Important Dams and Reservoirs Formulas PDF

Formulas
Examples
with Units

List of 15
Important Dams and Reservoirs Formulas

1) Forces acting on Gravity Dam Formulas

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

Evaluate Formula

Formula

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

Example with Units

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

1.2) Maximum Pressure Intensity due to Wave Action Formula

Evaluate Formula

Formula

$$P_w = \left(2.4 \cdot \Gamma_w \cdot h_w\right)$$

Example with Units

$$3.901\,\text{kN/m}^2 = \left(2.4 \cdot 9.807\,\text{kN/m}^3 \cdot 165.74\,\text{m}\right)$$

1.3) Moment of Hydrodynamic Force about Base Formula

Evaluate Formula

Formula

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

Example with Units

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

1.4) Net Effective Weight of Dam Formula

Evaluate Formula

Formula

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

Example with Units

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

1.5) Resultant Force due to External Water Pressure acting from Base Formula

Evaluate Formula

Formula

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

Example with Units

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

1.6) Von Karman Equation of Amount of Hydrodynamic Force acting from Base Formula

Evaluate Formula

Formula

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

Example with Units

$$39.1888\,\text{kN} = 0.555 \cdot 0.2 \cdot 9.807\,\text{kN/m}^3 \cdot \left(6\,\text{m}^2\right)$$

1.7) Wave Height for Fetch Less than 32 kilometers Formula

Evaluate Formula

Formula

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

Example with Units

$$94.1752\,\text{m} = \left(0.032 \cdot \sqrt{11\,\text{km/h} \cdot 5\,\text{km}} + 0.763\right) - \left(0.271 \cdot \left(5\,\text{km}^{\frac{3}{4}}\right)\right)$$

1.8) Wave Height for Fetch more than 32 kilometers Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Structural Stability of Gravity Dams Formulas

2.1) Max Vertical Direct Stress Distribution at Base Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$42.4867\,\text{m} = \frac{1000\,\text{kN/m}^2}{9.807\,\text{kN/m}^3 \cdot \left(2.2 - 0.8 + 1\right)}$$

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

Evaluate Formula

Formula

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

Example with Units

$$31.865\,\text{m} = \frac{1000\,\text{kN/m}^2}{9.807\,\text{kN/m}^3 \cdot \left(2.2 + 1\right)}$$

2.4) Minimum Vertical Direct Stress Distribution at Base Formula

Evaluate Formula

Formula

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

Example with Units

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

2.5) Shear Friction Factor Formula

Evaluate Formula

Formula

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

Example with Units

$$54.9714 = \frac{\left(0.7 \cdot 1400\,\text{kN}\right) + \left(25\,\text{m} \cdot 1500\,\text{kN/m}^2\right)}{700\,\text{kN}}$$

2.6) Sliding Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

2.7) Width of Elementary Gravity Dam Formula

Evaluate Formula

Formula

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

Example with Units

$$25.3546\,\text{m} = \frac{30\,\text{m}}{\sqrt{2.2 - 0.8}}$$

Variables used in list of Dams and Reservoirs Formulas above

- 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)*

Constants, Functions, Measurements used in list of Dams and Reservoirs 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), 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

- **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)*

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