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Density Currents in Harbors Formulas

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List of 27 Density Currents in Harbors Formulas

Density Currents in Harbors

1) Average Depth of Harbor for Water Volume Exchanged during Entire Tide Period

Open Calculator

fx $$h' = \frac{\left(\frac{V_w}{G} \cdot A_E\right)^{\frac{1}{2}}}{H^2}$$

ex $$15.87659\text{m} = \frac{\left(\frac{50\text{m}^3/\text{s}}{0.1} \cdot 61\text{m}^2\right)^{\frac{1}{2}}}{11}$$

2) Average Harbor Depth

Open Calculator

fx $$h' = \frac{\Delta h \cdot V}{P}$$

ex $$4.2\text{m} = \frac{21\text{m} \cdot 6.4\text{m}^3}{32\text{m}^3}$$

3) Average Harbor Depth given Portion caused by Filling

Open Calculator

fx $$h' = \frac{\Delta h}{\alpha_f}$$

ex $$6\text{m} = \frac{21\text{m}}{3.5}$$

4) Average River Density over one Tide Period given Relative Density

Open Calculator

fx $$\rho' = \frac{\rho_{max} - \rho_{min}}{H^2}$$

ex $$8\text{kg/m}^3 = \frac{100 - 12}{11}$$

5) Cross-Sectional Area of Entrance given Water Volume exchanged during entire Tide Period

Open Calculator

fx $$A_E = \frac{V_w}{G \cdot \sqrt{H^2 \cdot h'}}$$

ex $$61.54575\text{m}^2 = \frac{50\text{m}^3/\text{s}}{0.1 \cdot \sqrt{11 \cdot 6\text{m}}}$$

6) Density Influence given Ratio of Water Volume entering Harbor per Tide

Open Calculator

fx $$\alpha_D = \alpha - \alpha_f$$

ex $$6.5 = 10 - 3.5$$

7) Difference between High and Low Tide Levels given Portion caused by Filling

Open Calculator

fx $\Delta h = h' \cdot \alpha_f$

ex $21\text{m} = 6\text{m} \cdot 3.5$

8) Difference between High and Low Tide Levels given Tidal Prism of Harbor Basin

Open Calculator

fx $\Delta h = \left(\frac{P}{V}\right) \cdot h'$

ex $30\text{m} = \left(\frac{32\text{m}^3}{6.4\text{m}^3}\right) \cdot 6\text{m}$

9) Maximum River Density given Relative Density

Open Calculator

fx $\rho_{max} = \left(H^2 \cdot \rho'\right) + \rho_{min}$

ex $100 = (11 \cdot 8\text{kg/m}^3) + 12$

10) Minimum River Density given Relative Density

Open Calculator

fx $\rho_{min} = -\left(\left(H^2 \cdot \rho'\right) - \rho_{max}\right)$

ex $12 = -((11 \cdot 8\text{kg/m}^3) - 100)$

11) Portion caused by Filling Evaluated by Comparing Tidal Prism of Harbor to Total Harbor Volume

Open Calculator

fx $$\alpha_f = \frac{P}{V}$$

ex $$5 = \frac{32\text{m}^3}{6.4\text{m}^3}$$

12) Portion caused by Filling given Average Harbor Depth

Open Calculator

fx $$\alpha_f = \frac{\Delta h}{h'}$$

ex $$3.5 = \frac{21\text{m}}{6\text{m}}$$

13) Portion caused by Filling given Ratio of Water Volume Entering Harbor per Tide

Open Calculator

fx $$\alpha_f = \alpha - \alpha_D$$

ex $$3.5 = 10 - 6.5$$

14) Ratio of Water Volume entering Harbor per Tide to Harbor Volume

Open Calculator

fx $$\alpha = \alpha_f + \alpha_D$$

ex $$10 = 3.5 + 6.5$$

15) Relative Density given River Density

Open Calculator

fx $$H^2 = \frac{\rho_{max} - \rho_{min}}{\rho'}$$

ex $$11 = \frac{100 - 12}{8\text{kg/m}^3}$$

16) Relative Density given Velocity in Dry Bed Curve

Open Calculator

fx $$H^2 = \frac{V_{Dbc}^2}{0.45 \cdot [g] \cdot d}$$

ex $$5.098581 = \frac{(4.5\text{m/s})^2}{0.45 \cdot [g] \cdot 0.9\text{m}}$$

17) Tidal Prism of Harbor Basin

Open Calculator

fx $$P = \alpha_f \cdot V$$

ex $$22.4\text{m}^3 = 3.5 \cdot 6.4\text{m}^3$$

18) Tidal Prism of Harbor Basin given Difference between High and Low Tide Levels

Open Calculator

fx $$P = V \cdot \left(\frac{\Delta h}{h'}\right)$$

ex $$22.4\text{m}^3 = 6.4\text{m}^3 \cdot \left(\frac{21\text{m}}{6\text{m}}\right)$$

19) Total Harbor Volume based upon Depth

Open Calculator

fx $$V = \frac{P}{\alpha_f}$$

ex $$9.142857\text{m}^3 = \frac{32\text{m}^3}{3.5}$$

20) Total Harbor Volume based upon Depth given difference between High and Low Tide Levels

Open Calculator

fx $$V = \frac{P}{\frac{\Delta h}{h'}}$$

ex $$9.142857\text{m}^3 = \frac{32\text{m}^3}{\frac{21\text{m}}{6\text{m}}}$$

21) Total Water Volume Exchanged during entire Tide Period

Open Calculator

fx $$V_w = G \cdot A_E \cdot \sqrt{H^2 \cdot h'}$$

ex $$49.55663\text{m}^3/\text{s} = 0.1 \cdot 61\text{m}^2 \cdot \sqrt{11 \cdot 6\text{m}}$$

22) Velocity in Dry Bed Curve

Open Calculator

fx $$V_{Dbc} = 0.45 \cdot \sqrt{H^2 \cdot [g] \cdot d}$$

ex $$4.433947\text{m/s} = 0.45 \cdot \sqrt{11 \cdot [g] \cdot 0.9\text{m}}$$

23) Water Depth given Velocity in Dry Bed Curve

Open Calculator

fx $$d = \frac{\left(\frac{V_{Dbc}}{0.45}\right)^2}{H^2 \cdot [g]}$$

ex $$0.927015\text{m} = \frac{\left(\frac{4.5\text{m/s}}{0.45}\right)^2}{11 \cdot [g]}$$

Density Influence

24) Density Influence

Open Calculator

fx $$\alpha_D = (V_D - V_f) \cdot \frac{T_D}{2 \cdot L}$$

ex $$6.5 = (25\text{m/s} - 7\text{m/s}) \cdot \frac{130\text{s}}{2 \cdot 180\text{m}}$$

25) Filling Current Velocity given Density Influence

Open Calculator

fx $$V_f = -\left(\left(2 \cdot L \cdot \frac{\alpha_D}{T_D}\right) - V_D\right)$$

ex $$7\text{m/s} = -\left(\left(2 \cdot 180\text{m} \cdot \frac{6.5}{130\text{s}}\right) - 25\text{m/s}\right)$$

26) Length of Harbor given Density Influence

Open Calculator

$$L = (V_D - V_f) \cdot \frac{T_D}{2 \cdot \alpha_D}$$

$$180\text{m} = (25\text{m/s} - 7\text{m/s}) \cdot \frac{130\text{s}}{2 \cdot 6.5}$$

27) Time Interval over which Density Difference exists given Density Influence

Open Calculator

$$T_D = \frac{2 \cdot L \cdot \alpha_D}{V_D - V_f}$$

$$130\text{s} = \frac{2 \cdot 180\text{m} \cdot 6.5}{25\text{m/s} - 7\text{m/s}}$$

Variables Used

- A_E Cross Sectional Area of Entrance *(Square Meter)*
- **d** Water Depth *(Meter)*
- **G** Coefficient for Harbors
- **h'** Average Harbor Depth *(Meter)*
- H^2 Broad Sense Heritability
- **L** Length of Harbor *(Meter)*
- **P** Tidal Prism Filling Bay *(Cubic Meter)*
- T_D Time Interval *(Second)*
- **V** Total Harbor Volume *(Cubic Meter)*
- V_D Density Current Velocity *(Meter per Second)*
- V_{Dbc} Velocity in Dry Bed Curve *(Meter per Second)*
- V_f Filling Current Velocity *(Meter per Second)*
- V_w Total Water Volume *(Cubic Meter per Second)*
- α Ratio of Water Volume
- α_D Density Influence
- α_f Portion caused by Filling
- Δh Difference between High and Low Tide level *(Meter)*
- ρ' Average River Density *(Kilogram per Cubic Meter)*
- ρ_{max} Maximum River Density
- ρ_{min} Minimum River Density

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  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 Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

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