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Buttress Dams Formulas

Calculators! Examples! Conversions!

List of 33 Buttress Dams Formulas

Buttress Dams

Buttress Dams using law of Trapezoid

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

Open Calculator

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

ex $$20.02903\text{m} = \left(\frac{\left(1200\text{Pa} - \left(\frac{15\text{kN}}{13\text{m}^2} \right) \right) \cdot 23\text{m}^4}{53\text{N*m}} \right)$$

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

Open Calculator

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

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

3) Minimum Intensity in horizontal plane on Buttress Dam

Open Calculator

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

ex $$1107.298\text{Pa} = \left(\frac{15\text{kN}}{13\text{m}^2}\right) - \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{23\text{m}^4}\right)$$

4) Moment for Maximum Intensity in horizontal plane on Buttress Dam

Open Calculator

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

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

5) Moment for Minimum Intensity in horizontal plane on Buttress Dam

Open Calculator

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

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

6) Moment of Buttress dam in horizontal plane using stress

Open Calculator

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

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

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

Open Calculator

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

ex $$23.19633\text{m}^4 = \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{1200\text{Pa} - \left(\frac{15\text{kN}}{13\text{m}^2} \right)} \right)$$

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

Open Calculator

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

ex $$13.00444\text{m}^2 = \frac{15\text{kN}}{1200\text{Pa} - \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{23\text{m}^4} \right)}$$

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

Open Calculator

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

ex $$12.03323\text{m}^2 = \frac{15\text{kN}}{1200\text{Pa} + \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{23\text{m}^4} \right)}$$

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

Open Calculator

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

$$14.99488\text{kN} = \left(1200\text{Pa} - \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{23\text{m}^4}\right)\right) \cdot 13\text{m}^2$$

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

Open Calculator

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

$$16.20512\text{kN} = \left(1200\text{Pa} + \left(\frac{53\text{N*m} \cdot 20.2\text{m}}{23\text{m}^4}\right)\right) \cdot 13\text{m}^2$$

Dams on Soft or Porous Foundations

Dams on Soft or Porous Foundations by Darcy's law

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

Open Calculator

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

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

13) Equipotential Lines given discharge for Dams on Soft Foundations

Open Calculator

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

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

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

Open Calculator

fx $$N = i \cdot B$$

ex $$4.04 = 2.02 \cdot 2$$

15) Hydraulic Gradient per unit head for Dams on Soft Foundations

Open Calculator

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

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

16) Length of Conduit after using Area of Pipe in Discharge

Open Calculator

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

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

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

Open Calculator

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

$$2.90079\text{m} = \frac{15.6\text{m}}{\left(\frac{187.7\text{kN/m}^2}{3\text{m} \cdot 9.81\text{kN/m}^3} - 1\right)}$$

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

Open Calculator

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

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

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

Open Calculator

$$L_n = C_2 \cdot H_f$$

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

20) Neutral Stress per unit area for Dams on Soft Foundations

Open Calculator

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

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

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

Open Calculator

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

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

22) Number of Beds given discharge for Dams on Soft Foundations

Open Calculator

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

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

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

Open Calculator

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

ex $$1.980198 = \frac{4}{2.02}$$

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

Open Calculator

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

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

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

Open Calculator

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

ex $$6.649134 = \left(105\text{Pa} \cdot \frac{1 + 1.2}{3\text{m} \cdot 9.81\text{kN/m}^3} \right) - 1.2$$

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

Open Calculator

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

ex $$9.807748\text{kN/m}^3 = \frac{187.7\text{kN/m}^2}{3\text{m} \cdot \left(1 + \frac{15.6\text{m}}{2.9\text{m}}\right)}$$

27) Total Pressure per unit Area for Dams on Soft Foundations

Open Calculator

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

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

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

Open Calculator

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

ex $$40.90909\text{m/s} = 9 \cdot \frac{5\text{m}}{1.1\text{m}}$$

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

Open Calculator

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

ex $$1.20257 = \frac{7 - \left(\frac{109.6\text{Pa}}{3\text{m} \cdot 9.81\text{kN/m}^3}\right)}{\left(\frac{109.6\text{Pa}}{3\text{m} \cdot 9.81\text{kN/m}^3}\right) - 1}$$

Hydraulic Head

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

Open Calculator

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

ex $$2.871634\text{m} = \frac{105\text{Pa}}{9.81\text{kN/m}^3 \cdot \left(\frac{7+1.2}{1+1.2}\right)}$$

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

Open Calculator

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

ex $$3.009967\text{m} = \frac{106.3\text{N/m}^2}{9.81\text{kN/m}^3 \cdot \left(1 + \frac{15.6\text{m}}{6\text{m}}\right)}$$

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

Open Calculator

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

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

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

Open Calculator

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

ex $$15.67176\text{m} = \left(\frac{106.3\text{N/m}^2}{3\text{m} \cdot 9.81\text{kN/m}^3} - 1\right) \cdot 6\text{m}$$

Variables Used

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

Constants, Functions, Measurements used

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Kilopascal (kPa), Kilonewton per Square Meter (kN/m^2), Newton per Square Meter (N/m^2)
  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 (m^3/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/m^3)
  Specific Weight Unit Conversion
- Measurement: **Second Moment of Area** in $Meter^4$ (m^4)
  Second Moment of Area Unit Conversion

Check other formula lists

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

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