Coursework – Consolidation

The Figure shows a clay layer underlain by stiff, impermeable bedrock. Two buildings, represented by the strip loads shown, will be constructed. For convenience, assume that the founding plane is the ground surface. Both buildings will exert on their respective foundations a pressure of 50kPa. The load on each foundation is assumed to apply instantaneously at time t=0 and to remain constant afterwards.

1. Calculate the settlement vs time curve for each foundation and the final settlement. Also, determine the time by which 50% of the final settlement will have occurred.
2. Plot, versus depth and at key stages of the process, the components of flow velocity under the centre of one of the footings. Comment on the significance of the sand.

All soils have unit weight 20kN/m^3.

Sand parameters: Young's modulus 50MPa, Poisson's ratio v=0.3 and permeability $k_s=10^{-5}$ m/sec. A uniform value of e=1.0 may be used for the void ratio of the sand.

Clay parameters: Young's modulus 15MPa, Poisson's ratio v=0.3 and permeability $k_c=10^{-9}$ m/sec. A uniform value of e=1.0 may be used for the void ratio of the clay.

The groundwater level remains at the ground surface and the pore pressure is initially hydrostatic. Disregard gravity loads and initial effective stresses and pore pressures, and solve the problem starting from zero effective stress and pore pressure.

State clearly and justify all assumptions you make. Present your results in no more than 5 pages, and probably fewer. You will need to decide the distance of the boundaries and the boundary conditions applicable, the element to use, and the mesh. More than one models will be needed: e.g. you should systematically vary mesh refinement to demonstrate that your solution has converged.

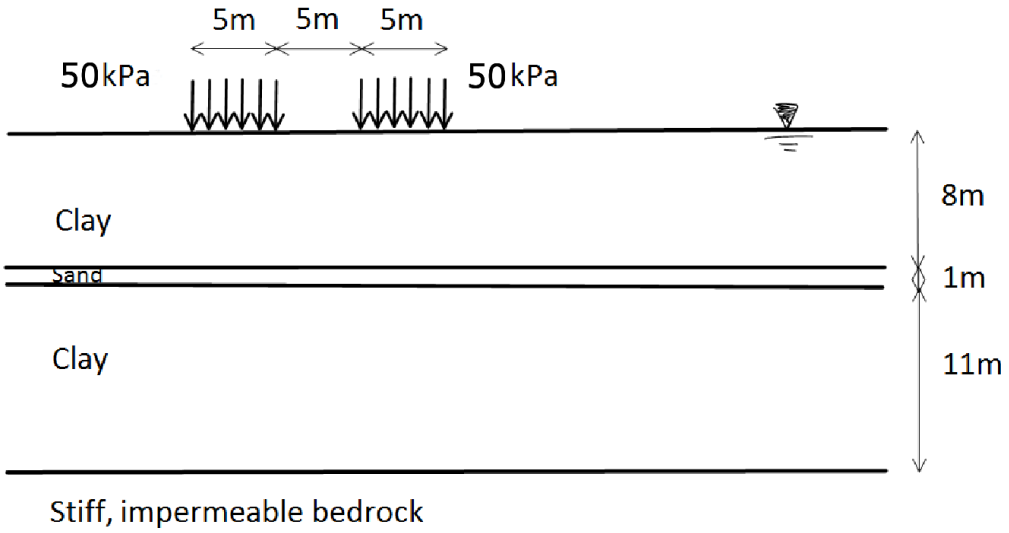

Figure: A soil profile loaded by two strip footings.