Important Buttress Dams Formulas PDF

Formulas
Examples
with Units

List of 33
Important Buttress Dams Formulas

1) Buttress Dams using law of Trapezoid Formulas

1.1) Distance from Centroid for Maximum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$Y_t = \left(\frac{\left(\sigma_i - \left(\frac{p}{A_{cs}} \right) \right) \cdot I_H}{M_b} \right)$$

Example with Units

$$20.029\,\text{m} = \left(\frac{\left(1200\,\text{Pa} - \left(\frac{15\,\text{kN}}{13\,\text{m}^2} \right) \right) \cdot 23\,\text{m}^4}{53\,\text{N*m}} \right)$$

1.2) Maximum Intensity of Vertical Force in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$\sigma_i = \left(\frac{p}{A_{cs}} \right) + \left(\frac{M_b \cdot Y_t}{I_H} \right)$$

Example with Units

$$1200.394\,\text{Pa} = \left(\frac{15\,\text{kN}}{13\,\text{m}^2} \right) + \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4} \right)$$

1.3) Minimum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$\sigma_i = \left(\frac{p}{A_{cs}} \right) - \left(\frac{M_b \cdot Y_t}{I_H} \right)$$

Example with Units

$$1107.2983\,\text{Pa} = \left(\frac{15\,\text{kN}}{13\,\text{m}^2} \right) - \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4} \right)$$

1.4) Moment for Maximum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$M = \left(\sigma - \left(\frac{p}{A_{cs}} \right) \right) \cdot \frac{I_H}{Y_t}$$

Example with Units

$$169.4783\,\text{kN*m} = \left(150\,\text{kPa} - \left(\frac{15\,\text{kN}}{13\,\text{m}^2} \right) \right) \cdot \frac{23\,\text{m}^4}{20.2\,\text{m}}$$

1.5) Moment for Minimum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$M = \left(\sigma - \left(\frac{L_{Vertical}}{A_{cs}} \right) \right) \cdot \frac{I_H}{Y_t}$$

Example with Units

$$166.5004\,\text{kN*m} = \left(150\,\text{kPa} - \left(\frac{49\,\text{kN}}{13\,\text{m}^2} \right) \right) \cdot \frac{23\,\text{m}^4}{20.2\,\text{m}}$$

1.6) Moment of Buttress dam in horizontal plane using stress Formula

Evaluate Formula

Formula

$$M = \left(\sigma + \left(\frac{L_{Vertical}}{A_{cs}}\right)\right) \cdot \frac{I_H}{Y_t}$$

Example with Units

$$175.0838\,\text{kN*m} = \left(150\,\text{kPa} + \left(\frac{49\,\text{kN}}{13\,\text{m}^2}\right)\right) \cdot \frac{23\,\text{m}^4}{20.2\,\text{m}}$$

1.7) Moment of Inertia for Minimum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$I_H = \left(\frac{M_b \cdot Y_t}{\sigma_i - \left(\frac{p}{A_{cs}}\right)}\right)$$

Example with Units

$$23.1963\,\text{m}^4 = \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{1200\,\text{Pa} - \left(\frac{15\,\text{kN}}{13\,\text{m}^2}\right)}\right)$$

1.8) Sectional Area of Base for Maximum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$A_{cs} = \frac{p}{\sigma_i - \left(\frac{M_b \cdot Y_t}{I_H}\right)}$$

Example with Units

$$13.0044\,\text{m}^2 = \frac{15\,\text{kN}}{1200\,\text{Pa} - \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4}\right)}$$

1.9) Sectional Area of base for Minimum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$A_{cs} = \frac{p}{\sigma_i + \left(\frac{M_b \cdot Y_t}{I_H}\right)}$$

Example with Units

$$12.0332\,\text{m}^2 = \frac{15\,\text{kN}}{1200\,\text{Pa} + \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4}\right)}$$

1.10) Total Vertical Load for Maximum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$p = \left(\sigma_i - \left(\frac{M_b \cdot Y_t}{I_H}\right)\right) \cdot A_{cs}$$

Example with Units

$$14.9949\,\text{kN} = \left(1200\,\text{Pa} - \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4}\right)\right) \cdot 13\,\text{m}^2$$

1.11) Total Vertical Load for Minimum Intensity in horizontal plane on Buttress Dam Formula

Evaluate Formula

Formula

$$p = \left(\sigma_i + \left(\frac{M_b \cdot Y_t}{I_H}\right)\right) \cdot A_{cs}$$

Example with Units

$$16.2051\,\text{kN} = \left(1200\,\text{Pa} + \left(\frac{53\,\text{N*m} \cdot 20.2\,\text{m}}{23\,\text{m}^4}\right)\right) \cdot 13\,\text{m}^2$$

2) Dams on Soft or Porous Foundations Formulas

2.1) Dams on Soft or Porous Foundations by Darcy's law Formulas

2.1.1) Discharge given Hydraulic Gradient per unit head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$Q_t = k \cdot H_{Water} \cdot \frac{N}{B}$$

Example with Units

$$0.46\,m^3/s = 10\,cm/s \cdot 2.3\,m \cdot \frac{4}{2}$$

2.1.2) Equipotential Lines given discharge for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$H_{Water} = \frac{Q_t \cdot B}{k \cdot N}$$

Example with Units

$$2.3\,m = \frac{0.46\,m^3/s \cdot 2}{10\,cm/s \cdot 4}$$

2.1.3) Equipotential Lines given Hydraulic Gradient per unit head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$N = i \cdot B$$

Example

$$4.04 = 2.02 \cdot 2$$

2.1.4) Hydraulic Gradient per unit head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$i = \frac{N}{B}$$

Example

$$2 = \frac{4}{2}$$

2.1.5) Length of Conduit after using Area of Pipe in Discharge Formula

Evaluate Formula

Formula

$$L_{pipe} = C_1 \cdot \frac{H_f}{V_{max}}$$

Example with Units

$$1.5\,m = 9 \cdot \frac{5\,m}{30\,m/s}$$

2.1.6) Length of Conduit given Neutral Stress per unit area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$L_n = \frac{h}{\left(\frac{\sigma_{Neutralstress}}{D \cdot W} - 1\right)}$$

Example with Units

$$2.9008\,m = \frac{15.6\,m}{\left(\frac{187.7\,kN/m^2}{3\,m \cdot 9.81\,kN/m^3} - 1\right)}$$

2.1.7) Maximum Velocity given New Material Coefficient C 2 for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$V_{max} = \frac{C_1}{C_2}$$

Example with Units

$$30\,m/s = \frac{9}{0.3}$$

2.1.8) Minimum Safe Length of Travel path under Dams on Soft or Porous Foundations Formula

Evaluate Formula

Formula

$$L_n = C_2 \cdot H_f$$

Example with Units

$$1.5\,\text{m} = 0.3 \cdot 5\,\text{m}$$

2.1.9) Neutral Stress per unit area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$\sigma_{Neutralstress} = D \cdot W \cdot \left(1 + \frac{h}{L_n}\right)$$

Example with Units

$$187.7431\,\text{kN/m}^2 = 3\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot \left(1 + \frac{15.6\,\text{m}}{2.9\,\text{m}}\right)$$

2.1.10) New Material Coefficient C2 for Dams on Soft or Porous Foundations Formula

Evaluate Formula

Formula

$$C_2 = \frac{C_1}{V_{max}}$$

Example with Units

$$0.3 = \frac{9}{30\,\text{m/s}}$$

2.1.11) Number of Beds given discharge for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$B = k \cdot H_{Water} \cdot \frac{N}{Q_t}$$

Example with Units

$$2 = 10\,\text{cm/s} \cdot 2.3\,\text{m} \cdot \frac{4}{0.46\,\text{m}^3\text{/s}}$$

2.1.12) Number of Beds given Hydraulic Gradient per unit head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$B = \frac{N}{i}$$

Example

$$1.9802 = \frac{4}{2.02}$$

2.1.13) Permeability given Hydraulic gradient per unit head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$k = \frac{Q_t \cdot B}{H_{Water} \cdot N}$$

Example with Units

$$10\,\text{cm/s} = \frac{0.46\,\text{m}^3\text{/s} \cdot 2}{2.3\,\text{m} \cdot 4}$$

2.1.14) Saturation for Total Pressure per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$S = \left(P_T \cdot \frac{1 + e}{D \cdot W}\right) - e$$

Example with Units

$$6.6491 = \left(105\,\text{Pa} \cdot \frac{1 + 1.2}{3\,\text{m} \cdot 9.81\,\text{kN/m}^3}\right) - 1.2$$

2.1.15) Specific Gravity of Water given Neutral stress per unit area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$W = \frac{\sigma_{Neutralstress}}{D \cdot \left(1 + \frac{h}{L_n}\right)}$$

Example with Units

$$9.8077\,\text{kN/m}^3 = \frac{187.7\,\text{kN/m}^2}{3\,\text{m} \cdot \left(1 + \frac{15.6\,\text{m}}{2.9\,\text{m}}\right)}$$

2.1.16) Total Pressure per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$P_0 = D \cdot W \cdot \left(\frac{S + e}{1 + e}\right)$$

Example with Units

$$109.6936\,\text{Pa} = 3\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot \left(\frac{7 + 1.2}{1 + 1.2}\right)$$

2.1.17) Velocity given Length of Conduit after using Area of Pipe in Discharge Formula

Evaluate Formula

Formula

$$V_{max} = C_1 \cdot \frac{H_f}{L_{pipe}}$$

Example with Units

$$40.9091\,\text{m/s} = 9 \cdot \frac{5\,\text{m}}{1.1\,\text{m}}$$

2.1.18) Void Ratio given Total Pressure per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$e = \frac{S - \left(\frac{P_0}{D \cdot W}\right)}{\left(\frac{P_0}{D \cdot W}\right) - 1}$$

Example with Units

$$1.2026 = \frac{7 - \left(\frac{109.6\,\text{Pa}}{3\,\text{m} \cdot 9.81\,\text{kN/m}^3}\right)}{\left(\frac{109.6\,\text{Pa}}{3\,\text{m} \cdot 9.81\,\text{kN/m}^3}\right) - 1}$$

2.2) Hydraulic Head Formulas

2.2.1) Depth below Surface for Total Pressure per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$D = \frac{P_T}{W \cdot \left(\frac{S + e}{1 + e}\right)}$$

Example with Units

$$2.8716\,\text{m} = \frac{105\,\text{Pa}}{9.81\,\text{kN/m}^3 \cdot \left(\frac{7 + 1.2}{1 + 1.2}\right)}$$

2.2.2) Depth below Surface given Neutral Stress per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$D = \frac{\sigma_{min}}{W \cdot \left(1 + \frac{h}{L_{Travelpath}}\right)}$$

Example with Units

$$3.01\,\text{m} = \frac{106.3\,\text{N/m}^2}{9.81\,\text{kN/m}^3 \cdot \left(1 + \frac{15.6\,\text{m}}{6\,\text{m}}\right)}$$

2.2.3) Head given Hydraulic Gradient per unit Head for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$H_{Water} = \frac{Q_t}{k \cdot N}$$

Example with Units

$$1.15\,\text{m} = \frac{0.46\,\text{m}^3/\text{s}}{10\,\text{cm/s} \cdot 4}$$

2.2.4) Head given Neutral Stress per unit Area for Dams on Soft Foundations Formula

Evaluate Formula

Formula

$$h = \left(\frac{\sigma_{min}}{D \cdot W} - 1 \right) \cdot L_{Travelpath}$$

Example with Units

$$15.6718\,\text{m} = \left(\frac{106.3\,\text{N/m}^2}{3\,\text{m} \cdot 9.81\,\text{kN/m}^3} - 1 \right) \cdot 6\,\text{m}$$

Variables used in list of Buttress Dams Formulas above

- A_{cs} Cross-Sectional Area of Base *(Square Meter)*
- **B** Number of Beds
- C_1 Material Coefficient
- C_2 New Material Coefficient C2
- **D** Depth of Dam *(Meter)*
- **e** Void Ratio
- **h** Height of Dam *(Meter)*
- H_f Head under Flow *(Meter)*
- H_{Water} Head of Water *(Meter)*
- **i** Hydraulic Gradient to Head Loss
- I_H Moment of Inertia of Horizontal Section *(Meter⁴)*
- **k** Coefficient of Permeability of Soil *(Centimeter per Second)*
- L_n Minimum Safe Length of Travel path *(Meter)*
- L_{pipe} Length of Pipe *(Meter)*
- $L_{Travelpath}$ Length of Travel path *(Meter)*
- $L_{Vertical}$ Vertical Load on Member *(Kilonewton)*
- **M** Moment of Buttress Dams *(Kilonewton Meter)*
- M_b Bending Moment *(Newton Meter)*
- **N** Equipotential Lines
- **p** Load on Buttress Dams *(Kilonewton)*
- P_0 Total Pressure at given Point *(Pascal)*
- P_T Total Pressure *(Pascal)*
- Q_t Discharge from Dam *(Cubic Meter per Second)*
- **S** Degree of Saturation
- V_{max} Maximum Velocity *(Meter per Second)*
- **W** Specific Weight of Water in KN per cubic meter *(Kilonewton per Cubic Meter)*
- Y_t Distance from Centroidal *(Meter)*
- **σ** Stress on Buttress Dams *(Kilopascal)*
- σ_i Intensity of Normal Stress *(Pascal)*

Constants, Functions, Measurements used in list of Buttress Dams Formulas above

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Kilopascal (kPa), Kilonewton per Square Meter (kN/m²), Newton per Square Meter (N/m²)
  Pressure Unit Conversion
- Measurement: **Speed** in Centimeter per Second (cm/s), Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Moment of Force** in Newton Meter (N*m), Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion
- Measurement: **Second Moment of Area** in Meter⁴ (m⁴)
  Second Moment of Area Unit Conversion

- σ_{min} Minimum Stress *(Newton per Square Meter)*
- $\sigma_{Neutralstress}$ Neutral Stress *(Kilonewton per Square Meter)*

Download other Important Dams PDFs

- Important Arch Dams Formulas
- Important Buttress Dams Formulas
- Important Earth Dam and Gravity Dam Formulas

Try our Unique Visual Calculators

- Percentage growth
- LCM calculator
- Divide fraction

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

7/8/2024 | 11:03:24 AM UTC