Important Soil Origin and Its Properties Formulas PDF

Formulas
Examples
with Units

List of 31
Important Soil Origin and Its Properties Formulas

1) Degree of Saturation given Dry Unit Weight of Soil Formula

Evaluate Formula

Formula

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

Example with Units

$$0.616 = \left(\left(\frac{6.12\,\text{kN/m}^3}{9.81\,\text{kN/m}^3}\right) \cdot \left(\left(\frac{1}{2.65}\right) + 0.61\right)\right)$$

2) Degree of Saturation of Soil Formula

Evaluate Formula

Formula

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

Example

$$0.7028 = \left(\frac{0.61 \cdot 2.65}{2.3}\right)$$

3) Dry Unit Weight of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example with Units

$$7.5188\,\text{kN/m}^3 = \left(\frac{5\,\text{kN/m}^3 \cdot 10\,\text{kN/m}^3}{10\,\text{kN/m}^3 - 0.67 \cdot \left(10\,\text{kN/m}^3 - 5\,\text{kN/m}^3\right)}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

$$5.9614\,\text{kN/m}^3 = \left(\frac{9.81\,\text{kN/m}^3 \cdot 2.65 \cdot 0.6}{1 + \left(0.61 \cdot 2.65\right)}\right)$$

5) Maximum Porosity given Relative Density in Porosity Formula

Evaluate Formula

Formula

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

Example

$$0.8967 = 0.8 \cdot \frac{11 - (0.32 \cdot 11) - 0.32 + 1}{11 - (0.32 \cdot 11) + 0.8 - 1}$$

6) Maximum Unit Weight of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example with Units

$$5.0846\,\text{kN/m}^3 = \left(\frac{5\,\text{kN/m}^3 \cdot 6.12\,\text{kN/m}^3 \cdot 11}{6.12\,\text{kN/m}^3 \cdot (11 - 1) + 5\,\text{kN/m}^3} \right)$$

7) Maximum Void Ratio of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example

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

8) Minimum Porosity given Relative Density in Porosity Formula

Evaluate Formula

Formula

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

Example

$$0.9093 = 0.92 \cdot \frac{1 + (0.32 \cdot 11) - 0.32 - 11}{0.92 - 0.32 - 11 + (0.32 \cdot 11)}$$

9) Minimum Unit Weight of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example with Units

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

10) Minimum Void Ratio of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example

$$0.7727 = \left(0.80 - \left(\frac{0.80 - 0.50}{11} \right) \right)$$

11) Natural Void Ratio of Soil given Relative Density Formula

Evaluate Formula

Formula

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

Example

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

12) Porosity Given Relative Density in Porosity Formula

Evaluate Formula

Formula

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

Example

$$0.8662 = \frac{0.92 \cdot \left(1 - 0.8 - 0.67 \right) + 0.67 \cdot 0.8}{1 - 0.8 + 0.67 \cdot 0.8 - 0.67 \cdot 0.92}$$

13) Porosity of soil Formula

Evaluate Formula

Formula

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

Example with Units

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

14) Porosity of Soil given Void Ratio Formula

Evaluate Formula

Formula

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

Example

$$0.697 = \left(\frac{2.3}{1 + 2.3} \right)$$

15) Relative density given porosity Formula

Evaluate Formula

Formula

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

Example

$$1.4706 = \frac{\left(0.92 - 0.32 \right) \cdot \left(1 - 0.8 \right)}{\left(0.92 - 0.8 \right) \cdot \left(1 - 0.32 \right)}$$

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

Evaluate Formula

Formula

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

Example with Units

$$0.366 = \frac{\left(\frac{1}{5\,\text{kN/m}^3} \right) - \left(\frac{1}{6.12\,\text{kN/m}^3} \right)}{\left(\frac{1}{5\,\text{kN/m}^3} \right) - \left(\frac{1}{10\,\text{kN/m}^3} \right)}$$

17) Relative Density of Cohesionless Soil given Void Ratio Formula

Evaluate Formula

Formula

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

Example

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

18) Specific Gravity of Soil given Degree of Saturation Formula

Evaluate Formula

Formula

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

Example

$$2.2623 = \left(\frac{0.6 \cdot 2.3}{0.61} \right)$$

19) Total Volume of Soil using Porosity Formula

Evaluate Formula

Formula

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

Example with Units

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

20) Void ratio of soil Formula

Evaluate Formula

Formula

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

Example with Units

$$2.1667 = \left(\frac{6.5\,\text{m}^3}{3\,\text{m}^3} \right)$$

21) Void Ratio of Soil given Degree of Saturation Formula

Evaluate Formula

Formula

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

Example

$$2.6942 = \left(\frac{0.61 \cdot 2.65}{0.6} \right)$$

22) Void Ratio of Soil given Porosity Formula

Evaluate Formula

Formula

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

Example

$$0.4706 = \left(\frac{0.32}{1 - 0.32} \right)$$

23) Volume of Voids using Porosity Formula

Evaluate Formula

Formula

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

Example with Units

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

24) Water Content of Soil given Degree of Saturation Formula

Evaluate Formula

Formula

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

Example

$$0.5208 = \left(\frac{0.6 \cdot 2.3}{2.65} \right)$$

25) Degree of Saturation Formulas

25.1) Air Content with Respect to Degree of Saturation Formula

Evaluate Formula

Formula

$$a_c = 1 - S$$

Example

$$0.4 = 1 - 0.6$$

25.2) Buoyant Unit Weight of Soil with Saturation 100 Percent Formula

Evaluate Formula

Formula

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

Example with Units

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

25.3) Degree of Saturation given Air Content with Respect to Degree of Saturation Formula

Evaluate Formula

Formula

$$S = 1 - a_c$$

Example

$$0.6 = 1 - 0.4$$

25.4) Degree of Saturation given Void Ratio in Specific Gravity Formula

Evaluate Formula

Formula

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

Example

$$1.3471 = 0.61 \cdot \frac{2.65}{1.2}$$

25.5) Degree of Saturation of Soil Sample Formula

Evaluate Formula

Formula

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

Example with Units

$$0.6667 = \left(\frac{2\,\text{m}^3}{3\,\text{m}^3} \right)$$

25.6) Volume of Voids given Degree of Saturation of Soil Sample Formula

Evaluate Formula

Formula

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

Example with Units

$$3.3333\,\text{m}^3 = \frac{2\,\text{m}^3}{0.6}$$

25.7) Volume of Water given Degree of Saturation of Soil Sample Formula

Evaluate Formula

Formula	Example with Units
$Vw = S \cdot Vv$	$1.8\,\text{m}^3 = 0.6 \cdot 3\,\text{m}^3$

Variables used in list of Soil Origin and Its Properties Formulas above

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

Constants, Functions, Measurements used in list of Soil Origin and Its Properties Formulas above

- 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

Download other Important Geotechnical Engineering PDFs

- Important Bearing Capacity for Strip Footing for C Φ Soils Formulas
- Important Bearing Capacity of Cohesive Soil Formulas
- Important Bearing Capacity of Non cohesive Soil Formulas
- Important Bearing Capacity of Soils Formulas
- Important Bearing Capacity of Soils by Meyerhof's Analysis Formulas
- Important Foundation Stability Analysis Formulas
- Important Atterberg Limits Formulas
- Important Bearing Capacity of Soil by Terzaghi's Analysis Formulas
- Important Compaction of Soil Formulas
- Important Earth Moving Formulas
- Important Lateral Pressure for Cohesive and Non Cohesive Soil Formulas
- Important Minimum Depth of Foundation by Rankine's Analysis Formulas
- Important Pile Foundations Formulas
- Important Porosity of Soil Sample Formulas
- Important Scraper Production Formulas
- Important Seepage Analysis Formulas
- Important Slope Stability Analysis using Bishops Method Formulas
- Important Slope Stability Analysis using Culman's Method Formulas
- Important Soil Origin and Its Properties Formulas
- Important Specific Gravity of Soil Formulas
- Important Stability Analysis of Infinite Slopes Formulas
- Important Stability Analysis of Infinite Slopes in Prism Formulas
- Important Vibration Control in Blasting Formulas
- Important Void Ratio of Soil Sample Formulas
- Important Water Content of Soil and Related Formulas

Try our Unique Visual Calculators

- Winning percentage
- LCM of two numbers
- Mixed fraction

9/18/2024 | 11:45:47 AM UTC