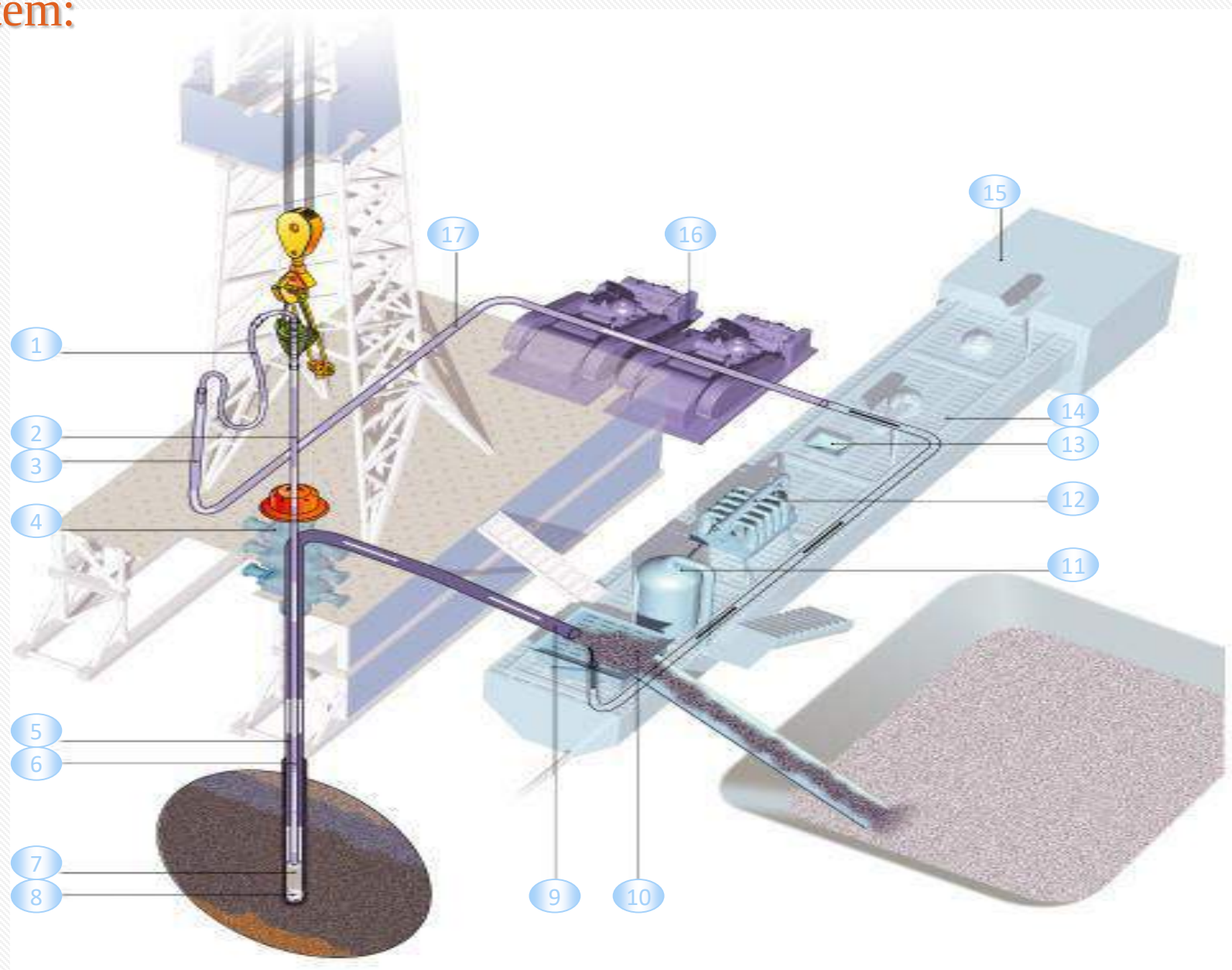
A waste pit, usually an excavated earthen-walled pit.


Eng. Elsayed Amer

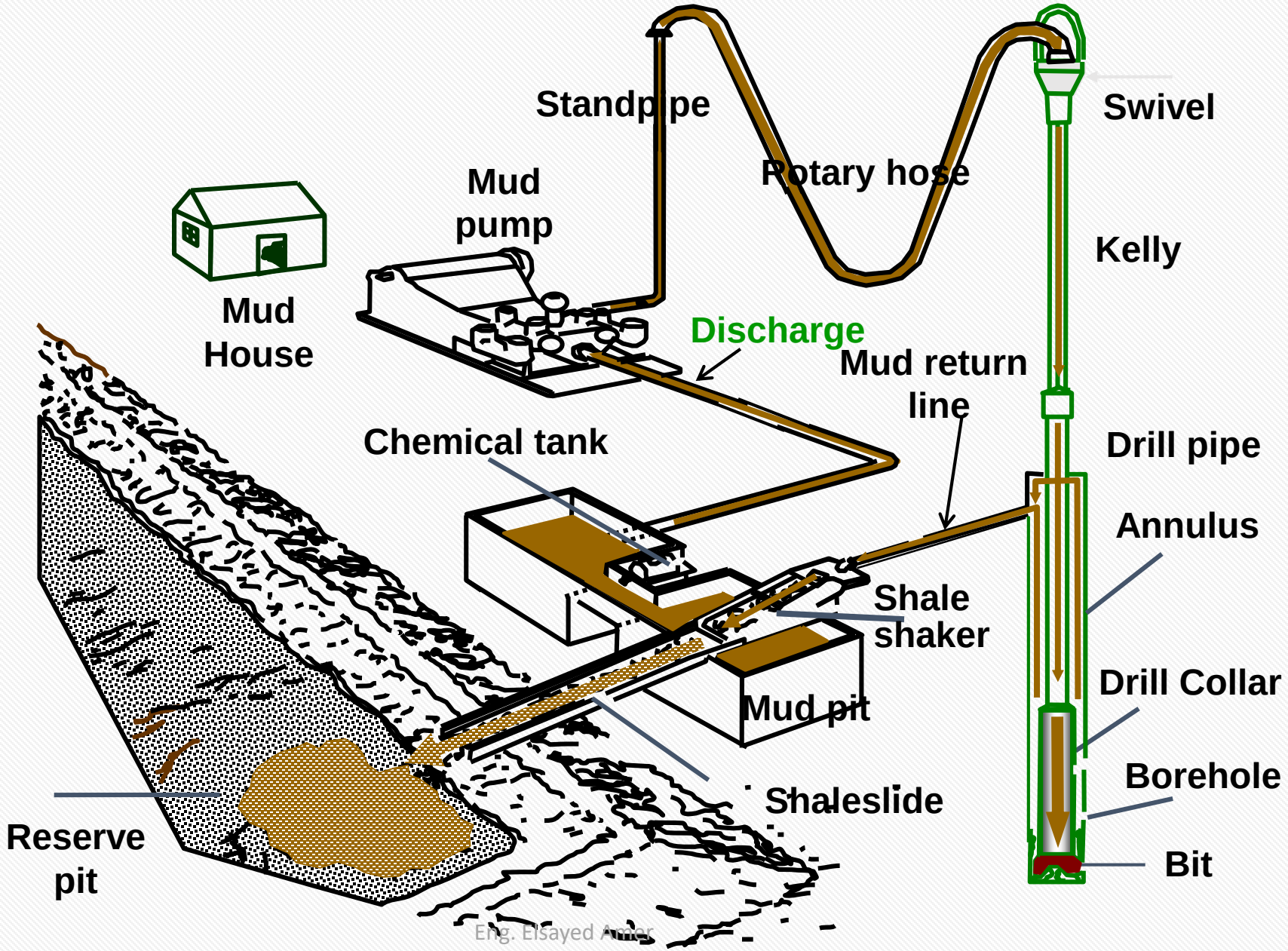

surface equipment
removes cuttings
wellbore
drill string
drilling mud
drill collars
bit

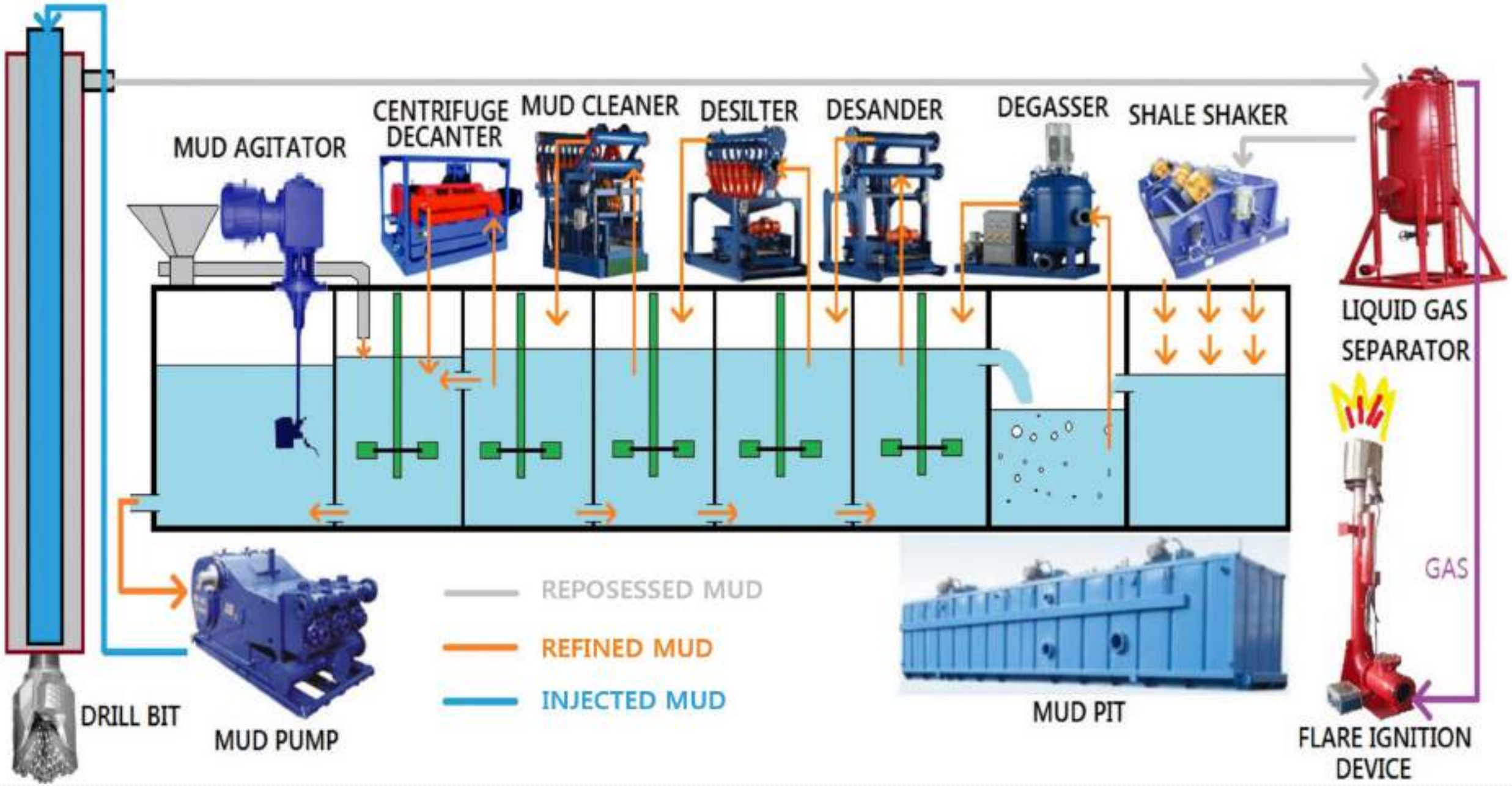
Mud Circulating System:

1. Hose
2. Kelly
3. Stand pipe
4. BOP
5. Annulus
6. Drillpipes
7. Drill collars
8. Drill bit
9. Return line
10. Shale shaker
11. Seprator
12. Desilter
13. Mud mixer
14. Mud tanks
15. Mud-mixing Shake
16. Mud pumps
17. Discharge line



Circulation System




MUD AGITATOR
CENTRIFUGE DECANTER
MUD CLEANER
DESILTER
DESANDER
DEGASSER
SHALE SHAKER
LIQUID GAS SEPARATOR
GAS
DRILL BIT
MUD PUMP
REPOSESSED MUD
REFINED MUD
INJECTED MUD
MUD PIT
FLARE IGNITION DEVICE

5. Power system

Rig components

Eng. Elsayed Amer

5. Power system

Rig component

- In a drilling site power is needed to run the machines driving the main components of the rig, such as the drawworks, the pumps, the rotary table and the engines of the various auxiliary facilities (compressed air, safety systems, centrifugal pumps, lighting, services, etc.)

- Internal combustion engine or a turbine that is the source of power for driving equipment on the Rig.

5. Power system

Rig component

SCR

- **Power and electrical control room**

5. Power system

Rig component

Diesel Tank

- Fuel tank for generator

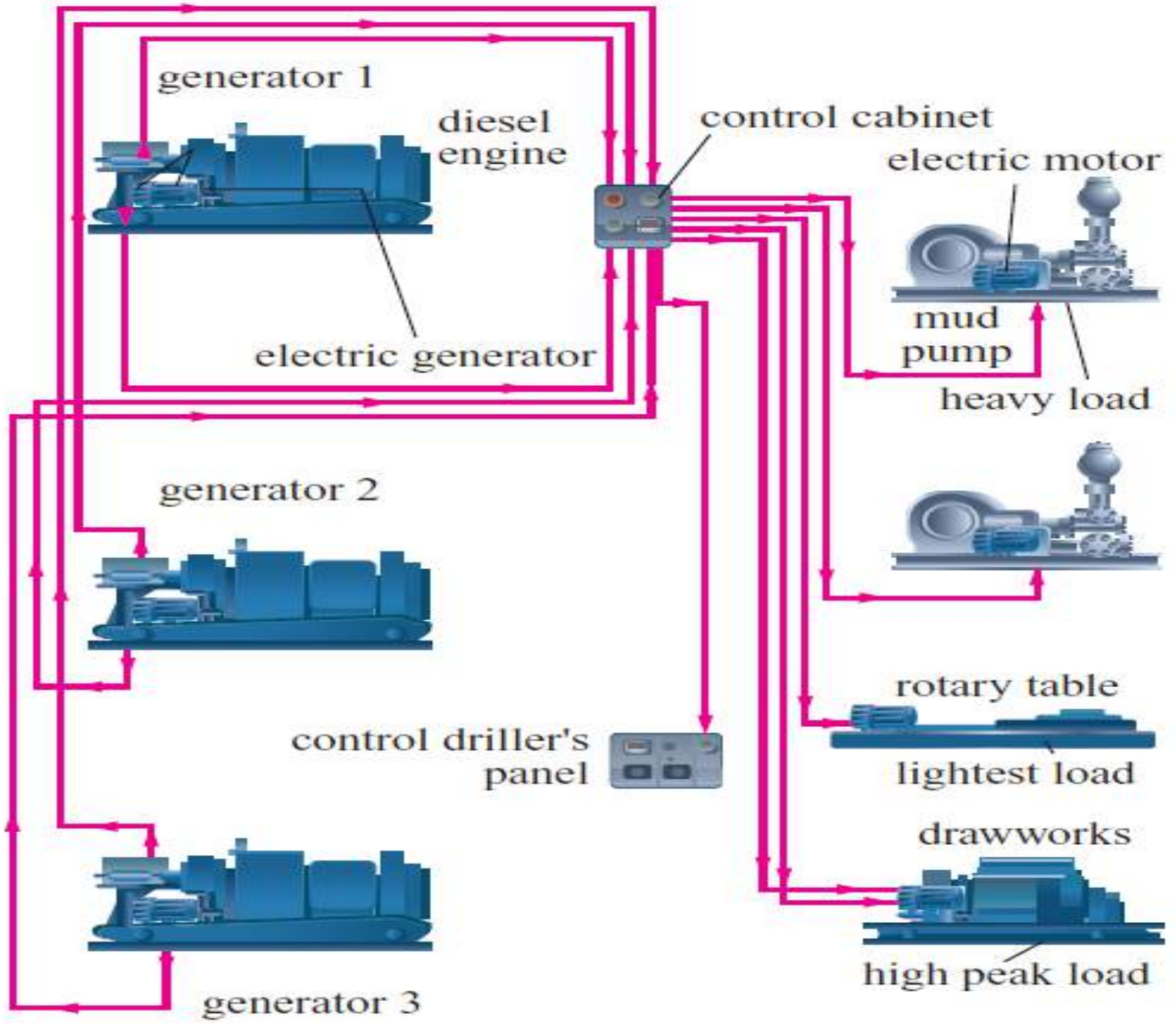


Fig. 10. Power generation and distribution system in an AC-DC plant.

6.Blowout Prevention System

Rig components

Eng. Elsayed Amer

6. 6.Blowout Prevention System

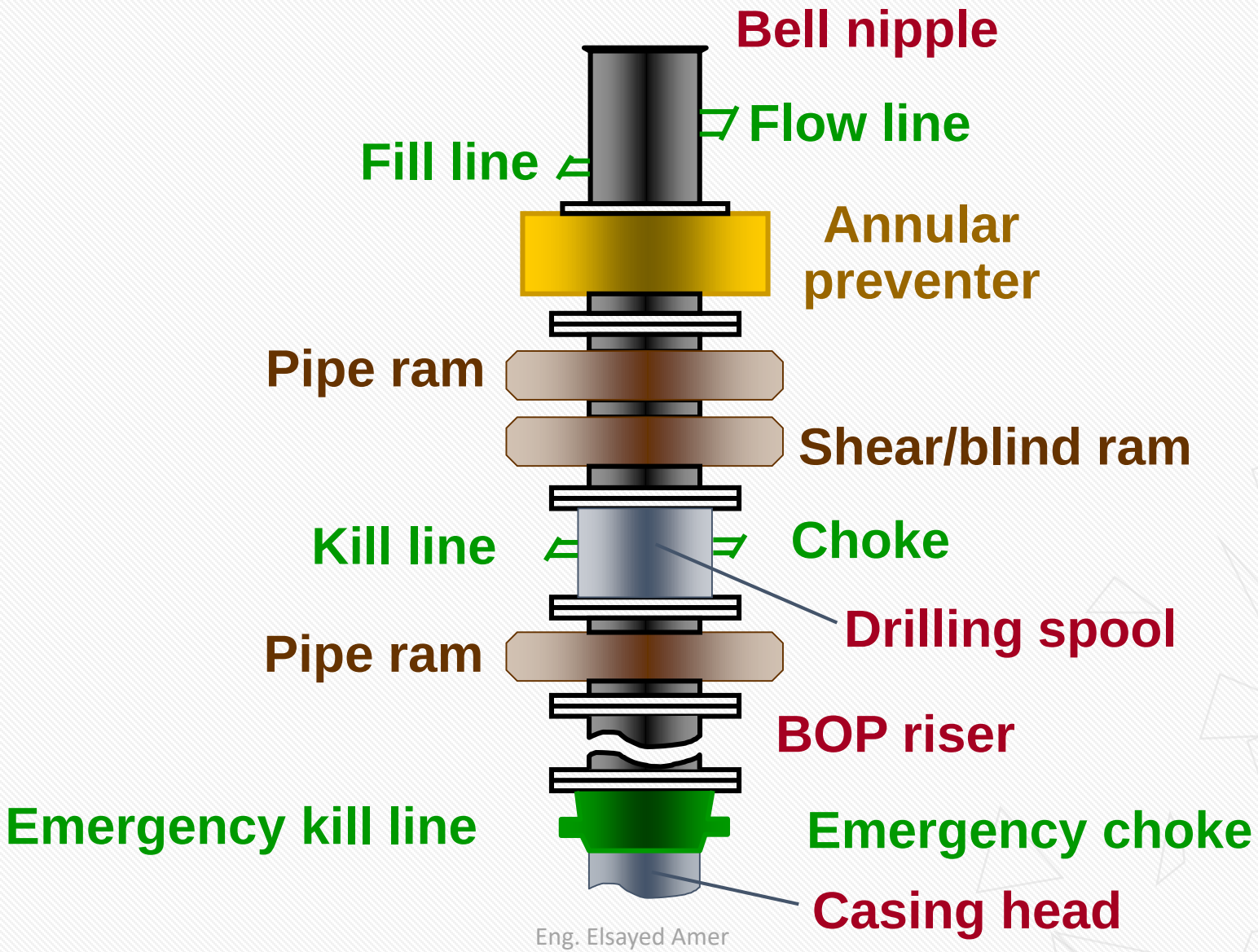
Function

The function of the well control system is to prevent the uncontrolled flow of formation fluids from the wellbore .

Principal Components:

1. Annular Blowout Preventer
2. Ram Blowout Preventer
3. Diverter
4. Drilling Spools
5. Manifold, Valves and Sensors
6. Accumulator
7. Inside BOP

BOP


Bell nipple
Flow line
Fill line
Annular preventer
Pipe ram
Shear/blind ram
Kill line
Choke
Drilling spool
Pipe ram
BOP riser
Emergency kill line
Emergency choke
Casing head

6. BOP

Rig component

BOP

- Blow Out Preventers (BOPs), are large valves located on the wellhead during drilling operations ,able to fully shut-in the well in just a few tens of seconds, whatever the working conditions.
- BOP stack consists, starting from below, of:

1. one or more spools for connection to the wellhead
2. a dual function ram preventer
3. a single-function ram preventer
4. an annular blowout preventer
5. a lateral tube which conveys the outgoing mud from the well to the shaker.

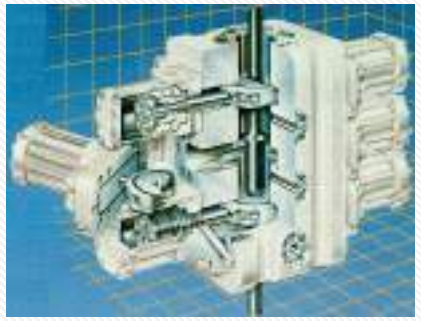
6. BOP

Rig component

BOP

As per ram numbers

- Single
- Double
- Terrible



As per ram shape

- Blind
- Pipe
- Shearing
- Variable

6. BOP

Rig component

2- Choke manifold

- The arrangement of piping and special valves, called chokes, through which drilling mud is circulated when the blowout preventers are closed to control the pressures encountered during a kick.

6. BOP

Rig component

3- accumulator

- The storage device for nitrogen pressurized hydraulic fluid, which is used in operating the blowout preventers.

6. BOP

Rig component

4. Diverter System

- The diverter is a large, low pressure, annular preventer equipped with large bore discharge flowlines. This type of BOP is generally used when drilling at shallow depths below the conductor.

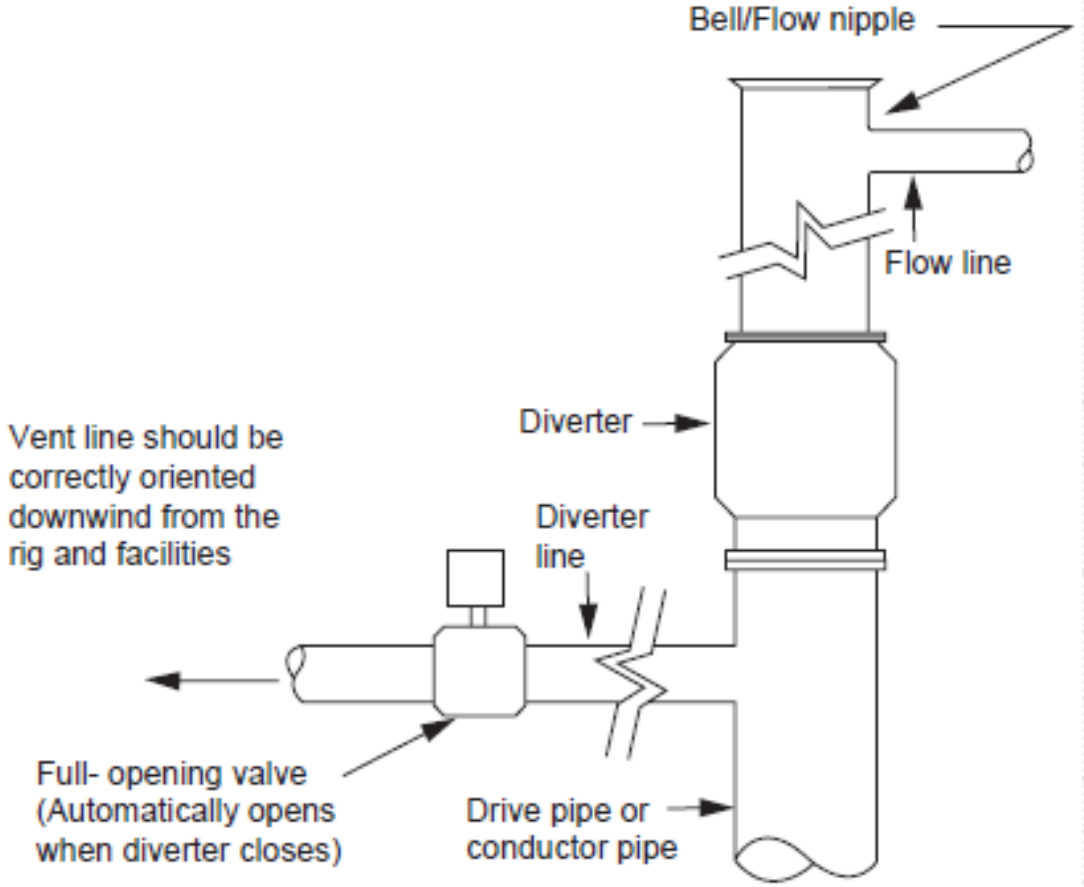
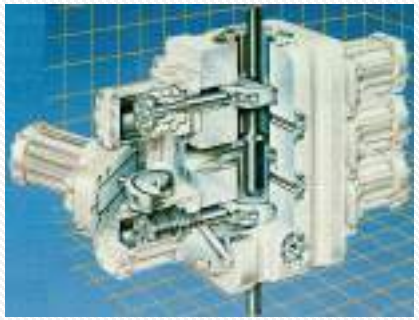


Figure 24 Diverter System

BOP

As per ram numbers

- Single
- Double
- Terrible



As per ram shape

- Blind
- Pipe
- Shearing
- Variable

Sino Tharwa Drilling Company

ST 4

2000 hp drilling rig

Rated Drilling Depth

20,000 ft. with 5” drill pipe.

Derrick

Static load capacity 1,000,000 lb
Height 149 ft

Draw Works

2000 hp
drilling line 1 1/2”

Hook load

Rated capacity 1,000,000 lb

Rotary Table

Max. Opening 37-1/2”
Height 29.5 ft

Mud Pumps

Two Triplex
1600 hp Rated input power
5000 psi working pressure

Mud Tanks

Total number 6 tanks
Total capacity 2250 bbl

Power Supply

3 ea. Engine Cat 3512 B

Well Control Equipment

- 21 ¼” x 2000 psi diverter system
- 13 5/8” annular preventer 5000 psi.
- 13 5/8” double ram preventer 10000 psi.
- 13 5/8” single ram preventer 10000 psi
- Accumulator unit 3000 psi working pressure with 210 gallon capacity & 20 bottle installed

Safety Equipment

As required by regulations

Camp

To accommodate 80 person

Drilling Time & Cost Impact

Original Design Cost Benefit						
	Section Lengths	Time Savings (Days)	Dayrate Cost ($70k / day)	Casing Cost	Cement Cost	Total Cost
26" Hole	1500	Base Case	$ -	$ 81,000.00	$ 41,000.00	$ 122,000.00
16" Hole	6445	Base Case	$ -	$ 278,075.00	$ 118,000.00	$ 396,075.00
14" Hole	4740	Base Case	$ -	$ 378,000.00	$ 110,000.00	$ 488,000.00
12 1/4" Hole	2315	Base Case	$ -	$ 465,000.00	$ 106,000.00	$ 571,000.00
8 1/2" Hole	3430	Base Case	$ -	$ -	$ -	$ -
Total Depth	18430	Base Case	$ -	$ 1,202,075.00	$ 375,000.00	$1,577,075.00

Revised Design Cost Benefit						
	Section Lengths	Time Savings (Days)	Dayrate Cost ($70k / day)	Casing Cost	Cement Cost	Total Cost
26" Hole	1500	0.00	$0.00	$ 81,000.00	$ 41,000.00	$ 122,000.00
16" Hole	6855	0.57	$39,861.11	$ 292,425.00	$ 125,506.59	$ 457,792.71
14" Hole	4081	(1.83)	($128,138.89)	$ 328,575.00	$ 94,706.75	$ 295,142.86
12 1/4" Hole	2303	(0.03)	($2,333.33)	$ 456,909.00	$ 105,450.54	$ 560,026.21
8 1/2" Hole	3393	(0.10)	($7,194.44)	$ -	$ -	$ (7,194.44)
Total Depth	18132	(1.40)	($97,805.56)	$ 1,158,909.00	$ 366,663.89	$1,427,767.33

Estimated Total Savings =	$149,307.67