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# Compaction of Soil Formulas

Calculators! Examples! Conversions!

# List of 45 Compaction of Soil Formulas

## Compaction of Soil

## Compaction Equipment

### 1) Compaction Production by Compaction Equipment

Open Calculator

fx $$y = \frac{16 \cdot W \cdot S \cdot L \cdot E \cdot PR}{P}$$

ex $$297.5995 m^3/hr = \frac{16 \cdot 2.89m \cdot 3.0 km/h \cdot 7.175mm \cdot 0.50 \cdot 2.99 m^3}{5}$$

### 2) Compaction Production by Compaction Equipment when Efficiency Factor is Average

Open Calculator

fx $$y_a = \frac{16 \cdot W \cdot S \cdot L \cdot PR \cdot 0.80}{P}$$

ex $$476.1592 m^3/hr = \frac{16 \cdot 2.89m \cdot 3.0 km/h \cdot 7.175mm \cdot 2.99 m^3 \cdot 0.80}{5}$$

## 3) Compaction Production by Compaction Equipment when Efficiency Factor is Excellent

Open Calculator

$$y_{ex} = \frac{16 \cdot W \cdot S \cdot L \cdot PR \cdot 0.90}{P}$$

$$535.6791 \text{m}^3/\text{hr} = \frac{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 7.175\text{mm} \cdot 2.99\text{m}^3 \cdot 0.90}{5}$$

## 4) Compaction Production by Compaction Equipment when Efficiency Factor is Poor

Open Calculator

$$y_p = \frac{16 \cdot W \cdot S \cdot L \cdot PR \cdot 0.75}{P}$$

$$446.3992 \text{m}^3/\text{hr} = \frac{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 7.175\text{mm} \cdot 2.99\text{m}^3 \cdot 0.75}{5}$$

## 5) Efficiency Factor using Compaction Production by Compaction Equipment

Open Calculator

$$E = \frac{y \cdot P}{16 \cdot W \cdot S \cdot L \cdot PR}$$

$$0.499984 = \frac{297.59 \text{m}^3/\text{hr} \cdot 5}{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 7.175\text{mm} \cdot 2.99\text{m}^3}$$

## 6) Number of Passes given Compaction Production by Compaction Equipment

Open Calculator

fx $$P = \frac{16 \cdot W \cdot S \cdot E \cdot L \cdot PR}{y}$$

ex $$5.000159 = \frac{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 0.50 \cdot 7.175\text{mm} \cdot 2.99\text{m}^3}{297.59\text{m}^3/\text{hr}}$$

## 7) Ratio of Pay to Loose using Compaction Production by Compaction Equipment

Open Calculator

fx $$PR = \frac{y \cdot P}{16 \cdot W \cdot S \cdot L \cdot E}$$

ex $$2.989905\text{m}^3 = \frac{297.59\text{m}^3/\text{hr} \cdot 5}{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 7.175\text{mm} \cdot 0.50}$$

## 8) Speed of Roller given Compaction Production by Compaction Equipment

Open Calculator

fx $$S = \frac{y \cdot P}{16 \cdot W \cdot L \cdot PR \cdot E}$$

ex $$2.999904\text{km/h} = \frac{297.59\text{m}^3/\text{hr} \cdot 5}{16 \cdot 2.89\text{m} \cdot 7.175\text{mm} \cdot 2.99\text{m}^3 \cdot 0.50}$$

## 9) Thickness of Lift given Compaction Production by Compaction Equipment

Open Calculator

$$L = \frac{y \cdot P}{16 \cdot W \cdot S \cdot E \cdot PR}$$

$$7.174771\text{mm} = \frac{297.59\text{m}^3/\text{hr} \cdot 5}{16 \cdot 2.89\text{m} \cdot 3.0\text{km/h} \cdot 0.50 \cdot 2.99\text{m}^3}$$

## 10) Width of Roller given Compaction Production by Compaction Equipment

Open Calculator

$$W = \frac{y \cdot P}{16 \cdot S \cdot L \cdot PR \cdot E}$$

$$2.889908\text{m} = \frac{297.59\text{m}^3/\text{hr} \cdot 5}{16 \cdot 3.0\text{km/h} \cdot 7.175\text{mm} \cdot 2.99\text{m}^3 \cdot 0.50}$$

# Relative Compaction

## 11) Density Compaction

Open Calculator

$$DCR = \frac{\gamma_{dmin}}{\gamma_{dmax}}$$

$$0.802521 = \frac{3.82\text{kg/m}^3}{4.76\text{kg/m}^3}$$

## 12) Density Compaction given Relative Compaction in Relative Density

Open Calculator

$$DCR = R_c \cdot \frac{1 - RD}{1 - (R_c \cdot RD)}$$

$$0.8 = 2.5 \cdot \frac{1 - 3.4}{1 - (2.5 \cdot 3.4)}$$

## 13) Dry Density given Relative Compaction in Density

Open Calculator

$$\rho_d = R_c \cdot \gamma_{dmax}$$

$$11.9 \text{kg/m}^3 = 2.5 \cdot 4.76 \text{kg/m}^3$$

## 14) Maximum Dry Density given Density Compaction

Open Calculator

$$\gamma_{dmax} = \frac{\gamma_{dmin}}{DCR}$$

$$4.775 \text{kg/m}^3 = \frac{3.82 \text{kg/m}^3}{0.8}$$

## 15) Maximum Dry Density given Relative Compaction

Open Calculator

$$\gamma_{dmax} = \frac{\rho_d}{R_c}$$

$$4 \text{kg/m}^3 = \frac{10 \text{kg/m}^3}{2.5}$$

## 16) Minimum Dry Density given Density Compaction

Open Calculator

fx $$\gamma_{dmin} = DCR \cdot \gamma_{dmax}$$

ex $$3.808\text{kg/m}^3 = 0.8 \cdot 4.76\text{kg/m}^3$$

## 17) Minimum Void Ratio given Relative Compaction in Void Ratio

Open Calculator

fx $$e_{min} = (R_c \cdot (1 + e)) - 1$$

ex $$4.5 = (2.5 \cdot (1 + 1.2)) - 1$$

## 18) Relative Compaction given Density

Open Calculator

fx $$R_c = \frac{\rho_d}{\gamma_{dmax}}$$

ex $$2.10084 = \frac{10\text{kg/m}^3}{4.76\text{kg/m}^3}$$

## 19) Relative Compaction given Relative Density

Open Calculator

fx $$R_c = \frac{DCR}{1 - RD \cdot (1 - R_o)}$$

ex $$0.071429 = \frac{0.8}{1 - 3.4 \cdot (1 - 4)}$$

### 20) Relative Compaction given Void Ratio

Open Calculator

fx $$R_c = \frac{1 + e_{min}}{1 + e}$$

ex $$2.5 = \frac{1 + 4.5}{1 + 1.2}$$

### 21) Relative Density given Relative Compaction

Open Calculator

fx $$RD = \frac{DCR - R_c}{R_c \cdot (DCR - 1)}$$

ex $$3.4 = \frac{0.8 - 2.5}{2.5 \cdot (0.8 - 1)}$$

## Soil Compaction Test

### 22) California Bearing Ratio for Strength of Soil that Underlies Pavement

Open Calculator

fx $$CBR = \left(\frac{F}{F_s}\right)$$

ex $$0.5 = \left(\frac{3N/m^2}{6N/m^2}\right)$$

## 23) Coefficient of Permeability given Rate of Flow of Water

Open Calculator

$$k = \left( \frac{q_{flow}}{i \cdot A_{cs}} \right)$$

$$0.918485 \text{m/s} = \left( \frac{24 \text{m}^3/\text{s}}{2.01 \cdot 13 \text{m}^2} \right)$$

## 24) Cross-Sectional Area of Soil Conveying Flow given Rate of Flow of Water

Open Calculator

$$A_{cs} = \left( \frac{q_{flow}}{k \cdot i} \right)$$

$$12.06091 \text{m}^2 = \left( \frac{24 \text{m}^3/\text{s}}{0.99 \text{m/s} \cdot 2.01} \right)$$

## 25) Density of Sand given Volume of Soil for Sand Filling in Sand Cone Method

Open Calculator

$$\rho = \left( \frac{W_t}{V} \right)$$

$$4 \text{kg/m}^3 = \left( \frac{80 \text{kg}}{20 \text{m}^3} \right)$$

## 26) Dry Density of Soil given Percent Compaction of Soil in Sand Cone Method

Open Calculator

fx $$\rho_{dsc} = \frac{C \cdot \gamma_{dmax}}{100}$$

ex $$4.284\text{kg/m}^3 = \frac{90 \cdot 4.76\text{kg/m}^3}{100}$$

## 27) Dry Density of Soil in Sand Cone Method

Open Calculator

fx $$\rho_d = \left( \frac{\gamma_t}{1 + \left( \frac{M}{100} \right)} \right)$$

ex $$11.99556\text{kg/m}^3 = \left( \frac{12\text{kg/m}^3}{1 + \left( \frac{0.037}{100} \right)} \right)$$

## 28) Field Density in Sand Cone Method

Open Calculator

fx $$\rho_{fd} = \left( \frac{W_t}{V} \right)$$

ex $$4\text{kg/m}^3 = \left( \frac{80\text{kg}}{20\text{m}^3} \right)$$

## 29) Field Density of Soil given Dry Density of Soil in Sand Cone Method

Open Calculator

fx $$\gamma_t = \left(\rho_d \cdot \left(1 + \left(\frac{M}{100}\right)\right)\right)$$

ex $$10.0037\text{kg/m}^3 = \left(10\text{kg/m}^3 \cdot \left(1 + \left(\frac{0.037}{100}\right)\right)\right)$$

## 30) Force per Unit Area Required for Penetration of Standard Material

Open Calculator

fx $$F_s = \left(\frac{F}{CBR}\right)$$

ex $$6.382979\text{N/m}^2 = \left(\frac{3\text{N/m}^2}{0.47}\right)$$

## 31) Force per Unit Area Required to Penetrate Soil Mass with Circular Piston

Open Calculator

fx $$F = CBR \cdot F_s$$

ex $$2.82\text{N/m}^2 = 0.47 \cdot 6\text{N/m}^2$$

## 32) Hydraulic Gradient given Rate of Flow of Water

Open Calculator

fx $$i = \left(\frac{q_{flow}}{k \cdot A_{cs}}\right)$$

ex $$1.864802 = \left(\frac{24\text{m}^3/\text{s}}{0.99\text{m/s} \cdot 13\text{m}^2}\right)$$

## 33) Maximum Dry Density given Percent Compaction of Soil in Sand Cone Method

Open Calculator

fx $$\gamma_{dmax} = (\rho_{dsc}) \cdot \frac{100}{C}$$

ex $$4.76\text{kg/m}^3 = (4.284\text{kg/m}^3) \cdot \frac{100}{90}$$

## 34) Percent Compaction of Soil in Sand Cone Method

Open Calculator

fx $$C = \frac{100 \cdot \rho_{dsc}}{\gamma_{dmax}}$$

ex $$90 = \frac{100 \cdot 4.284\text{kg/m}^3}{4.76\text{kg/m}^3}$$

## 35) Percent Moisture Content given Dry Density of Soil in Sand Cone Method

Open Calculator

fx $$M_{sc} = 100 \cdot \left( \left( \frac{\gamma_t}{\rho_{dsc}} \right) - 1 \right)$$

ex $$180.112 = 100 \cdot \left( \left( \frac{12\text{kg/m}^3}{4.284\text{kg/m}^3} \right) - 1 \right)$$

## 36) Percent Moisture in Sand Cone Method

Open Calculator

fx $$M_{sc} = \frac{100 \cdot (W_m - W_d)}{W_d}$$

ex $$100 = \frac{100 \cdot (10.0\text{kg} - 5.0\text{kg})}{5.0\text{kg}}$$

## 37) Rate of Flow of Water through Saturated Soil by Darcy's Law

Open Calculator

fx $$q_{flow} = (k \cdot i \cdot A_{cs})$$

ex $$25.8687\text{m}^3/\text{s} = (0.99\text{m/s} \cdot 2.01 \cdot 13\text{m}^2)$$

## 38) Settlement of Plate in Load Bearing Test

Open Calculator

fx $$\rho^1 = \Delta \cdot \left(\frac{1 + B}{2 \cdot B}\right)^2$$

ex $$0.0027\text{m} = 4.8\text{mm} \cdot \left(\frac{1 + 2000\text{mm}}{2 \cdot 2000\text{mm}}\right)^2$$

## 39) Volume of Soil for Sand Filling in Sand Cone Method

Open Calculator

fx $$V = \left(\frac{W_t}{\rho}\right)$$

ex $$17.13062\text{m}^3 = \left(\frac{80\text{kg}}{4.67\text{kg/m}^3}\right)$$

## 40) Volume of Soil given Field Density in Sand Cone Method

Open Calculator

$$V = \left(\frac{W_t}{\rho_{fd}}\right)$$

$$20\text{m}^3 = \left(\frac{80\text{kg}}{4.0\text{kg/m}^3}\right)$$

## 41) Weight of Dry Soil given Percent Moisture in Sand Cone Method

Open Calculator

$$W_d = \frac{100 \cdot W_m}{M_{sc} + 100}$$

$$4\text{kg} = \frac{100 \cdot 10.0\text{kg}}{150 + 100}$$

## 42) Weight of Moist Soil given Percent Moisture in Sand Cone Method

Open Calculator

$$W_m = \left(\left(M_{sc} \cdot \frac{W_d}{100}\right) + W_d\right)$$

$$12.5\text{kg} = \left(\left(150 \cdot \frac{5.0\text{kg}}{100}\right) + 5.0\text{kg}\right)$$

## 43) Weight of Sand Filling Hole in Sand Cone Method

Open Calculator

$$W_t = (V \cdot \rho)$$

$$93.4\text{kg} = (20\text{m}^3 \cdot 4.67\text{kg/m}^3)$$

## 44) Weight of Soil in Sand Cone Method

Open Calculator

$$W_t = (\rho_{fd} \cdot V)$$

$$80\text{kg} = (4.0\text{kg/m}^3 \cdot 20\text{m}^3)$$

## 45) Width of Full Size Bearing Plate in Load Bearing Test

Open Calculator

$$B = \left( \frac{1}{2 \cdot \sqrt{\frac{\rho^1}{\Delta}} - 1} \right)$$

$$2000\text{mm} = \left( \frac{1}{2 \cdot \sqrt{\frac{0.0027\text{m}}{4.8\text{mm}}} - 1} \right)$$

# Variables Used

- **$A_{cs}$** Cross Sectional Area in Permeability *(Square Meter)*
- **B** Width of Full Size Bearing Plate *(Millimeter)*
- **C** Percent Compaction
- **CBR** California Bearing Ratio
- **DCR** Density Compaction Ratio
- **e** Void Ratio
- **E** Efficiency Factor
- **$e_{min}$** Minimum Void Ratio
- **F** Force per Unit Area *(Newton per Square Meter)*
- **$F_s$** Force Per Unit Area Standard *(Newton per Square Meter)*
- **i** Hydraulic Gradient in Soil
- **k** Coefficient of Permeability *(Meter per Second)*
- **L** Lift Thickness *(Millimeter)*
- **M** Percent Moisture
- **$M_{sc}$** Percent Moisture from Sand Cone Test
- **P** Number of Passes
- **PR** Pay Ratio *(Cubic Meter)*
- **$q_{flow}$** Rate of Flow of Water through Soil *(Cubic Meter per Second)*
- **$R_c$** Relative Compaction
- **$R_o$** Density Compaction
- **RD** Relative Density
- **S** Roller Speed *(Kilometer per Hour)*
- **V** Volume of Soil *(Cubic Meter)*

- **W** Width of Roller *(Meter)*
- **$W_d$** Weight of Dry Soil *(Kilogram)*
- **$W_m$** Weight of Moist Soil *(Kilogram)*
- **$W_t$** Weight of Total Soil *(Kilogram)*
- **y** Production due to Compaction *(Cubic Meter per Hour)*
- **$y_a$** Compaction Production (Effi. Factor is Average) *(Cubic Meter per Hour)*
- **$y_{ex}$** Compaction Production (Effi. Factor is Excellent) *(Cubic Meter per Hour)*
- **$y_p$** Compaction Production (Effi. Factor is Poor) *(Cubic Meter per Hour)*
- **$\gamma_{dmax}$** Maximum Dry Density *(Kilogram per Cubic Meter)*
- **$\gamma_{dmin}$** Minimum Dry Density *(Kilogram per Cubic Meter)*
- **$\gamma_t$** Bulk Density of Soil *(Kilogram per Cubic Meter)*
- **Δ** Settlement Foundation *(Millimeter)*
- **ρ** Density of Sand *(Kilogram per Cubic Meter)*
- **$\rho_d$** Dry Density *(Kilogram per Cubic Meter)*
- **$\rho_{dsc}$** Dry Density from Sand Cone Test *(Kilogram per Cubic Meter)*
- **$\rho_{fd}$** Field Density from Sand Cone Test *(Kilogram per Cubic Meter)*
- **$\rho^1$** Settlement of Plate *(Meter)*

# Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m), Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg)
  *Weight Unit Conversion*
- Measurement: **Volume** in Cubic Meter ($m^3$)
  *Volume Unit Conversion*
- Measurement: **Area** in Square Meter ($m^2$)
  *Area Unit Conversion*
- Measurement: **Pressure** in Newton per Square Meter ($N/m^2$)
  *Pressure Unit Conversion*
- Measurement: **Speed** in Kilometer per Hour (km/h), Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Hour ($m^3/hr$), Cubic Meter per Second ($m^3/s$)
  *Volumetric Flow Rate Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter ($kg/m^3$)
  *Density Unit Conversion*

## Check other formula lists

- Bearing Capacity for Strip Footing for C-Φ 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
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- Water Content of Soil and Related Formulas

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