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



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

## 1) Bay Superelevation Formulas 🕝

### 1.1) Depth given Water Surface Slope Formula 🕝



Evaluate Formula 🕝

## 1.2) Superelevation Formula 🕝

Formula



Evaluate Formula 🕝

$$\Delta_{BS} = a_o \cdot \left( \frac{\sin\left(2 \cdot \pi \cdot \frac{t}{T}\right)}{1 \cdot \cos\left(2 \cdot \pi \cdot \frac{t}{T}\right)} \right) \\ = 4.5151_m = 4.0_m \cdot \left( \frac{\sin\left(2 \cdot 3.1416 \cdot \frac{1.2_h}{130_s}\right)}{1 \cdot \cos\left(2 \cdot 3.1416 \cdot \frac{1.2_h}{130_s}\right)} \right)$$

## 1.3) Superelevation due to Varying Entrance Channel Cross-Section Formula

Evaluate Formula

$$S = a_{o} \cdot \left(1 - \left(\frac{\left(\frac{a_{B}}{a_{o}}\right)^{2}}{4 \cdot \left(\frac{D_{t}}{a_{o}}\right)}\right) - \left(\frac{a_{o}}{m \cdot W}\right) \cdot \left(0.5 - \left(\frac{a_{B}}{a_{o}}\right) \cdot \cos\left(k\right) - \left(\left(\frac{3}{2}\right) \cdot \left(\frac{a_{B}}{a_{o}}\right)^{2}\right) + 4 \cdot \left(\frac{D_{t}}{a_{o}}\right)^{2}\right)\right)$$

$$2.0029\,{}_{m} \, = \, 4.0\,{}_{m} \, \cdot \left(1 \, - \left(\frac{\left(\frac{3.7}{4.0\,\mathrm{m}}\right)^{2}}{4 \cdot \left(\frac{5.01\,\mathrm{m}}{4.0\,\mathrm{m}}\right)}\right) \, - \left(\frac{4.0\,\mathrm{m}}{1.5 \cdot 52\,\mathrm{m}}\right) \cdot \left(0.5 \, - \left(\frac{3.7}{4.0\,\mathrm{m}}\right) \cdot \cos\left(185.2\right) \, - \left(\left(\frac{3}{2}\right) \cdot \left(\frac{3.7}{4.0\,\mathrm{m}}\right)^{2}\right) + 4 \cdot \left(\frac{5.01\,\mathrm{m}}{4.0\,\mathrm{m}}\right)^{2}\right)\right)$$

## 1.4) Tidal Amplitude in Ocean Formula (7)

Evaluate Formula

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

## 2) Effect of Freshwater Inflow Formulas (7)

#### 2.1) King's Dimensionless Variable Formula

Evaluate Formula

 $Qr' = Qr \cdot \frac{T}{2 \cdot \pi \cdot a_0 \cdot A_b}$ 

## 2.2) Ocean Tide Amplitude using King's Dimensionless Variable Formula

Example with Units  $a_0 = \frac{Qr \cdot T}{Qr' \cdot 2 \cdot \pi \cdot A_b} \quad \boxed{ 4.0329_m = \frac{10^{m^2/min} \cdot 130_s}{0.57 \cdot 2 \cdot 3.1416 \cdot 1.5001_{m^2}} }$ 

Evaluate Formula 🕝

2.3) River or Freshwater Inflow to Bay using King's Dimensionless Variable Formula 🕝

 $Qr = \frac{Qr' \cdot 2 \cdot \pi \cdot a_0 \cdot A_b}{T} \qquad 9.9184 \, m^3 / min = \frac{0.57 \cdot 2 \cdot 3.1416 \cdot 4.0 \, m \cdot 1.5001 \, m^2}{130 \, s}$ 

2.4) Surface Area of Bay or Basin using King's Dimensionless Variable Formula 🕝

 $A_b = \frac{Qr \cdot T}{Qr' \cdot 2 \cdot \pi \cdot a_0} \left[ -1.5124 \, \text{m}^2 = \frac{10 \, \text{m}^3 / \text{min} \cdot 130 \, \text{s}}{0.57 \cdot 2 \cdot 3.1416 \cdot 4.0 \, \text{m}} \right]$ 

Evaluate Formula 🕝

2.5) Tidal Period using King's Dimensionless Variable Formula

Example with Units  Evaluate Formula

## 3) Multiple Inlets Formulas (\*\*)

3.1) Maximum Velocity in Inlet Throat given Total Maximum Discharge Formula 🕝

 $V_{max} = \frac{Q_{max} \cdot T}{2 \cdot \pi \cdot a_{o} \cdot A_{b}}$  34.9985 m/s =  $\frac{10.15 \, m^{3}/s \cdot 130 \, s}{2 \cdot 3.1416 \cdot 4.0 \, m \cdot 1.5001 \, m^{2}}$ 

Evaluate Formula

3.2) Ocean Tide Amplitude given Total Maximum Discharge for Total of all Inlets Formula C

 $a_{o} = \frac{Q_{max} \cdot T}{2 \cdot \pi \cdot A_{h} \cdot V_{max}} \quad \boxed{ 3.9998_{m} = \frac{10.15_{m^{3}/s} \cdot 130_{s}}{2 \cdot 3.1416 \cdot 1.5001_{m^{2}} \cdot 35_{m/s}} }$ 

3.3) Surface Area of Bay or Basin given Total Maximum Discharge Formula 🕝

Example with Units

Evaluate Formula

## 3.4) Tidal Period given Total Maximum Discharge for Total of all Inlets Formula 🕝

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

Example with Units 
$$130.0056s = \frac{2 \cdot 3.1416 \cdot 4.0 \, \text{m} \cdot 35 \, \text{m/s} \cdot 1.5001 \, \text{m}^2}{10.15 \, \text{m}^3/\text{s}}$$

3.5) Total Maximum Discharge for Total of all Inlets Formula C

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

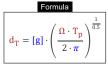
## 4) Wave-Current Interaction Formulas

## 4.1) Angle Wave Orthogonal makes with Current in Non-propagated Wave Values on Forbidden Region Formula

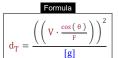
Formula
$$\theta = a\cos\left(F \cdot \frac{\left([g] \cdot d_{T}\right)^{0.5}}{V}\right)$$

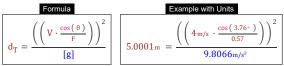
Formula Example with Units 
$$\theta = a\cos\left(F \cdot \frac{\left([g] \cdot d_T\right)^{0.5}}{V}\right) \qquad 3.768^{\circ} = a\cos\left(0.57 \cdot \frac{\left(9.8066 \text{m/s}^2 \cdot 5 \text{m}\right)^{0.5}}{4 \text{m/s}}\right)$$

## 4.2) Channel Depth in Non-propagated Wave Values Formula C



## 4.3) Channel Depth in Non-propagated Wave values in Forbidden Region Formula 🗂





## 4.4) Channel Velocity in Non-propagated Wave Values in Forbidden Region Formula 🗁

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

Formula Example with Units 
$$V = \frac{F \cdot \left( \left[ g \right] \cdot d_T \right)^{0.5}}{\cos \left( \theta \right)} \quad \boxed{ 4_{\text{m/s}} = \frac{0.57 \cdot \left( 9.8066_{\text{m/s}^2} \cdot 5_{\text{m}} \right)^{0.5}}{\cos \left( 3.76^{\circ} \right)} }$$

## 4.5) Effect of Current on Wave Height Formula C

Formula 
$$H = R_h \cdot H_A$$

Example with Units 
$$80 \, \text{m} = 0.8 \cdot 100 \, \text{m}$$

Evaluate Formula

Evaluate Formula 🕝

Evaluate Formula

Evaluate Formula 🕝

Evaluate Formula

Evaluate Formula (

## 4.6) Inlet Current Wave Height Factor Formula



Formula Example with Units 
$$R_h = \frac{H}{H_A} \qquad 0.8 = \frac{80\,\mathrm{m}}{100\,\mathrm{m}}$$

Evaluate Formula

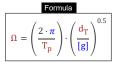
## 4.7) Non-propagated Wave Values in Forbidden Region Boundary Line Formula

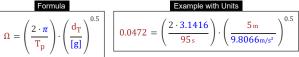
$$F = \frac{V \cdot \cos(\theta)}{([g] \cdot d_T)^{0.5}}$$

Formula Example with Units 
$$F = \frac{V \cdot \cos(\theta)}{\left([g] \cdot d_T\right)^{0.5}} \quad 0.57 = \frac{4 \text{ m/s} \cdot \cos(3.76^{\circ})}{\left(9.8066 \text{m/s}^2 \cdot 5 \text{ m}\right)^{0.5}}$$



4.8) Non-propagated Wave Values in Forbidden Region of Boundary Line Formula 🕝







4.9) Wave Height Entering Inlet Formula C

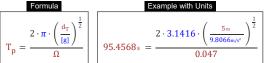
Formula
$$H_{A} = \frac{H}{R_{h}}$$

Example with Units
$$100 \,\mathrm{m} \,= \frac{80 \,\mathrm{m}}{0.8}$$

Evaluate Formula 🕝

## 4.10) Wave Period in Non-propagated Wave Values Formula 🕝

$$T_{p} = \frac{2 \cdot \pi \cdot \left(\frac{d_{T}}{[g]}\right)^{\frac{1}{2}}}{\Omega}$$





# Variables used in list of Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction Formulas above

- a<sub>B</sub> Bay Tide Amplitude
- A<sub>b</sub> Surface Area of Bay (Square Meter)
- a<sub>0</sub> Ocean Tide Amplitude (Meter)
- d<sub>T</sub> Time Averaged Water Depth (Meter)
- Dt Channel Depth (Meter)
- F Non-propagated Wave Values of 'F'
- **h** Eckman Constant Depth (Meter)
- H Wave Height (Meter)
- H<sub>△</sub> Wave Height Entering Inlet (Meter)
- k Phase Lag
- m Bank Slope
- **Q**<sub>max</sub> Maximum Discharge of Total Inlets (Cubic Meter per Second)
- Qr River or Freshwater Inflow to a Bay (Cubic Meter per
- Qr' King's Dimensionless Variable for Freshwater
- R<sub>h</sub> Inlet Current Wave Height Factor
- Superelevation (Meter)
- t Duration of Inflow (Hour)
- T Tidal Period (Second)
- T<sub>n</sub> Wave Period (Second)
- V Velocity in Channel (Meter per Second)
- V<sub>max</sub> Maximum Velocity in the Inlet Throat (Meter per Second)
- W Channel Width corresponding to Mean Water Depth (Meter)
- B Water Surface Slope
- ▲ Coefficient of Eckman
- Δ<sub>BS</sub> Bay Superelevation (Meter)
- 6 Angle b/w Horizontal Velocity and Horizontal Wave (Degree)
- ρ<sub>water</sub> Water Density (Kilogram per Cubic Meter)
- T Shear Stress at the Water Surface (Newton per Square Meter)
- Ω Non-propagated Wave Values

# Constants, Functions, Measurements used in list of Bay Superelevation, Effect of Freshwater Inflow, Multiple Inlets and Wave-Current Interaction Formulas above

- constant(s): pi,
  - 3.14159265358979323846264338327950288
- Archimedes' constantconstant(s): [g], 9.80665
- Gravitational acceleration on Earth
- Functions: 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.
- Functions: cos, cos(Angle)
  - Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: 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

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