Important Inlet Currents and Tidal Elevations Formulas PDF

Formulas
Examples
with Units

List of 28
Important Inlet Currents and Tidal Elevations Formulas

1) Average Area over Channel Length for Flow through Inlet into Bay Formula

Evaluate Formula

Formula

$$A_{avg} = \frac{A_b \cdot d_{Bay}}{V_{avg}}$$

Example with Units

$$8.0005\,\text{m}^2 = \frac{1.5001\,\text{m}^2 \cdot 20}{3.75\,\text{m/s}}$$

2) Average Area over Channel Length using King's Dimensionless Velocity Formula

Evaluate Formula

Formula

$$A_{avg} = \frac{V'_m \cdot 2 \cdot \pi \cdot a_o \cdot A_b}{T \cdot V_m}$$

Example with Units

$$7.7808\,\text{m}^2 = \frac{110 \cdot 2 \cdot 3.1416 \cdot 4.0\,\text{m} \cdot 1.5001\,\text{m}^2}{130\,\text{s} \cdot 4.1\,\text{m/s}}$$

3) Average Velocity in Channel for Flow through Inlet into Bay Formula

Evaluate Formula

Formula

$$V_{avg} = \frac{A_b \cdot d_{Bay}}{A_{avg}}$$

Example with Units

$$3.7502\,\text{m/s} = \frac{1.5001\,\text{m}^2 \cdot 20}{8\,\text{m}^2}$$

4) Bay Tide Amplitude given Tidal Prism Filling Bay Formula

Evaluate Formula

Formula

$$a_B = \frac{P}{2 \cdot A_b}$$

Example with Units

$$10.666 = \frac{32\,\text{m}^3}{2 \cdot 1.5001\,\text{m}^2}$$

5) Change of Bay Elevation with Time for Flow through Inlet into Bay Formula

Evaluate Formula

Formula

$$d_{Bay} = \frac{A_{avg} \cdot V_{avg}}{A_b}$$

Example with Units

$$19.9987 = \frac{8\,\text{m}^2 \cdot 3.75\,\text{m/s}}{1.5001\,\text{m}^2}$$

6) Darcy - Weisbach Friction Term given Inlet Impedance Formula

Evaluate Formula

Formula

$$f = \frac{4 \cdot r_H \cdot \left(Z - K_{en} - K_{ex} \right)}{L}$$

Example with Units

$$0.03 = \frac{4 \cdot 0.33\,\text{m} \cdot \left(2.246 - 1.01 - 0.1 \right)}{50\,\text{m}}$$

7) Dimensionless Parameter Function of Hydraulic Radius and Manning's Roughness Coefficient Formula

Evaluate Formula

Formula

$$f = \frac{116 \cdot n^2}{R_H^{\frac{1}{3}}}$$

Example with Units

$$0.0298 = \frac{116 \cdot 0.0198^2}{3.55\,\text{m}^{\frac{1}{3}}}$$

8) Duration of Inflow given Inlet Channel Velocity Formula

Evaluate Formula

Formula

$$t = \frac{asin\left(\frac{c_1}{V_m} \right) \cdot T}{2 \cdot \pi}$$

Example with Units

$$0.0078\,\text{h} = \frac{asin\left(\frac{4.01\,\text{m/s}}{4.1\,\text{m/s}} \right) \cdot 130\,\text{s}}{2 \cdot 3.1416}$$

9) Entrance Energy Loss Coefficient given Inlet Impedance Formula

Evaluate Formula

Formula

$$K_{en} = Z - K_{ex} - \left(f \cdot \frac{L}{4 \cdot r_H} \right)$$

Example with Units

$$1.0096 = 2.246 - 0.1 - \left(0.03 \cdot \frac{50\,\text{m}}{4 \cdot 0.33\,\text{m}} \right)$$

10) Exit Energy Loss Coefficient given Inlet Impedance Formula

Evaluate Formula

Formula

$$K_{ex} = Z - K_{en} - \left(f \cdot \frac{L}{4 \cdot r_H} \right)$$

Example with Units

$$0.0996 = 2.246 - 1.01 - \left(0.03 \cdot \frac{50\,\text{m}}{4 \cdot 0.33\,\text{m}} \right)$$

11) Hydraulic Radius given Dimensionless Parameter Formula

Evaluate Formula

Formula

$$R_H = \left(116 \cdot \frac{n^2}{f} \right)^3$$

Example with Units

$$3.4834\,\text{m} = \left(116 \cdot \frac{0.0198^2}{0.03} \right)^3$$

12) Inlet Channel Velocity Formula

Evaluate Formula

Formula

$$c_1 = V_m \cdot \sin\left(2 \cdot \pi \cdot \frac{t}{T} \right)$$

Example with Units

$$4.0701\,\text{m/s} = 4.1\,\text{m/s} \cdot \sin\left(2 \cdot 3.1416 \cdot \frac{1.2\,\text{h}}{130\,\text{s}} \right)$$

13) Inlet Friction Coefficient given Keulegan Repletion Coefficient Formula

Evaluate Formula

Formula

$$K_1 = \frac{1}{\left(K \cdot K_2\right)^2}$$

Example

$$28.4444 = \frac{1}{\left(0.75 \cdot 0.25\right)^2}$$

14) Inlet Friction Coefficient Parameter given Keulegan Repletion Coefficient Formula

Evaluate Formula

Formula

$$K_2 = \frac{\sqrt{\frac{1}{K_1}}}{K}$$

Example

$$0.2485 = \frac{\sqrt{\frac{1}{28.8}}}{0.75}$$

15) Inlet Hydraulic Radius given Inlet Impedance Formula

Evaluate Formula

Formula

$$r_H = \frac{f \cdot L}{4 \cdot \left(Z - K_{ex} - K_{en}\right)}$$

Example with Units

$$0.3301\,\text{m} = \frac{0.03 \cdot 50\,\text{m}}{4 \cdot \left(2.246 - 0.1 - 1.01\right)}$$

16) Inlet Impedance Formula

Evaluate Formula

Formula

$$Z = K_{en} + K_{ex} + \left(f \cdot \frac{L}{4 \cdot r_H}\right)$$

Example with Units

$$2.2464 = 1.01 + 0.1 + \left(0.03 \cdot \frac{50\,\text{m}}{4 \cdot 0.33\,\text{m}}\right)$$

17) Inlet Length given Inlet Impedance Formula

Evaluate Formula

Formula

$$L = 4 \cdot r_H \cdot \frac{Z - K_{ex} - K_{en}}{f}$$

Example with Units

$$49.984\,\text{m} = 4 \cdot 0.33\,\text{m} \cdot \frac{2.246 - 0.1 - 1.01}{0.03}$$

18) Keulegan Repletion Coefficient Formula

Evaluate Formula

Formula

$$K = \frac{1}{K_2} \cdot \sqrt{\frac{1}{K_1}}$$

Example

$$0.7454 = \frac{1}{0.25} \cdot \sqrt{\frac{1}{28.8}}$$

19) King's Dimensionless Velocity Formula

Evaluate Formula

Formula

$$V'_m = \frac{A_{avg} \cdot T \cdot V_m}{2 \cdot \pi \cdot a_o \cdot A_b}$$

Example with Units

$$113.0986 = \frac{8\,\text{m}^2 \cdot 130\,\text{s} \cdot 4.1\,\text{m/s}}{2 \cdot 3.1416 \cdot 4.0\,\text{m} \cdot 1.5001\,\text{m}^2}$$

20) Manning's Roughness Coefficient using Dimensionless Parameter Formula

Evaluate Formula

Formula

$$n = \sqrt{f \cdot \frac{R_H^{\frac{1}{3}}}{116}}$$

Example with Units

$$0.0199 = \sqrt{0.03 \cdot \frac{3.55\,\text{m}^{\frac{1}{3}}}{116}}$$

21) Maximum Cross-Sectionally Averaged Velocity during Tidal Cycle Formula

Evaluate Formula

Formula

$$V_m = \frac{V'_m \cdot 2 \cdot \pi \cdot a_o \cdot A_b}{A_{avg} \cdot T}$$

Example with Units

$$3.9877\,\text{m/s} = \frac{110 \cdot 2 \cdot 3.1416 \cdot 4.0\,\text{m} \cdot 1.5001\,\text{m}^2}{8\,\text{m}^2 \cdot 130\,\text{s}}$$

22) Maximum Cross-Sectionally Averaged Velocity during Tidal Cycle given Inlet Channel Velocity Formula

Evaluate Formula

Formula

$$V_m = \frac{c_1}{\sin\left(2 \cdot \pi \cdot \frac{t}{T}\right)}$$

Example with Units

$$4.0395\,\text{m/s} = \frac{4.01\,\text{m/s}}{\sin\left(2 \cdot 3.1416 \cdot \frac{1.2\,\text{h}}{130\,\text{s}}\right)}$$

23) Ocean Tide Amplitude using King's Dimensionless Velocity Formula

Evaluate Formula

Formula

$$a_o = \frac{A_{avg} \cdot V_m \cdot T}{V'_m \cdot 2 \cdot \pi \cdot A_b}$$

Example with Units

$$4.1127\,\text{m} = \frac{8\,\text{m}^2 \cdot 4.1\,\text{m/s} \cdot 130\,\text{s}}{110 \cdot 2 \cdot 3.1416 \cdot 1.5001\,\text{m}^2}$$

24) Surface Area of Bay for Flow through Inlet into Bay Formula

Evaluate Formula

Formula

$$A_b = \frac{V_{avg} \cdot A_{avg}}{d_{Bay}}$$

Example with Units

$$1.5\,\text{m}^2 = \frac{3.75\,\text{m/s} \cdot 8\,\text{m}^2}{20}$$

25) Surface Area of Bay given Tidal Prism Filling Bay Formula

Evaluate Formula

Formula

$$A_b = \frac{P}{2 \cdot a_B}$$

Example with Units

$$4.3243\,\text{m}^2 = \frac{32\,\text{m}^3}{2 \cdot 3.7}$$

26) Surface Area of Bay using King's Dimensionless Velocity Formula

Evaluate Formula

Formula

$$A_b = \frac{A_{avg} \cdot T \cdot V_m}{V'_m \cdot 2 \cdot \pi \cdot a_o}$$

Example with Units

$$1.5424\,\text{m}^2 = \frac{8\,\text{m}^2 \cdot 130\,\text{s} \cdot 4.1\,\text{m/s}}{110 \cdot 2 \cdot 3.1416 \cdot 4.0\,\text{m}}$$

27) Tidal Period using King's Dimensionless Velocity Formula

Evaluate Formula

Formula

$$T = \frac{2 \cdot \pi \cdot a_o \cdot A_b \cdot V'_m}{A_{avg} \cdot V_m}$$

Example with Units

$$126.4384\,\text{s} = \frac{2 \cdot 3.1416 \cdot 4.0\,\text{m} \cdot 1.5001\,\text{m}^2 \cdot 110}{8\,\text{m}^2 \cdot 4.1\,\text{m/s}}$$

28) Tidal Prism Filling Bay Formula

Evaluate Formula

Formula

$$P = 2 \cdot a_B \cdot A_b$$

Example with Units

$$11.1007\,\text{m}^3 = 2 \cdot 3.7 \cdot 1.5001\,\text{m}^2$$

Variables used in list of Inlet Currents and Tidal Elevations Formulas above

- A_{avg} Average Area over the Channel Length *(Square Meter)*
- a_B Bay Tide Amplitude
- A_b Surface Area of Bay *(Square Meter)*
- a_o Ocean Tide Amplitude *(Meter)*
- c_1 Inlet Velocity *(Meter per Second)*
- d_{Bay} Change of Bay Elevation with Time
- **f** Dimensionless Parameter
- **K** Keulegan Repletion Coefficient [dimensionless]
- K_1 King's Inlet Friction Coefficient
- K_2 King's 1st Inlet Friction Coefficient
- K_{en} Entrance Energy Loss Coefficient
- K_{ex} Exit Energy Loss Coefficient
- **L** Inlet Length *(Meter)*
- **n** Manning's Roughness Coefficient
- **P** Tidal Prism Filling Bay *(Cubic Meter)*
- r_H Hydraulic Radius *(Meter)*
- R_H Hydraulic Radius of the Channel *(Meter)*
- **t** Duration of Inflow *(Hour)*
- **T** Tidal Period *(Second)*
- V_{avg} Average Velocity in Channel for Flow *(Meter per Second)*
- V_m Maximum Cross Sectional Average Velocity *(Meter per Second)*
- V'_m King's Dimensionless Velocity
- **Z** Inlet Impedance

Constants, Functions, Measurements used in list of Inlet Currents and Tidal Elevations Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **asin**, asin(Number) *The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- 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.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Time** in Second (s), Hour (h) *Time Unit Conversion*
- Measurement: **Volume** in Cubic Meter (m^3) *Volume Unit Conversion*
- Measurement: **Area** in Square Meter (m^2) *Area Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*

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