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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

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

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

### 2) Air Content with respect to Volume of Water

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

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

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

### 3) Percentage Air Voids given Void Ratio

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

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

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



#### 4) Percentage of Air Voids of Soil

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

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

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

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

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

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

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

#### 6) Void Ratio given Dry Density

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

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

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



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

[Open Calculator !\[\]\(dfbd6b3763a6d1d9afaa974f64e2e4b5\_img.jpg\)](#)

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

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

## 8) Void Ratio given Specific Gravity

[Open Calculator !\[\]\(ec9132f1d27c8919987d92907322654d\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(758ebdf4629c903da74c2e079717ae32\_img.jpg\)](#)

$$fx \quad e = w_s \cdot G_s$$

$$ex \quad 1.6165 = 0.61 \cdot 2.65$$

## 10) Void Ratio of Soil Sample

[Open Calculator !\[\]\(248b91fcdac4810ffd15cf33fb6aec6f\_img.jpg\)](#)

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

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



### 11) Void Ratio of Soil using Buoyant Unit Weight

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

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

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

### 12) Void Ratio of Soil using Dry Unit Weight

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

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

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

### 13) Void Ratio of Soil using Saturated Unit Weight

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

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

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

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

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

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

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



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

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

Open Calculator 

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

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

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

Open Calculator 

$$\text{ex } 4.01\text{m}^3 = 6.01\text{m}^3 - 2\text{m}^3$$

17) Volume of Solids given Void Ratio of Soil Sample 

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

Open Calculator 

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

18) Volume of Voids given Air Content of Soil 

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

Open Calculator 

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



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

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

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

## 20) Volume of Voids given Void Ratio of Soil Sample

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

$$\text{ex } 6\text{m}^3 = 1.2 \cdot 5\text{m}^3$$

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

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

$$\text{ex } 4.1\text{m}^3 = 2.1\text{m}^3 + 2\text{m}^3$$

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

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

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19\_img.jpg\)](#)

$$\text{ex } 3.606\text{m}^3 = 6.01\text{m}^3 \cdot (1 - 0.4)$$

## 23) Volume of Water given Volume of Air Voids

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

[Open Calculator !\[\]\(465772ce2fc0e39b7001e2580b915cc2\_img.jpg\)](#)

$$\text{ex } 3.91\text{m}^3 = 6.01\text{m}^3 - 2.1\text{m}^3$$



## 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
- $\gamma$  Unit Weight of Soil (*Kilonewton per Cubic Meter*)
- $\gamma_b$  Buoyant Unit Weight (*Kilonewton per Cubic Meter*)
- $\gamma_{dry}$  Dry Unit Weight (*Kilonewton per Cubic Meter*)
- $\gamma_{sat}$  Saturated Unit Weight (*Kilonewton per Cubic Meter*)
- $\gamma_{water}$  Unit Weight of Water (*Kilonewton per Cubic Meter*)



## Constants, Functions, Measurements used

- **Measurement: Volume** in Cubic Meter ( $\text{m}^3$ )  
*Volume Unit Conversion* 
- **Measurement: Specific Weight** in Kilonewton per Cubic Meter ( $\text{kN/m}^3$ )  
*Specific Weight Unit Conversion* 



## Check other formula lists

- **Bearing Capacity for Strip Footing for C- $\Phi$  Soils Formulas** 
- **Bearing Capacity of Cohesive Soil Formulas** 
- **Bearing Capacity of Non-cohesive Soil Formulas** 
- **Bearing Capacity of Soils Formulas** 
- **Bearing Capacity of Soils: Meyerhof's Analysis Formulas** 
- **Foundation Stability Analysis Formulas** 
- **Atterberg Limits Formulas** 
- **Bearing Capacity of Soil: Terzaghi's Analysis Formulas** 
- **Compaction of Soil Formulas** 
- **Earth Moving Formulas** 
- **Lateral Pressure for Cohesive and Non Cohesive Soil Formulas** 
- **Minimum Depth of Foundation by Rankine's Analysis Formulas** 
- **Pile Foundations Formulas** 
- **Porosity of Soil Sample Formulas** 
- **Scraper Production Formulas** 
- **Seepage Analysis Formulas** 
- **Slope Stability Analysis using Bishops Method Formulas** 
- **Slope Stability Analysis using Culman's Method Formulas** 
- **Soil Origin and Its Properties Formulas** 
- **Specific Gravity of Soil Formulas** 
- **Stability Analysis of Infinite Slopes in Prism Formulas** 
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