Important Compaction of Soil Formulas PDF



Formulas Examples with Units

List of 37

Important Compaction of Soil Formulas

1) Compaction Equipment Formulas 🕝

1.1) Compaction Production by Compaction Equipment Formula



Formula

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

Example with Units

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

1.2) Compaction Production by Compaction Equipment when Efficiency Factor is Average Formula

Formula

 $y_{a} = \frac{16 \cdot W \cdot S \cdot L \cdot PR \cdot 0.80}{P}$

Evaluate Formula 🕝

Example with Units

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

1.3) Compaction Production by Compaction Equipment when Efficiency Factor is Excellent Formula

Formula

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

Evaluate Formula 🕝

Example with Units

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

1.4) Compaction Production by Compaction Equipment when Efficiency Factor is Poor Formula (

Formula

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

Evaluate Formula (

Example with Units

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

1.5) Efficiency Factor using Compaction Production by Compaction Equipment Formula 🗂

Evaluate Formula (Example with Units

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

$$0.5 = \frac{297.59 \, \text{m}^3 / \text{hr} \cdot 5}{16 \cdot 2.89 \, \text{m} \cdot 3.0 \, \text{km/h} \cdot 7.175 \, \text{mm} \cdot 2.99 \, \text{m}^3}$$

1.6) Number of Passes given Compaction Production by Compaction Equipment Formula 🕝

Evaluate Formula

Formula Example with Units
$$P = \frac{16 \cdot W \cdot S \cdot E \cdot L \cdot PR}{y} = \frac{16 \cdot 2.89 \, \text{m} \cdot 3.0 \, \text{km/h} \cdot 0.50 \cdot 7.175 \, \text{mm} \cdot 2.99 \, \text{m}^3}{297.59 \, \text{m}^3/\text{hr}}$$

1.7) Ratio of Pay to Loose using Compaction Production by Compaction Equipment Formula

Evaluate Formula (Formula Example with Units

1.8) Speed of Roller given Compaction Production by Compaction Equipment Formula

Evaluate Formula (Example with Units

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

$$2.9999 \, \text{km/h} = \frac{297.59 \, \text{m}^3 / \text{hr} \cdot 5}{16 \cdot 2.89 \, \text{m} \cdot 7.175 \, \text{mm} \cdot 2.99 \, \text{m}^3 \cdot 0.50}$$

1.9) Thickness of Lift given Compaction Production by Compaction Equipment Formula 🗂

Evaluate Formula (Example with Units Formula

1.10) Width of Roller given Compaction Production by Compaction Equipment Formula 🗂

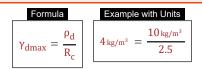
Formula Example with Units
$$W = \frac{y \cdot P}{16 \cdot S \cdot L \cdot PR \cdot E} = \frac{297.59 \, \text{m}^3 / \text{hr} \cdot 5}{16 \cdot 3.0 \, \text{km/h} \cdot 7.175 \, \text{mm} \cdot 2.99 \, \text{m}^3 \cdot 0.50}$$

Evaluate Formula 🕝

2) Relative Compaction Formulas 🕝

2.1) Dry Density given Relative Compaction in Density Formula

2.2) Maximum Dry Density given Relative Compaction Formula

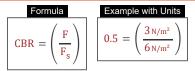


2.3) Relative Compaction given Density Formula



3) Soil Compaction Test Formulas 🗂

3.1) California Bearing Ratio for Strength of Soil that Underlies Pavement Formula



3.2) Coefficient of Permeability given Rate of Flow of Water Formula C

$$k = \left(\frac{q_{flow}}{i \cdot A_{cs}}\right) \qquad \boxed{ \begin{aligned} &\text{Example with Units} \\ &0.9185\,\text{m/s} \ = \left(\frac{24\,\text{m}^3/\text{s}}{2.01 \cdot 13\,\text{m}^2}\right) \end{aligned} }$$

3.3) Cross-Sectional Area of Soil Conveying Flow given Rate of Flow of Water Formula

Formula Example with Units
$$A_{cs} = \left(\frac{q_{flow}}{k \cdot i}\right) \boxed{ 12.0609 \, \text{m}^2 \, = \left(\frac{24 \, \text{m}^3/\text{s}}{0.99 \, \text{m/s} \, \cdot 2.01}\right) }$$

3.4) Density of Sand given Volume of Soil for Sand Filling in Sand Cone Method Formula

Evaluate Formula

Evaluate Formula (

Evaluate Formula (

Evaluate Formula (

Evaluate Formula

3.5) Dry Density of Soil given Percent Compaction of Soil in Sand Cone Method Formula 🕝

Evaluate Formula (

Evaluate Formula (

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

$$\rho_{dsc} = \frac{C \cdot \gamma_{dmax}}{100} \qquad 4.284 \, \text{kg/m}^3 = \frac{90 \cdot 4.76 \, \text{kg/m}^3}{100}$$

3.6) Dry Density of Soil in Sand Cone Method Formula 🕝



$$\rho_{d} = \left(\frac{\gamma_{t}}{1 + \left(\frac{M}{100}\right)}\right)$$

Formula Example with Units
$$\rho_d = \left(\frac{\gamma_t}{1 + \left(\frac{\text{M}}{100}\right)}\right) \boxed{11.9956\,\text{kg/m}^3 = \left(\frac{12\,\text{kg/m}^3}{1 + \left(\frac{0.037}{100}\right)}\right)}$$

3.7) Field Density in Sand Cone Method Formula C

Formula Example with Units Evaluate Formula

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

$$\rho_{fd} = \left(\frac{W_t}{V}\right) \boxed{ 4_{kg/m^3} = \left(\frac{80 \, kg}{20 \, m^3}\right)}$$

3.8) Field Density of Soil given Dry Density of Soil in Sand Cone Method Formula 🦵

Formula

Example with Units

Evaluate Formula (

Evaluate Formula (

$$\gamma_{t} = \left(\rho_{d} \cdot \left(1 + \left(\frac{M}{100}\right)\right)\right)$$

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

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

3.9) Force per Unit Area Required for Penetration of Standard Material Formula 🕝



3.10) Force per Unit Area Required to Penetrate Soil Mass with Circular Piston Formula 🗂

Formula Example with Units $F = CBR \cdot F_S \qquad 2.82 \, \text{N/m}^2 \, = \, 0.47 \cdot 6 \, \text{N/m}^2$

Evaluate Formula (

3.11) Hydraulic Gradient given Rate of Flow of Water Formula 🕝

Example with Units

Evaluate Formula (



i =
$$\left(\frac{q_{flow}}{k \cdot A_{cs}}\right)$$
 1.8648 = $\left(\frac{24 \, \text{m}^3/\text{s}}{0.99 \, \text{m/s} \cdot 13 \, \text{m}^2}\right)$

3.12) Maximum Dry Density given Percent Compaction of Soil in Sand Cone Method Formula



Example with Units

Evaluate Formula (

Evaluate Formula

Evaluate Formula (

Evaluate Formula (

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

 $\gamma_{\text{dmax}} = \left(\rho_{\text{dsc}}\right) \cdot \frac{100}{C}$ $4.76 \,\text{kg/m}^3 = \left(4.284 \,\text{kg/m}^3\right) \cdot \frac{100}{90}$

3.13) Percent Compaction of Soil in Sand Cone Method Formula

Example with Units

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

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

3.14) Percent Moisture Content given Dry Density of Soil in Sand Cone Method Formula 🕝

Formula

Formula Example with Units
$$M_{SC} = 100 \cdot \left(\left(\frac{\gamma_t}{\rho_{dsc}} \right) - 1 \right) \boxed{ 180.112 = 100 \cdot \left(\left(\frac{12 \, \text{kg/m}^3}{4.284 \, \text{kg/m}^3} \right) - 1 \right) }$$

3.15) Percent Moisture in Sand Cone Method Formula

Formula Example with Units
$$M_{sc} = \frac{100 \cdot \left(W_{m} - W_{d}\right)}{W_{d}} \qquad \boxed{100 = \frac{100 \cdot \left(10.0 \, \text{kg} - 5.0 \, \text{kg}\right)}{5.0 \, \text{kg}}}$$

3.16) Rate of Flow of Water through Saturated Soil by Darcy's Law Formula 🕝

Evaluate Formula

3.17) Settlement of Plate in Load Bearing Test Formula 🕝

Formula Example with Units
$$\rho^1 = \Delta \cdot \left(\frac{1+B}{2 \cdot B}\right)^2 \qquad 0.0027_{\text{m}} = 4.8_{\text{mm}} \cdot \left(\frac{1+2000_{\text{mm}}}{2 \cdot 2000_{\text{mm}}}\right)^2$$

Evaluate Formula 🕝

3.18) Volume of Soil for Sand Filling in Sand Cone Method Formula C

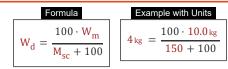
Formula Example with Units
$$V = \left(\frac{W_t}{\rho}\right) \boxed{ 17.1306\,\mathrm{m}^3 = \left(\frac{80\,\mathrm{kg}}{4.67\,\mathrm{kg/m}^3}\right) }$$

Evaluate Formula 🕝

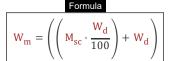
3.19) Volume of Soil given Field Density in Sand Cone Method Formula

Formula Example with Units
$$V = \left(\frac{W_t}{\rho_{fd}}\right) \qquad 20_{m^3} = \left(\frac{80\,\mathrm{kg}}{4.0\,\mathrm{kg/m^3}}\right)$$

3.20) Weight of Dry Soil given Percent Moisture in Sand Cone Method Formula 🕝



3.21) Weight of Moist Soil given Percent Moisture in Sand Cone Method Formula 🦵



Formula Example with Units
$$W_{m} = \left(\left(M_{sc} \cdot \frac{W_{d}}{100} \right) + W_{d} \right) \qquad \boxed{12.5 \, \text{kg} = \left(\left(150 \cdot \frac{5.0 \, \text{kg}}{100} \right) + 5.0 \, \text{kg} \right)}$$

3.22) Weight of Sand Filling Hole in Sand Cone Method Formula 🕝

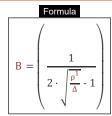
Formula Example with Units
$$W_t = \left(\ V \cdot \rho \ \right) \\ \boxed{ 93.4 \, \text{kg} \, = \, \left(\ 20 \, \text{m}^3 \, \cdot 4.67 \, \text{kg/m}^3 \ \right) }$$

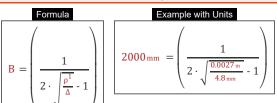
3.23) Weight of Soil in Sand Cone Method Formula C



Formula Example with Units
$$W_t = \left(\; \rho_{fd} \cdot V \; \right) \\ \hline \left(\; 80 \, \mathrm{kg} \; = \; \left(\; 4.0 \, \mathrm{kg/m^3} \, \cdot 20 \, \mathrm{m^3} \; \right) \; \right)$$

3.24) Width of Full Size Bearing Plate in Load Bearing Test Formula 🗂





Evaluate Formula (

Evaluate Formula (

Evaluate Formula (

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Evaluate Formula [

Evaluate Formula (

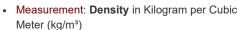
Variables used in list of Compaction of Soil Formulas above

- A_{cs} Cross Sectional Area in Permeability (Square Meter)
- **B** Width of Full Size Bearing Plate (Millimeter)
- C Percent Compaction
- · CBR California Bearing Ratio
- E Efficiency Factor
- 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
- 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)
- Y_{dmax} Maximum Dry Density (Kilogram per Cubic Meter)

Constants, Functions, Measurements used in list of Compaction of Soil Formulas above

- Functions: 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 (m³)
 Volume Unit Conversion
- Measurement: Area in Square Meter (m²)
 Area Unit Conversion
- Measurement: Pressure in Newton per Square Meter (N/m²)
 - 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 (m³/hr), Cubic Meter per Second (m³/s)

Volumetric Flow Rate Unit Conversion



Density Unit Conversion



- γ_t Bulk Density of Soil (Kilogram per Cubic Meter)
- **△** Settlement Foundation (Millimeter)
- ρ Density of Sand (Kilogram per Cubic Meter)
- ρ_d Dry Density (Kilogram per Cubic Meter)
- ρ_{dsc} Dry Density from Sand Cone Test (Kilogram per Cubic Meter)
- **ρ**fd Field Density from Sand Cone Test (Kilogram per Cubic Meter)
- ρ¹ Settlement of Plate (Meter)

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Proper fraction

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