GWH
IAT-03

1) Ground water exploration using Seismic Method.

-> The seismic refraction method involves the creation of a small shock at the earth's surface either by the impact of a heavy instrument or by a small explosive charge and measuring the time required for the resulting sound or shock wave to travel known distances

-> Seismic Reflection method provide information on geological structure thousands of meters below the surface whereas seismic refraction methods of interest in ground water studies go only about 100 meters deep. The travel time of a seismic wave depends on the media through which it is passing through. The velocities are greatest in solid igneous rocks and least in unconsolidated materials

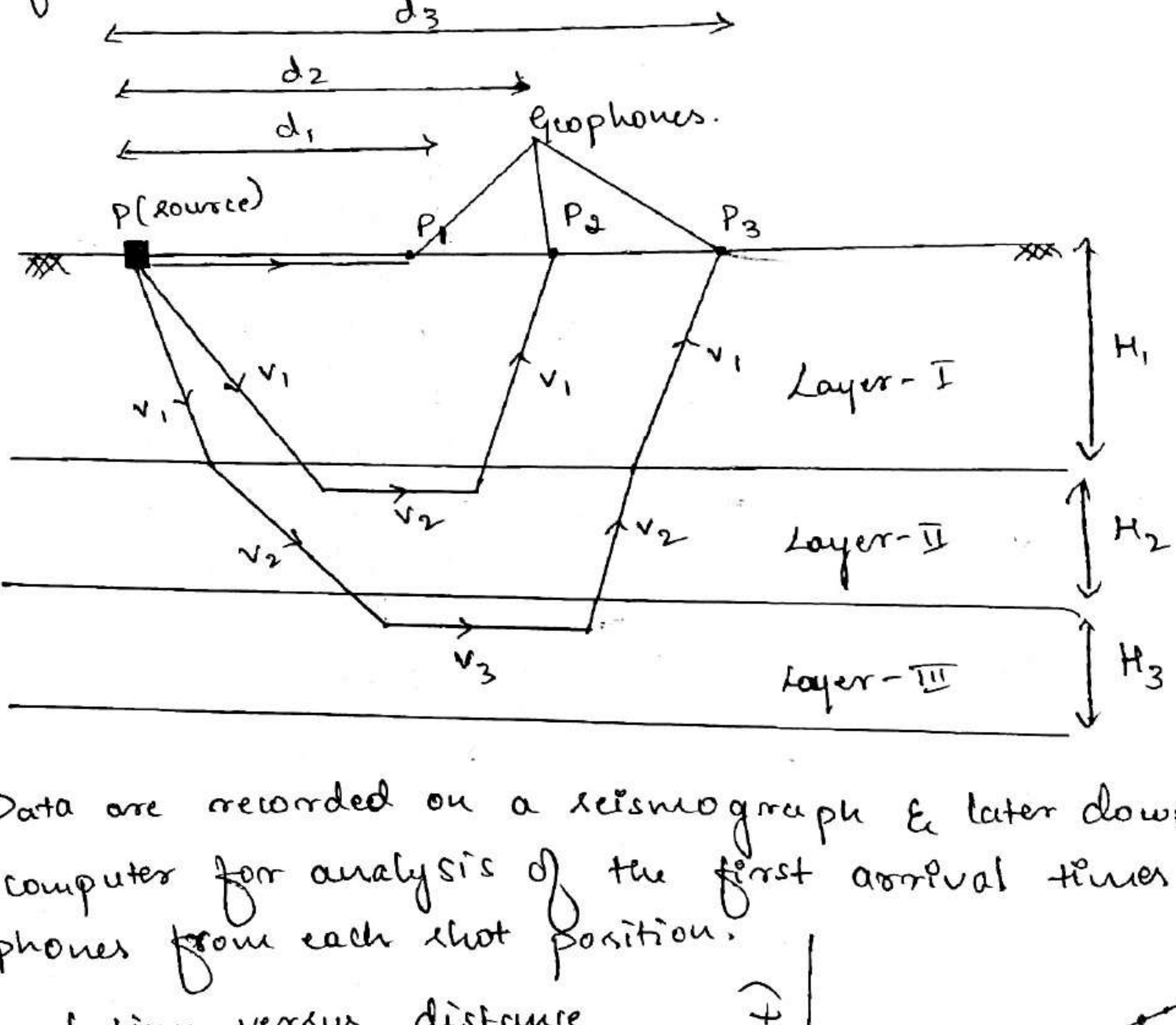
-> Siesmic energy is provided by a source like hammer, weight drop or small explosive charge located on the surface.

-> A series of siesmic receivers geophones are laid out along the survey line at regular intervals and receive the reflected wave energy.

-> The seismic waves travel through the subsurface at a velocity dependent on the density of the soil /rocks

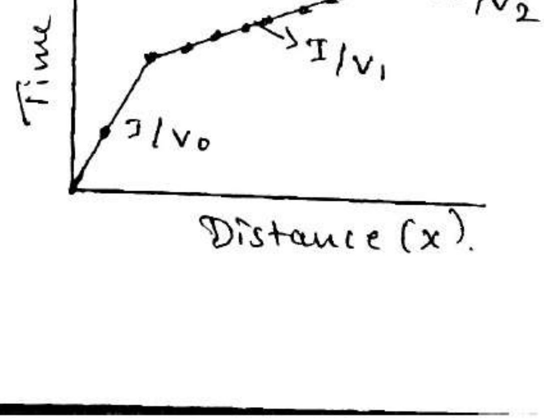
→ when the seismic wave front encounters an interface where seismic velocity drastically increases. a portion of the wave critically refracts at the interface, traveling laterally along higher velocity layers.

→ Due to compressional stresses along the interface boundary, a portion of the wave front returns to the surface



→ Data are recorded on a seismograph & later downloaded to computer for analysis of the first arrival times to the geophones from each shot position.

→ Travel-time versus distance graphs are then constructed and velocities calculated for the refractor layers.



For horizontal two layer case

$$Z_1 = \frac{V_2 V_1}{\sqrt{V_2^2 - V_1^2}} \left[t_{2x} - \frac{x}{V_2} \right]$$

For three layer case

$$Z_2 = \frac{V_3 V_2}{\sqrt{V_3^2 - V_2^2}} \left[\frac{t_3}{2} - Z_1 \frac{\sqrt{V_3^2 - V_1^2}}{V_3 V_1} \right]$$

Where, V → velocity
t → time
x → distance
Z → thickness of each layer.

2) The electric logging for ground water exploration.

* Electrical well logging is a kind of geophysical logging tool for ground water exploration.
* It involves the continuous recording of electrical resistance, resistivity & spontaneous potentional (SP) of formations of a drilled bore hole.
* This helps to identify the formation & also indicate freshwater aquifer from saline aquifer.
* It is also used to indicate the fracture system in hard rock terrain for rejuvention of poor / low-yielding bore wells

Spontaneous potential logs

-> The SP is recorded between the bore hole electrode & reference electrode at the surface.

-> The logging device for SP & point resistance is the same in most of the cases.

-> SP logs are highly useful to delineate clay dominant & saline water zones.

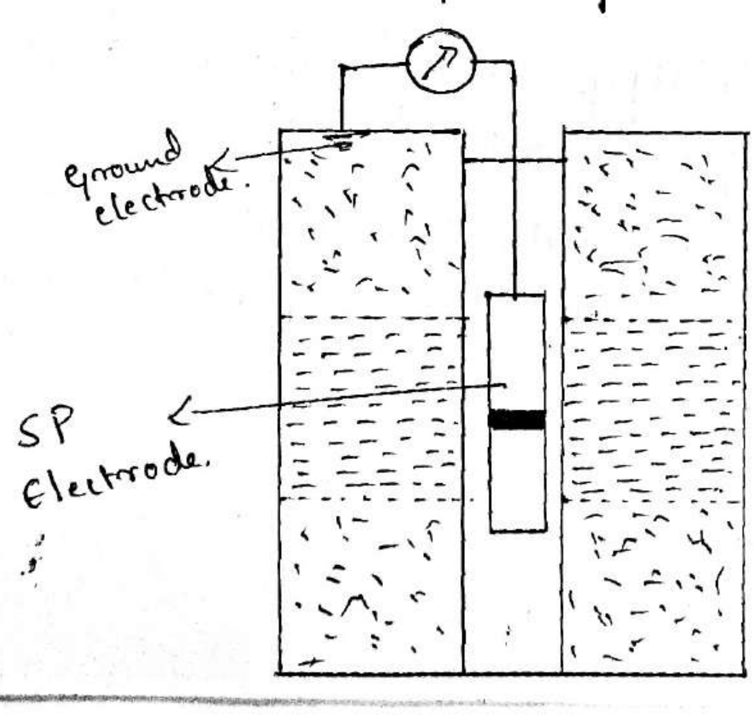
-> Clay manifests as low SP & low resistance on electric log.

-> The quality of formation water can be estimated from SP log.

Resistivity log

-> usually while drilling, drilling fluids invade the formation, changes in the resistivity are measured by the tool in the invade zone.

-> For this reason, several resistivity tool with different investigation lengths are used to measure the formation resistivity.



3) Dug wells Constructions

-> Dug wells are holes in the ground dug by shovel or backhole

-> Historically, a dug well was excavated below the groundwater table until incoming water exceeded the digger's bailing rate.

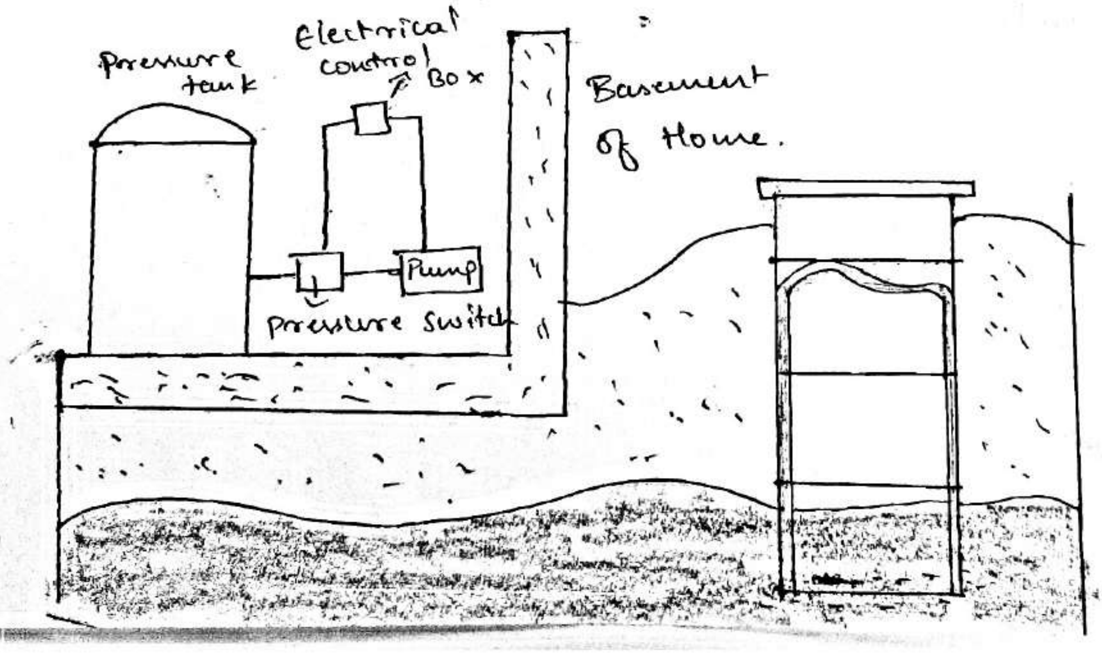
-> The well was then lined with stones, bricks, tile or other material to prevent collapse.

-> It was covered with a cap of wood, stone, or concrete.

-> Since it is so difficult to dig beneath the ground water table, dug wells are not very deep.

-> Typically, they are only 10 - 30 feet deep. Being so shallow, dug wells have the highest risk of becoming contaminated.

-> To minimize the likehood of contamination, your dug well should have certain features. These features help to prevent contaminants from travelling along the outside of the casing or through the casing and into the well.



4) Tube well based on method of constructions

These are grouped as
i) drilled wells
ii) driven wells
iii) jetted wells

i) Drilled tube wells

→ Drilled wells are constructed by making bore holes, using different drilling methods.

→ Tube well construction involves drilling the bore hole, installing the casing and well screen and developing the well to ensure sand-free operation at maximum yield.

→ Techniques of drilling are
* Hand auger drilling
* Percussion drilling
* water injection drilling
* Sludge drilling

→ Drilled wells can get water from a much deeper level than dug wells can often up to several hundred meters and smaller in diameter.

→ Drilled wells are typically created using either top-head rotary style, table rotary or cabel tool drilling machines all of which use drilling stems that are turned to create a cutting action in the formation hence the term drilling.

→ Drilled wells are usually cased with a factory made pipe, typically steel or plastic / PVC.

ii) Driven tube wells

-> It consists of a pipe and well point which are forced into the water bearing formation by driving with a wooden maul, drop hammer or other suitable means

-> They develop small yields & their construction is limited to shallow depths in soft unconsolidated formations free from boulders and other obstructions

-> They are commonly used for domestic water supply.

-> constructed by driving a smaller diameter, perforated tube with a pointed end into friable ground like sand or gravel using a vertical to and fro movements

-> Techniques of driving

* Percussion driving
* water injection driving.
* undercutting driving.

iii) Jetted tube wells :

-> It is constructed with hand operated equipment or power-driven machines. depending upon the type of formation & the size & the depth of the well.

-> A hole in the ground is made by the cutting action of a stream water.

-> The water is pumped in to the well through a pipe of small diameter. It is forced against the bottom of the hole through the nozzles of a jetting bit

-> The hole is cased to prevent a cave-in

-> Jetted tube wells have small yields & their construction is possible only in ~~unconsidated~~ unconsolidated formations.

5) A)

unconsolidated formations

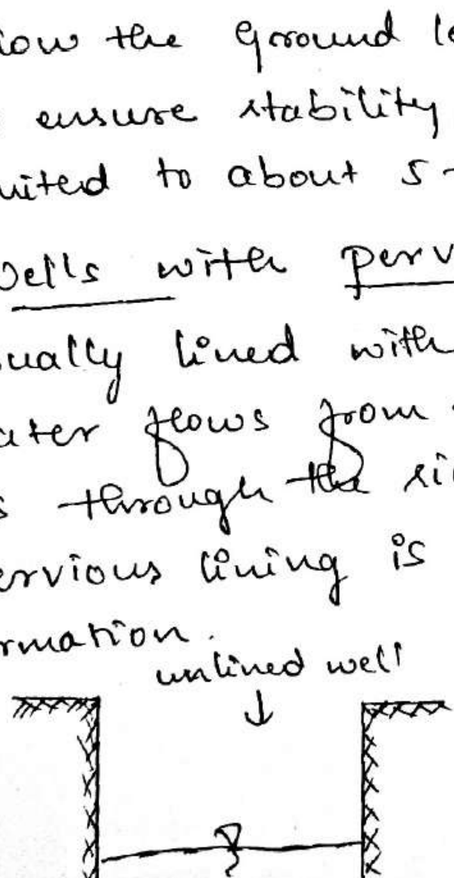
i) unlined wells

* wells dug purely for temporary purposes & are not protected by lining.
* As the sides of the wells are not protected, it is essential that the sub soil is compact enough to stand vertically under natural condition.
* The water table should not be less than about 4m below the ground level
* To ensure stability, the depth of the undlined wells limited to about 5-6m.

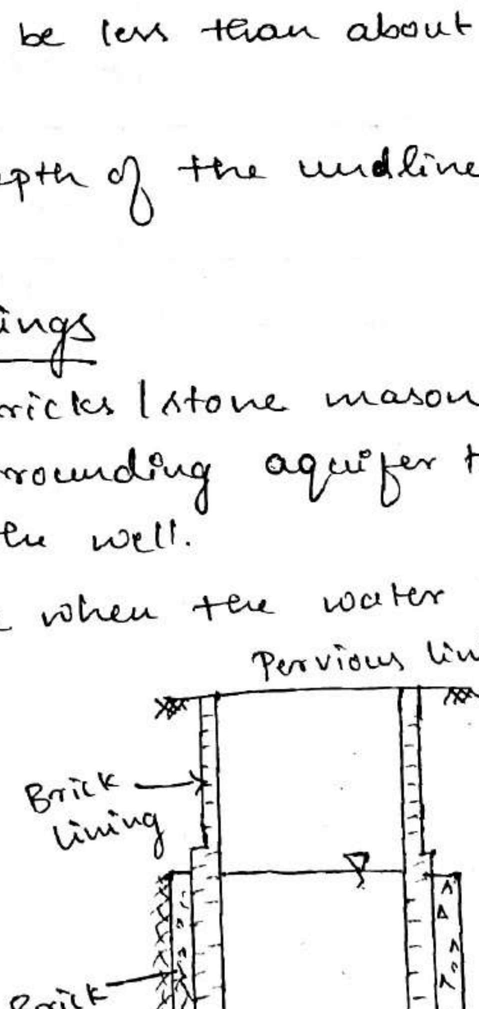
ii) wells with pervious linings

* usually lined with dry bricks/stone masonry.
* water flows from the surrounding aquifer to the wells through the sides of the well.
* Pervious lining is suitable when the water bearing formation.

unlined well

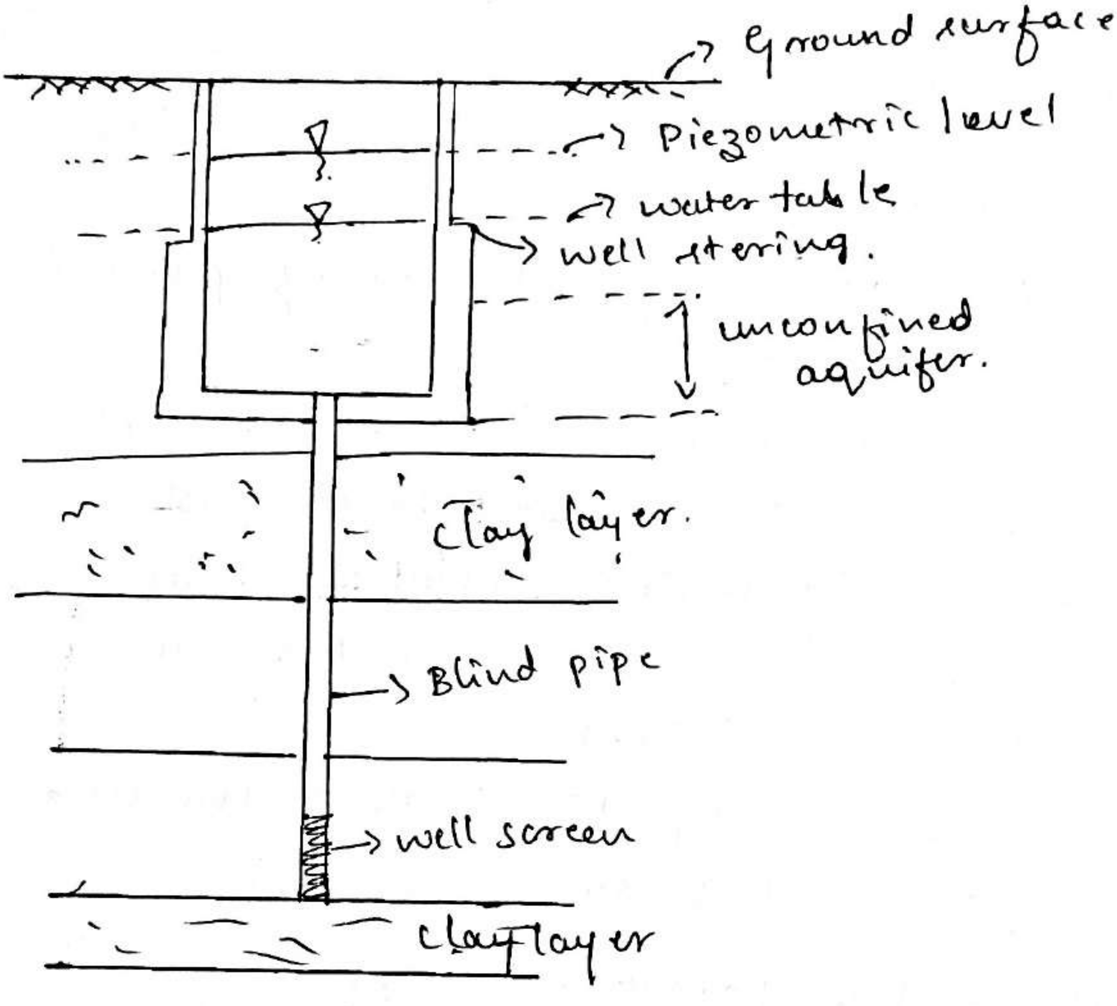


Pervious lining well.



iii) Dug cum bore wells

→ Dug wells are sometimes provided with vertical borres at the bottom to augment, thus yields such wells are refered as dug cum bore wells.



5) B)

Advantages

* Do not requires much space
* Can be constructed quickly not time consuming.
* Fairly sustained yield of water can be obtained even in yiers of drough.
* Economical when deep steated aquifers are seated.
* Generally good quaintity of water is tapped.

Disadvantages

* Requires costly & complicated drilling equipment and machinery.
* Requires skilled workers & great care to drill and complete the tube well.
* Installation of costly turbine or submersible pumps is required.
* Possibility of missing the fractures, fissures and joints in hard rock areas resulting in many dry holes.