

1. Drive an expression for ρ_s in terms of porosity (n) and the water content (ω) for:
 - a. a fully saturated soil
 - b. a partially saturated soil

2. A sensitive volcanic clay soil was tested in the laboratory and found to have the following properties:
 - . $\rho = 1.28 \text{ Mg/m}^3$
 - . $e = 9.0$
 - . $S = 95\%$
 - . $\rho_s = 2.75 \text{ Mg/m}^3$
 - . $\omega = 311\%$

In rechecking the above values, one was found to be inconsistent with the rest. Find the inconsistent value and report it correctly. Show all your computations and phase diagrams.

3. For a sandy soil, $e_{max} = 0.75$, $e_{min} = 0.52$, and $G_s = 2.70$. What are the void ratio and the dry unit weight (in lb/ft^3) at $D_r = 65\%$.

4. A loose, uncompacted sand fill is 2 m in depth and has a relative density of 40%. Laboratory tests indicate that the minimum and maximum void ratios of the sand are 0.46 and 0.90, respectively. The specific gravity of solids of the sand is 2.65.
 - a. What is the dry unit weight of the sand?
 - b. If the sand is compacted to a relative density of 80%, what is the decrease in thickness of the 2 m fill.

5. An embankment for a highway is to be constructed from a soil compacted to a dry unit weight of 18.2 kN/m^3 . The clay has to be trucked to the site from a borrow pit. The bulk unit weight of the soil in the borrow pit is 17.5 kN/m^3 and its natural water content is 6%. Calculate the volume of clay from the borrow pit required for 1 cubic meter of embankment. Assume $G_s = 2.72$.

6. A proposed embankment fill require $8,200 \text{ m}^3$ of compacted soil. The void ratio of the compacted fill is specified as 0.7. Four borrow pits are available as described in the following table, which lists the respective void ratios of the soil and the cost per cubic meter for moving the soil to the proposed construction site. Make the necessary calculations to select the pit from which the soil should be bought to minimize the cost. Assume G_s to be the same at all pits.

Borrow pit	Void ratio	Cost (\$/m³)
A	<i>0.82</i>	<i>11.50</i>
B	<i>1.10</i>	<i>10.00</i>
C	<i>0.90</i>	<i>12.50</i>
D	<i>0.78</i>	<i>15.00</i>

7. For an inorganic soil, the following grain-size analysis is given:

U.S. Sieve No.	Percent Passing
4	<i>100</i>
10	<i>90</i>
20	<i>64</i>
40	<i>38</i>
80	<i>18</i>
200	<i>13</i>

- Plot GSD curve by using a computer program.
- Determine C_u and C_c .
- Find out whether the soil is well graded or poorly graded.