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Bearing Capacity of Soils Formulas

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List of 16 Bearing Capacity of Soils Formulas

Bearing Capacity of Soils

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

Open Calculator

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

ex $$1.436852^\circ = a\tan\left(\frac{0.151}{2\cdot(2.01+1)}\right)$$

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

Open Calculator

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

ex $$0.151999 = 2\cdot(2.01+1)\cdot\tan\left(\frac{82.87^\circ\cdot\pi}{180}\right)$$

3) Depth of Footing given Safe Bearing Capacity

Open Calculator

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

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

4) Effective Surcharge given Depth of Footing

Open Calculator

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

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

5) Effective Surcharge given Net Pressure Intensity

Open Calculator

fx $$\sigma_s = q_g - q_n$$

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

6) Net Pressure Intensity

Open Calculator

fx $$q_n = q_g - \sigma_s$$

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

7) Net Safe Bearing Capacity

Open Calculator

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

$$1.892857\text{kN/m}^2 = \frac{5.3\text{kN/m}^2}{2.8}$$

8) Net Safe Bearing Capacity given Ultimate Bearing Capacity

Open Calculator

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

$$45.48214\text{kN/m}^2 = \frac{127.8\text{kPa} - 0.45\text{kN/m}^2}{2.8}$$

9) Net Ultimate Bearing Capacity given Net Safe Bearing Capacity

Open Calculator

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

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

10) Net Ultimate Bearing Capacity given Ultimate Bearing Capacity

Open Calculator

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

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

11) Safe Bearing Capacity

Open Calculator

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

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

12) Safe Bearing Capacity given Net Ultimate Bearing Capacity

Open Calculator

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

$$47.61286\text{kN/m}^2 = \left(\frac{5.3\text{kN/m}^2}{2.8}\right) + (18\text{kN/m}^3 \cdot 2.54\text{m})$$

13) Ultimate Bearing Capacity

Open Calculator

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

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

14) Ultimate Bearing Capacity given Depth of Footing

Open Calculator

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

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

15) Ultimate Bearing Capacity given Factor of Safety

Open Calculator

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

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

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

Open Calculator

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

$$60.65884\text{kPa} = \left(\left(\frac{3\text{kgf/m}^2}{\tan(82.87^\circ)}\right) + \left(0.5 \cdot 0.073\text{kN/m}^3 \cdot 0.23\text{m} \cdot \sqrt{2E\text{^}-5}\right) \cdot (2E\text{^}-5 \cdot \exp(\pi \cdot \tan(82.87^\circ)) - 1$$

Variables Used

- **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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **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.
- Function: **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.
- 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.
- Function: **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

Check other formula lists

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