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Soil Origin and Its Properties Formulas

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List of 31 Soil Origin and Its Properties Formulas

Soil Origin and Its Properties

1) Degree of Saturation given Dry Unit Weight of Soil

Open Calculator

fx $$S = \left(\left(\frac{\gamma_{dry}}{\gamma_{water}}\right) \cdot \left(\left(\frac{1}{G_s}\right) + w_s\right)\right)$$

ex $$0.615967 = \left(\left(\frac{6.12\text{kN/m}^3}{9.81\text{kN/m}^3}\right) \cdot \left(\left(\frac{1}{2.65}\right) + 0.61\right)\right)$$

2) Degree of Saturation of Soil

Open Calculator

fx $$S = \left(\frac{w_s \cdot G_s}{e_s}\right)$$

ex $$0.702826 = \left(\frac{0.61 \cdot 2.65}{2.3}\right)$$

3) Dry Unit Weight of Soil given Relative Density

Open Calculator

fx $$\gamma_{dry} = \left(\frac{\gamma_{min} \cdot \gamma_{max}}{\gamma_{max} - R_D \cdot (\gamma_{max} - \gamma_{min})}\right)$$

ex $$7.518797\text{kN/m}^3 = \left(\frac{5\text{kN/m}^3 \cdot 10\text{kN/m}^3}{10\text{kN/m}^3 - 0.67 \cdot (10\text{kN/m}^3 - 5\text{kN/m}^3)}\right)$$

4) Dry Unit Weight of Soil with any Degree of Saturation

Open Calculator

fx $$\gamma_{dry} = \left(\frac{\gamma_{water} \cdot G_s \cdot S}{1 + (w_s \cdot G_s)}\right)$$

ex $$5.961361 kN/m^3 = \left(\frac{9.81 kN/m^3 \cdot 2.65 \cdot 0.6}{1 + (0.61 \cdot 2.65)}\right)$$

5) Maximum Porosity given Relative Density in Porosity

Open Calculator

fx $$n_{max} = n_{min} \cdot \frac{R - (\eta \cdot R) - \eta + 1}{R - (\eta \cdot R) + n_{min} - 1}$$

ex $$0.896703 = 0.8 \cdot \frac{11 - (0.32 \cdot 11) - 0.32 + 1}{11 - (0.32 \cdot 11) + 0.8 - 1}$$

6) Maximum Unit Weight of Soil given Relative Density

Open Calculator

fx $$\gamma_{max} = \left(\frac{\gamma_{min} \cdot \gamma_{dry} \cdot R}{\gamma_{dry} \cdot (R - 1) + \gamma_{min}}\right)$$

ex $$5.084592 kN/m^3 = \left(\frac{5 kN/m^3 \cdot 6.12 kN/m^3 \cdot 11}{6.12 kN/m^3 \cdot (11 - 1) + 5 kN/m^3}\right)$$

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7) Maximum Void Ratio of Soil given Relative Density

Open Calculator

fx $$e_{max} = \frac{e_o - (R \cdot e_{min})}{1 - R}$$

ex $$0.28 = \frac{0.50 - (11 \cdot 0.30)}{1 - 11}$$

8) Minimum Porosity given Relative Density in Porosity

Open Calculator

fx $$n_{min} = n_{max} \cdot \frac{1 + (\eta \cdot R) - \eta - R}{n_{max} - \eta - R + (\eta \cdot R)}$$

ex $$0.909302 = 0.92 \cdot \frac{1 + (0.32 \cdot 11) - 0.32 - 11}{0.92 - 0.32 - 11 + (0.32 \cdot 11)}$$

9) Minimum Unit Weight of Soil given Relative Density

Open Calculator

fx $$\gamma_{min} = \left(\frac{\gamma_{dry} \cdot \gamma_{max} \cdot (R - 1)}{(R \cdot \gamma_{dry}) - \gamma_{max}} \right)$$

ex $$10.6769 \text{kN/m}^3 = \left(\frac{6.12 \text{kN/m}^3 \cdot 10 \text{kN/m}^3 \cdot (11 - 1)}{(11 \cdot 6.12 \text{kN/m}^3) - 10 \text{kN/m}^3} \right)$$

10) Minimum Void Ratio of Soil given Relative Density

Open Calculator

fx $$e_{min} = \left(e_{max} - \left(\frac{e_{max} - e_o}{R}\right)\right)$$

ex $$0.772727 = \left(0.80 - \left(\frac{0.80 - 0.50}{11}\right)\right)$$

11) Natural Void Ratio of Soil given Relative Density

Open Calculator

fx $$e_o = (e_{max} \cdot (1 - R_D) + (R_D \cdot e_{min}))$$

ex $$0.465 = (0.80 \cdot (1 - 0.67) + (0.67 \cdot 0.30))$$

12) Porosity Given Relative Density in Porosity

Open Calculator

fx $$\eta = \frac{n_{max} \cdot (1 - n_{min} - R_D) + R_D \cdot n_{min}}{1 - n_{min} + R_D \cdot n_{min} - R_D \cdot n_{max}}$$

ex $$0.866221 = \frac{0.92 \cdot (1 - 0.8 - 0.67) + 0.67 \cdot 0.8}{1 - 0.8 + 0.67 \cdot 0.8 - 0.67 \cdot 0.92}$$

13) Porosity of soil

Open Calculator

fx $$\eta = \left(\frac{V_v}{V}\right)$$

ex $$0.325 = \left(\frac{6.5\text{m}^3}{20\text{m}^3}\right)$$

14) Porosity of Soil given Void Ratio

Open Calculator

fx $$\eta = \left(\frac{e_s}{1 + e_s}\right)$$

ex $$0.69697 = \left(\frac{2.3}{1 + 2.3}\right)$$

15) Relative density given porosity

Open Calculator

fx $$R_D = \frac{(n_{max} - \eta) \cdot (1 - n_{min})}{(n_{max} - n_{min}) \cdot (1 - \eta)}$$

ex $$1.470588 = \frac{(0.92 - 0.32) \cdot (1 - 0.8)}{(0.92 - 0.8) \cdot (1 - 0.32)}$$

16) Relative Density of Cohesionless Soil given Unit Weight of Soil

Open Calculator

fx $$R_D = \frac{\left(\frac{1}{\gamma_{min}}\right) - \left(\frac{1}{\gamma_{dry}}\right)}{\left(\frac{1}{\gamma_{min}}\right) - \left(\frac{1}{\gamma_{max}}\right)}$$

ex $$0.366013 = \frac{\left(\frac{1}{5\text{kN/m}^3}\right) - \left(\frac{1}{6.12\text{kN/m}^3}\right)}{\left(\frac{1}{5\text{kN/m}^3}\right) - \left(\frac{1}{10\text{kN/m}^3}\right)}$$

17) Relative Density of Cohesionless Soil given Void Ratio

Open Calculator

fx $$R_D = \left(\frac{e_{max} - e_o}{e_{max} - e_{min}}\right)$$

ex $$0.6 = \left(\frac{0.80 - 0.50}{0.80 - 0.30}\right)$$

18) Specific Gravity of Soil given Degree of Saturation

Open Calculator

fx $$G_s = \left(\frac{S \cdot e_s}{w_s}\right)$$

ex $$2.262295 = \left(\frac{0.6 \cdot 2.3}{0.61}\right)$$

19) Total Volume of Soil using Porosity

Open Calculator

fx $$V = \left(\frac{V_v}{\eta}\right)$$

ex $$20.3125\text{m}^3 = \left(\frac{6.5\text{m}^3}{0.32}\right)$$

20) Void ratio of soil

Open Calculator

fx $$e_s = \left(\frac{V_v}{V_s}\right)$$

ex $$2.166667 = \left(\frac{6.5\text{m}^3}{3\text{m}^3}\right)$$

21) Void Ratio of Soil given Degree of Saturation

Open Calculator

fx $$e_s = \left(\frac{w_s \cdot G_s}{S}\right)$$

ex $$2.694167 = \left(\frac{0.61 \cdot 2.65}{0.6}\right)$$

22) Void Ratio of Soil given Porosity

Open Calculator

fx $$e_s = \left(\frac{\eta}{1-\eta}\right)$$

ex $$0.470588 = \left(\frac{0.32}{1-0.32}\right)$$

23) Volume of Voids using Porosity

Open Calculator

fx $$V_v = (\eta \cdot V)$$

ex $$6.4\text{m}^3 = (0.32 \cdot 20\text{m}^3)$$

24) Water Content of Soil given Degree of Saturation

Open Calculator

fx $$w_s = \left(\frac{S \cdot e_s}{G_s}\right)$$

ex $$0.520755 = \left(\frac{0.6 \cdot 2.3}{2.65}\right)$$

Degree of Saturation

25) Air Content with Respect to Degree of Saturation

Open Calculator

fx $a_c = 1 - S$

ex $0.4 = 1 - 0.6$

26) Buoyant Unit Weight of Soil with Saturation 100 Percent

Open Calculator

fx $\gamma_b = \left(\frac{(G_s \cdot \gamma_{water}) - \gamma_{water}}{1 + e}\right)$

ex $7.3575 kN/m^3 = \left(\frac{(2.65 \cdot 9.81 kN/m^3) - 9.81 kN/m^3}{1 + 1.2}\right)$

27) Degree of Saturation given Air Content with Respect to Degree of Saturation

Open Calculator

fx $S = 1 - a_c$

ex $0.6 = 1 - 0.4$

28) Degree of Saturation given Void Ratio in Specific Gravity

Open Calculator

fx $S = w_s \cdot \frac{G_s}{e}$

ex $1.347083 = 0.61 \cdot \frac{2.65}{1.2}$

29) Degree of Saturation of Soil Sample

Open Calculator

fx $$S = \left(\frac{Vw}{Vv}\right)$$

ex $$0.666667 = \left(\frac{2m^3}{3m^3}\right)$$

30) Volume of Voids given Degree of Saturation of Soil Sample

Open Calculator

fx $$Vv = \frac{Vw}{S}$$

ex $$3.333333m^3 = \frac{2m^3}{0.6}$$

31) Volume of Water given Degree of Saturation of Soil Sample

Open Calculator

fx $$Vw = S \cdot Vv$$

ex $$1.8m^3 = 0.6 \cdot 3m^3$$

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Variables Used

- a_c Air Content
- e Void Ratio
- e_{max} Maximum Void Ratio
- e_{min} Minimum Void Ratio
- e_o Natural Void Ratio
- e_s Void Ratio of Soil
- G_s Specific Gravity of Soil
- n_{max} Maximum Porosity
- n_{min} Minimum Porosity
- R Relative Density
- R_D Relative Density in Soil Mechanics
- S Degree of Saturation
- V Volume of Soil *(Cubic Meter)*
- V_s Solid Volume *(Cubic Meter)*
- V_v Volume of Voids *(Cubic Meter)*
- Vv Void Space Volume *(Cubic Meter)*
- Vw Volume of Water *(Cubic Meter)*
- w_s Water Content of Soil from Pycnometer
- γ_b Buoyant Unit Weight *(Kilonewton per Cubic Meter)*
- γ_{dry} Dry Unit Weight *(Kilonewton per Cubic Meter)*
- γ_{max} Maximum Unit Weight *(Kilonewton per Cubic Meter)*

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- γ_{min} Minimum Unit Weight *(Kilonewton per Cubic Meter)*
- γ_{water} Unit Weight of Water *(Kilonewton per Cubic Meter)*
- η Porosity of Soil

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Constants, Functions, Measurements used

- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
  Specific Weight Unit Conversion

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- Bearing Capacity for Strip Footing for C-Φ Soils Formulas
- Bearing Capacity of Cohesive Soil Formulas
- Bearing Capacity of Non-cohesive Soil Formulas
- Bearing Capacity of Soils: Meyerhof's Analysis Formulas
- Foundation Stability Analysis Formulas
- Atterberg Limits Formulas
- Bearing Capacity of Soil: Terzaghi's Analysis Formulas
- Compaction of Soil Formulas
- Earth Moving Formulas
- Lateral Pressure for Cohesive and Non Cohesive Soil Formulas
- Minimum Depth of Foundation by Rankine's Analysis Formulas
- Pile Foundations Formulas
- Scraper Production Formulas
- Seepage Analysis Formulas
- Slope Stability Analysis using Bishops Method Formulas
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