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# Density of Soil Formulas

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# List of 17 Density of Soil Formulas

## Density of Soil

### 1) Bulk Density of Soil

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

Open Calculator 

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

### 2) Density of Water given Dry Density and Void Ratio

$$fx \quad \rho_w = \rho_{ds} \cdot \frac{1 + e}{G_s}$$

Open Calculator 

$$ex \quad 995.3962\text{kg}/\text{m}^3 = 1199\text{kg}/\text{m}^3 \cdot \frac{1 + 1.2}{2.65}$$

### 3) Dry Density Given Void Ratio

$$fx \quad \rho_{ds} = \frac{G_s \cdot \rho_w}{1 + e}$$

Open Calculator 

$$ex \quad 1200.932\text{kg}/\text{m}^3 = \frac{2.65 \cdot 997.0\text{kg}/\text{m}^3}{1 + 1.2}$$



4) Dry Density of Soil 

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)


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

5) Dry Density of Solids 

$$fx \quad \rho_{\text{dry}} = \frac{W_s}{V_{\text{SO}}}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 0.049023\text{kg}/\text{m}^3 = \frac{0.602\text{kg}}{12.28\text{m}^3}$$

6) Mass of Saturated Sample given Saturated Density of Soil 

$$fx \quad W_{\text{sat}} = \rho_{\text{sat}} \cdot V$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 19.97402\text{kg} = 1.63\text{kg}/\text{m}^3 \cdot 12.254\text{m}^3$$

7) Saturated Density of Soil 

$$fx \quad \rho_{\text{sat}} = \frac{M_{\text{sat}}}{V}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 1.63212\text{kg}/\text{m}^3 = \frac{20\text{kg}}{12.254\text{m}^3}$$



## 8) Saturated Unit Weight given Submerged Unit Weight

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

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

## 9) Submerged Unit Weight of Soil

$$fx \quad \gamma_S = \frac{W_{\text{su}}}{V}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 0.962951\text{kN/m}^3 = \frac{11.8\text{kN}}{12.254\text{m}^3}$$

## 10) Submerged Weight of Soil given Submerged Unit Weight of Soil

$$fx \quad W_{\text{su}} = \gamma_S \cdot V$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 11.76384\text{kN} = 0.96\text{kN/m}^3 \cdot 12.254\text{m}^3$$

## 11) Total Mass of Soil given Bulk Density of Soil

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

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

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



12) Total Volume given Submerged Unit Weight of Soil 

$$fx \quad V = \frac{W_{su}}{\gamma_s}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)


$$ex \quad 12.29167m^3 = \frac{11.8kN}{0.96kN/m^3}$$

13) Total Volume of Soil given Bulk Density of Soil 

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)


$$ex \quad 12.26994m^3 = \frac{80kg}{6.52kg/m^3}$$

14) Total Volume of Soil given Dry Unit Weight 

$$fx \quad V = \frac{W_{sk}}{\gamma_{dry}}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 30.03268m^3 = \frac{183.8kN}{6.12kN/m^3}$$

15) Total Volume with respect to Saturated Unit Weight of Soil 

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 7.616484m^3 = \frac{90.56kN}{11.89kN/m^3}$$



## 16) Unit Weight of Water

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$ex \quad 10.93\text{kN/m}^3 = 11.89\text{kN/m}^3 - 0.96\text{kN/m}^3$$

## 17) Weight of Solids given Unit Weight of Solids

$$fx \quad W_{sk} = \gamma_{\text{soilds}} \cdot V$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 183.81\text{kN} = 15\text{kN/m}^3 \cdot 12.254\text{m}^3$$



## Variables Used

- **e** Void Ratio
- **G<sub>s</sub>** Specific Gravity of Soil
- **M<sub>sat</sub>** Mass of Saturated Soil (*Kilogram*)
- **V** Total Volume in Soil Mechanics (*Cubic Meter*)
- **v<sub>so</sub>** Volume of Solids in Soil (*Cubic Meter*)
- **W<sub>s</sub>** Weight of Solids in Soil Mechanics (*Kilogram*)
- **W<sub>sat</sub>** Saturated Weight of Soil (*Kilogram*)
- **W<sub>satk</sub>** Saturated Weight of Soil in KN (*Kilonewton*)
- **W<sub>sk</sub>** Weight of Solids in Soil Mechanics in KN (*Kilonewton*)
- **W<sub>su</sub>** Submerged Weight of Soil (*Kilonewton*)
- **W<sub>t</sub>** Total Weight of Soil (*Kilogram*)
- **γ<sub>s</sub>** Submerged Unit Weight in KN per Cubic Meter (*Kilonewton per Cubic Meter*)
- **γ<sub>dry</sub>** Dry Unit Weight (*Kilonewton per Cubic Meter*)
- **γ<sub>saturated</sub>** Saturated Unit Weight of Soil (*Kilonewton per Cubic Meter*)
- **γ<sub>solids</sub>** Unit Weight of Solids (*Kilonewton per Cubic Meter*)
- **γ<sub>t</sub>** Bulk Density of Soil (*Kilogram per Cubic Meter*)
- **γ<sub>water</sub>** Unit Weight of Water (*Kilonewton per Cubic Meter*)
- **ρ<sub>d</sub>** Dry Density (*Kilogram per Cubic Meter*)
- **ρ<sub>dry</sub>** Dry Density of Solids (*Kilogram per Cubic Meter*)
- **ρ<sub>ds</sub>** Dry Density in Soil Mechanics (*Kilogram per Cubic Meter*)








- $\rho_{\text{sat}}$  Saturated Density (Kilogram per Cubic Meter)
- $\rho_{\text{w}}$  Density of Water (Kilogram per Cubic Meter)





## Constants, Functions, Measurements used

- **Measurement: Weight** in Kilogram (kg)  
*Weight Unit Conversion* 
- **Measurement: Volume** in Cubic Meter (m<sup>3</sup>)  
*Volume Unit Conversion* 
- **Measurement: Force** in Kilonewton (kN)  
*Force Unit Conversion* 
- **Measurement: Density** in Kilogram per Cubic Meter (kg/m<sup>3</sup>)  
*Density Unit Conversion* 
- **Measurement: Specific Weight** in Kilonewton per Cubic Meter (kN/m<sup>3</sup>)  
*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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