

Important Design of Retaining Walls Formulas PDF

Formulas Examples with Units

List of 15 Important Design of Retaining Walls Formulas

1) Cantilever and Counterfort Retaining Walls Formulas

1.1) Counterfort Shear Unit Stress on Horizontal Section Formula

Formula

$$v_c = \frac{V_o}{t_c \cdot d}$$

Example with Units

$$3.136 \text{ MPa} = \frac{8 \text{ MPa}}{5.1 \text{ mm} \cdot 500.2 \text{ m}}$$

Evaluate Formula

1.2) Horizontal Distance from Face of Wall to Main Steel Formula

Formula

$$d = \frac{V_o}{t_c \cdot v_c}$$

Example with Units

$$490.1961 \text{ m} = \frac{8 \text{ MPa}}{5.1 \text{ mm} \cdot 3.2 \text{ MPa}}$$

Evaluate Formula

1.3) Normal Shear Unit Stress on Horizontal Section Formula

Formula

$$V_o = (v_c \cdot t_c \cdot d)$$

Example with Units

$$8.1633 \text{ MPa} = (3.2 \text{ MPa} \cdot 5.1 \text{ mm} \cdot 500.2 \text{ m})$$

Evaluate Formula

1.4) Shear Force on Section for Vertical Wall Face Formula

Formula

$$F_{\text{shear}} = V_1 + \left(\frac{M_b}{d} \right) \cdot \tan(\theta)$$

Example with Units

$$500 \text{ N} = 500 \text{ N} + \left(\frac{53 \text{ N} \cdot \text{m}}{500.2 \text{ m}} \right) \cdot \tan(180^\circ)$$

Evaluate Formula

1.5) Thickness of Counterfort Shear Unit Stress on Horizontal Section Formula

Formula

$$t_c = \frac{V_o}{v_c \cdot d}$$

Example with Units

$$4.998 \text{ mm} = \frac{8 \text{ MPa}}{3.2 \text{ MPa} \cdot 500.2 \text{ m}}$$

Evaluate Formula



2) Earth Pressure and Stability Formulas

2.1) Height of Water above Bottom of Wall given Total Thrust from Water Retained behind Wall Formula

Formula

$$H_w = \sqrt{2 \cdot \frac{T_w}{\gamma_w}}$$

Example with Units

$$1.8061 \text{ m} = \sqrt{2 \cdot \frac{16 \text{ kN/m}}{9.81 \text{ kN/m}^3}}$$

Evaluate Formula

2.2) Total Thrust from Water Retained by Wall Formula

Formula

$$T_w = \left(0.5 \cdot \gamma_w \cdot (H_w)^2 \right)$$

Example with Units

$$15.8922 \text{ kN/m} = \left(0.5 \cdot 9.81 \text{ kN/m}^3 \cdot (1.80 \text{ m})^2 \right)$$

Evaluate Formula

2.3) Unit Weight of Water given Total Thrust from Water Retained behind Wall Formula

Formula

$$\gamma_w = \left(2 \cdot \frac{T_w}{(H_w)^2} \right)$$

Example with Units

$$9.8765 \text{ kN/m}^3 = \left(2 \cdot \frac{16 \text{ kN/m}}{(1.80 \text{ m})^2} \right)$$

Evaluate Formula

3) Gravity Retaining Wall Formulas

3.1) Earth Thrust Horizontal Component given Sum of Righting Moments Formula

Formula

$$P_h = \left(\frac{\mu \cdot R_v}{1.5} \right)$$

Example with Units

$$200.04 \text{ N} = \left(\frac{0.6 \cdot 500.1 \text{ N}}{1.5} \right)$$

Evaluate Formula

3.2) Overturning Moment Formula

Formula

$$M_o = \frac{M_r}{1.5}$$

Example with Units

$$10.0667 \text{ N}^*\text{m} = \frac{15.1 \text{ N}^*\text{m}}{1.5}$$

Evaluate Formula

3.3) Pressure when Resultant is Outside Middle Third Formula

Formula

$$p = 2 \cdot \frac{R_v}{3 \cdot a}$$

Example with Units

$$83.35 \text{ Pa} = 2 \cdot \frac{500.1 \text{ N}}{3 \cdot 4 \text{ m}}$$

Evaluate Formula



3.4) Resultant Outside Middle Third Formula

Formula

$$a = 2 \cdot \frac{R_v}{3 \cdot p}$$

Example with Units

$$4.0024 \text{ m} = 2 \cdot \frac{500.1 \text{ N}}{3 \cdot 83.3 \text{ Pa}}$$

Evaluate Formula 

3.5) Retaining Wall Righting Moment Formula

Formula

$$M_r = 1.5 \cdot M_o$$

Example with Units

$$15.15 \text{ N*m} = 1.5 \cdot 10.1 \text{ N*m}$$

Evaluate Formula 

3.6) Total Downward Force on Soil for Horizontal Component Formula

Formula

$$R_v = \frac{P_h \cdot 1.5}{\mu}$$

Example with Units

$$500 \text{ N} = \frac{200 \text{ N} \cdot 1.5}{0.6}$$

Evaluate Formula 

3.7) Total Downward Force on Soil when Resultant is Outside Middle Third Formula

Formula

$$R_v = \frac{p \cdot 3 \cdot a}{2}$$

Example with Units

$$499.8 \text{ N} = \frac{83.3 \text{ Pa} \cdot 3 \cdot 4 \text{ m}}{2}$$

Evaluate Formula 



Variables used in list of Design of Retaining Walls Formulas above


- **a** Middle Third Distance (Meter)
- **d** Horizontal Distance (Meter)
- **F_{shear}** Shear Force on Section (Newton)
- **H_w** Height of Water (Meter)
- **M_b** Bending Moment (Newton Meter)
- **M_o** Overturning Moment (Newton Meter)
- **M_r** Retaining Wall Righting Moment (Newton Meter)
- **p** Earth Pressure (Pascal)
- **P_h** Horizontal Component of Earth Thrust (Newton)
- **R_v** Total Downward Force on Soil (Newton)
- **t_c** Thickness of Counterfort (Millimeter)
- **T_w** Thrust from Water (Kilonewton per Meter)
- **V₁** Shear on Section 1 (Newton)
- **v_c** Counterfort Shear Unit Stress (Megapascal)
- **V_o** Normal Shear Unit Stress (Megapascal)
- **Y_w** Unit Weight of Water (Kilonewton per Cubic Meter)
- **θ** Angle between Earth and Wall (Degree)
- **μ** Coefficient of Sliding Friction

Constants, Functions, Measurements used in list of Design of Retaining Walls 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.
- **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 Millimeter (mm), Meter (m)
Length Unit Conversion ↻
- **Measurement: Pressure** in Megapascal (MPa), Pascal (Pa)
Pressure Unit Conversion ↻
- **Measurement: Force** in Newton (N)
Force Unit Conversion ↻
- **Measurement: Angle** in Degree (°)
Angle Unit Conversion ↻
- **Measurement: Surface Tension** in Kilonewton per Meter (kN/m)
Surface Tension Unit Conversion ↻
- **Measurement: Moment of Force** in Newton Meter (N*m)
Moment of Force Unit Conversion ↻
- **Measurement: Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
Specific Weight Unit Conversion ↻



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