PE8601 / WELL DRILLING EQUIPHENT AND OPERATION

Unit - III

Part B & C

1. Explain the Long's method and property measurements:-

Definition

→ In this method, drilling fluid (mud) is applied to pressurize the well until the rock formation fractures.

→ The mud pressure at fracture, known as leak-off pressure, is recorded and then added to the hydrostatic pressure of the mud inside the borehole to determine the total pressure required to fracture the formation.

Applications

* well drilling
* Site investigation
* piling
* Long hole drilling
* horizontal drilling
* Forepoling
* Drifting, Tunneling & Bolting
* Bench drilling and Quarrying
* Anchoring.

→ In top hammer long hole drilling, namely production drilling, the hole length is typically blw 10m up to 40m, and the hole size vary from 51 mm up to 127 mm.

→ The long holes are drilled with extension rods. The rods can be either male-male type with separate coupling to ensure best hole straightness top hammer drill tubes are used either as whole drillstring or as single guide tube.

→ In underground applications air flushing is used to remove the drilling cutting from the hole.

→ Long hole drilling is used in various mining methods like Sublevel open stoped and VCR Stoping.

→ It is also used in special applications like cable bolting and Slot and Inverse raising.

---

2. Explain about vertical and deviated holes:-

vertical hole:-

→ vertical drilling is used by operators to access oil and natural gas reserves directly below a drilling site.

→ vertical drilling is performed before horizontal occurs so that rock formations at different levels can be examined for potential oil or gas reserves.

→ horizontal wells are then created from the vertical well.

vertical and deviated holes :-

→ vertical well drilling allows access to oil or natural gas reserves directly below the surface. while horizontal drilling allows operators to access reserves over a wider underground areas.

→ vertical drilling can only access reserves directly below the end of a well.

→ To access more of the oil and gas reserves directly below the surface, operators must drill several vertical wells.

→ Before operators begin vertical drilling they must generally estimate which portions of the underground reserves have the most energy ~~reservoir~~ resources.

→ Unconventional sources of oil and gas, such as shale rock, generally cannot be accessed solely through vertical drilling because the reserves span horizontally.

→ A vertical well must be drilled before operators can conduct horizontal drilling, which is used to access larger portions of a reserve with fewer wells.

→ To determine how far a driller must go to access energy intensive reserves, a vertical well is drilled.

→ Geologists then examine the rock fragments at different depths to determine where horizontal drilling should begin.

→ The spot that is determined at a particular depth for drillers to begin horizontal drilling is known as kick off point.

→ Drillers then create a horizontally curved hole to access natural gas within the rock formation.

---

3. Explain about jet hydraulics optimizing and maximizing:-

definitions

→ This method of changing the trajectory of a wellbore requires the use of a jetting bit to wash away the formation. water or drilling mud is pumped through a large jet that is oriented in the direction of the desired trajectory change.

Hydraulic Method:

→ Jetting is a technique best suited to soft medium formation in which the compressive strength is relatively low and hydraulic power can be used to wash away a pocket of the formation to initiate deflection.

→ One is a two-cone bit with an extended jet replacing the third cone and the second one is a conventional three cone bit with two small and one large "big eye" jet.

→ The actual design of the jetting process is a function of hole size, pump capacity, expected formation hardness, and the desired bit cleaning efficiency while drilling.

→ Compared to trajectory deflection using a whipstock or downhole motors, jetting is the most approximate method. On any particular run, the bit is mounted on an assembly, which includes an orienting sub and a full-gauge stabilizer near the bit.

→ Once the bit touches the bottom the large nozzle is oriented in the required direction. Maximum circulation rate is used to begin washing without rotating the drillstring.

→ The pipe is worked up and down with continuous jetting, until a pocket is washed away.

Advantages

→ several attempts can be made to initiate deflection without pulling out of the hole.

→ A full gauge hole can be drilled from the beginning.

Disadvantages

→ The technique is limited to soft medium formations.

→ severe dog-legs can occur if the jetting is not carefully controlled.

→ On small rigs there may not be enough pump capacity to wash away the formation.

---

4. Explain briefly about the advantages and disadvantages of oil based drilling muds:-

Definition :-

→ Opposite to water-base muds where water is the continuous phase, at oil-base mud systems crude or diesel oil forms the continuous phase in the water-in-oil emulsion.

→ In this way oil-base mud can have as little as 3% to 5% or as much as 20% to 40% water content. Oil base mud systems are applied,

→ Mud systems are applied when,

* drilling sensitive production zones or problem shales.
* Drilling salt sections and formations that contain hydrogen sulfide.
* Danger of stuck pipe problems.

Advantages of oil based Mud:-

→ High drilling rates
→ Lowered drillpipe torque and drag.
→ Less bit balling and
→ Reduction in differential sticking

Oil-based muds are expensive, but are worth the cost when drilling through

→ troublesome shales that would otherwise swell and disperse in water based mud e.g smectite.

→ To drill pipe, high temperature holes that dehydrate water based mud.
→ to drill water-solubles zones
→ To drill producing zones.

Disadvantages of oil based mud:

→ Inability to analyze oil shows in cuttings because the oil-based mud has fluorescense confusing with the original oil formation.
→ Contamination samples of cuttings, cores, side wall cores for geochemical analysis of TOC and masks the real determination of API gravity due to this contamination.
→ Contaminate areas of freshwater aquifers causing environmental damage.
→ Disposal of cuttings is an appropriate place to isolate possible environmental contamination.

---

5. Explain briefly about measurement while drilling

Applications:-

Definition :-

→ The term "measurement while drilling" refers to the while drilling measurement of directional parameters (MD, inclination, azimuth) as well as certain drilling parameters like WOB downhole torque, temperature etc.,

MWD :

→ The drilling parameters measured with MWD tools are aimed to increase the drilling efficiency, be applied to detect abnormal formation pressures or any kind of hole problems.

→ Most MWD tools can Operate at tool-temperatures up to 150°C, some sensor work up to 175°C. it should be noted that the tool temperatures are generally about 20°C less than the formation temperatures, measured by wireline logs which is caused by the cooling effect of mud circulation.

→ Downhole pressure create less problems for MWD tools than downhole temperatures. Most MWD tools are designed to withstand up to 20,000 [psi] which is rarely encountered.

→ MWD tools are most sensitive to shock & vibrations. Torsional shock, created by stick-slip have been found to be able to cause tool failure lateral shocks which can be magnitudes higher than axial shocks, can be reduced by the use of Jars.

→ Normally sensors measure MWD shock loads constantly and transmit them to the rig. There the driller can manipulate the drilling parameters to keep them in acceptable limits.

Application Of MWD:

* MWD halliburton utilizes measurement while drilling surveying technology to determine the well path and its position in three-dimensional space.

* MWD is a valuable tool that can establish true vertical depth, bottom hole location and orientation of directional drilling systems.

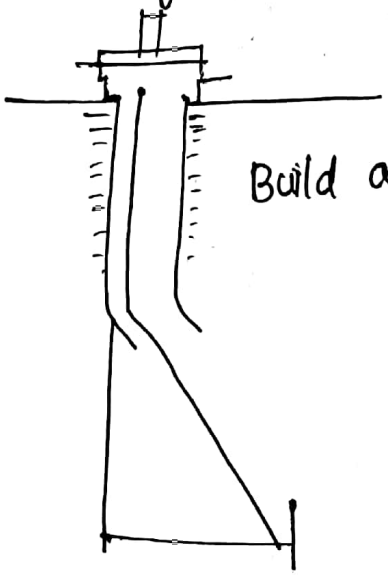
6. Explain the following a) Build and hold b) S type, c) Deep kick off and build.

Build and hold:

→ In general a build and hold profile is planned so that the initial deflection angle is obtained at a shallow depth, and from that point on the angle is maintained as a straight line to the target zone.

→ Once the angle and deflection are obtained casing may be set through the deviated section and cemented.

→ In general the build and hold profile is the basic building block of extended reach wells.



Build and hold.

→ These profiles can be used for moderate-depth drilling in areas where intermediate casing is not required and where oil-bearing strata are a single horizon.

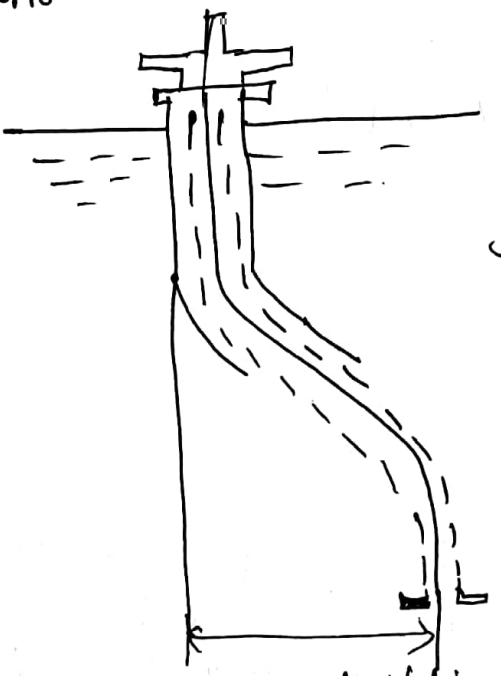
→ They can also be used for deeper wells requiring a large lateral displacement.

(ii) S type:

→ The main reasons for drilling an S shaped well are completion requirements for the reservoir. For example when a massive stimulation operation is required during the completion an 'S' shaped well also sets the initial deflection angle near the surface.

→ The S-shaped well is often employed with deep wells in areas where gas troubles, saltwater flows, etc, dictate the setting of intermediate casing.

→ It permits more accurate bottomhole spacing in a multiple pay area. The deflection angle may be set in surface zones in which drilling is fast and round trip costs can be held to a minimum.



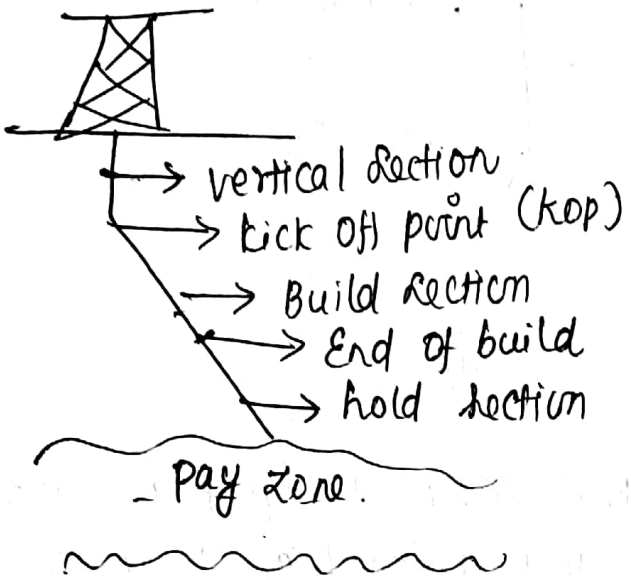
S-well.

(iii) Deep kick-off and build:

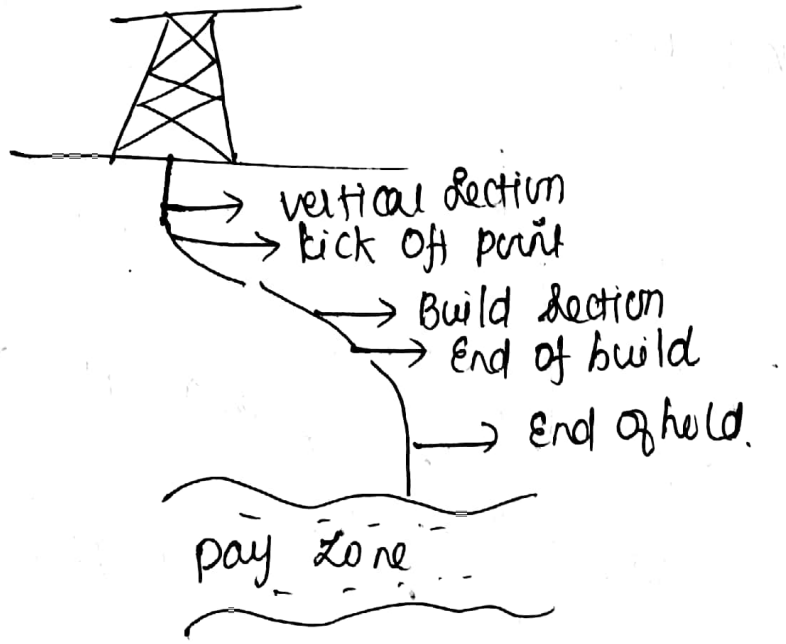
Type I Wells:

→ Type I wells are made up of a kick off point, one buildup section and a tangent section up to the target.

→ They are also called build and hold trajectory or L profile wells (as it is L-shaped). These wells are drilled vertically from the surface to kick off point at a relatively shallow depth.

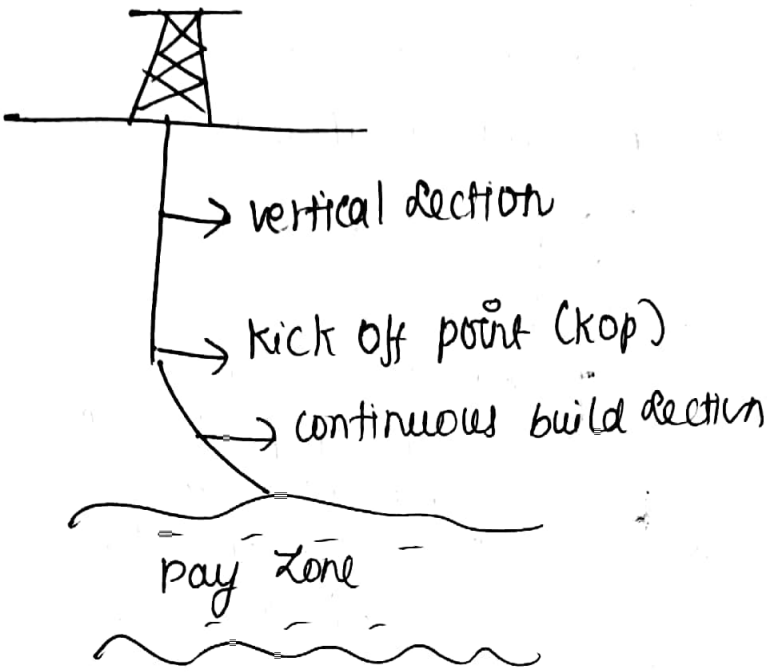


Type II well :-



→ Type II wells are made up of a vertical section, a kick-off point, a build up section, a tangent section, a drop-off section and a hold section upto targets.

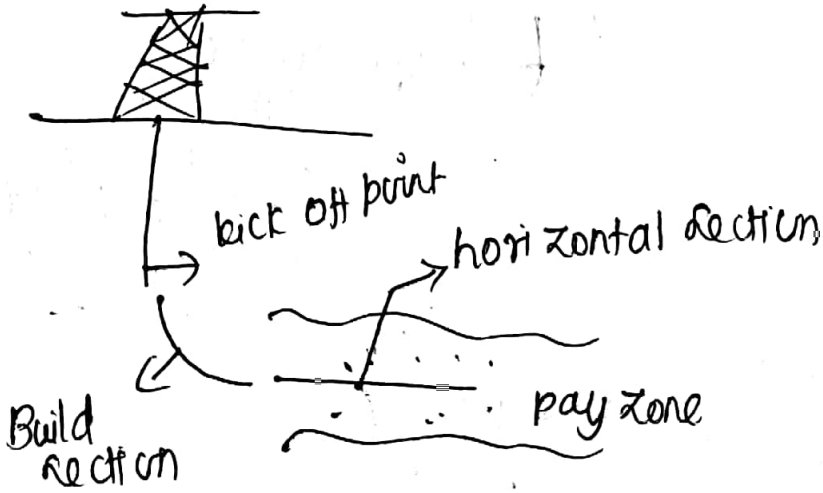
Type III wells



→ Type III wells are made up of a vertical section, a deep kick off and a build up to a target.

→ They are also called Deep kick off wells or J profile wells.

Type IV wells:



→ Type IV wells are made up of anyone of the above profiles plus a horizontal section within the reservoir, They are also called horizontal wells or horizontal directional wells.

7. Explain in detail about well planning:-

Definition:

→ Well planning is perhaps the most demanding aspect of drilling engineering. It requires the integration of Engineering principles, corporate or personal philosophies and experience factors.

→ Although well planning methods and practices may vary within the drilling industry, the end result should be safely drilled, minimum-cost hole that satisfies the reservoir engineers requirements for oil/gas production.

Qualities of a well planner

→ They are experienced drilling personal who understand how all aspects of the drilling operation must be integrated smoothy.

→ They utilize available Engineering tools, such as computers and third-party recommendations, to guide the development of the well plan

→ They usually have an investigation characteristic that drives them to research and review every aspect of the plan in an effort to isolate and remove potential problem areas.

Objective

→ Safe
→ minimum cost
→ Usable

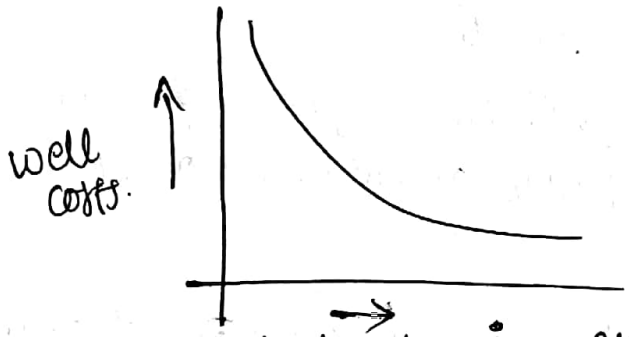
Unfortunately, it is not always possible to accomplish these objectives on each well because of constraints based on.

- → Geology
- → Drilling equipment
- → Temperature
- → Casing limitations
- → hole sizing
- → Budget.

Safety

→ Safety should be the highest priority in the well planning. personnel considerations must be placed above all other aspects of the plan.

Minimum cost



→ A valid objective of the well-planning process is to minimize the cost of the well without jeopardizing the safety aspects.

→ In most cases, costs can be reduced to a certain level as additional effort is given to the planning.

Usable holes

→ The hole diameter is sufficiently large so an adequate completion can be made.

→ The hole or producing formation is not irreparably damaged.

well type classification:

→ wildcats
→ Exploratory holes
→ Step outs
→ infills
→ Re-entries.

wildcast – no known (or little) geological foundation for site selection

Exploratory – Site selection based on seismic data, satellite surveys etc., no drilling data in the prospective horizon.

Step out – Delineates the reservoir's boundaries drilled after the Exploratory discovery

infill – Infill drills the known as delineation well.

Re-entry – Existing well - re entered to deepen, sidetract, rework, or recomplete; various amount of planning required.

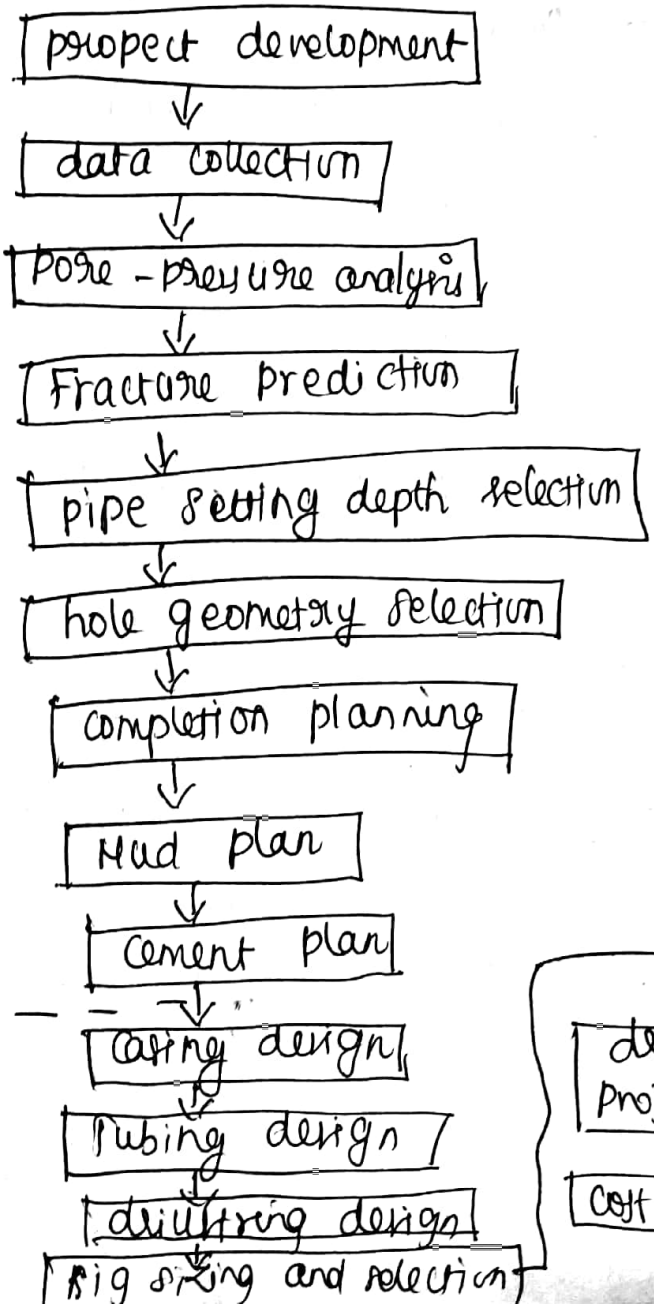
Abnormal pressures affect the well plan in many ... areas,

- → casing and tubing design
- → Mud weight and Type selection
- → Casing - Setting - depth selection
- → cement planning.

in addition,

- → Kicks and Blowouts
- → Differential - pressure pipe sticking
- → Lost circulation.

Well planning process



Bit program:-