

- A cylindrical specimen of 72.65mm diameter and 145.3 mm height needs to be prepared at a target moisture content of 16% and maximum dry unit weight of 15.51 kN/m^3 . 14.34 N of soil was taken from a bucket containing 85.96 N of soil and was mixed with 2 N of water in a mixing bowl. The soil and water were mixed thoroughly to form a homogeneous mixture and 1.11 N subsample of the mixture was oven-dried to determine the water content of the mixture. The water content of the subsample was found out to be 17%. Looking at this discrepancy between actual water content of the mixture and target water content, it was realized that the 14.34 N of soil was in air-dried condition and had some residual water content even before addition of 3 N of water. Specific gravity of soil solids is 2.7, unit weight of water is 9.81 kN/m^3 . Based on the aforementioned information:

 - What was the residual water content of the air-dried soil?
 - How much air-dried soil needs to be added to 15.23 N of the prepared soil-water mixture to attain the target water content?

[15M]

- A footing with dimension 2m x 2m is transmitting a load of 600 kN on to the ground (clay layer) as shown in Fig. 1. Another footing adjacent to the existing footing is to be constructed in close vicinity. The size of the new footing is 1.5m x 1.5m. Determine the maximum load which can be applied to the new footing if the differential settlement is to be restricted to 5% of the total settlement of existing footing. Assume a trapezoidal stress distribution and divide the clay layer into four sub layers of 1 m thickness. The depth of the footing and the water table are located at 2.5m below the ground surface. There is no overlap between the stress distribution zone of the two footings.

[12M]

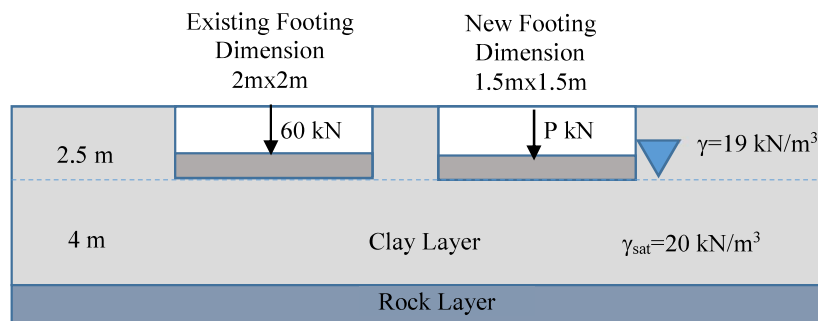


Fig. 1. Footings subjected to loads resting on clay layer

3. An embankment was constructed by compacting soil collected from a borrow site. The in-situ density of the soil at borrow site was determined using core-cutter method as per IS Standards. The weight of the core-cutter was 9.61 N and weight of the core-cutter with soil was 26 N. A representative sample of moist soil was collected from the core in a metallic can weighing 20 g. The can filled with moist soil weighed 64 g whereas a mass loss of 4 g was recorded 24 hours after oven drying. Excavation of borrow soil resulted in a bulk volume increase of 30%. This borrow soil was transported by dump trucks and deposited at the site in lifts of 0.9 m. Assuming an average moisture loss of 2% during transportation, estimate the volume of water that had to be added to the soil surface to reach the target moisture content of 16%. Report thickness of soil layer after compaction that ensures minimum dry density of 16.5 kN/m^3 . Specific gravity of soil solids = 2.65. **[12M]**
4. The consolidation settlement for an office building constructed over a 5 m thick clay layer was estimated to be 12 cm. At the end of 6 months of construction, the settlement of the structure was noted to be 2 cm. If the clay layer is overlain by a layer of coarse sand and underlain by an impervious rock, determine
- Time required for 50 % consolidation
 - Total settlement at the end of 1 year of construction (in mm)
- [6M]**
5. Explain the lubrication theory for the compaction curve. In which type of soil will you prefer compaction by sheep foot rollers? **[3M]**
6. With the help of a Mohr Circle sketch, highlight the difference between the UU, CU and CD tests. Highlight the field conditions in which each of the tests are applicable. What is the time required for each test? **[5M]**
7. Define the term overconsolidation ratio (OCR). How does the OCR help in differentiating between overconsolidated and normally consolidated clays? **[3M]**
8. Considering the water table to be located at mid-depth of a soil layer, prove the following statements. Detailed steps with diagrams and assumptions needs to be clearly highlighted.
- Effective stress decreases when the water table rises to the ground surface
 - If the water table rises above the ground surface, the effective stress remains the same as observed in case (a) above.
- [4M]**