Important Bearing Capacity of Soils Formulas PDF

Formulas
Examples
with Units

List of 16
Important Bearing Capacity of Soils Formulas

1) Angle of Internal Friction given Bearing Capacity by Vesic's Analysis Formula

Evaluate Formula

Formula

$$\varphi = a\tan\left(\frac{N_\gamma}{2\cdot\left(N_q+1\right)}\right)$$

Example with Units

$$14.884^\circ = a\tan\left(\frac{1.6}{2\cdot\left(2.01+1\right)}\right)$$

2) Bearing Capacity Factor Dependent on Unit Weight by Vesic's Analysis Formula

Evaluate Formula

Formula

$$N_\gamma = 2\cdot\left(N_q+1\right)\cdot\tan\left(\frac{\Phi_i\cdot\pi}{180}\right)$$

Example with Units

$$0.152 = 2\cdot\left(2.01+1\right)\cdot\tan\left(\frac{82.87^\circ\cdot 3.1416}{180}\right)$$

3) Depth of Footing given Safe Bearing Capacity Formula

Evaluate Formula

Formula

$$D = \frac{q_{s'} - q_{nsa}}{\gamma}$$

Example with Units

$$25\,\text{m} = \frac{2.34\,\text{kN/m}^2 - 1.89\,\text{kN/m}^2}{18\,\text{kN/m}^3}$$

4) Effective Surcharge given Depth of Footing Formula

Evaluate Formula

Formula

$$\sigma_s = \gamma\cdot D$$

Example with Units

$$0.45\,\text{kN/m}^2 = 18\,\text{kN/m}^3\cdot 25\,\text{m}$$

5) Effective Surcharge given Net Pressure Intensity Formula

Evaluate Formula

Formula

$$\sigma_s = q_g - q_n$$

Example with Units

$$0.45\,\text{kN/m}^2 = 60.9\,\text{kN/m}^2 - 60.45\,\text{kN/m}^2$$

6) Net Pressure Intensity Formula

Evaluate Formula

Formula

$$q_n = q_g - \sigma_s$$

Example with Units

$$60.45\,\text{kN/m}^2 = 60.9\,\text{kN/m}^2 - 0.45\,\text{kN/m}^2$$

7) Net Safe Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{nsa} = \frac{q_{net'}}{FOS}$$

Example with Units

$$1.8929\,\text{kN/m}^2 = \frac{5.3\,\text{kN/m}^2}{2.8}$$

8) Net Safe Bearing Capacity given Ultimate Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{nsa'} = \frac{q_{fc} - \sigma_s}{FOS}$$

Example with Units

$$45.4821\,\text{kN/m}^2 = \frac{127.8\,\text{kPa} - 0.45\,\text{kN/m}^2}{2.8}$$

9) Net Ultimate Bearing Capacity given Net Safe Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{net'} = q_{nsa} \cdot FOS$$

Example with Units

$$5.292\,\text{kN/m}^2 = 1.89\,\text{kN/m}^2 \cdot 2.8$$

10) Net Ultimate Bearing Capacity given Ultimate Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{net} = q_f - \sigma_s$$

Example with Units

$$59.55\,\text{kN/m}^2 = 60\,\text{kPa} - 0.45\,\text{kN/m}^2$$

11) Safe Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{sa} = q_{nsa} + \left(\gamma \cdot D_{footing}\right)$$

Example with Units

$$47.61\,\text{kN/m}^2 = 1.89\,\text{kN/m}^2 + \left(18\,\text{kN/m}^3 \cdot 2.54\,\text{m}\right)$$

12) Safe Bearing Capacity given Net Ultimate Bearing Capacity Formula

Evaluate Formula

Formula

$$q_{sa} = \left(\frac{q_{net'}}{FOS}\right) + \left(\gamma \cdot D_{footing}\right)$$

Example with Units

$$47.6129\,\text{kN/m}^2 = \left(\frac{5.3\,\text{kN/m}^2}{2.8}\right) + \left(18\,\text{kN/m}^3 \cdot 2.54\,\text{m}\right)$$

13) Ultimate Bearing Capacity Formula

Evaluate Formula

Formula

$$q_f = q_{net} + \sigma_s$$

Example with Units

$$38.75\,\text{kPa} = 38.3\,\text{kN/m}^2 + 0.45\,\text{kN/m}^2$$

14) Ultimate Bearing Capacity given Depth of Footing Formula

Evaluate Formula

Formula

$$q_f = q_{net'} + \left(\gamma \cdot D_{footing}\right)$$

Example with Units

$$51.02\,\text{kPa} = 5.3\,\text{kN/m}^2 + \left(18\,\text{kN/m}^3 \cdot 2.54\,\text{m}\right)$$

15) Ultimate Bearing Capacity given Factor of Safety Formula

Evaluate Formula

Formula

$$q_{fc} = \left(q_{nsa'} \cdot FOS\right) + \sigma_s$$

Example with Units

$$127.794\,\text{kPa} = \left(45.48\,\text{kN/m}^2 \cdot 2.8\right) + 0.45\,\text{kN/m}^2$$

16) Ultimate Bearing Capacity of Soil under Long Footing at Surface of Soil Formula

Evaluate Formula

Formula

$$q_f = \left(\left(\frac{C}{\tan\left(\Phi_i \right)} \right) + \left(0.5 \cdot \gamma_d \cdot B \cdot \sqrt{K_P} \right) \cdot \left(K_P \cdot \exp\left(\pi \cdot \tan\left(\Phi_i \right) \right) - 1 \right) \right)$$

Example with Units

$$60.6588\,\text{kPa} = \left(\left(\frac{3\,\text{kgf/m}^2}{\tan\left(82.87° \right)} \right) + \left(0.5 \cdot 0.073\,\text{kN/m}^3 \cdot 0.23\,\text{m} \cdot \sqrt{2\text{E-}5} \right) \cdot \left(2\text{E-}5 \cdot \exp\left(3.1416 \cdot \tan\left(82.87° \right) \right) - 1 \right) \right)$$

Variables used in list of Bearing Capacity of Soils Formulas above

- **B** Width of Footing *(Meter)*
- **C** Prandtls Cohesion *(Kilogram-Force per Square Meter)*
- **D** Depth of Footing *(Meter)*
- $D_{footing}$ Depth of Footing in Soil *(Meter)*
- **FOS** Factor of Safety in Bearing Capacity of Soil
- K_P Coefficient of Passive Pressure
- N_q Bearing Capacity Factor dependent on Surcharge
- N_γ Bearing Capacity Factor dependent on Unit Weight
- q_f Ultimate Bearing Capacity *(Kilopascal)*
- q_{fc} Ultimate Bearing Capacity of Soil *(Kilopascal)*
- q_g Gross Pressure *(Kilonewton per Square Meter)*
- q_n Net Pressure *(Kilonewton per Square Meter)*
- q_{net} Net Ultimate Bearing Capacity of Soil *(Kilonewton per Square Meter)*
- $q_{net'}$ Net Ultimate Bearing Capacity *(Kilonewton per Square Meter)*
- q_{nsa} Net Safe Bearing Capacity in Soil *(Kilonewton per Square Meter)*
- $q_{nsa'}$ Net Safe Bearing Capacity *(Kilonewton per Square Meter)*
- $q_{s'}$ Safe Bearing Capacity of Soil *(Kilonewton per Square Meter)*
- q_{sa} Safe Bearing Capacity *(Kilonewton per Square Meter)*
- γ Unit Weight of Soil *(Kilonewton per Cubic Meter)*
- γ_d Dry Unit Weight of Soil *(Kilonewton per Cubic Meter)*
- σ_s Effective Surcharge in Kilo Pascal *(Kilonewton per Square Meter)*
- φ Angle of Internal Friction *(Degree)*
- Φ_i Angle of Internal Friction of Soil *(Degree)*

Constants, Functions, Measurements used in list of Bearing Capacity of Soils Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **atan**, atan(Number) *Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.*
- Functions: **exp**, exp(Number) *n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.*
- 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.*
- Functions: **tan**, tan(Angle) *The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Pressure** in Kilonewton per Square Meter (kN/m²), Kilopascal (kPa), Kilogram-Force per Square Meter (kgf/m²) *Pressure Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³) *Specific Weight Unit Conversion*

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