

Assignment -2 (Consolidation)

Part-I (Questions from Qureshi's Book)

Solved Examples: 7.1, 7.2, 7.3, 7.5, 7.6, 7.7, 7.8, 7.9

Exercise Problems: 7.1, 7.6 to 7.11.

Part-II

Q-1: A strata of normally consolidated clay of 3 m thick is drained on both sides. It has a coefficient of permeability $k=5 \times 10^{-8}$ cm/sec and a coefficient of volume change $m_v=125 \times 10^{-2}$ cm²/kN. Determine the ultimate value of the compression of the strata by assuming distributed load of 250 kN/m² and also determine the time required for 20% and 80% consolidation.

Q-2: An oedometer test is performed on a 2 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation be achieved in the field where the clay layer is 3.7 m thick? Assume the sample and the clay layer have the same drainage boundary conditions (double drainage).

Q-3: A laboratory sample of clay 2 cm thick took 15 min to attain 60% consolidation under double drainage condition. What time will be required to attain the same degree of consolidation for a clay layer 3 m thick which under the foundation of a building for a similar loading drainage condition, what is value of C_v ?

Q-3: A laboratory sample of clay 2 cm thick took 15 min to attain 60% consolidation under double drainage condition. What time will be required to attain the same degree of consolidation for a clay layer 3 m thick which under the foundation of a building for a similar loading drainage condition, what is value of C_v ?

Q-4: A stratum of normally loaded clay of 7m thick is located at a depth of 12 m below ground level. The natural moisture content of the clay is 43% and its liquid limit is 48%. The specific gravity of the solid particles is 2.76. The water table is located at a depth of 5 m below the ground surface. The soil is sand above the clay stratum. The submerged unit weight of sand is 11 kN/m^3 and the same weighs 18 kN/m^3 above water table. The average increase in pressure at the centre of the clay stratum is 120 kN/m^2 due to the weight of a building that will be constructed on the sand above the clay stratum. Estimate the expected settlement of the structure.

Q-5: A column of a building carries a load of 4000 kN. The load is transferred to subsoil through a square footing of size 5x5 m founded at a depth of 2 m below ground level. The soil below the footing is fine sand up to 5 m and below this is a soft compressible clay soil of thickness 5 m. The water table is found at a depth of 2 m below the base of the footing. The specific gravities of the solid particles of sand and clay are 2.64 and 2.72 and their natural moisture contents are 25 and 40%, respectively. The sand above the water table may be assumed to remain saturated. The plastic limit and the plasticity index of clay soil are 30 and 40%, respectively. Estimate the probable settlement of the footing if the average increase in stress at the centre of the clay layer is 0.4 times the contact pressure at the footing base.

Q-6: Soil investigation at a site gave the following information. Topsoil up to a depth of 10.6 m is fine sand, and below this lies soft clay layer of 7.6 m thick. The water table is at 4.6 m below the ground surface. The submerged unit weight of sand is 10.4 kN/m^3 , and the wet unit weight above water table is 17.6 kN/m^3 . The natural water content of the normally consolidated clay is 40%, its liquid limit is 45% and specific gravity of the solid particles is 2.78. The proposed construction will transmit a net stress of 120 kN/m^2 . Estimate the average settlement of the clay layer.

Q-7: The effective overburden pressure at the middle of a saturated clay layer 4 m thick is 10 T/m^2 , and is drained both sides. The overburden pressure at the middle of the clay layer is expected to be increased by 150 kN/m^2 due to the load from a building structure at the ground surface. An undisturbed sample of clay 20 mm in thickness is tested in a consolidometer. The total change in thickness of the specimen is 0.8 mm when the applied pressure is 100 kN/m^2 . The final water content of the sample is 24% and the specific gravity of the solid is 2.72. Estimate the probable settlement of the proposed structure.

Q-8: Two points on a curve for normally consolidated clay have the following coordinates.

$$\begin{array}{ll} \text{Point 1: } e_1=0.7, & p_1=1.0 \text{ kg/cm}^2 \\ \text{Point 2: } e_2=0.6, & p_2=3.0 \text{ kg/cm}^2 \end{array}$$

If the average overburden pressure on a 6 m thick clay layer is 1.5 kg/cm^2 , how much settlement the clay layer experience due to additional load intensity of 1.6 kg/cm^2 .

Q-9: A consolidation test is performed on a representative sample taken from a 12 m thick clay layer and following parameters were obtained:

$$p_c=190 \text{ kPa}; \quad C_r=0.022; \quad C_c=0.262; \quad e_o=0.725$$

If the existing overburden pressure at the centre of the clay layer $p_o=130 \text{ kPa}$ and the additional pressure at the centre of the clay layer due to the structural load is 220 kPa , compute the total settlement due to the primary consolidation.

Q-10: A soil sample has a compression index of 0.3. If the void ratio e at a stress of 1.4 kg/cm^2 is 0.5, compute (i) the void ratio if the stress is increased to 2 kg/cm^2 , and (ii) the settlement of a soil stratum of 4 m thick.