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Unit Weight of Soil Formulas

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List of 28 Unit Weight of Soil Formulas

Unit Weight of Soil

1) Average Unit Weight of Soil given Effective Surcharge

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$ex \quad 18.07087\text{kN/m}^3 = \frac{45.9\text{kN/m}^2}{2.54\text{m}}$$

2) Average Unit Weight of Soil given Net Pressure Intensity

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

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$ex \quad 18.07087\text{kN/m}^3 = \frac{60.9\text{kN/m}^2 - 15.0\text{kN/m}^2}{2.54\text{m}}$$

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

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

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$ex \quad 8.921822\text{kN/m}^3 = \frac{36.34\text{kN/m}^2 - \left(\frac{38.3\text{kN/m}^2}{2.8} \right)}{2.54\text{m}}$$



4) Average Unit Weight of Soil given Safe Bearing Capacity

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 8.051181 \text{ kN/m}^3 = \frac{36.34 \text{ kN/m}^2 - 15.89 \text{ kN/m}^2}{2.54 \text{ m}}$$

5) Bulk Unit Weight given Degree of Saturation

$$fx \quad \gamma_{bulk} = \gamma_{dry} + (S \cdot (\gamma_{saturated} - \gamma_{dry}))$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

6) Bulk Unit Weight of Soil

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 6.52848 \text{ kg/m}^3 = \frac{80 \text{ kg}}{12.254 \text{ m}^3}$$

7) Density in Relation with Unit Weight

$$fx \quad \rho_s = \frac{\gamma_{soils}}{9.8}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 1530.612 \text{ kg/m}^3 = \frac{15 \text{ kN/m}^3}{9.8}$$



8) Dry Unit Weight of Soil 

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 0.049127 \text{kg/m}^3 = \frac{0.602 \text{kg}}{12.254 \text{m}^3}$$

9) Gross Pressure Intensity given Average Unit Weight of Soil 

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

10) Gross Pressure Intensity given Net Pressure Intensity 

$$fx \quad q_g = q_n + \sigma_s$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 11.88953 \text{kN/m}^3 = \left(\frac{20.89 \text{kN/m}^3 - 6.12 \text{kN/m}^3}{2.56} \right) + 6.12 \text{kN/m}^3$$



12) Saturated Unit Weight of Soil given Submerged Unit Weight

$$fx \quad \gamma_{\text{saturated}} = \gamma_S + \gamma_{\text{water}}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

13) Saturated Unit Weight of Soil given Water Content

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 73.26286\text{kN/m}^3 = \left(\frac{(1 + 8.3) \cdot 2.65 \cdot 9.81\text{kN/m}^3}{1 + 2.3} \right)$$

14) Saturated Unit Weight of Soil with Saturation 100 Percent

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

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

15) Submerged Unit Weight

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

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



16) Submerged Unit Weight of Soil given Porosity 

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

Open Calculator 

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

17) Submerged Unit Weight with respect to Saturated Unit Weight 

$$fx \quad \gamma_S = \gamma_{saturated} - \gamma_{water}$$

Open Calculator 

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

18) Submerged Weight of Soil given Submerged Unit Weight 

$$fx \quad W_d = \gamma_{su} \cdot V$$

Open Calculator 

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

19) Total Volume given Saturated Unit Weight of Soil 

$$fx \quad V = \frac{W_{sat}}{\gamma_{saturated}}$$

Open Calculator 

$$ex \quad 1.679563 \text{ m}^3 = \frac{19.97 \text{ kg}}{11.89 \text{ kN/m}^3}$$



20) Total Volume given Submerged Unit Weight 

$$fx \quad V = \frac{W_d}{\gamma_{su}}$$

Open Calculator 

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

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

$$fx \quad V = \frac{W_t}{\gamma_{bulk}}$$

Open Calculator 

$$ex \quad 3.829584m^3 = \frac{80kg}{20.89kN/m^3}$$

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

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

Open Calculator 

$$ex \quad 12.28571m^3 = \frac{0.602kg}{0.049kg/m^3}$$

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

$$fx \quad W_t = \gamma_t \cdot V$$

Open Calculator 

$$ex \quad 79.89608kg = 6.52kg/m^3 \cdot 12.254m^3$$



24) Unit Weight of Solids

$$\text{fx } \gamma_{\text{soilds}} = \gamma_{\text{dry}} \cdot \frac{V}{V_S}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

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

25) Unit weight of Solids in Relation with Specific Gravity

$$\text{fx } \gamma_{\text{soilds}} = 9.81 \cdot G_s$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

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

26) Unit Weight of Water given Submerged Unit Weight

$$\text{fx } \gamma_{\text{water}} = \frac{\gamma_{\text{soilds}}}{G_s}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 5.660377\text{kN/m}^3 = \frac{15\text{kN/m}^3}{2.65}$$

27) Volume of Solids given Unit Weight of Solids

$$\text{fx } V_S = \frac{W_s}{\rho_s}$$

[Open Calculator !\[\]\(4146d17f71dced09c6ad789cacceaa6d_img.jpg\)](#)

$$\text{ex } 0.000393\text{m}^3 = \frac{0.602\text{kg}}{1530\text{kg/m}^3}$$



28) Weight of Solids given Dry Unit Weight of Soil

fx $W_s = V \cdot \rho_d$

Open Calculator 

ex $0.600446\text{kg} = 12.254\text{m}^3 \cdot 0.049\text{kg}/\text{m}^3$



Variables Used

- 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)
- γ_s Submerged Unit Weight in KN per Cubic Meter (Kilonewton per Cubic Meter)
- γ Unit Weight of Soil (Kilonewton per Cubic Meter)
- γ_{avg} Average Unit Weight (Kilonewton per Cubic Meter)



- **γ_{bulk}** Bulk Unit Weight (Kilonewton per Cubic Meter)
- **γ_{dry}** Dry Unit Weight (Kilonewton per Cubic Meter)
- **$\gamma_{\text{saturated}}$** Saturated Unit Weight of Soil (Kilonewton per Cubic Meter)
- **γ_{solids}** Unit Weight of Solids (Kilonewton per Cubic Meter)
- **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)



Constants, Functions, Measurements used

- **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 



Check other formula lists

- [Density of Soil Formulas](#) 
- [Unit Weight of Soil Formulas](#) 
- [Dry Unit Weight of Soil Formulas](#) 
- [Water Content and Volume of Solids in Soil Formulas](#) 

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