Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction Formulas

List of 24 Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction Formulas

Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction

Bay Superelevation

1) Depth given Water Surface Slope

Open Calculator

fx $$h = \frac{\Delta \cdot \tau}{\beta \cdot \rho_{water} \cdot [g]}$$

ex $$11.91668\text{m} = \frac{1.49 \cdot 0.6\text{N/m}^2}{0.00000765 \cdot 1000\text{kg/m}^3 \cdot [g]}$$

2) Superelevation

Open Calculator

fx $$\Delta_{BS} = a_o \cdot \left(\frac{\sin\left(2 \cdot \pi \cdot \frac{t}{T}\right)}{1 - \cos\left(2 \cdot \pi \cdot \frac{t}{T}\right)} \right)$$

ex $$4.515067\text{m} = 4.0\text{m} \cdot \left(\frac{\sin\left(2 \cdot \pi \cdot \frac{1.2\text{h}}{130\text{s}}\right)}{1 - \cos\left(2 \cdot \pi \cdot \frac{1.2\text{h}}{130\text{s}}\right)} \right)$$

3) Superelevation due to Varying Entrance Channel Cross-Section

fx

Open Calculator

$$S = a_o \cdot \left(1 - \left(\frac{\left(\frac{a_B}{a_o}\right)^2}{4 \cdot \left(\frac{D_t}{a_o}\right)} \right) - \left(\frac{a_o}{m \cdot W}\right) \cdot \left(0.5 - \left(\frac{a_B}{a_o}\right) \cdot \cos(k) - \left(\left(\frac{3}{2}\right) \cdot \left(\frac{a_B}{a_o}\right)^2\right) + 4$$

ex

$$2.000651\text{m} = 4.0\text{m} \cdot \left(1 - \left(\frac{\left(\frac{3.7}{4.0\text{m}}\right)^2}{4 \cdot \left(\frac{5.01\text{m}}{4.0\text{m}}\right)} \right) - \left(\frac{4.0\text{m}}{1.5 \cdot 52\text{m}}\right) \cdot \left(0.5 - \left(\frac{3.7}{4.0\text{m}}\right) \cdot \cos(22) - \left(\left(\frac{3}{2}\right) \cdot \left(\frac{3.7}{4.0\text{m}}\right)^2\right.\right.\right.$$

4) Tidal Amplitude in Ocean

Open Calculator

fx $$a_o = \frac{\Delta_{BS}}{\frac{\sin\left(2 \cdot \pi \cdot \frac{t}{T}\right)}{1 - \cos\left(2 \cdot \pi \cdot \frac{t}{T}\right)}}$$

ex $$3.995511\text{m} = \frac{4.51\text{m}}{\frac{\sin\left(2 \cdot \pi \cdot \frac{1.2\text{h}}{130\text{s}}\right)}{1 - \cos\left(2 \cdot \pi \cdot \frac{1.2\text{h}}{130\text{s}}\right)}}$$

Effect of Freshwater Inflow

5) King's Dimensionless Variable

Open Calculator

fx $$Qr' = Qr \cdot \frac{T}{2 \cdot \pi \cdot a_o \cdot A_b}$$

ex $$0.574688 = 10\text{m}^3/\text{min} \cdot \frac{130\text{s}}{2 \cdot \pi \cdot 4.0\text{m} \cdot 1.5001\text{m}^2}$$

6) Ocean Tide Amplitude using King's Dimensionless Variable

Open Calculator

fx $$a_o = \frac{Qr \cdot T}{Qr' \cdot 2 \cdot \pi \cdot A_b}$$

ex $$4.032897\text{m} = \frac{10\text{m}^3/\text{min} \cdot 130\text{s}}{0.57 \cdot 2 \cdot \pi \cdot 1.5001\text{m}^2}$$

7) River or Freshwater Inflow to Bay using King's Dimensionless Variable

Open Calculator

fx $$Qr = \frac{Qr' \cdot 2 \cdot \pi \cdot a_o \cdot A_b}{T}$$

ex $$9.918428\text{m}^3/\text{min} = \frac{0.57 \cdot 2 \cdot \pi \cdot 4.0\text{m} \cdot 1.5001\text{m}^2}{130\text{s}}$$

8) Surface Area of Bay or Basin using King's Dimensionless Variable

Open Calculator

fx $$A_b = \frac{Qr \cdot T}{Qr' \cdot 2 \cdot \pi \cdot a_o}$$

ex $$1.512437\text{m}^2 = \frac{10\text{m}^3/\text{min} \cdot 130\text{s}}{0.57 \cdot 2 \cdot \pi \cdot 4.0\text{m}}$$

9) Tidal Period using King's Dimensionless Variable

Open Calculator

fx $$T = \frac{Qr' \cdot 2 \cdot \pi \cdot a_o \cdot A_b}{Qr}$$

ex $$128.9396\text{s} = \frac{0.57 \cdot 2 \cdot \pi \cdot 4.0\text{m} \cdot 1.5001\text{m}^2}{10\text{m}^3/\text{min}}$$

Multiple Inlets

10) Maximum Velocity in Inlet Throat given Total Maximum Discharge

Open Calculator

fx $$V_{max} = \frac{Q_{max} \cdot T}{2 \cdot \pi \cdot a_o \cdot A_b}$$

ex $$34.99849\text{m/s} = \frac{10.15\text{m}^3/\text{s} \cdot 130\text{s}}{2 \cdot \pi \cdot 4.0\text{m} \cdot 1.5001\text{m}^2}$$

11) Ocean Tide Amplitude given Total Maximum Discharge for Total of all Inlets

Open Calculator

fx $$a_o = \frac{Q_{max} \cdot T}{2 \cdot \pi \cdot A_b \cdot V_{max}}$$

ex $$3.999828\text{m} = \frac{10.15\text{m}^3/\text{s} \cdot 130\text{s}}{2 \cdot \pi \cdot 1.5001\text{m}^2 \cdot 35\text{m/s}}$$

12) Surface Area of Bay or Basin given Total Maximum Discharge

Open Calculator

fx $$A_b = \frac{Q_{max} \cdot T}{2 \cdot \pi \cdot a_o \cdot V_{max}}$$

ex $$1.500035\text{m}^2 = \frac{10.15\text{m}^3/\text{s} \cdot 130\text{s}}{2 \cdot \pi \cdot 4.0\text{m} \cdot 35\text{m/s}}$$

13) Tidal Period given Total Maximum Discharge for Total of all Inlets

Open Calculator

fx $$T = \frac{2 \cdot \pi \cdot a_o \cdot V_{max} \cdot A_b}{Q_{max}}$$

ex $$130.0056\text{s} = \frac{2 \cdot \pi \cdot 4.0\text{m} \cdot 35\text{m/s} \cdot 1.5001\text{m}^2}{10.15\text{m}^3/\text{s}}$$

14) Total Maximum Discharge for Total of all Inlets

Open Calculator

fx $$Q_{max} = \frac{2 \cdot \pi \cdot a_o \cdot A_b \cdot V_{max}}{T}$$

ex $$10.15044 \text{m}^3/\text{s} = \frac{2 \cdot \pi \cdot 4.0\text{m} \cdot 1.5001\text{m}^2 \cdot 35\text{m/s}}{130\text{s}}$$

Wave-Current Interaction

15) Angle Wave Orthogonal makes with Current in Non-propagated Wave Values on Forbidden Region

Open Calculator

fx $$\theta = a\cos\left(F \cdot \frac{([g] \cdot d_T)^{0.5}}{V} \right)$$

ex $$3.767954^\circ = a\cos\left(0.57 \cdot \frac{([g] \cdot 5\text{m})^{0.5}}{4\text{m/s}} \right)$$

16) Channel Depth in Non-propagated Wave Values

Open Calculator

fx $$d_T = [g] \cdot \left(\frac{\Omega \cdot T_p}{2 \cdot \pi} \right)^{\frac{1}{0.5}}$$

ex $$4.952265\text{m} = [g] \cdot \left(\frac{0.047 \cdot 95\text{s}}{2 \cdot \pi} \right)^{\frac{1}{0.5}}$$

17) Channel Depth in Non-propagated Wave values in Forbidden Region

Open Calculator

fx $$d_T = \frac{\left(\left(V \cdot \frac{\cos(\theta)}{F} \right) \right)^2}{[g]}$$

ex $$5.000091\text{m} = \frac{\left(\left(4\text{m/s} \cdot \frac{\cos(3.76^\circ)}{0.57} \right) \right)^2}{[g]}$$

18) Channel Velocity in Non-propagated Wave Values in Forbidden Region

Open Calculator

fx $$V = \frac{F \cdot ([g] \cdot d_T)^{0.5}}{\cos(\theta)}$$

ex $$3.999963\text{m/s} = \frac{0.57 \cdot ([g] \cdot 5\text{m})^{0.5}}{\cos(3.76^\circ)}$$

19) Effect of Current on Wave Height

Open Calculator

$$H = R_H \cdot H_A$$

$$80m = 0.8 \cdot 100m$$

20) Inlet Current Wave Height Factor

Open Calculator

$$R_H = \frac{H}{H_A}$$

$$0.8 = \frac{80m}{100m}$$

21) Non-propagated Wave Values in Forbidden Region Boundary Line

Open Calculator

$$F = \frac{V \cdot \cos(\theta)}{([g] \cdot d_T)^{0.5}}$$

$$0.570005 = \frac{4m/s \cdot \cos(3.76°)}{([g] \cdot 5m)^{0.5}}$$

22) Non-propagated Wave Values in Forbidden Region of Boundary Line

Open Calculator

$$\Omega = \left(\frac{2 \cdot \pi}{T_p}\right) \cdot \left(\frac{d_T}{[g]}\right)^{0.5}$$

$$0.047226 = \left(\frac{2 \cdot \pi}{95s}\right) \cdot \left(\frac{5m}{[g]}\right)^{0.5}$$

23) Wave Height Entering Inlet

Open Calculator

$$H_A = \frac{H}{R_H}$$

$$100m = \frac{80m}{0.8}$$

24) Wave Period in Non-propagated Wave Values

Open Calculator

$$T_p = \frac{2 \cdot \pi \cdot \left(\frac{d_T}{[g]}\right)^{\frac{1}{2}}}{\Omega}$$

$$95.45676s = \frac{2 \cdot \pi \cdot \left(\frac{5m}{[g]}\right)^{\frac{1}{2}}}{0.047}$$

Variables Used

- **a_B** Bay Tide Amplitude
- **A_b** Surface Area of Bay *(Square Meter)*
- **a_o** Ocean Tide Amplitude *(Meter)*
- **d_T** Time Averaged Water Depth *(Meter)*
- **D_t** Channel Depth *(Meter)*
- **F** Non-propagated Wave Values of 'F'
- **h** Eckman Constant Depth *(Meter)*
- **H** Wave Height *(Meter)*
- **H_A** Wave Height Entering Inlet *(Meter)*
- **k** Phase Lag
- **m** Bank Slope
- **Q_{max}** Maximum Discharge of Total Inlets *(Cubic Meter per Second)*
- **Qr** River or Freshwater Inflow to a Bay *(Cubic Meter per Minute)*
- **Qr'** King's Dimensionless Variable for Freshwater
- **R_H** Inlet Current Wave Height Factor
- **S** Superelevation *(Meter)*
- **t** Duration of Inflow *(Hour)*
- **T** Tidal Period *(Second)*
- **T_p** Wave Period *(Second)*
- **V** Velocity in Channel *(Meter per Second)*
- **V_{max}** Maximum Velocity in the Inlet Throat *(Meter per Second)*
- **W** Channel Width corresponding to Mean Water Depth *(Meter)*
- **β** Water Surface Slope
- **Δ** Coefficient of Eckman
- **Δ_{BS}** Bay Superelevation *(Meter)*
- **θ** Angle b/w Horizontal Velocity and Horizontal Wave *(Degree)*
- **ρ_{water}** Water Density *(Kilogram per Cubic Meter)*
- **τ** Shear Stress at the Water Surface *(Newton per Square Meter)*
- **Ω** Non-propagated Wave Values

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **acos**, acos(Number)
  The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Hour (h), Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Newton per Square Meter (N/m²)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Minute (m³/min), Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

Check other formula lists

- **Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction Formulas**
- **Inlet Currents and Tidal Elevations Formulas**

4/9/2024 | 9:49:25 AM UTC