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LECTURER: Dr Keerthi Ranasinghe (k.ranasinghe@uwtsd.ac.uk)

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4 Dewatering & Drainage

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4.1 Dewatering

4.1.1 Dewatering theory

- Lower the water table in the vicinity of an excavation
- Provides safe and dry access
- Pumping from wells outside the area to be excavated
- The type of soil encountered – the particle sizes
- Thickness of permeable soil and the permeability of the soil

4.1.2 Flow/Pumping rate

- Correct estimation is not possible without a trial borehole
- Use of standpipes
- Series of wells as opposed to single large well
- Pumping from open excavations
- Well pointing
- Steady state and well losses

4.1.3 During operation

- Install dummy wells to monitor drawdown
- Achieve steady state before excavation work begins
- Pumping to continue until all permanent works are complete above the water level
- If the output gets lower, valves blocked. Reverse the process
- If the water table isn't steadily decreasing, or rising, air leaks in the system
- If the discharge continues to be coloured, soil is getting drawn in. Not good for surrounding structures

4.1.4 Electro-osmosis

- Used in silts and silt clays
- Capillary forces are present, prevents the free flow of water under gravity
- Steel rod as an anode and a filter well as a cathode
- The positively charged water flows to the filter well
- Alternative options are grouting or ground freezing

4.1.5 Recharge

- Lowering of water table reduces buoyancy of soil
- Can cause settlement
- To reduce, minimum amounts of water (recharge) are introduced back in to the system

4.1.6 Pumping Equipment

- Lift and force pump
 - Comprises a cylinder and a piston
 - Uses atmospheric pressure
- Centrifugal pumps
 - Rotation of an impeller
 - Uses atmospheric pressure
 - Spiral shaped casing
 - At discharge, area of flow increases, velocity of water decreases, the pressure will be high
- Submersible pumps
 - Centrifugal pump
 - Wear of the impeller blades due to particulate matter

4.2 Drainage

4.2.1 Drainage theory

- Dealing with excess water
- Urban storm drainage, land drainage and highway drainage
- Drainage vs flood mitigation
- Provides safe and dry access
- Pumping from wells outside the area to be excavated
- The type of soil encountered – the particle sizes
- Thickness of permeable soil and the permeability of the soil

4.2.2 Urban storm drainage

- Inlets, conduits, discharge (stream, rivers, lakes, ocean, infiltration ponds)
- Accumulated water to be discharged as close to the source as possible
- Gravity discharge, pumping plants
- Detention (retention) basins, synchronised discharge
- Ponding of streets
- Detailed contour maps (to highlight drainage)
- Underground facilities (gas, water, electricity, telephone, sewers)
- Above ground structures (buildings, canals, railway lines, roads)
- Soil structure below ground
- Flow estimates, storm return periods Vs damage
- 1 to 2 year return periods for residential and 5 to 10 years in commercial areas
- Rainfall data
- Computer simulations
- Gutters – discharge (shape, slope and roughness)
- Slope - longitudinal around 1 in 100, transverse around 1 in 20
- Velocity of flow usually prevents sedimentation
- Inlets – gutter flow is intercepted and directed to underground drainage systems
 - Grated inlets
 - Bars parallel to the curb
 - sufficient clear length
 - clear drop of water below the grate
 - surrounding paving can be shaped to encourage flow in to the inlet
 - hazard to cyclists
 - Bars perpendicular to curb is not as efficient
 - Curb-opening inlet
 - Requires change of direction of flow to enter the inlet
 - Ponding of water at the inlet is desirable (weirs and orifices)
 - Gutter bottom downstream of the inlet could be higher to allow ponding
- Manholes
 - Allows easy access to the pipe work and the drainage system
 - Changes in pipe sizes, slopes or the direction can be accommodated
 - Depending on the diameter of piping in between, may be required frequently
 - Brick, concrete (pre-cast), Metal, Fibreglass
 - Curved or sloping bottoms
 - Inlet designed to prevent splashback

4.2.3 Land drainage

- Removes excess water
- Reduces water table to facilitate plant growth
- Open ditches vs buried pipes
- Suitable soil conditions will allow lowering of the water table by using open ditches
- Drainage coefficient
- A trapezoidal cross section is most preferred
- Ditch bottoms should be designed to minimise scouring

4.2.4 Highway drainage

- Disposal without flooding the highway or the surrounding areas
- Should not interfere with the flow of natural channels in the surrounding area
- The flow away from the highway should prevent erosion of the shoulder or the embankment
- Shallow V shaped road-side ditches
- Bare earth will withstand up to a certain velocity of water without scouring
- Otherwise lining of the ditch to be provided
- When the flow is higher, intercept at regular intervals and divert to natural channels
- Around 1/4th cost of a highway is in the drainage
- Cross drainage facilities, embankment and ridges
 - Culverts,
 - Bridges
 - Dips

References Used:

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