

Shanghai Normal University

Tutorial (T02) - Phase relationships

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May 2025

1. A sample of wet soil in a metallic tin has a mass of 450g. After drying in an oven overnight, the sample and tin have a mass of 368g. The mass of the dish alone is 24g. Calculate the water content (w) of the sample.
2. A sample of sand has a bulk density (ρ_t) of 1.8 Mg/m^3 and a water content (w) of 25%. Calculate e , n , S , ρ_d , ρ_{sat} and ρ' . Assume that $V_s = 1.0 \text{ m}^3$.
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4. Derive an expression for the porosity (n) in terms of the void ratio (e)
5. A soil has a unit weight (γ_s) of 26.5 kN/m^3 and a bulk unit weight (γ_t) of 18.0 kN/m^3 . The void ratio (e) was found to be 1.06 and the water content (w) was calculated as 40%. Is the soil saturated? NOTE: Use $g = 10 \text{ m/s}^2$ in your calculations.
6. A sensitive volcanic clay soil tested in the laboratory was found to have the following properties: a) $\rho_s = 2.60 \text{ Mg/m}^3$, b) $\rho_t = 1.35 \text{ Mg/m}^3$, c) $w = 307\%$, d) $e = 9.5$ and e) $S = 84\%$. After reviewing the values one was found to be inconsistent. Which one?
7. The in-situ dry density of a sand is 1.75 Mg/m^3 . The maximum and minimum dry densities, determined by standard laboratory tests, are 1.85 and 1.45 Mg/m^3 . Determine the relative density of the sand.
8. A soil of total volume 200 ml contains 25 ml air and 30 ml water. Calculate the void ratio and the degree of saturation.
9. A soil has a porosity of 0.45. What is the void ratio?
10. A soil had a wet mass of 2.180 kg and occupied a volume of 1.2 litres. After oven drying the mass reduced to 1.890 kg. Calculate bulk density, moisture content and dry density.

11. A sample of saturated clay has a volume of 245 ml and after oven drying has a mass of 453g. If $G_s = 2.75$, determine the dry and saturated unit weights of the soil in its natural state.
12. A soil has a bulk density of $1.91 \text{ Mg}/\text{m}^3$ and a moisture content of 9.5%. The value of G_s is 2.70. Calculate the void ratio and degrees of saturation of the soil. What would be the values of density and moisture content if the soil were fully saturated at the same void ratio?
13. In its natural condition a soil sample has a mass of 2290 g and a volume of $1.15 \times 10^{-3} \text{ m}^3$. After being completely dried in an oven the mass of the sample is 2035 g. The value of G_s for the soil is 2.68. Determine the bulk density, unit weight, water content, void ratio, porosity, degree of saturation and air content.