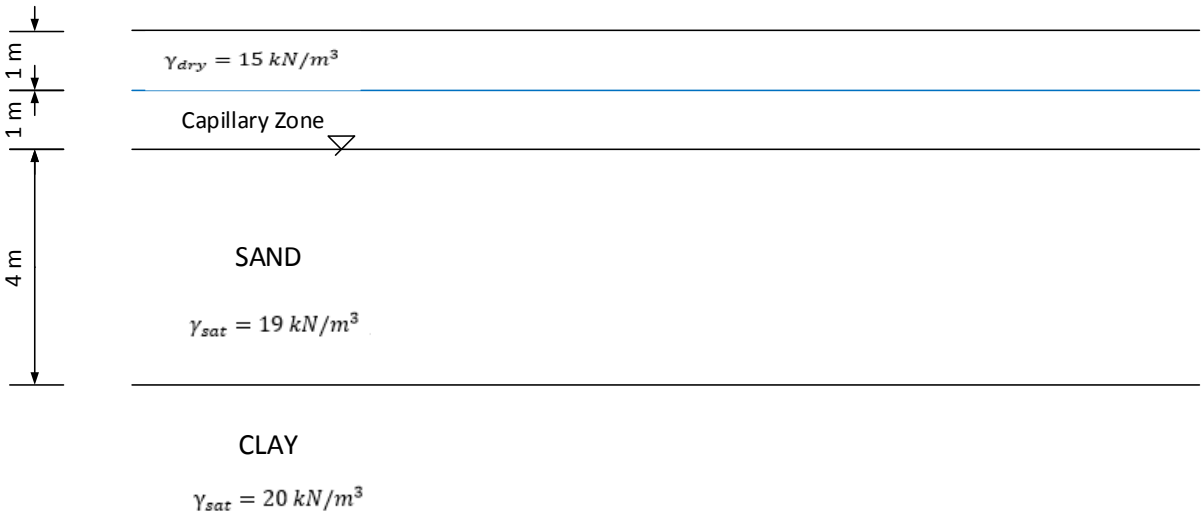
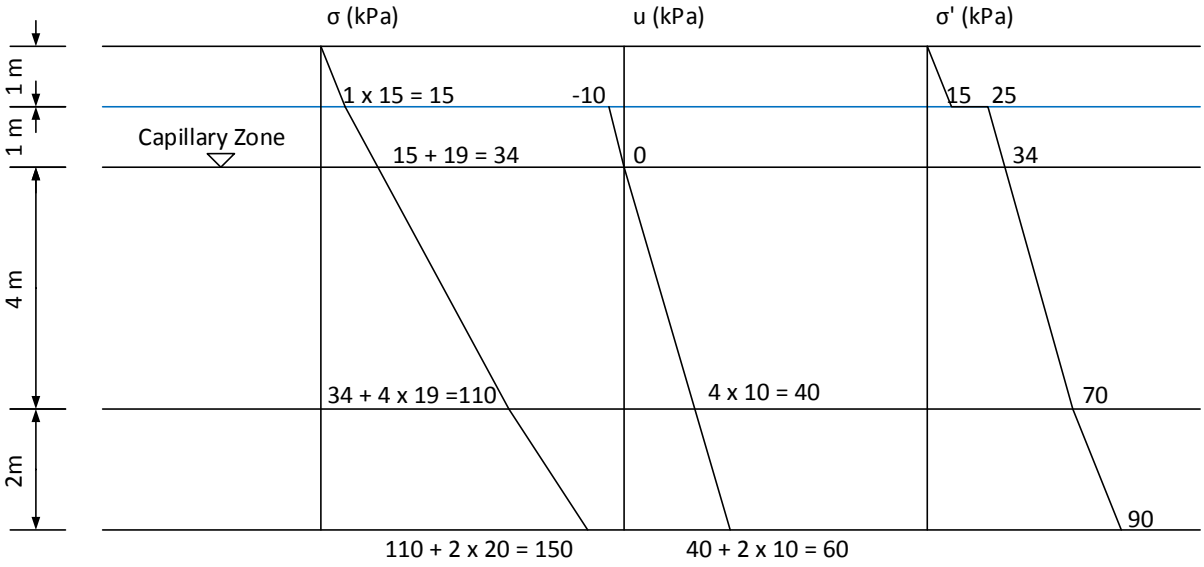
CE 363-364 Homework-2-Solution

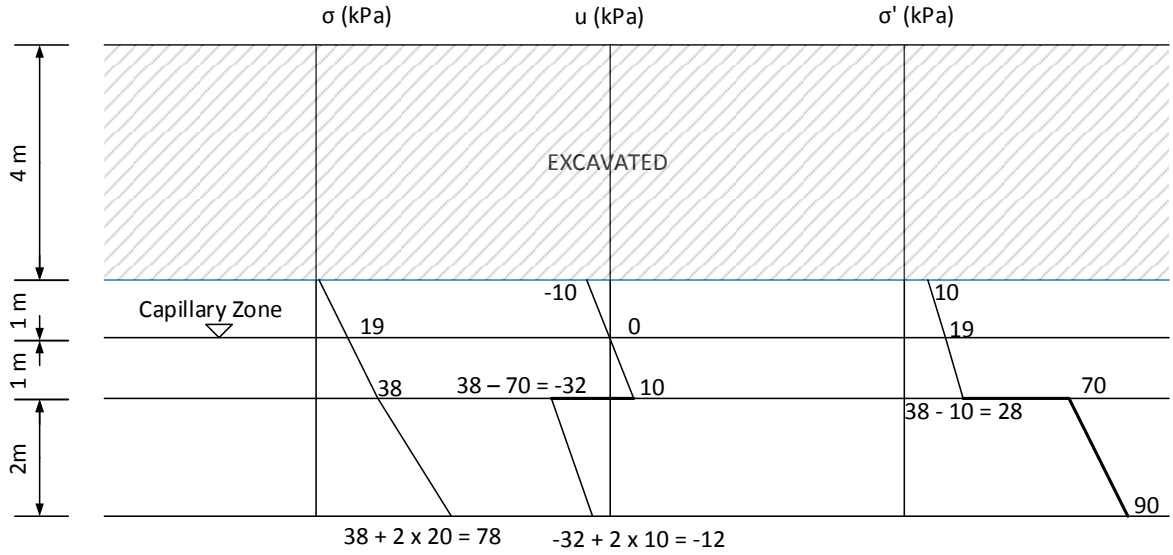
Question 1



a) Variation of total vertical stress, pore pressure and vertical effective stress with depth, down to the depth of 8 m,

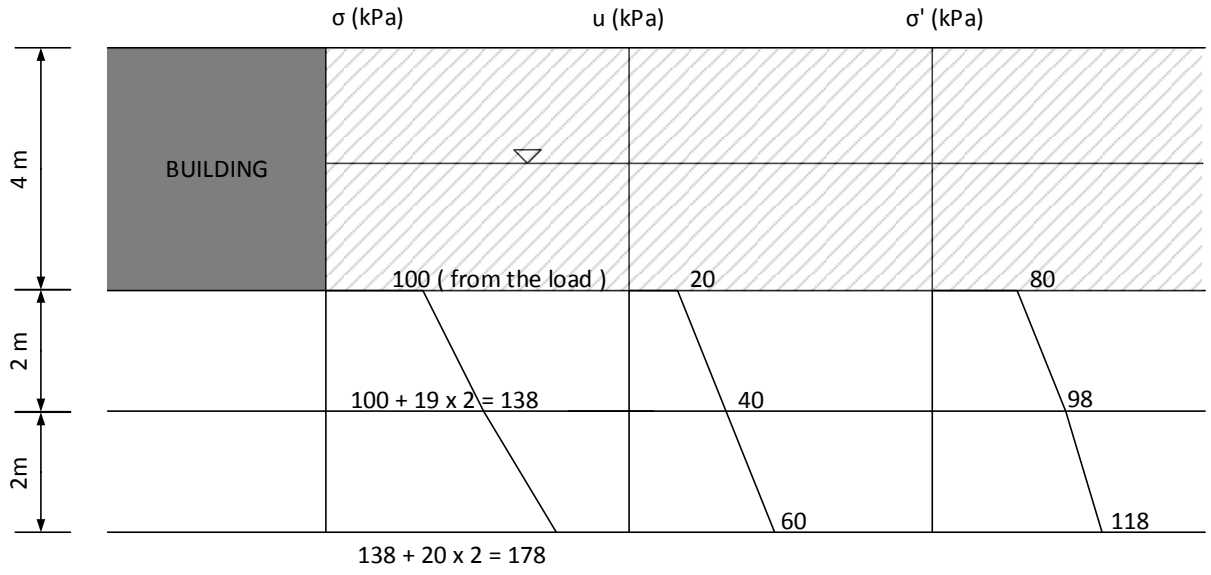


b) After groundwater lowering and excavation in a short time ,

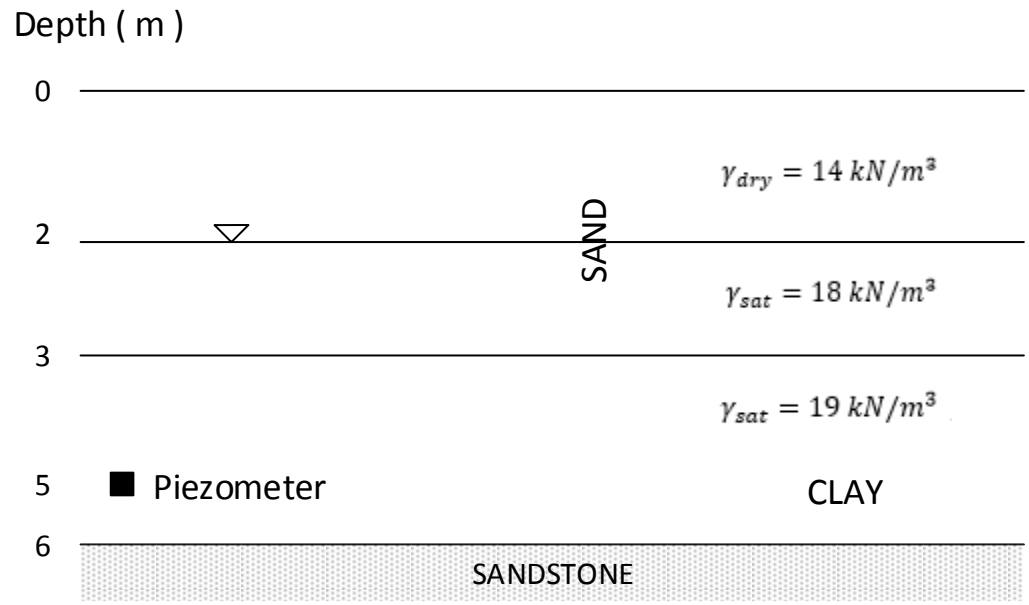


For clay (undrained soil) , same effective stress values (70 kPa to 90 kPa) as part a (before the stress change) are applied and pore pressure is calculated accordingly.

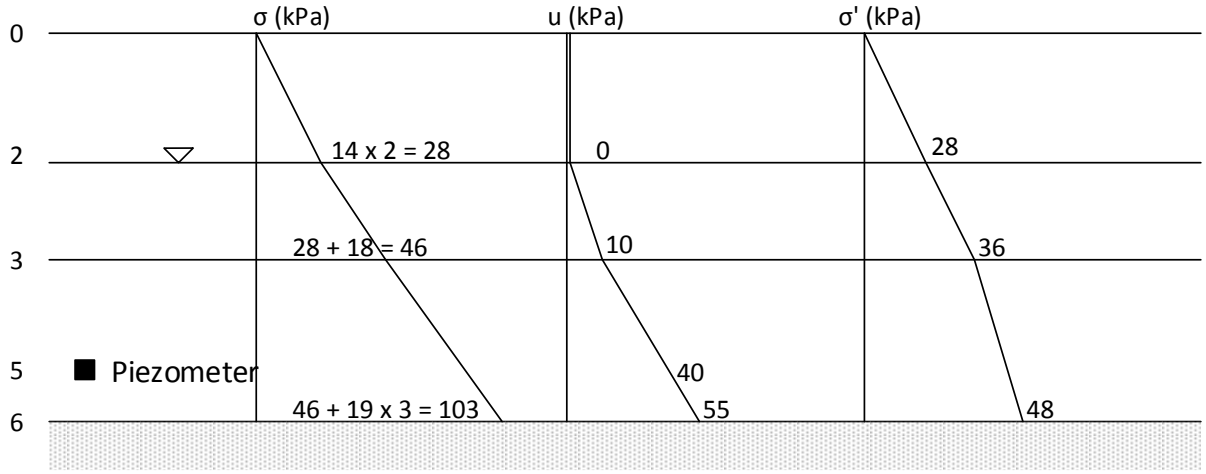
c) Long time after the building is completed and GW is at its original level



Question 2



a) Variation of total vertical stress, pore water pressure, and vertical effective stress with depth,



NOTE : i ⬆ in clay

The piezometer measures 40 kPa pore water pressure at a depth of 5 m. Since the pore water pressure changes linearly within the clay layer. Making necessary calculations lead to 55 kPa pore water pressure at the bottom :

$$From\ a\ depth\ of\ 3\ m\ to\ 5\ m\ , \frac{(\ 40\ kPa - 10\ kPa\ )}{2} = 15\ kPa\ increase\ per\ meter\ depth$$

$$At\ a\ depth\ of\ 6\ m\ , \qquad 40\ kPa + 15\ kPa = 55\ kPa$$

b) Immediately after the placement of the fill ,

$$Due\ to\ 2\ m\ thickness\ ,an\ additional\ pressure\ increase\ of$$

$$17kN/m^3\ *2\ m = 34kN/m\text{^}2\ \ is\ expected.$$

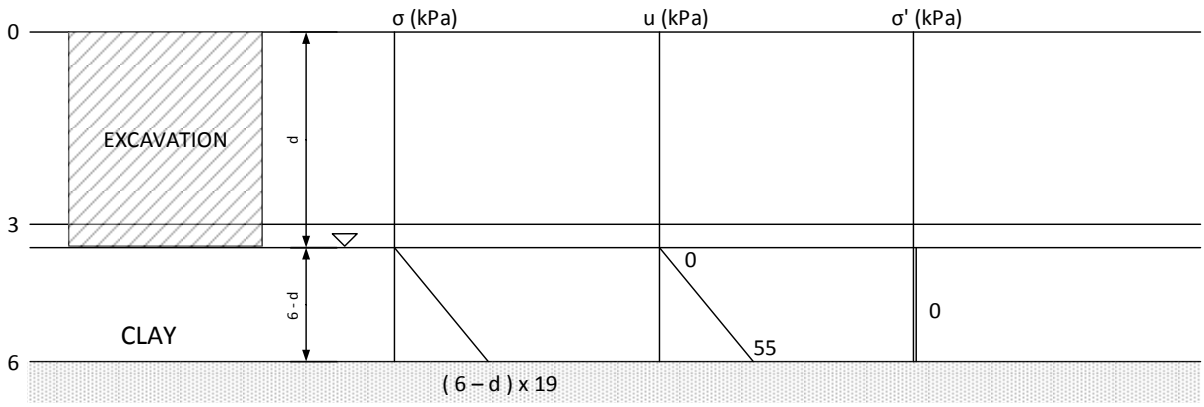
Since the estimation is done immediately after the placement of the fill, inside the clay layer (undrained case) effective stress remains constant and pore pressure changes accordingly :

$$40\ kPa + 34\ kPa = 74\ kPa\ is\ the\ estimated\ pore\ pressure\ value$$

c) Maximum depth of excavation without having instability at the bottom of excavation (the groundwater level is kept at the base of the excavation) ,

In order to provide stability, $\sigma' > 0$

At the bottom , u = 55 kPa is kept and since the GW is at the base of the excavation, from 0 to 55 kPa, there will be linear increase in the u. The total stress will also change linearly and we are trying to find the depth which makes effective stress is equal to zero.



$$For\ \sigma' > 0\ ,\sigma > u$$

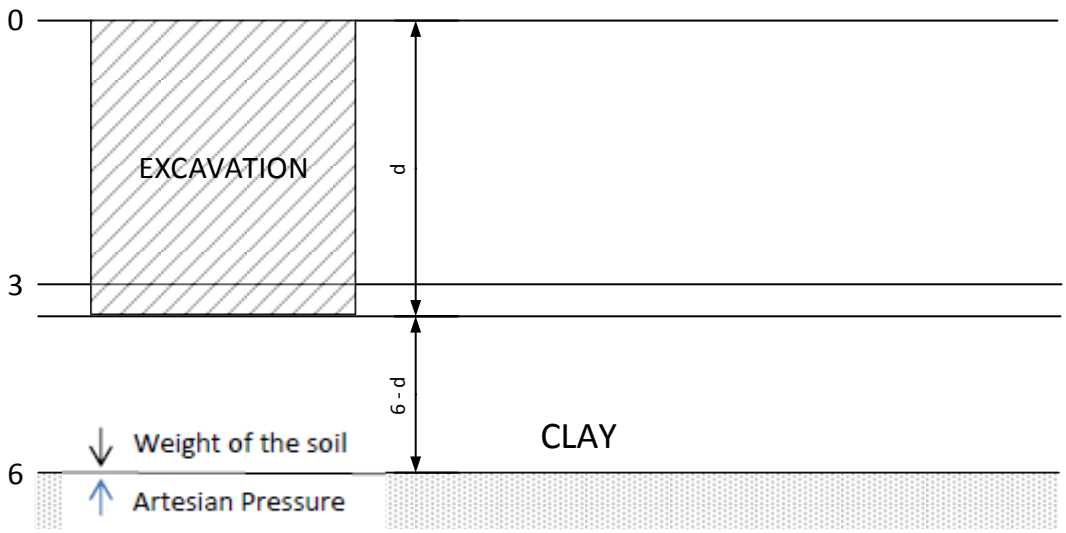
$$(\ 6 - d\ ) * 19kN/m^3 > 55\ kN/m^2$$

$$114 - 19\ d > 55$$

$$d < 3.1\ m$$

OR

The following drawing also shows the same condition ,



If Artesian Pressure (u) is equal to the weight of the soil (σ_v) , then effective stress (σ_v') becomes zero.