

TUBE WELLSDefinition

A device for obtaining water from beneath the ground to the surface and consisting of a long tube bored into the ground and sunk to the depth of the water table. is known as Tube well.

OR

Tube wells are formed when water is pumped out from a deep bore made in the ground.

Optimum Capacity :

The optimum capacity of a tube well is defined as the maximum yield (an amount produced on the tube well) at the least unit cost.

The capacity of a conventional tube well is 0.056 cumec based on the quantum of water that a single cultivator can handle easily.

Acc. to Indian Ground water and Surface Conditions, the discharge of tube well should be 0.1 cumec. and the wells spaced 24m apart.

However, the optimum capacity of a tube well considered most suitable and compatible with the conditions and ~~in~~ in Northern India is 0.07 cumec.

Silting of Tube well

Silting of tube well is a problem and tube wells have to be de-silted often.

Indication for Silting -

- * Appearance of fine silt with water is an early indication of silting.
- * Reduction in the depth of tube well.

Causes for Silting -

- * Over Pumping
- * Improper siting of casing pipe.
- * Improper jointing of casing pipe.
- * Poor development of tube wells.

Suggestions to overcome Silting -

- * Flushing of tube well
- * Re-development of tube well.
- * Replacement of pump sets with proper conditions, with the safe yield of the tube well.

Types of Tube Wells :-

Depending upon the entry of the water through the screen or a cavity, the tube wells can be broadly classified into following two categories —

- 1) Cavity type tube wells
- 2) Screen type (strainer) tube wells.

Cavity type tube wells :-

A cavity type Tube well draws water from the bottom of the well, and not from the ~~sides~~ sides, as is done by a screen well.

The flow in a cavity type well is therefore spherical.

The principle behind the working of a cavity type tube well is essentially similar to that of deep open well with the only one basic difference that the open deep well taps the first aquifer just below the mota layer while the cavity tube well need not do so.

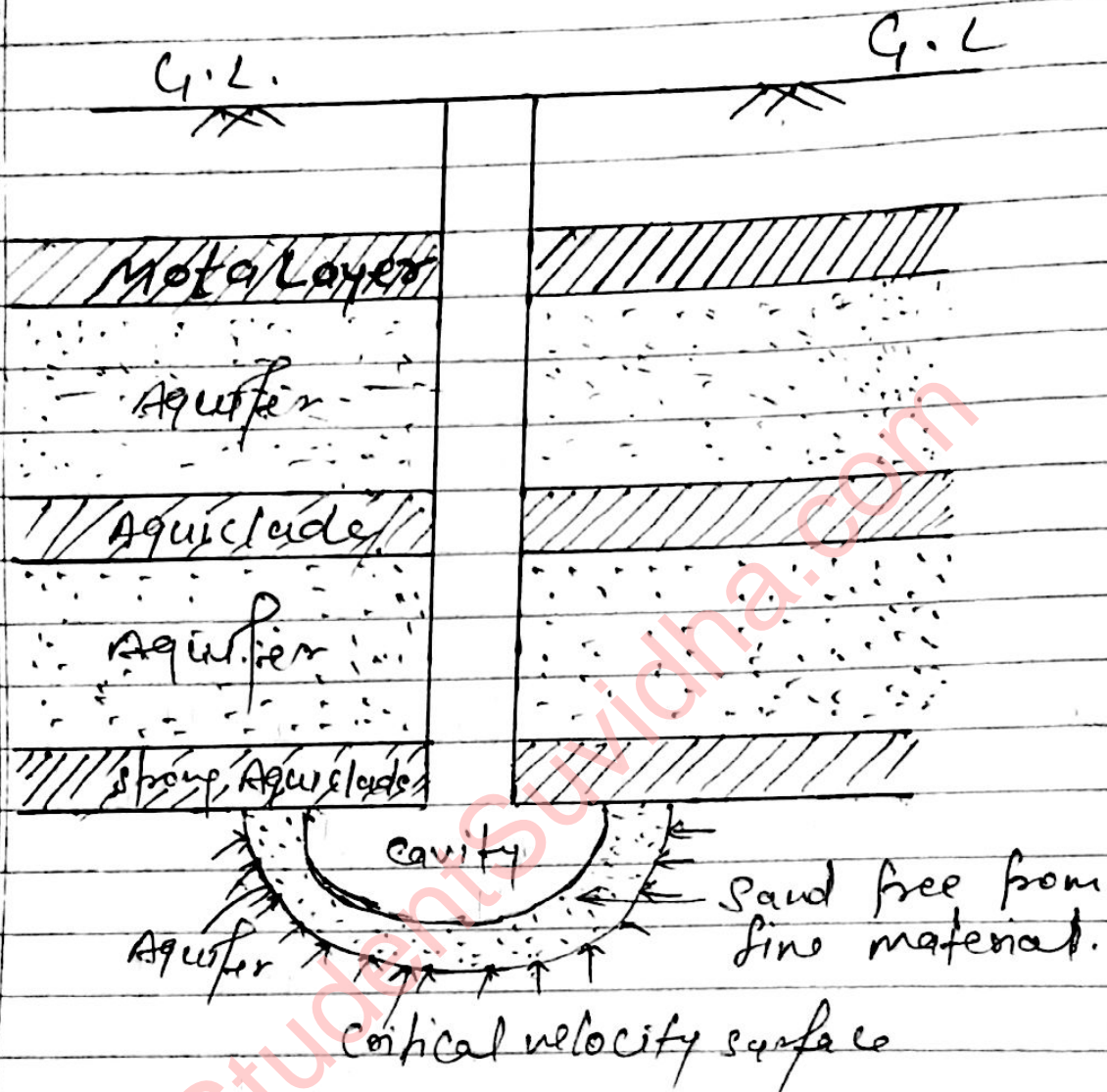


Fig- Cavity type tube well.

Screen type tube well :-

Screen type tube wells are most widely adopted and have been constructed particularly for irrigation purposes.

Generally, screen type tube wells draw water from the sides not from the

bottom as is done by the cavity type tube wells.

The flow in the screen type tube wells is essentially radial flow.

Such a well can easily tap a no. of aquifers.

Screen type tube wells can be further divided into two types -

- ① strainer ~~type~~ tube well.
- ② slotted pipe gravel pack tube well.

Discharge in Confined Aquifer

$$Q = \frac{2\pi k L S}{2.3 \log_{10} R/r}$$

L = strainer length (m)

S = depression head (m).

Discharge in unconfined Aquifer -

$$Q = \frac{2\pi k s (L + s/2)}{2.3 \log_{10} R/r}$$

Component of tube wells :-

Pump :-

To lift water by creating a strong vacuum head under which it rushes at a high velocity through the strainer into the well pipe and further into the delivery pipe.

Motor :-

To run the pump.

Impeller :- The rotating element producing head. It receives water and impels it to lower passage.

Casing Pipe :- To support the hole temporarily during drilling (in cable tool method) to complete the well assembly.

Strainer :- To allow sand free water into the well and to support loose formation material in unconsolidated formation.

Blind pipe :-

To serve as a conduit to carry further the water that has entered through the strainer.

Delivery pipe :- It is a water conductor from pump to the water-course which carries water to the field.

Construction and working of Tube well :-

Site Selection :-

- * The method of well design depends upon topography, geological conditions of the underlying strata, depth to water table, rainfall, climate and the quantity of water required.
- * A tube well design involves selection of proper dimensions like the diameter and length of the tube well.
- * Tube well must be large enough to accommodate the pump to be installed.

For ground water monitoring, wells may be drilled in a way that allows the specialists to closely examine the rock formation and take frequent water samples with respect to the method of boring adopted, the tube well can be classified into the following three categories -

- ① Driven tube well, ② Jetted tube well,
- ③ Drilled tube well,

DRILLED TUBE WELLS

Deep and high capacity wells are constructed by drilling. Most home wells are drilled to 8 or 6 inches (20 or 15 cm) in diameter.

Municipal or irrigation wells are likely to be drilled at larger diameters, sometimes as much as 24 inches or more.

Some of the drilling methods commonly used are given below—

- ① Rotary Method of Drilling wells.
- ② Air Hammer Method
- ~~Drill~~ ③ Standard Method or Cable tool method of Drilling -

(A) In Rotary drilling, a drill bit is attached to a length of connected drill pipe. The drill bit will be made of tough metals such as tungsten, and as the drill is rotated, the bit acts to grind up the rock. The broken pieces (cuttings) are flushed upward and out of the hole by circulating a drilling fluid (sometimes called drilling mud) down through the drill pipe and back to the surface.

(B) Air Hammer Method :-

In areas of hard rocks many drillers prefer to use a well drilling technique that uses compressed air to operate a down-hole air hammer on the end of the drill string that helps to break up the hard rocks.

The compressed air also blows the crushed rock fragments out of the hole to the surface along with any water that flows in the well during drilling.

(C) Cable Tool Method :-

Another drilling technique uses a "pounder" machine, usually referred to as cable tool drilling.

With this method, a heavy bit is attached to the end of a wire cable and is raised and dropped repeatedly, pounding its way downward.

The method is slow and in most places has been replaced by rotary drilling. However the cable tool method is responsible for millions of successful wells around the world.

Type - I —

Wells with impervious lining —
Resting on impervious layer

- * Pit is excavated
- * Masonry lining is built up on a kerb upto few meter above ground level.
- * Kerb-ring (R.C.C.) having cutting edge at bottom.
- * Kerb is descended by loading sand bags.

Type - II

Wells with pervious lining such as brick stone and fed through pores sides are lined with bricks or stones without mortar.

- * Water enters through sides.
- * For stability concrete plug (1m depth) is installed.
- * Pervious lining is surrounded by gravel filter.

Type - III

No lining at all in Kacha wells or unlined wells.

- * Temporary wells in hard soils
- * When water table is high ($\frac{4m}{4m}$ high).
- * cheap and useful but collapse.

Advantages :-

- * Cable tool drilling rigs are relatively cheaper.
- * The rigs are simpler and require little maintenance.
- * The machines have low power requirements.
- * Wells can be drilled in water-scarce areas.
- * Wells can be drilled in formation where water is likely to be lost.

well Screen Assembly Installation :-

A well screen is considered as the most important part of a tubewell, since it serves as the intake structure for the entry of water into the well.

The quickest and easiest way to finish a well is to simply put a well screen at the bottom.

The method of installing well screens is influenced by the design of the well and the drilling method.

Casing is driven to the full depth of the well. Then the screen is lowered inside the casing and allowed to rest on the bottom. The casing pipe is then pulled up far enough to expose the full length of the screen in the water bearing formation.

Using the swedge block, the lead packer provided at the top of the well screen is expanded to make a sand-tight seal b/w the screen and inside of the casing.

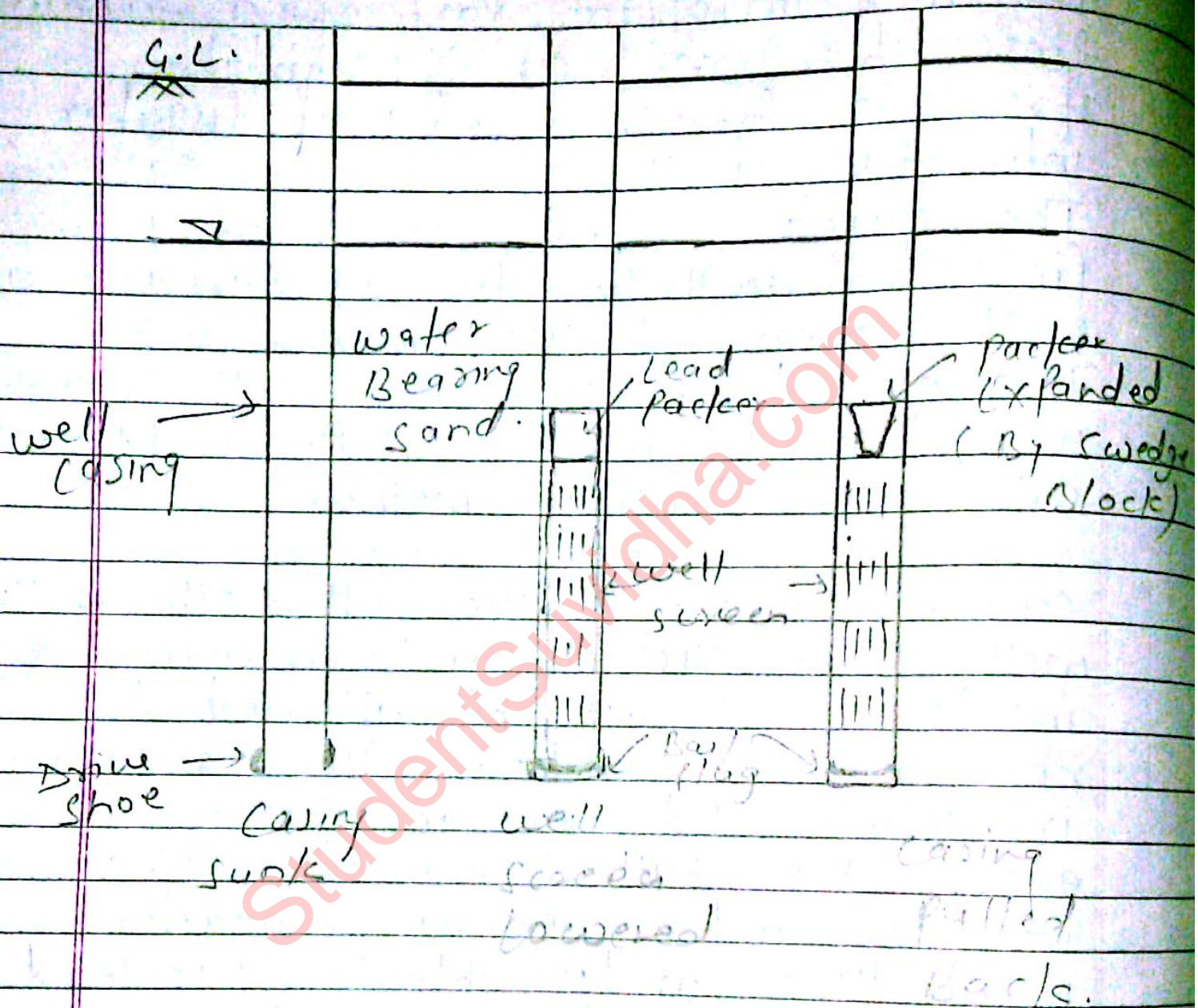


fig - setting well screen.

well Development :-

The well screen is the heart of a well and the filter pack acts as the lungs passing water to the screen.

However, after drilling a bore hole and installing a casing and filter pack, it is necessary to get the heart pumping and the lungs breathing.

Thus,

The act of cleaning out the clay and silt introduced during the drilling processes as well as the finer part of the aquifer directly around the well screen prior to putting the well into service is called well development.

The main objectives of well development are —

- i) To increase the rate of water movement from the aquifer into the well.
- ii) Stabilizes the aquifer to prevent sand pumping, thereby producing better quality water.
- iii) Removes organic and inorganic materials which may inhibit effective well

disinfection

- iv) to increase well capacity, prevent discharge of discharge.
- v) to increase the porosity and permeability of the water bearing formation in the well.

Development is necessary in all gravel packed wells and the screened wells.

The commonly adopted well development methods are discussed below —

① well development by pumping :-

The simplest but least effective development method is pumping a well at a discharge rate higher than the discharge rate of the well during its normal operation.

However, it is useful because if the well can be pumped sand free at a high rate, it can be pumped sand free at a lower rate.

If the water level is within 3 to 4.5 m of ground surface, it is sometimes possible to use the mud pump as a suction pump to pump water from the well for 2 to 3 hours.

② well development by Back washing —

This is a relatively simple method of development which requires a water lifting device and a container in which water can be stored and then from which it will be allowed to flow easily back into the well. Water is pumped to the surface until the container is full, it is then rapidly dumped back into the well and provide some development of the surrounding water bearing formation.

③ Surging :-

Surging is the most common method of well development. It involves forcefully moving water into and out of the well screen using the surge plunger.

④ well development by compressed air

⑤ well development by jetting.

Life of a Tube well and Reasons for its failure :-

A normal tube well lasts for about 15 to 20 years in Northern India. It may fail due to (a) Incrustation (b) Corrosion.

(A) Incrustation :-

The incrustation of the well pipe occurs due to the deposition of alkali salts on the inside walls of the pipe.

The incrustation of the well pipe reduces the effective diameter of the well pipe, and hence reduces the discharge of the tube well.

The incrustation can be reduced —

* whenever the incrustation is likely to occur, the tube well screen should be so selected as to allow

* Drawdown may be kept low.

* Slot size and percentage of open area should be large and sufficient to allow some allowance for incrustation.

* Periodic maintenance and clearing may be practised.

(B) Corrosion :-

The well pipe is gradually destroyed by corrosion due to the action of acidic water on the pipe material.

when chlorides and sulphates ~~are~~ or Carbon dioxide are present in the water, the well pipe will definitely get corroded.

The corrosion can be reduced —

- * Use of corrosion resisting materials.
- * Thickening of the pipes.
- * ~~Corrosion~~
- * Use of corrosion resisting coatings on the pipe.
- * Decreasing the pumping rate or the drawdown.
- * By reducing the flow velocity by increasing the percentage of the open area or the diameter of the well pipe.

Some Important Terms

① Pumping Equipment :-

In most of the wells, static water level is below the ground surface and hence, flowing wells are rare. The water has to be lifted from inside the well to the ground surface. Rope and buckets have been used and are still being used for shallow wells and for low discharges.

For deeper wells and high yields of water, pumps have to be used.

The purpose of installing pumps in wells is to lift water from inside the well to the ground surface.

The main factors which must be considered while selecting a pump for water well are the anticipated pumping condition, specific installation and maintenance conditions and the basic pump characteristics.

The major types of pumps are as follows -

① Centrifugal pumps

- a) suction lift pump
- b) Deep-well turbine pump
- c) Submersible - turbine pump.

② Jet pumps

③ Air lift pumps.

Verticality and Alignment of Tube well :-

Verticality of tube well means verticality of casing pipe or housing pipe upto 200 mm dia and upto 30 m depth is in one direction and in one plane.

The tube well should be in a vertical alignment so that installation of vertical turbine pump or submersible pump can be done in the tube well without any difficulty.

Alignment means plumbness and straightness of the tube well.

Plumbness refers to the variation with the depth of the actual centre line of the tube well.

Thus, a tube well may be straight but not in plumb, since its alignment may be displaced in one direction or other from the vertical.

A drilled hole may not be in a perfect vertical alignment because of various reasons. and hence a tolerance limit of verticality has been fixed while drilling, such that within this limit also the installation of vertical turbine pump or submersible pump is possible in the tube well.

Note: Wells with the gravel pack ratio blow 4 to 5 generally have a high o/p efficiency while - 7 to 10 are less efficient.

Gravel Packing :-

A Gravel Pack around the well screens becomes necessary to improve well efficiency.

An artificial gravel pack around the screens prevents migration of fine sands into the well.

A gravel pack is also necessary, when the aquifer is nearly homogeneous with a uniformity coefficient of less than 3, and effective size is less than 0.25 mm.

The main advantages of an artificial gravel pack are -

- * Amplifies the effective radius of the well.
- * Specific Capacity is enhanced as a result of the increased entrance velocity.
- * Sand migration into the well is minimized.
- * Enables provision of a larger slot opening against fine, highly permeable formations.

Design of Gravel Pack -

Gravel Packs increase the efficiency and life of a well.

The effective size ratio of gravel pack to formation known as the Gravel Pack Ratio is obtained by.

$$\text{Gravel Pack Ratio (G.P.R)} = \frac{50\% \text{ gravel pack}}{50\% \text{ aquifer}}$$