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Dams and Reservoirs Formulas

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List of 15 Dams and Reservoirs Formulas

Dams and Reservoirs

Forces acting on Gravity Dam

1) Force Exerted by Silt in Addition to External Water Pressure represented by Rankine's Formula

Open Calculator

fx $$P_{silt} = \left(\frac{1}{2}\right) \cdot \Gamma_s \cdot \left(h^2\right) \cdot K_a$$

ex $$153\text{kN/m}^2 = \left(\frac{1}{2}\right) \cdot 17\text{kN/m}^3 \cdot \left((3\text{m})^2\right) \cdot 2$$

2) Maximum Pressure Intensity due to Wave Action

Open Calculator

fx $$P_w = (2.4 \cdot \Gamma_w \cdot h_w)$$

ex $$3.900989\text{kN/m}^2 = (2.4 \cdot 9.807\text{kN/m}^3 \cdot 165.74\text{m})$$

3) Moment of Hydrodynamic Force about Base

Open Calculator

fx $$M_e = 0.424 \cdot P_e \cdot H$$

ex $$101.76\text{kN*m} = 0.424 \cdot 40\text{kN} \cdot 6\text{m}$$

4) Net Effective Weight of Dam

Open Calculator

fx $$W_{net} = W - \left(\left(\frac{W}{g}\right) \cdot a_v\right)$$

ex $$225.0255\text{kN} = 250\text{kN} - \left(\left(\frac{250\text{kN}}{9.81\text{m/s}^2}\right) \cdot 0.98\text{m/s}^2\right)$$

5) Resultant Force due to External Water Pressure acting from Base

Open Calculator

fx $$P = \left(\frac{1}{2}\right) \cdot \Gamma_w \cdot H^2$$

ex $$176.526\text{kN/m}^2 = \left(\frac{1}{2}\right) \cdot 9.807\text{kN/m}^3 \cdot (6\text{m})^2$$

6) Von Karman Equation of Amount of Hydrodynamic Force acting from Base

Open Calculator

fx $$P_e = 0.555 \cdot K_h \cdot \Gamma_w \cdot \left(H^2\right)$$

ex $$39.18877\text{kN} = 0.555 \cdot 0.2 \cdot 9.807\text{kN/m}^3 \cdot \left((6\text{m})^2\right)$$

7) Wave Height for Fetch Less than 32 kilometers

Open Calculator

$$h_w = \left(0.032 \cdot \sqrt{V \cdot F} + 0.763\right) - \left(0.271 \cdot \left(F^{\frac{3}{4}}\right)\right)$$

ex

$$94.17524\text{m} = \left(0.032 \cdot \sqrt{11\text{km/h} \cdot 5\text{km}} + 0.763\right) - \left(0.271 \cdot \left((5\text{km})^{\frac{3}{4}}\right)\right)$$

8) Wave Height for Fetch more than 32 kilometers

Open Calculator

$$h_w = 0.032 \cdot \sqrt{V \cdot F}$$

ex

$$237.3184\text{m} = 0.032 \cdot \sqrt{11\text{km/h} \cdot 5\text{km}}$$

Structural Stability of Gravity Dams

9) Max Vertical Direct Stress Distribution at Base

Open Calculator

$$\rho_{max} = \left(\frac{\Sigma_v}{B}\right) \cdot \left(1 + \left(6 \cdot \frac{e}{B}\right)\right)$$

ex

$$103.04\text{kN/m}^2 = \left(\frac{1400\text{kN}}{25\text{m}}\right) \cdot \left(1 + \left(6 \cdot \frac{3.5}{25\text{m}}\right)\right)$$

10) Maximum Height in Elementary Profile without Exceeding Allowable Compressive Stress of Dam

Open Calculator

fx $$H_{min} = \frac{f}{\Gamma_w \cdot (S_c - C + 1)}$$

ex $$42.48666\text{m} = \frac{1000\text{kN/m}^2}{9.807\text{kN/m}^3 \cdot (2.2 - 0.8 + 1)}$$

11) Maximum Possible Height when Uplift is Neglected in Elementary Profile of Gravity Dam

Open Calculator

fx $$H_{max} = \frac{f}{\Gamma_w \cdot (S_c + 1)}$$

ex $$31.86499\text{m} = \frac{1000\text{kN/m}^2}{9.807\text{kN/m}^3 \cdot (2.2 + 1)}$$

12) Minimum Vertical Direct Stress Distribution at Base

Open Calculator

fx $$\rho_{min} = \left(\frac{\Sigma_v}{B}\right) \cdot \left(1 - \left(6 \cdot \frac{e}{B}\right)\right)$$

ex $$8.96\text{kN/m}^2 = \left(\frac{1400\text{kN}}{25\text{m}}\right) \cdot \left(1 - \left(6 \cdot \frac{3.5}{25\text{m}}\right)\right)$$

13) Shear Friction Factor

Open Calculator

$$S.F.F = \frac{(\mu \cdot \Sigma_v) + (B \cdot q)}{\Sigma H}$$

$$54.97143 = \frac{(0.7 \cdot 1400\text{kN}) + (25\text{m} \cdot 1500\text{kN/m}^2)}{700\text{kN}}$$

14) Sliding Factor

Open Calculator

$$S.F = \mu \cdot \frac{\Sigma_v}{\Sigma H}$$

$$1.4 = 0.7 \cdot \frac{1400\text{kN}}{700\text{kN}}$$

15) Width of Elementary Gravity Dam

Open Calculator

$$B = \frac{H_d}{\sqrt{S_c - C}}$$

$$25.35463\text{m} = \frac{30\text{m}}{\sqrt{2.2 - 0.8}}$$

Variables Used

- a_v Fraction Gravity adapted for Vertical Acceleration *(Meter per Square Second)*
- **B** Base Width *(Meter)*
- **C** Seepage Coefficient at Base of Dam
- **e** Eccentricity of Resultant Force
- **f** Allowable Compressive Stress of Dam Material *(Kilonewton per Square Meter)*
- **F** Straight Length of Water Expense *(Kilometer)*
- **g** Gravity adapted for Vertical Acceleration *(Meter per Square Second)*
- **h** Height of Silt Deposited *(Meter)*
- **H** Depth of Water due to External Force *(Meter)*
- H_d Height of Elementary Dam *(Meter)*
- H_{max} Maximum Possible Height *(Meter)*
- H_{min} Minimum Possible Height *(Meter)*
- h_w Height of Water from Top Crest to Bottom of Trough *(Meter)*
- K_a Coefficient of Active Earth Pressure of Silt
- K_h Fraction of Gravity for Horizontal Acceleration
- M_e Moment of Hydrodynamic Force about Base *(Kilonewton Meter)*
- **P** Resultant Force due to External Water *(Kilonewton per Square Meter)*
- P_e Von Karman Amount of Hydrodynamic Force *(Kilonewton)*
- P_{silt} Force Exerted by Silt in Water Pressure *(Kilonewton per Square Meter)*
- P_w Maximum Pressure Intensity due to Wave Action *(Kilonewton per Square Meter)*

- **q** Average Shear of Joint *(Kilonewton per Square Meter)*
- **S_c** Specific Gravity of Dam Material
- **S.F** Sliding Factor
- **S.F.F** Shear Friction
- **V** Wind Velocity of Wave Pressure *(Kilometer per Hour)*
- **W** Total Weight of Dam *(Kilonewton)*
- **W_{net}** Net Effective Weight of Dam *(Kilonewton)*
- **Γ_s** Sub Merged Unit Weight of Silt Materials *(Kilonewton per Cubic Meter)*
- **Γ_w** Unit Weight of Water *(Kilonewton per Cubic Meter)*
- **μ** Coefficient of Friction between Two Surfaces
- **ρ_{max}** Vertical Direct Stress *(Kilonewton per Square Meter)*
- **ρ_{min}** Minimum Vertical Direct Stress *(Kilonewton per Square Meter)*
- **Σ_v** Total Vertical Force *(Kilonewton)*
- **ΣH** Horizontal Forces *(Kilonewton)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m), Kilometer (km)
  Length Unit Conversion
- Measurement: **Pressure** in Kilonewton per Square Meter (kN/m²)
  Pressure Unit Conversion
- Measurement: **Speed** in Kilometer per Hour (km/h)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Moment of Force** in Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion
- Measurement: **Stress** in Kilonewton per Square Meter (kN/m²)
  Stress Unit Conversion

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