Lecture Two

Earthwork
(Excavations and Filling)

Earthwork:

Earthwork is one of the works that are found in all building construction projects, and they are divided into two types:

1. **Excavations** الحفريات الترابية
2. **Earthen diking, sometimes called burial filling.** الاملائيات الترابية

The purpose of earthworks is to making the soil with the level indicated in the plans, the level that is considered necessary to carry out other works, as in the case of foundations or sewers and others.

Earthwork Excavations : **أعمال الحفريات الترابية**
Which include the following works:

1. Excavations of foundations of all kinds and basements.
2. Excavations works of canals and streams of services Excavations of various services.
3. Excavation works needed between buildings, roads, squares, etc.

Excavation works are performed either by manual excavation or by mechanical equipment excavation or both. The determining factors of the drilling method depend on the nature of the soil, the required section shape, the presence of groundwater, the time required to complete the work and the cost of the work.

Manual Excavation. الحفر اليدوي

Manual Excavation is done by using simple equipment, and the method of manual excavation is used in small businesses such as continuous wall foundations, single pillar foundations, sewer channels that have fewer lengths and double foundations that are shallow and also complete the bottom excavations that are carried out by mechanical equipment.

***Note*: Manual excavation is not used in hard soil as rocky soil.**

Excavations With Mechanical Equipment: -

Mechanical equipment is used in large excavations as well as excavations that transfer its soil to the outside or excavations that must be completed quickly as mechanical equipment is characterized by high productivity, especially in large works and can dig and lift the soil outside the hole and even load it on the tankers directly for some types or it itself is carrying out a process Transport in others. Among the commonly used types are: (Robot shovel, backhoe, digger, dozer, skimmer and more).

Rock Excavations: الحفريات في المناطق الصخرية

The foundations may be in a rocky area, and this requires excavations in special methods where the mentioned excavations equipment cannot be used, and manual excavations (if possible) is slow and expensive, in which primitive equipment such as the hammer is used. It is dug in the rock in several ways, mainly relying on the miniature with special hammers, then blasting with explosives.

Excavations With Mechanical Equipment

Rock Excavations

Groundwater drainage and drying of the work yard and excavation:

To carry out excavation works and foundations, groundwater must be drained(if any) from inside the excavation, some of these methods used are: -

1. **Direct discharge.** التصريف المباشر
2. **Pumped discharge.** التصريف بالضخ
3. **Discharge using a WellPoint system.** التصريف باستعمال نظام نقاط البئر
4. **Other methods**. طرق أخرى

1 - Direct drainage: - It is one of the cheapest ways and depends on watering pits at the bottom of the pits. From the sides, the collected water is drained by the waterways slopes outside the excavation area. This drainage is possible in very few cases, as the bottom of the pits is often lower than the rest of the site, where the water cannot flow smoothly.

2 - Drainage by pumping (Open Sump and Ditches): -

It is similar to the first type, except that the waterways themselves gather at one point or more at the lowest level and make holes with suitable dimensions from which the water is pumped to the outside. This method is especially followed under the floors of the building cellars when the groundwater pressure and The amount of water collected are moderate, as this method does not guarantee the drying of the excavation floor if it is wide, but it is effective in drawing only surface water.

Advantages of Open Sump and Ditches

1. Widely used method.

2. Most economical method for installation and maintenance.

3. Can be applied for most soil and rock conditions.

4. Most appropriate method in situation where boulders or massive obstructions are met Within the ground. Greatest depth to which the water table can be lowered by this method is about 8 m below the pump.

Disadvantages of Open Sump and Ditches

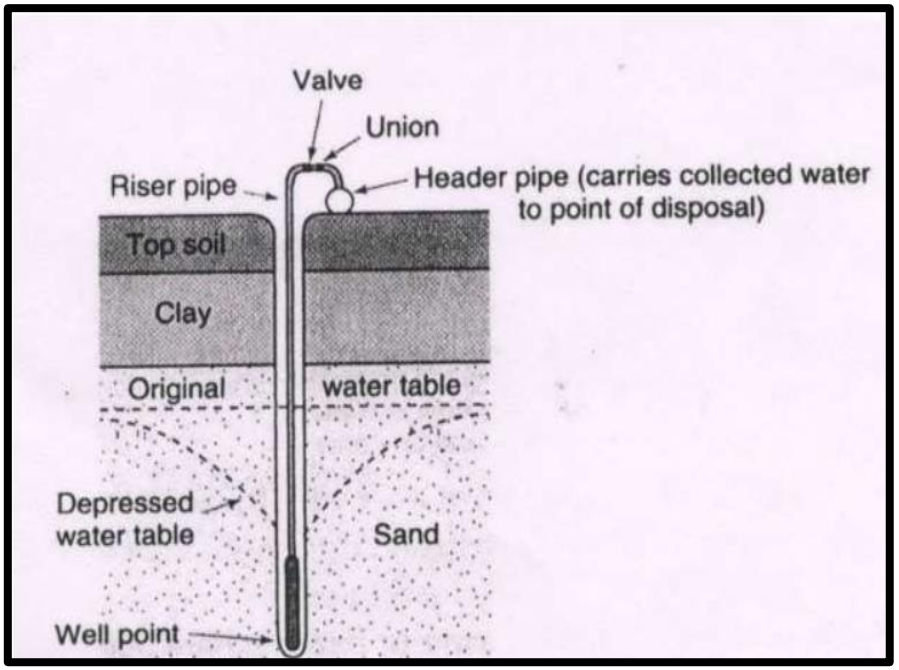
1. Ground water flows towards the excavation with high head or a steep slope and hence there is a risk of collapse of sides.

2. In open or timbered excavations there is risk of instability of the base due to upward.

3 - Discharge using the well points system: -

There are points that must be taken into account when resorting to this method, including:
* These methods are generally costly, as the cost of the system includes the cost of soil investigations necessary to design the system before work begins.

* The permeability of the soil and the difference between the groundwater level and the bottom of the excavation is an important factor in determining the amount of discharge possible.
* Through the use of this system, it is possible to reduce the level of groundwater to below the level of the drilling floor in the field of work in large excavations.
*It is not preferable to use this system in rocky lands or if it is from a boulder, while sandy soil is ideal for it.



Design Considerations of Well-Point System of Dewatering

When designing a well point system, it is necessary to give first consideration to the physical conditions of the site to be dewatered. Following is the list of information to be collected:

a) The physical layout

b) Adjacent areas

c) Soil conditions

d) Permeability of the soil

e) The amount of water to be pumped

f) Depth to imperviousness

g) Stratification

Advantages of Well Point System

a) Installation is very rapid.

b) Requires reasonably simple and less costly equipment.

c) Water is filtered and carries little or no soil particles.

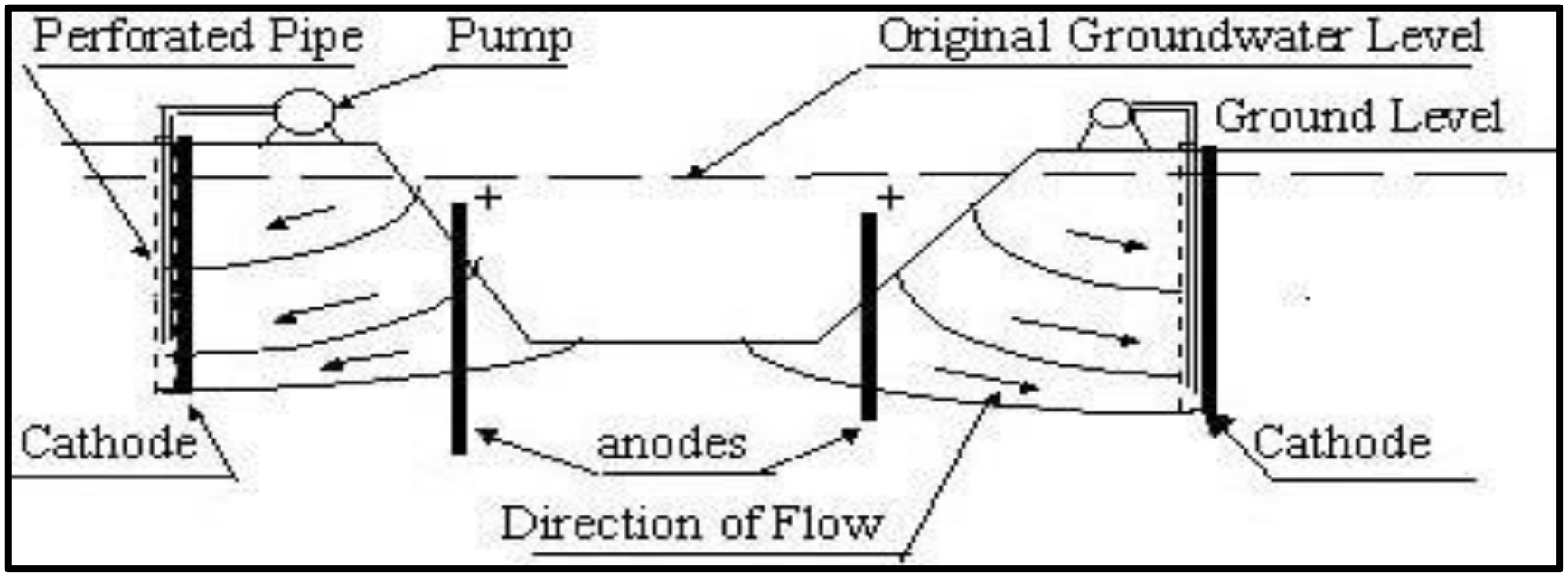
d) There is less danger of subsidence of the surrounding ground than with open-sump pumping.

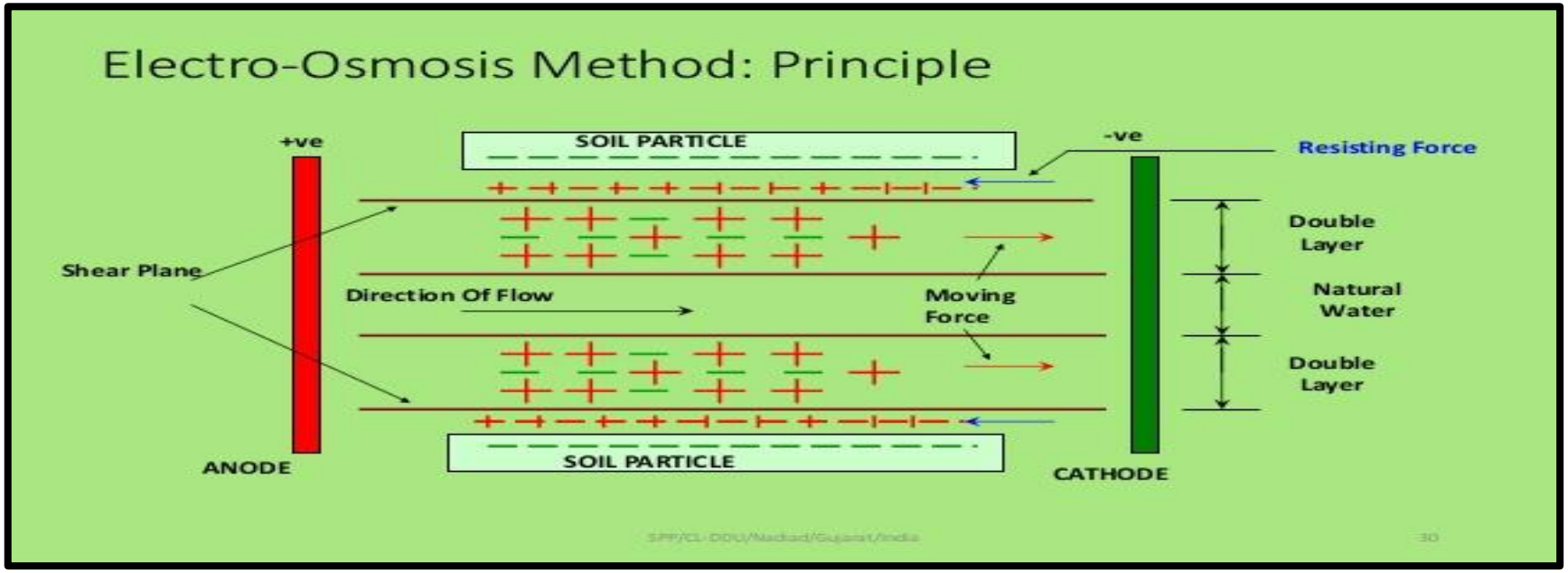
Limitations of Well Point System

1) A lowering of about 6 m (20 ft) below pump level is generally possible beyond which excessive air shall be drawn into the system through the joints in the pipes, valves, etc., resulting in the loss of pumping efficiency.

2) If the ground is consisting mainly of large gravel, stiff clay or soil containing cobbles or boulders it is not possible to install well points.

4- Other methods: - There are a number of other methods that can be followed, but they are generally more expensive and less used, including following **The regular open channels system around workplaces** or **The method of electrical osmosis.**


Perforated Pipe
Pump
Original Groundwater Level
Ground Level
Cathode
anodes
Cathode
Direction of Flow


Electro-Osmosis Method: Principle
+ve
SOIL PARTICLE
-ve
Resisting Force
Shear Plane
Direction Of Flow
Moving Force
Double Layer
Natural Water
Double Layer
ANODE
SOIL PARTICLE
CATHODE

Soil fill up and soil compacting: -

All buildings need earthworks for several reasons, including:

- Re-filling the aspects of the foundations after implementation
- Backfill sewage and services channels.
- In flooring works for the purpose of raising the floor level to a certain level.

And in this case it is necessary to scrape the topsoil with a thickness of about 15 cm first "to remove the traces of plants and organic matter and to reach a layer of soil with good tolerance.

The soil used in earthworks is almost free of organic matter, plant roots and debris, and has appropriate engineering properties.

Soils mixed with a small percentage of sand, as well as the mixture of sand and natural gravel, are considered suitable soil for this purpose. The cheapest soil can be used is the soil produced from excavations of the same site if it is suitable for use and for this it is preferable to scrape the soil with a thickness of about 15 cm at the foundation and other pits and throw the resulting soil outside the work area and then dig the foundations and accumulate its soil for reuse without contamination with an invalid soil. The purpose of compacting the soil is to give it a certain strength and make it resilient to the loads imposed on it with an acceptable amount of depression. This requires that the soil be of good quality and with a certain humidity approximating the so-called optimum and compacted to the extent of

obtaining the required density which is measured by the dry density and set In a special examination in the soil testing laboratory, it is necessary to obtain on-site 90 - 100% of the maximum dry density according to the type of facility and its importance.

It is possible to compact the soil and reduce it by means of large bulldozers, but these are not usually used in buildings because of the difficulty of their work inside buildings and facilities, but are used in large works such as squares, airports, roads, and others.

When the humidity in a certain location is high and is likely to affect the floors, the burial material used is usually from coarse granular aggregate, such as gravel, crushed stone, or coarse sand, so that moisture in the capillary property does not transfer to the top of the burial layer.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QUSTIONS OF LECTURE TWO

Q1/ What is the meaning of Earthwork, what are its types?

Q2/What is the meaning of Earthwork Excavations, what are its include, what are its performed and what are the factors which the drilling method depend on?

Q3/What are the most known methods used in Groundwater drainage from construction sites ?explain briefly.

Q4/ What are the Advantages and Disadvantages of Drainage by pumping which used in Groundwater drainage from construction sites ?

Q5/ What is well points system method and What are the points that must be taken into account when resorting to the well points system method?

Q6/ What are the information must be collected before Design of Well-Point System of Dewatering?

Q7/ What is well points system method and What are the Advantages of Well Point System and What are its limitations ?

Q8/What are the reasons of Soil fill up and soil compacting in construction projects?