5.1 AGRICULTURAL DRAINAGE

Drainage is the artificial removal of water from the cropped fields within the tolerance limit of the crops in the area under consideration

5.1.1 DRAINAGE PROBLEM

Excess rain fall or by over irrigation of upper fields will normally drain in to the lower fields by the action of gravity.

When the lower fields does not have proper drainage facility water logging condition occurs.By the raising ground water table.

Presence of ground water table in the root zone affects the growth of roots

5.1.2 REQUIREMENTS

Leaching and reclamation of problem soils. The saline soils are reclaimed by incorporation of gypsum in the field with standing water and draining the field after three days

5.1.3 BENEFITS OF PROPER DRAINAGE:

Improvement of aeration within soils which results in better yields.

This is due to the fact that:

The crops can root more deeply

The choice of types of crops that can be planted is expanded

There will be fewer weeds

Efficiency in fertilizer use will be improved

Denitrification will be reduced

Grass swards will be better

5.1.4 ADDITIONAL BENEFITS

Easier access to the land

Greater bearing capacity in the land

The soil has better tilth and workability

Tillage operations can take place over a longer period of time

A better environment for micro-fauna (ex. Earthworms) is created which improves permeability

Crops can be grown earlier due to increases in soil temperature

5.1.5 DRAINAGE COEFFICIENT

Darcy’s law states that the velocity of flow in a porous medium is proportional to hydraulic gradient.

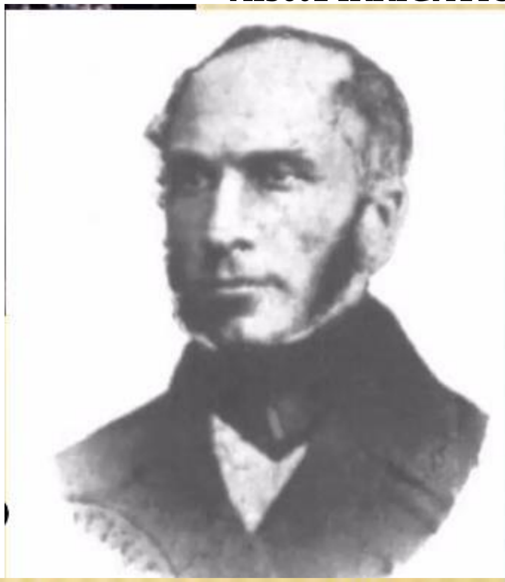
$$V \propto i$$

Where $i = \Delta h/\Delta L$

Introducing a constant of proportionality, K,

$$\mathbf{V = Ki} \text{ (or) } \mathbf{Q = AV = Ki}$$

Darcy's law describes the relationship between the instantaneous rate of discharge through a porous medium and pressure drop at a distance.



Henry Philibert Gaspard Darcy (1803–1858)

Seepage velocity

$$V_s = V_D (A/A_V)$$

Multiply by length of the soil medium $V_s = V_D(AL/A_VL) = V_D(V_T/V_V)$

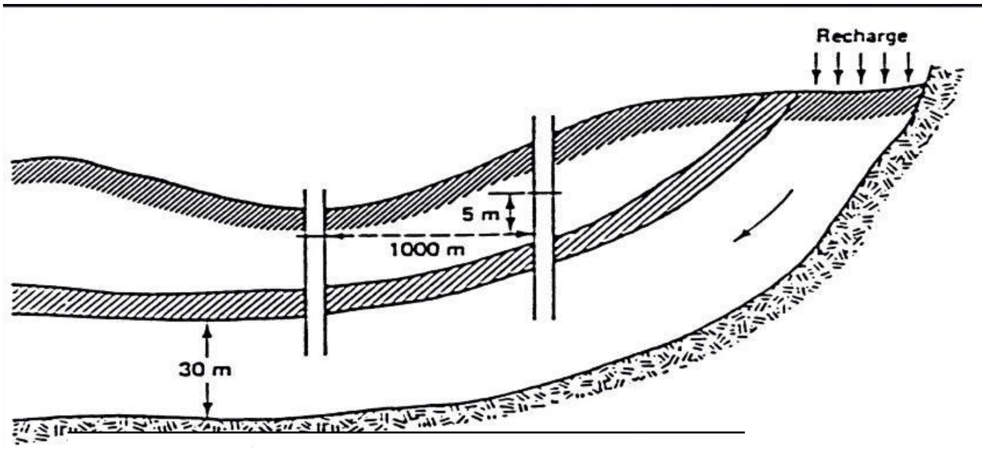
Where

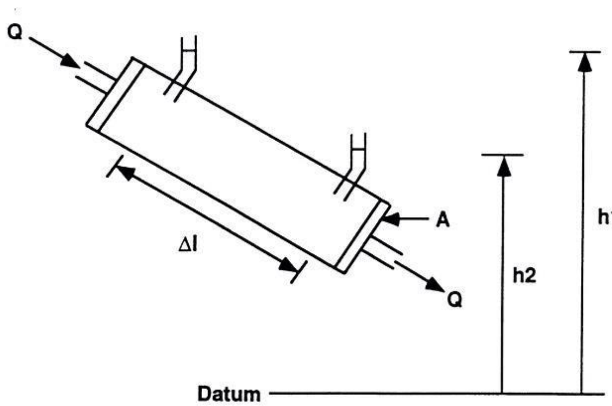
V_T=total volume

V_v=void volume

V_T/V_V=n, soil porosity

Thus $V_S = V_D/n$





Darcy’s law assumes and estimates

- The soil is homogeneous over a large area
- The flow is laminar through the soil
- The soil temperature is same over space

ESTIMATES…

- The velocity or flow rate moving within the aquifer
- The average time of travel from the head of the aquifer to a point located

downstream

Darcy law holds for

Saturated flow and unsaturated flow

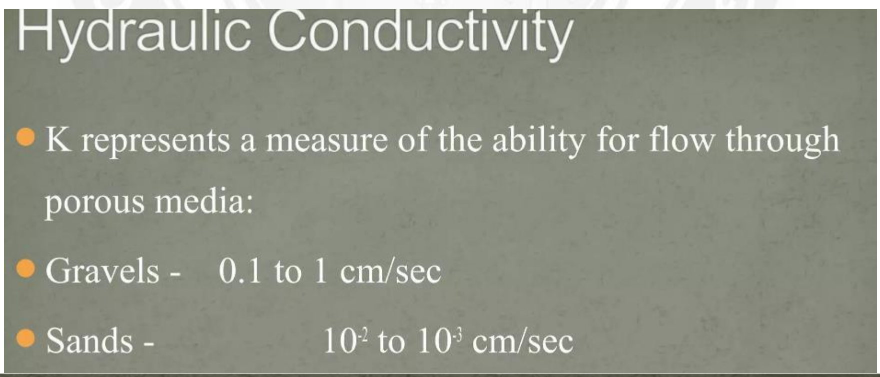
Steady state ad transient flow

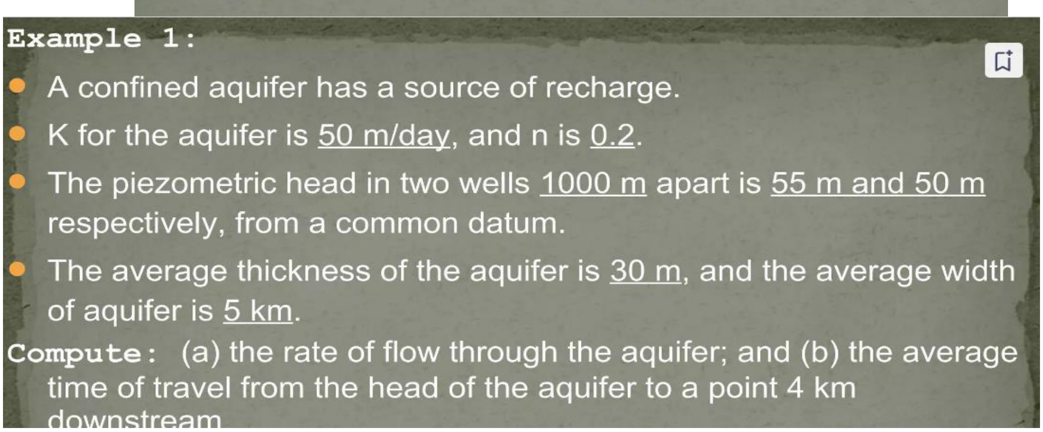
Flow in aquifers and aquitards

Flow in homogeneous and heterogeneous systems

Flow in isotropic and anisotropic media

Flow in rock and granular media





- Cross-Sectional area, A = (30) (5 x 1000) = $15 \times 10^4 m^2$
- Hydraulic gradient, i = (55-50)/1000 = 5×10^{-3}
- Rate of Flow for K = 50 m/day

  Q = K.i.A = (50 m/day) ($15 \times 10^4 m^2$) (5×10^{-3})

  = 37,500 m^3/day
- Darcy Velocity: V_D = Q/A

  = (37,500 m^3/day) / ($15 \times 10^4 m^2$)

  = 0.25 m/day

- Seepage Velocity:

  $V_s = V_D/n$ = (0.25) / (0.2)

  = 1.25 m/day (about 4.1 ft/day)
- Time to travel 4 km downstream:

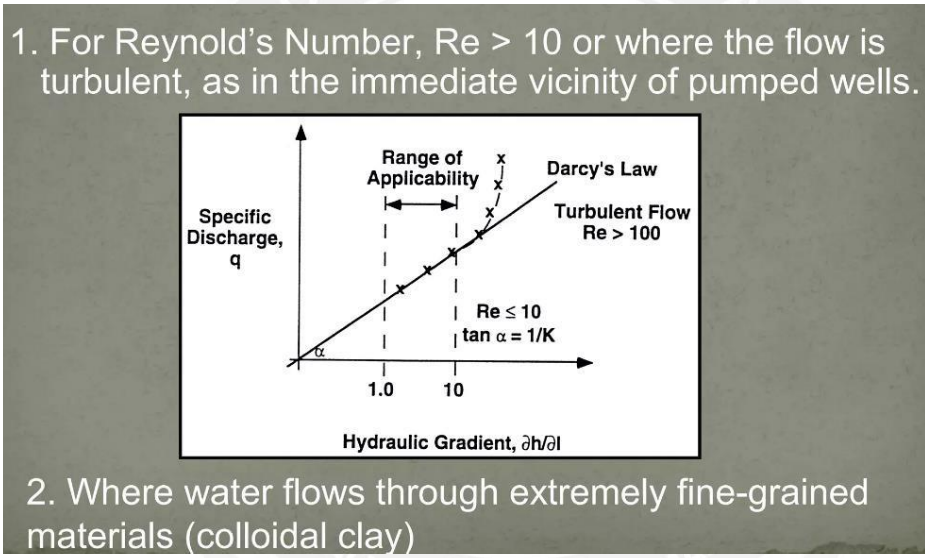
  since, Velocity = Distance/Time

  or Time = Distance/Velocity

  Time = (4 x1000 m) / (1.25 m/day)

  = 3200 days or 8.77 years
- *This example shows that water moves very slowly underground.*

5.1.6 LIMITATIONS OF DARCIAN APPROACH

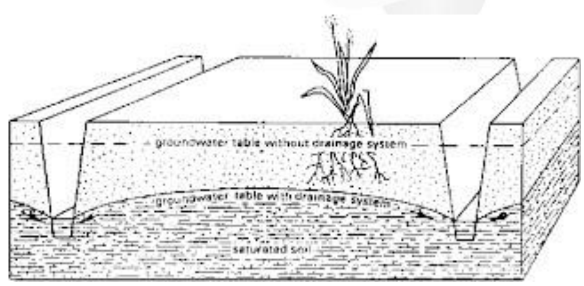


5.1.7 COMPONENTS OF DRAINAGE SYSTEM

A field drainage system.

A main drainage system

An outlet



This system is used to control the water table and prevent ponding. This component is the most important part of the drainage system. It is comprised of a network which gathers excess water from the land.

This is accomplished with the assistance of field drains.

This part of the drainage system brings the water away from the farm to the outlet point. The water comes from the field drainage system, surface runoff and groundwater flower using a main drain known as a canalized stream.

This means that there was an existing stream that was altered to improve the flow.

This is where the drainage water is led out of the area and discharged into another body of water (lake, river, sea). An outlet will either be gravity powered or require a pumping station.

If it is gravity powered, the water levels rise and fall.

An outlet will require a pumping station if the water levels in a drainage system are lower than the levels of the receiving body of water.

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