

Important Unit Weight of Soil Formulas PDF



Formulas Examples with Units

List of 28 Important Unit Weight of Soil Formulas

1) Average Unit Weight of Soil given Effective Surcharge Formula ↺

Formula

$$\gamma = \frac{\sigma_s}{D_{\text{footing}}}$$

Example with Units

$$18.0709 \text{ kN/m}^3 = \frac{45.9 \text{ kN/m}^2}{2.54 \text{ m}}$$

Evaluate Formula ↺

2) Average Unit Weight of Soil given Net Pressure Intensity Formula ↺

Formula

$$\gamma = \frac{q_g - q_n}{D_{\text{footing}}}$$

Example with Units

$$18.0709 \text{ kN/m}^3 = \frac{60.9 \text{ kN/m}^2 - 15.0 \text{ kN/m}^2}{2.54 \text{ m}}$$

Evaluate Formula ↺

3) Average Unit Weight of Soil given Net Ultimate Bearing Capacity Formula ↺

Formula

$$\gamma_{\text{avg}} = \frac{q_{\text{sa}} - \left(\frac{q_{\text{net}}}{F_s} \right)}{D_{\text{footing}}}$$

Example with Units

$$8.9218 \text{ kN/m}^3 = \frac{36.34 \text{ kN/m}^2 - \left(\frac{38.3 \text{ kN/m}^2}{2.8} \right)}{2.54 \text{ m}}$$

Evaluate Formula ↺

4) Average Unit Weight of Soil given Safe Bearing Capacity Formula ↺

Formula

$$\gamma_{\text{avg}} = \frac{q_{\text{sa}} - q_{\text{nsa}}}{D_{\text{footing}}}$$

Example with Units

$$8.0512 \text{ kN/m}^3 = \frac{36.34 \text{ kN/m}^2 - 15.89 \text{ kN/m}^2}{2.54 \text{ m}}$$

Evaluate Formula ↺

5) Bulk Unit Weight given Degree of Saturation Formula ↺

Formula

$$\gamma_{\text{bulk}} = \gamma_{\text{dry}} + \left(S \cdot \left(\gamma_{\text{saturated}} - \gamma_{\text{dry}} \right) \right)$$

Example with Units

$$20.8912 \text{ kN/m}^3 = 6.12 \text{ kN/m}^3 + \left(2.56 \cdot \left(11.89 \text{ kN/m}^3 - 6.12 \text{ kN/m}^3 \right) \right)$$

Evaluate Formula ↺



6) Bulk Unit Weight of Soil Formula ↻

Formula

$$\gamma_t = \frac{W_t}{V}$$

Example with Units

$$6.5285 \text{ kg/m}^3 = \frac{80 \text{ kg}}{12.254 \text{ m}^3}$$

Evaluate Formula ↻

7) Density in Relation with Unit Weight Formula ↻

Formula

$$\rho_s = \frac{\gamma_{\text{soils}}}{9.8}$$

Example with Units

$$1530.6122 \text{ kg/m}^3 = \frac{15 \text{ kN/m}^3}{9.8}$$

Evaluate Formula ↻

8) Dry Unit Weight of Soil Formula ↻

Formula

$$\rho_d = \frac{W_s}{V}$$

Example with Units

$$0.0491 \text{ kg/m}^3 = \frac{0.602 \text{ kg}}{12.254 \text{ m}^3}$$

Evaluate Formula ↻

9) Gross Pressure Intensity given Average Unit Weight of Soil Formula ↻

Formula

$$q_g = q_n + (\gamma \cdot D_{\text{footing}})$$

Example with Units

$$60.72 \text{ kN/m}^2 = 15.0 \text{ kN/m}^2 + (18 \text{ kN/m}^3 \cdot 2.54 \text{ m})$$

Evaluate Formula ↻

10) Gross Pressure Intensity given Net Pressure Intensity Formula ↻

Formula

$$q_g = q_n + \sigma_s$$

Example with Units

$$60.9 \text{ kN/m}^2 = 15.0 \text{ kN/m}^2 + 45.9 \text{ kN/m}^2$$

Evaluate Formula ↻

11) Saturated Unit Weight given Bulk Unit Weight and Degree of Saturation Formula ↻

Formula

$$\gamma_{\text{saturated}} = \left(\frac{\gamma_{\text{bulk}} - \gamma_{\text{dry}}}{S} \right) + \gamma_{\text{dry}}$$

Example with Units

$$11.8895 \text{ kN/m}^3 = \left(\frac{20.89 \text{ kN/m}^3 - 6.12 \text{ kN/m}^3}{2.56} \right) + 6.12 \text{ kN/m}^3$$

Evaluate Formula ↻

12) Saturated Unit Weight of Soil given Submerged Unit Weight Formula ↻

Formula

$$\gamma_{\text{saturated}} = \gamma_s + \gamma_{\text{water}}$$

Example with Units

$$10.77 \text{ kN/m}^3 = 0.96 \text{ kN/m}^3 + 9.81 \text{ kN/m}^3$$

Evaluate Formula ↻



13) Saturated Unit Weight of Soil given Water Content Formula

Formula

$$\gamma_{\text{saturated}} = \left(\frac{(1 + w_s) \cdot G_s \cdot \gamma_{\text{water}}}{1 + e_s} \right)$$

Evaluate Formula 

Example with Units

$$73.2629 \text{ kN/m}^3 = \left(\frac{(1 + 8.3) \cdot 2.65 \cdot 9.81 \text{ kN/m}^3}{1 + 2.3} \right)$$

14) Saturated Unit Weight of Soil with Saturation 100 Percent Formula

Formula

$$\gamma_{\text{saturated}} = \left(\frac{(G_s \cdot \gamma_{\text{water}}) + (e_s \cdot \gamma_{\text{water}})}{1 + e_s} \right)$$

Evaluate Formula 

Example with Units

$$14.715 \text{ kN/m}^3 = \left(\frac{(2.65 \cdot 9.81 \text{ kN/m}^3) + (2.3 \cdot 9.81 \text{ kN/m}^3)}{1 + 2.3} \right)$$

15) Submerged Unit Weight Formula

Formula

$$\gamma_{\text{su}} = \frac{W_d}{V}$$

Example with Units

$$8 \text{ kg/m}^3 = \frac{98.032 \text{ kg}}{12.254 \text{ m}^3}$$

Evaluate Formula 

16) Submerged Unit Weight of Soil given Porosity Formula

Formula

$$\gamma_S = \gamma_{\text{dry}} - (1 - \eta) \cdot \gamma_{\text{water}}$$

Example with Units

$$1.215 \text{ kN/m}^3 = 6.12 \text{ kN/m}^3 - (1 - 0.5) \cdot 9.81 \text{ kN/m}^3$$

Evaluate Formula 

17) Submerged Unit Weight with respect to Saturated Unit Weight Formula

Formula

$$\gamma_S = \gamma_{\text{saturated}} - \gamma_{\text{water}}$$

Example with Units

$$2.08 \text{ kN/m}^3 = 11.89 \text{ kN/m}^3 - 9.81 \text{ kN/m}^3$$

Evaluate Formula 

18) Submerged Weight of Soil given Submerged Unit Weight Formula

Formula

$$W_d = \gamma_{\text{su}} \cdot V$$

Example with Units

$$98.032 \text{ kg} = 8 \text{ kg/m}^3 \cdot 12.254 \text{ m}^3$$

Evaluate Formula 



19) Total Volume given Saturated Unit Weight of Soil Formula ↻

Formula

$$V = \frac{W_{\text{sat}}}{\gamma_{\text{saturated}}}$$

Example with Units

$$1.6796 \text{ m}^3 = \frac{19.97 \text{ kg}}{11.89 \text{ kN/m}^3}$$

Evaluate Formula ↻

20) Total Volume given Submerged Unit Weight Formula ↻

Formula

$$V = \frac{W_d}{\gamma_{\text{su}}}$$

Example with Units

$$12.254 \text{ m}^3 = \frac{98.032 \text{ kg}}{8 \text{ kg/m}^3}$$

Evaluate Formula ↻

21) Total Volume of Soil given Bulk Unit Weight of Soil Formula ↻

Formula

$$V = \frac{W_t}{\gamma_{\text{bulk}}}$$

Example with Units

$$3.8296 \text{ m}^3 = \frac{80 \text{ kg}}{20.89 \text{ kN/m}^3}$$

Evaluate Formula ↻

22) Total Volume of Soil given Dry Unit Weight of Soil Formula ↻

Formula

$$V = \frac{W_s}{\rho_d}$$

Example with Units

$$12.2857 \text{ m}^3 = \frac{0.602 \text{ kg}}{0.049 \text{ kg/m}^3}$$

Evaluate Formula ↻

23) Total Weight of Soil given Bulk Unit Weight of Soil Formula ↻

Formula

$$W_t = \gamma_t \cdot V$$

Example with Units

$$79.8961 \text{ kg} = 6.52 \text{ kg/m}^3 \cdot 12.254 \text{ m}^3$$

Evaluate Formula ↻

24) Unit Weight of Solids Formula ↻

Formula

$$\gamma_{\text{solids}} = \gamma_{\text{dry}} \cdot \frac{V}{V_s}$$

Example with Units

$$14.9989 \text{ kN/m}^3 = 6.12 \text{ kN/m}^3 \cdot \frac{12.254 \text{ m}^3}{5.0 \text{ m}^3}$$

Evaluate Formula ↻

25) Unit weight of Solids in Relation with Specific Gravity Formula ↻

Formula

$$\gamma_{\text{solids}} = 9.81 \cdot G_s$$

Example with Units

$$25.9965 \text{ kN/m}^3 = 9.81 \cdot 2.65$$

Evaluate Formula ↻

26) Unit Weight of Water given Submerged Unit Weight Formula ↻

Formula

$$\gamma_{\text{water}} = \frac{\gamma_{\text{solids}}}{G_s}$$

Example with Units

$$5.6604 \text{ kN/m}^3 = \frac{15 \text{ kN/m}^3}{2.65}$$

Evaluate Formula ↻



27) Volume of Solids given Unit Weight of Solids Formula

Formula

$$V_s = \frac{W_s}{\rho_s}$$

Example with Units

$$0.0004 \text{ m}^3 = \frac{0.602 \text{ kg}}{1530 \text{ kg/m}^3}$$

Evaluate Formula 

28) Weight of Solids given Dry Unit Weight of Soil Formula

Formula

$$W_s = V \cdot \rho_d$$

Example with Units

$$0.6004 \text{ kg} = 12.254 \text{ m}^3 \cdot 0.049 \text{ kg/m}^3$$

Evaluate Formula 



Variables used in list of Unit Weight of Soil Formulas above

- **D_{footing}** Depth of Footing in Soil (Meter)
- **e_s** Void Ratio of Soil
- **F_s** Factor of Safety in Soil Mechanics
- **G_s** Specific Gravity of Soil
- **q_g** Gross Pressure (Kilonewton per Square Meter)
- **q_n** Net Pressure (Kilonewton per Square Meter)
- **q_{net}** Net Ultimate Bearing Capacity in Soil (Kilonewton per Square Meter)
- **q_{nsa}** Net Safe Bearing Capacity in Soil (Kilonewton per Square Meter)
- **q_{sa}** Safe Bearing Capacity (Kilonewton per Square Meter)
- **S** Degree of Saturation
- **V** Total Volume in Soil Mechanics (Cubic Meter)
- **V_s** Volume of Solids (Cubic Meter)
- **W_d** Submerged Weight of Solids (Kilogram)
- **w_s** Water Content of Soil from Pycnometer
- **W_s** Weight of Solids in Soil Mechanics (Kilogram)
- **W_{sat}** Saturated Weight of Soil (Kilogram)
- **W_t** Total Weight of Soil (Kilogram)
- **y_s** Submerged Unit Weight in KN per Cubic Meter (Kilonewton per Cubic Meter)
- **Y** Unit Weight of Soil (Kilonewton per Cubic Meter)
- **Y_{avg}** Average Unit Weight (Kilonewton per Cubic Meter)
- **Y_{bulk}** Bulk Unit Weight (Kilonewton per Cubic Meter)
- **Y_{dry}** Dry Unit Weight (Kilonewton per Cubic Meter)
- **Y_{saturated}** Saturated Unit Weight of Soil (Kilonewton per Cubic Meter)
- **Y_{soils}** Unit Weight of Solids (Kilonewton per Cubic Meter)

Constants, Functions, Measurements used in list of Unit Weight of Soil Formulas above

- **Measurement: Length** in Meter (m)
Length Unit Conversion 
- **Measurement: Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement: Volume** in Cubic Meter (m³)
Volume Unit Conversion 
- **Measurement: Pressure** in Kilonewton per Square Meter (kN/m²)
Pressure Unit Conversion 
- **Measurement: Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 
- **Measurement: Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
Specific Weight Unit Conversion 



- **γ_{su}** Submerged Unit Weight of Water (Kilogram per Cubic Meter)
- **γ_t** Bulk Density of Soil (Kilogram per Cubic Meter)
- **γ_{water}** Unit Weight of Water (Kilonewton per Cubic Meter)
- **η** Porosity in Soil Mechanics
- **ρ_d** Dry Density (Kilogram per Cubic Meter)
- **ρ_s** Density of Solids (Kilogram per Cubic Meter)
- **σ_s** Effective Surcharge in Kilopascal (Kilonewton per Square Meter)



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