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Hydrodynamics of Tidal Inlets- 2 Formulas

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List of 23 Hydrodynamics of Tidal Inlets-2 Formulas

Hydrodynamics of Tidal Inlets-2

Hydrodynamic and Sediment Interaction at Tidal Inlets

Tidal Dispersion and Mixing

1) Average Volume of Bay over Tidal Cycle given Residence Time

$$\text{fx } V = \frac{T_r \cdot \varepsilon \cdot P}{T}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

$$\text{ex } 179.2\text{m}^3/\text{hr} = \frac{16\text{Year} \cdot 0.7 \cdot 32\text{m}^3}{2\text{Year}}$$

2) Fraction of New Water Entering Bay from Sea each Tidal Cycle given Residence Time

$$\text{fx } \varepsilon = \frac{V \cdot T}{P \cdot T_r}$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$\text{ex } 0.703125 = \frac{180\text{m}^3/\text{hr} \cdot 2\text{Year}}{32\text{m}^3 \cdot 16\text{Year}}$$



3) Residence Time

$$fx \quad T_r = T \cdot \left(\frac{V}{\varepsilon \cdot P} \right)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 16.07143 \text{Year} = 2 \text{Year} \cdot \left(\frac{180 \text{m}^3/\text{hr}}{0.7 \cdot 32 \text{m}^3} \right)$$

4) Tidal Period given Residence Time

$$fx \quad T = \frac{T_r \cdot \varepsilon \cdot P}{V}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 1.991111 \text{Year} = \frac{16 \text{Year} \cdot 0.7 \cdot 32 \text{m}^3}{180 \text{m}^3/\text{hr}}$$

5) Tidal Prism given Residence Time

$$fx \quad P = \frac{T \cdot V}{T_r \cdot \varepsilon}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 32.14286 \text{m}^3 = \frac{2 \text{Year} \cdot 180 \text{m}^3/\text{hr}}{16 \text{Year} \cdot 0.7}$$



Tidal Prism

6) Average Area over Channel Length given Tidal Prism

$$\text{fx } A_{\text{avg}} = \frac{P \cdot \pi}{T \cdot V_m}$$

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)](#)

$$\text{ex } 12.25987\text{m}^2 = \frac{32\text{m}^3 \cdot \pi}{2\text{Year} \cdot 4.1\text{m/s}}$$

7) Average Area over Channel Length given Tidal Prism of Non-Sinusoidal Prototype Flow

$$\text{fx } A_{\text{avg}} = \frac{P \cdot \pi \cdot C}{T \cdot V_m}$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

$$\text{ex } 12.38247\text{m}^2 = \frac{32\text{m}^3 \cdot \pi \cdot 1.01}{2\text{Year} \cdot 4.1\text{m/s}}$$

8) Depth of Water at Current Meter Location

$$\text{fx } D = \frac{r_H}{\left(\frac{V_{\text{avg}}}{V_{\text{meas}}}\right)^{\frac{3}{2}}}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

$$\text{ex } 8.101062\text{m} = \frac{0.33\text{m}}{\left(\frac{3\text{m/s}}{25.34\text{m/s}}\right)^{\frac{3}{2}}}$$



9) Hydraulic Radius of Entire Cross-Section

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

$$\text{fx } r_H = D \cdot \left(\frac{V_{\text{avg}}}{V_{\text{meas}}} \right)^{\frac{3}{2}}$$

$$\text{ex } 0.329957\text{m} = 8.1\text{m} \cdot \left(\frac{3\text{m/s}}{25.34\text{m/s}} \right)^{\frac{3}{2}}$$

10) Maximum Cross-Sectionally Averaged Velocity during Tidal Cycle given Tidal Prism

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba_img.jpg\)](#)

$$\text{fx } V_m = \frac{P \cdot \pi}{T \cdot A_{\text{avg}}}$$

$$\text{ex } 6.283185\text{m/s} = \frac{32\text{m}^3 \cdot \pi}{2\text{Year} \cdot 8\text{m}^2}$$

11) Maximum Cross-Sectionally Averaged Velocity given Tidal Prism of Non-sinusoidal Prototype Flow

[Open Calculator !\[\]\(47734e4656765d20df4fdbd5b7aff048_img.jpg\)](#)

$$\text{fx } V_m = \frac{P \cdot \pi \cdot C}{T \cdot A_{\text{avg}}}$$

$$\text{ex } 6.346017\text{m/s} = \frac{32\text{m}^3 \cdot \pi \cdot 1.01}{2\text{Year} \cdot 8\text{m}^2}$$



12) Maximum Ebb Tide Discharge Accounting for Non-Sinusoidal Character of Prototype Flow by Keulegan

$$\text{fx } Q_{\max} = \frac{P \cdot \pi \cdot C}{T}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 50.76814\text{m}^3/\text{s} = \frac{32\text{m}^3 \cdot \pi \cdot 1.01}{2\text{Year}}$$

13) Maximum Instantaneous Ebb Tide Discharge given Tidal Prism

$$\text{fx } Q_{\max} = P \cdot \frac{\pi}{T}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 50.26548\text{m}^3/\text{s} = 32\text{m}^3 \cdot \frac{\pi}{2\text{Year}}$$

14) Maximum Velocity Averaged over Entire Cross-Section

$$\text{fx } V_{\text{avg}} = V_{\text{meas}} \cdot \left(\frac{r_H}{D} \right)^{\frac{2}{3}}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } 3.000262\text{m/s} = 25.34\text{m/s} \cdot \left(\frac{0.33\text{m}}{8.1\text{m}} \right)^{\frac{2}{3}}$$



15) Point Measurement of Maximum Velocity

[Open Calculator !\[\]\(feabb98897b440bc8695a03336a6e2df_img.jpg\)](#)

$$\text{fx } V_{\text{meas}} = \frac{V_{\text{avg}}}{\left(\frac{r_H}{D}\right)^{\frac{2}{3}}}$$

$$\text{ex } 25.33778\text{m/s} = \frac{3\text{m/s}}{\left(\frac{0.33\text{m}}{8.1\text{m}}\right)^{\frac{2}{3}}}$$

16) Tidal Period Accounting for Non-sinusoidal Character of Prototype Flow by Keulegan

[Open Calculator !\[\]\(642aa997563f9a325b310230bb5078b7_img.jpg\)](#)

$$\text{fx } T = \frac{P \cdot \pi \cdot C}{Q_{\text{max}}}$$

$$\text{ex } 2.030725\text{Year} = \frac{32\text{m}^3 \cdot \pi \cdot 1.01}{50\text{m}^3/\text{s}}$$

17) Tidal Period given Maximum Cross-sectionally Averaged Velocity and Tidal Prism

[Open Calculator !\[\]\(51514032c8ca341817228f39f1307b05_img.jpg\)](#)

$$\text{fx } T = \frac{P \cdot \pi}{V_m \cdot A_{\text{avg}}}$$

$$\text{ex } 3.064968\text{Year} = \frac{32\text{m}^3 \cdot \pi}{4.1\text{m/s} \cdot 8\text{m}^2}$$



18) Tidal Period given Maximum Instantaneous Ebb Tide Discharge and Tidal Prism

$$\text{fx } T = \frac{P \cdot \pi}{Q_{\max}}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$\text{ex } 2.010619\text{Year} = \frac{32\text{m}^3 \cdot \pi}{50\text{m}^3/\text{s}}$$

19) Tidal Period when Tidal Prism Accounting for Non-sinusoidal Prototype Flow by Keulegan

$$\text{fx } T = \frac{P \cdot \pi \cdot C}{V_m \cdot A_{\text{avg}}}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$\text{ex } 3.095618\text{Year} = \frac{32\text{m}^3 \cdot \pi \cdot 1.01}{4.1\text{m}/\text{s} \cdot 8\text{m}^2}$$

20) Tidal Prism Filling Bay Accounting for Non-sinusoidal Prototype Flow by Keulegan

$$\text{fx } P = \frac{T \cdot Q_{\max}}{\pi \cdot C}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 31.51583\text{m}^3 = \frac{2\text{Year} \cdot 50\text{m}^3/\text{s}}{\pi \cdot 1.01}$$



21) Tidal Prism filling Bay given Maximum Ebb Tide Discharge

$$fx \quad P = T \cdot \frac{Q_{\max}}{\pi}$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

$$ex \quad 31.83099m^3 = 2Year \cdot \frac{50m^3/s}{\pi}$$

22) Tidal Prism for Non-sinusoidal character of Prototype Flow by Keulegan

$$fx \quad P = T \cdot \frac{Q_{\max}}{\pi \cdot C}$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

$$ex \quad 31.51583m^3 = 2Year \cdot \frac{50m^3/s}{\pi \cdot 1.01}$$

23) Tidal Prism given Average Area over Channel Length

$$fx \quad P = \frac{T \cdot V_m \cdot A_{\text{avg}}}{\pi}$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)

$$ex \quad 20.88113m^3 = \frac{2Year \cdot 4.1m/s \cdot 8m^2}{\pi}$$









Variables Used

- **A_{avg}** Average Area over the Channel Length (*Square Meter*)
- **C** Keulegan Constant for Non-sinusoidal Character
- **D** Depth of Water at Current Meter Location (*Meter*)
- **P** Tidal Prism Filling Bay (*Cubic Meter*)
- **Q_{max}** Maximum Instantaneous Ebb Tide Discharge (*Cubic Meter per Second*)
- **r_H** Hydraulic Radius (*Meter*)
- **T** Tidal Duration (*Year*)
- **T_r** Residence Time (*Year*)
- **V** Average Volume of Bay over Tidal Cycle (*Cubic Meter per Hour*)
- **V_{avg}** Max Velocity averaged Over Inlet Cross Section (*Meter per Second*)
- **V_m** Maximum Cross Sectional Average Velocity (*Meter per Second*)
- **V_{meas}** Point Measurement of Maximum Velocity (*Meter per Second*)
- **ϵ** Fraction of New Water entering the Bay



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Time** in Year (Year)
Time Unit Conversion 
- **Measurement:** **Volume** in Cubic Meter (m³)
Volume Unit Conversion 
- **Measurement:** **Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Volumetric Flow Rate** in Cubic Meter per Hour (m³/hr),
Cubic Meter per Second (m³/s)
Volumetric Flow Rate Unit Conversion 



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