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Canal Design Formulas

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List of 17 Canal Design Formulas

Canal Design

Design of Lined Irrigation Channels

1) Area of Trapezoidal Channel Section for Smaller Discharge

Open Calculator

fx $A = (B \cdot y) + y^2 \cdot (\theta + \cot(\theta))$

ex $83.25277\text{m}^2 = (48\text{m} \cdot 1.635\text{m}) + (1.635\text{m})^2 \cdot (45^\circ + \cot(45^\circ))$

2) Area of Triangular Channel Section for Small Discharges

Open Calculator

fx $A = y^2 \cdot (\theta + \cot(\theta))$

ex $4.772771\text{m}^2 = (1.635\text{m})^2 \cdot (45^\circ + \cot(45^\circ))$

3) Hydraulic Mean Depth of Triangular Section

Open Calculator

fx $H = \frac{y^2 \cdot (\theta + \cot(\theta))}{2 \cdot y \cdot (\theta + \cot(\theta))}$

ex $0.8175\text{m} = \frac{(1.635\text{m})^2 \cdot (45^\circ + \cot(45^\circ))}{2 \cdot 1.635\text{m} \cdot (45^\circ + \cot(45^\circ))}$

4) Perimeter of Trapezoidal Channel Section for Small Discharges

Open Calculator

fx $P = B + (2 \cdot y \cdot \theta + 2 \cdot y \cdot \cot(\theta))$

ex $53.83825\text{m} = 48\text{m} + (2 \cdot 1.635\text{m} \cdot 45^\circ + 2 \cdot 1.635\text{m} \cdot \cot(45^\circ))$

5) Perimeter of Triangular Channel Section for Small Discharges

Open Calculator

fx $P = 2 \cdot y \cdot (\theta + \cot(\theta))$

ex $5.838252\text{m} = 2 \cdot 1.635\text{m} \cdot (45^\circ + \cot(45^\circ))$

Design of Non-Scouring Stable Channels having Protected Side Slopes (Shield's Entrainmnet Method)

6) Drag Force Exerted by Flow

Open Calculator

fx $$F_1 = K_1 \cdot (C_D) \cdot \left(d^2\right) \cdot (0.5) \cdot (\rho_w) \cdot \left(V^{\circ}\right)$$

ex $$0.015228\text{N} = 1.20 \cdot (0.47) \cdot \left((6\text{mm})^2\right) \cdot (0.5) \cdot (1000\text{kg/m}^3) \cdot (1.5\text{m/s})$$

7) General Relation between Resisting Shear and Diameter of Particle

Open Calculator

fx $$\zeta_c = 0.155 + \left(0.409 \cdot \frac{d^2}{\sqrt{1 + 0.77 \cdot d^2}}\right)$$

ex $$0.000155\text{kN/m}^2 = 0.155 + \left(0.409 \cdot \frac{(6\text{mm})^2}{\sqrt{1 + 0.77 \cdot (6\text{mm})^2}}\right)$$

8) Manning's Rugosity Coefficient according to Stickler's Formula

Open Calculator

fx $$n = \left(\frac{1}{24}\right) \cdot (d)^{\frac{1}{6}}$$

ex $$0.017762 = \left(\frac{1}{24}\right) \cdot (6\text{mm})^{\frac{1}{6}}$$

9) Resisting Shear against Movement of Particle

Open Calculator

fx $$\zeta_c = 0.056 \cdot \Gamma_w \cdot d \cdot (S_s - 1)$$

ex $$0.005437\text{kN/m}^2 = 0.056 \cdot 9.807\text{kN/m}^3 \cdot 6\text{mm} \cdot (2.65 - 1)$$

10) Unprotected Side Slopes Shear Stress Required to Move Single Grain

Open Calculator

fx $$\zeta c' = \zeta_c \cdot \sqrt{1 - \left(\frac{\sin(\theta)^2}{\sin(\Phi)^2}\right)}$$

ex $$0.003139\text{kN/m}^2 = 0.005437\text{kN/m}^2 \cdot \sqrt{1 - \left(\frac{\sin(45^\circ)^2}{\sin(60^\circ)^2}\right)}$$

Kennedy's Theory

11) Kutter's Formula

Open Calculator

fx $$V = \left(\frac{1}{n} + \frac{23 + \left(\frac{0.00155}{S}\right)}{1 + \left(23 + \left(\frac{0.00155}{S}\right)\right)} \cdot \left(\frac{n}{\sqrt{R}}\right)\right) \cdot \left(\sqrt{R \cdot S}\right)$$

ex $$1.536432\text{m/s} = \left(\frac{1}{0.0177} + \frac{23 + \left(\frac{0.00155}{0.000333}\right)}{1 + \left(23 + \left(\frac{0.00155}{0.000333}\right)\right)} \cdot \left(\frac{0.0177}{\sqrt{2.22\text{m}}}\right)\right) \cdot \left(\sqrt{2.22\text{m} \cdot 0.000333}\right)$$

12) R G Kennedy Equation for Critical Velocity

Open Calculator

fx $$V' = 0.55 \cdot m \cdot \left(Y^{0.64}\right)$$

ex $$1.498227\text{m/s} = 0.55 \cdot 1.2 \cdot \left((3.6\text{m})^{0.64}\right)$$

Lacey's Theory

13) Area of Regime Channel Section

Open Calculator

fx $$A = \left(\frac{Q}{V}\right)$$

ex $$27.84407\text{m}^2 = \left(\frac{35\text{m}^3/\text{s}}{1.257\text{m/s}}\right)$$

14) Bed Slope of Channel

Open Calculator

$$S = \frac{f^{\frac{5}{3}}}{3340 \cdot Q^{\frac{1}{6}}}$$

$$0.001824 = \frac{(4.22)^{\frac{5}{3}}}{3340 \cdot (35\text{m}^3/\text{s})^{\frac{1}{6}}}$$

15) Hydraulic Mean Depth for Regime Channel using Lacey's Theory

Open Calculator

$$R = \left(\frac{5}{2}\right) \cdot \left(\frac{(V)^2}{f}\right)$$

$$0.936048\text{m} = \left(\frac{5}{2}\right) \cdot \left(\frac{(1.257\text{m/s})^2}{4.22}\right)$$

16) Velocity for Regime Channel using Lacey's Theory

Open Calculator

$$V = \left(\frac{Q \cdot f^2}{140}\right)^{0.166}$$

$$1.281332\text{m/s} = \left(\frac{35\text{m}^3/\text{s} \cdot (4.22)^2}{140}\right)^{0.166}$$

17) Wetted Perimeter of Channel

Open Calculator

$$P = 4.75 \cdot \sqrt{Q}$$

$$28.10138\text{m} = 4.75 \cdot \sqrt{35\text{m}^3/\text{s}}$$

Variables Used

- **A** Area of Channel *(Square Meter)*
- **B** Bed Width of Channel *(Meter)*
- C_D Coefficient of Drag Exerted by Flow
- **d** Diameter of Particle *(Millimeter)*
- **f** Silt Factor
- F_1 Drag Force Exerted by Flow *(Newton)*
- **H** Hydraulic Mean Depth of Triangular Section *(Meter)*
- K_1 Factor Depending on Shape of Particles
- **m** Critical Velocity Ratio
- **n** Rugosity Coefficient
- **P** Perimeter of Channel *(Meter)*
- **Q** Discharge for Regime Channel *(Cubic Meter per Second)*
- **R** Hydraulic Mean Depth in Meters *(Meter)*
- **S** Bed Slope of Channel
- S_s Specific Gravity of Particles
- **V** Velocity of Flow in Meter *(Meter per Second)*
- V° Velocity Flow at Bottom of Channel *(Meter per Second)*
- **y** Depth of Canal with Trapezoidal Cross Section *(Meter)*
- **Y** Water Depth in Channel *(Meter)*
- Γ_w Unit Weight of Water *(Kilonewton per Cubic Meter)*
- ζ_c Resisting Shear against Movement of Particle *(Kilonewton per Square Meter)*
- $\zeta c'$ Critical Shear Stress on Horizontal Bed *(Kilonewton per Square Meter)*
- **θ** Side Slope *(Degree)*
- ρ_w Density of Flowing Fluid *(Kilogram per Cubic Meter)*
- **Φ** Angle of Repose of Soil *(Degree)*

Constants, Functions, Measurements used

- Function: **cot**, cot(Angle)
  Trigonometric cotangent function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density 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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