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Void Ratio of Soil Sample Formulas

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List of 23 Void Ratio of Soil Sample Formulas

Void Ratio of Soil Sample ↗

1) Air Content of Soil ↗

$$fx \quad a_c = \frac{V_a}{V_{void}}$$

[Open Calculator ↗](#)

$$ex \quad 0.349418 = \frac{2.1m^3}{6.01m^3}$$

2) Air Content with respect to Volume of Water ↗

$$fx \quad a_c = 1 - \left(\frac{V_w}{V_{void}} \right)$$

[Open Calculator ↗](#)

$$ex \quad 0.667221 = 1 - \left(\frac{2m^3}{6.01m^3} \right)$$

3) Percentage Air Voids given Void Ratio ↗

$$fx \quad n_a = \left(e \cdot \frac{1 - S}{1 + e} \right) \cdot 100$$

[Open Calculator ↗](#)

$$ex \quad 10.36364 = \left(1.2 \cdot \frac{1 - 0.81}{1 + 1.2} \right) \cdot 100$$



4) Percentage of Air Voids of Soil ↗

$$fx \quad n_a = \frac{V_a \cdot 100}{V}$$

[Open Calculator ↗](#)

$$ex \quad 10.5 = \frac{2.1m^3 \cdot 100}{20m^3}$$

5) Total Volume of Soil given Percentage of Air Voids of Soil ↗

$$fx \quad V = \frac{V_a \cdot 100}{n_a}$$

[Open Calculator ↗](#)

$$ex \quad 21m^3 = \frac{2.1m^3 \cdot 100}{10}$$

6) Void Ratio given Dry Density ↗

$$fx \quad e = \left(\frac{G \cdot \gamma_{\text{water}}}{\gamma_{\text{dry}}} \right) - 1$$

[Open Calculator ↗](#)

$$ex \quad 24.66309 = \left(\frac{16.01 \cdot 9.81kN/m^3}{6.12kN/m^3} \right) - 1$$



7) Void Ratio given Percentage Air Voids in Void Ratio ↗

fx
$$e = \frac{\frac{n_a}{100}}{1 - S - \left(\frac{n_a}{100}\right)}$$

[Open Calculator ↗](#)

ex
$$1.111111 = \frac{\frac{10}{100}}{1 - 0.81 - \left(\frac{10}{100}\right)}$$

8) Void Ratio given Specific Gravity ↗

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

[Open Calculator ↗](#)

ex
$$1.995679 = 0.61 \cdot \frac{2.65}{0.81}$$

9) Void Ratio given Specific Gravity for Fully Saturated Soil ↗

fx
$$e = w_s \cdot G_s$$

[Open Calculator ↗](#)

ex
$$1.6165 = 0.61 \cdot 2.65$$

10) Void Ratio of Soil Sample ↗

fx
$$e = \frac{V_{void}}{V_s}$$

[Open Calculator ↗](#)

ex
$$1.202 = \frac{6.01m^3}{5m^3}$$



11) Void Ratio of Soil using Buoyant Unit Weight ↗

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

[Open Calculator ↗](#)

$$ex \quad 1.69775 = \left(\frac{2.65 \cdot 9.81\text{kN/m}^3 - 9.81\text{kN/m}^3 - 6\text{kN/m}^3}{6\text{kN/m}^3} \right)$$

12) Void Ratio of Soil using Dry Unit Weight ↗

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

[Open Calculator ↗](#)

$$ex \quad 3.247794 = \left(\left(\frac{2.65 \cdot 9.81\text{kN/m}^3}{6.12\text{kN/m}^3} \right) - 1 \right)$$

13) Void Ratio of Soil using Saturated Unit Weight ↗

$$fx \quad e = \left(\frac{(G_s \cdot \gamma) - \gamma_{sat}}{\gamma_{sat} - \gamma_{water}} \right)$$

[Open Calculator ↗](#)

$$ex \quad 1.67019 = \left(\frac{(2.65 \cdot 18\text{kN/m}^3) - 24\text{kN/m}^3}{24\text{kN/m}^3 - 9.81\text{kN/m}^3} \right)$$

14) Volume of Air Voids given Air Content of Soil ↗

$$fx \quad V_a = a_c \cdot V_{void}$$

[Open Calculator ↗](#)

$$ex \quad 2.404\text{m}^3 = 0.4 \cdot 6.01\text{m}^3$$



15) Volume of Air Voids given Percentage of Air Voids of Soil 

fx $V_a = \frac{n_a \cdot V}{100}$

Open Calculator 

ex $2m^3 = \frac{10 \cdot 20m^3}{100}$

16) Volume of Air Voids with respect to Volume of Voids 

fx $V_a = V_{void} - V_w$

Open Calculator 

ex $4.01m^3 = 6.01m^3 - 2m^3$

17) Volume of Solids given Void Ratio of Soil Sample 

fx $V_s = \frac{V_{void}}{e}$

Open Calculator 

ex $5.008333m^3 = \frac{6.01m^3}{1.2}$

18) Volume of Voids given Air Content of Soil 

fx $V_{void} = \frac{V_a}{a_c}$

Open Calculator 

ex $5.25m^3 = \frac{2.1m^3}{0.4}$



19) Volume of Voids given Air Content with respect to Volume of Water 

$$fx \quad V_{\text{void}} = \frac{V_w}{1 - a_c}$$

Open Calculator 

$$ex \quad 3.333333m^3 = \frac{2m^3}{1 - 0.4}$$

20) Volume of Voids given Void Ratio of Soil Sample 

$$fx \quad V_{\text{void}} = e \cdot V_s$$

Open Calculator 

$$ex \quad 6m^3 = 1.2 \cdot 5m^3$$

21) Volume of Voids given Volume of Air Voids with respect to Volume of Voids 

$$fx \quad V_{\text{void}} = V_a + V_w$$

Open Calculator 

$$ex \quad 4.1m^3 = 2.1m^3 + 2m^3$$

22) Volume of Water given Air Content with respect to Volume of Water 

$$fx \quad V_w = V_{\text{void}} \cdot (1 - a_c)$$

Open Calculator 

$$ex \quad 3.606m^3 = 6.01m^3 \cdot (1 - 0.4)$$

23) Volume of Water given Volume of Air Voids 

$$fx \quad V_w = V_{\text{void}} - V_a$$

Open Calculator 

$$ex \quad 3.91m^3 = 6.01m^3 - 2.1m^3$$



Variables Used

- a_c Air Content
- e Void Ratio
- G Specific Gravity of Particle
- G_s Specific Gravity of Soil
- n_a Percentage of Air Voids
- S Degree of Saturation
- V Volume of Soil (*Cubic Meter*)
- V_a Volume Air Voids (*Cubic Meter*)
- V_{void} Volume of Voids (*Cubic Meter*)
- V_s Volume of Solids (*Cubic Meter*)
- V_w Volume of Water (*Cubic Meter*)
- w_s Water Content of Soil from Pycnometer
- γ Unit Weight of Soil (*Kilonewton per Cubic Meter*)
- γ_b Buoyant Unit Weight (*Kilonewton per Cubic Meter*)
- γ_{dry} Dry Unit Weight (*Kilonewton per Cubic Meter*)
- γ_{sat} Saturated Unit Weight (*Kilonewton per Cubic Meter*)
- γ_{water} Unit Weight of Water (*Kilonewton per Cubic Meter*)



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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