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Shore Protection Formulas

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List of 25 Shore Protection Formulas

Shore Protection

Seawall Trap Ratio

1) Active Sediment Volume given Seawall Trap Ratio

Open Calculator

$$Vs = \frac{V_{WT}}{WTR}$$

$$8.98\text{cm}^3 = \frac{44.9\text{cm}^3}{5}$$

2) Depth of Closure given Volume of Sand per unit Length of Shoreline

Open Calculator

$$D_c = A_F \cdot \left(\frac{V}{\left(\frac{3}{5}\right) \cdot (A_N - A_F)} \right)^{\frac{2}{5}}$$

$$6.269396\text{m} = 0.101 \cdot \left(\frac{255\text{m}^2}{\left(\frac{3}{5}\right) \cdot (0.115 - 0.101)} \right)^{\frac{2}{5}}$$

3) Depth of Closure given Volume per unit Length of Shoreline

Open Calculator

$$D_c = \left(\left(\frac{V}{W} \right) - B \right)$$

$$6\text{m} = \left(\left(\frac{255\text{m}^2}{30\text{m}} \right) - 2.5\text{m} \right)$$

4) Design Berm Elevation given Volume per unit Length of Shoreline

Open Calculator

$$B = \left(\left(\frac{V}{W} \right) - D_c \right)$$

$$2.5\text{m} = \left(\left(\frac{255\text{m}^2}{30\text{m}} \right) - 6\text{m} \right)$$

5) Seawall Trap Ratio

Open Calculator

$$WTR = \frac{V_{WT}}{Vs}$$

$$4.988889 = \frac{44.9\text{cm}^3}{9\text{cm}^3}$$

6) Volume of Sand per unit Length of Shoreline placed before there is any Dry Beach after Equilibrium

Open Calculator

$$V = \left(\frac{3}{5}\right) \cdot \left(\frac{D_c}{A_F}\right)^{\frac{5}{2}} \cdot (A_N - A_F)$$

$$228.483\text{m}^2 = \left(\frac{3}{5}\right) \cdot \left(\frac{6\text{m}}{0.101}\right)^{\frac{5}{2}} \cdot (0.115 - 0.101)$$

7) Volume per unit Length of Shoreline required to produce Beach Width

Open Calculator

$$V = W \cdot (B + D_c)$$

$$255\text{m}^2 = 30\text{m} \cdot (2.5\text{m} + 6\text{m})$$

8) Wall Trap Volume given Seawall Trap Ratio

Open Calculator

$$V_{WT} = WTR \cdot Vs$$

$$45\text{cm}^3 = 5 \cdot 9\text{cm}^3$$

Sediment Transport along Coasts

9) Deepwater Wave Height for Total Transport

Open Calculator

$$H_d = \sqrt{\frac{S'}{1.65 \cdot 10^6}}$$

$$3.481553\text{m} = \sqrt{\frac{2E\hat{}7}{1.65 \cdot 10^6}}$$

10) Refraction Coefficient at Breaker Line given Total Littoral Transport in Breaker Zone in m3 per Year

Open Calculator

$$K_r = \sqrt{\frac{S'}{(0.44 \cdot 10^6) \cdot H_o^2 \cdot C_o \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})}}$$

$$0.100015 = \sqrt{\frac{2E\hat{}7}{(0.44 \cdot 10^6) \cdot (44.94m)^2 \cdot 4.5m/s \cdot \sin(45°) \cdot \cos(45°)}}$$

11) Total Littoral Transport in Entire Breaker Zone in CERC Formula

Open Calculator

$$S = 0.014 \cdot H_d^2 \cdot C_o \cdot K_r^2 \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})$$

$$0.003859 = 0.014 \cdot (3.5m)^2 \cdot 4.5m/s \cdot (0.1)^2 \cdot \sin(45°) \cdot \cos(45°)$$

12) Total Transport given by Galvin

Open Calculator

$$S' = (1.65 \cdot 10^6) \cdot H_d^2$$

$$2E\hat{}7 = (1.65 \cdot 10^6) \cdot (3.5m)^2$$

13) Wave Height in Deepwater for Total Littoral Transport in Breaker Zone in Cubic Meter per Year

Open Calculator

$$H_o = \sqrt{\frac{S'}{(0.44 \cdot 10^6) \cdot C_o \cdot K_r^2 \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})}}$$

$$44.94666m = \sqrt{\frac{2E\hat{}7}{(0.44 \cdot 10^6) \cdot 4.5m/s \cdot (0.1)^2 \cdot \sin(45°) \cdot \cos(45°)}}$$

14) Wave Height in Deepwater given Total Littoral Transport in Entire Breaker Zone in CERC Formula

Open Calculator

$$H_d = \sqrt{\frac{S}{0.014 \cdot C_o \cdot K_r^2 \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})}}$$

$$3.500567m = \sqrt{\frac{0.00386}{0.014 \cdot 4.5m/s \cdot (0.1)^2 \cdot \sin(45°) \cdot \cos(45°)}}$$

15) Wave Speed in Deepwater for Total Littoral Transport in Breaker Zone in Cubic Meter per Year

Open Calculator

$$C_o = \frac{S'}{(0.44 \cdot 10^6) \cdot H_o^2 \cdot K_r^2 \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})}$$

$$4.501333m/s = \frac{2E\hat{}7}{(0.44 \cdot 10^6) \cdot (44.94m)^2 \cdot (0.1)^2 \cdot \sin(45°) \cdot \cos(45°)}$$

16) Wave Speed in Deepwater for Total Littoral Transport in Entire Breaker Zone in CERC Formula

Open Calculator

fx $$C_o = \left(\frac{S}{0.014 \cdot H_d^2 \cdot K_r^2 \cdot \sin(\varphi_{br}) \cdot \cos(\varphi_{br})} \right)$$

ex $$4.501458\text{m/s} = \left(\frac{0.00386}{0.014 \cdot (3.5\text{m})^2 \cdot (0.1)^2 \cdot \sin(45^\circ) \cdot \cos(45^\circ)} \right)$$

SMB Prediction Method

17) Duration of Wind in SMB Prediction Method

Open Calculator

fx $$d = U \cdot 6.5882 \cdot \frac{\exp\left(\left(0.0161 \cdot \left(\ln(\varphi)^2 \right) - 0.3692 \cdot \ln(\varphi) + 2.2024 \right)^{0.5} + 0.8798 \cdot \ln(\varphi) \right)}{[g]}$$

ex $$13.77403\text{s} = 4\text{m/s} \cdot 6.5882 \cdot \frac{\exp\left(\left(0.0161 \cdot \left(\ln(1.22)^2 \right) - 0.3692 \cdot \ln(1.22) + 2.2024 \right)^{0.5} + 0.8798 \cdot \ln(1.22) \right)}{[g]}$$

18) Fetch Length given Fetch Parameter in SMB Prediction Method

Open Calculator

fx $$F_l = \frac{\varphi \cdot U^2}{[g]}$$

ex $$1.990486\text{m} = \frac{1.22 \cdot (4\text{m/s})^2}{[g]}$$

19) Fetch Parameter in SMB Prediction Method

Open Calculator

fx $$\varphi = \frac{[g] \cdot F_l}{U^2}$$

ex $$1.225831 = \frac{[g] \cdot 2\text{m}}{(4\text{m/s})^2}$$

20) Period of Significant Wave in SMB Prediction Method

Open Calculator

$$T_{sig} = \frac{U \cdot 7.540 \cdot \tanh\left(0.077 \cdot \varphi^{0.25}\right)}{[g]}$$

$$0.248339s = \frac{4m/s \cdot 7.540 \cdot \tanh\left(0.077 \cdot (1.22)^{0.25}\right)}{[g]}$$

21) Significant Wave Height in SMB Prediction Method

Open Calculator

$$H_{sig} = \frac{U^2 \cdot 0.283 \cdot \tanh\left(0.0125 \cdot \varphi^{0.42}\right)}{[g]}$$

$$0.006274m = \frac{(4m/s)^2 \cdot 0.283 \cdot \tanh\left(0.0125 \cdot (1.22)^{0.42}\right)}{[g]}$$

22) Wind Speed for Significant Wave Height in SMB Prediction Method

Open Calculator

$$U = \sqrt{[g] \cdot \frac{H_{sig}}{0.283 \cdot \tanh\left(0.0125 \cdot \varphi^{0.42}\right)}}$$

$$4.0083m/s = \sqrt{[g] \cdot \frac{0.0063m}{0.283 \cdot \tanh\left(0.0125 \cdot (1.22)^{0.42}\right)}}$$

23) Wind Speed given Duration of Wind in SMB Prediction Method

Open Calculator

$$U = \frac{[g] \cdot d}{6.5882 \cdot \exp\left(\left(0.0161 \cdot \left(\ln(\varphi)^2\right) - 0.3692 \cdot \ln(\varphi) + 2.2024\right)^{0.5} + 0.8798 \cdot \ln(\varphi)\right)}$$

$$3.99883m/s = \frac{[g] \cdot 13.77s}{6.5882 \cdot \exp\left(\left(0.0161 \cdot \left(\ln(1.22)^2\right) - 0.3692 \cdot \ln(1.22) + 2.2024\right)^{0.5} + 0.8798 \cdot \ln(1.22)\right)}$$

24) Wind Speed given Fetch Parameter in SMB Prediction Method

Open Calculator

fx $$U = \sqrt{[g] \cdot \frac{F_l}{\varphi}}$$

ex $$4.009548\text{m/s} = \sqrt{[g] \cdot \frac{2\text{m}}{1.22}}$$

25) Wind Speed given Period of Significant Wave in SMB Prediction Method

Open Calculator

fx $$U = \frac{[g] \cdot T_{sig}}{7.540 \cdot \tanh\left(0.077 \cdot \varphi^{0.25}\right)}$$

ex $$3.994541\text{m/s} = \frac{[g] \cdot 0.248\text{s}}{7.540 \cdot \tanh\left(0.077 \cdot (1.22)^{0.25}\right)}$$

Variables Used

- A_F Parameter for Fill Sands
- A_N Parameter for Native Sands
- **B** Design Berm Elevation *(Meter)*
- C_o Deepwater Wave Celerity *(Meter per Second)*
- **d** Duration of the Wind *(Second)*
- D_c Depth of Closure *(Meter)*
- F_l Fetch Length *(Meter)*
- H_d Deepwater Wave Height *(Meter)*
- H_o Wave Height in Deep Water *(Meter)*
- H_{sig} Significant Wave Height for SMB Prediction Method *(Meter)*
- K_r Refraction Coefficient
- **S** Total Littoral Transport
- **S'** Total Littoral Transport in cubic meter per year
- T_{sig} Significant Wave Period *(Second)*
- **U** Wind Speed *(Meter per Second)*
- **V** Volume per unit Length of Shoreline *(Square Meter)*
- V_{WT} Wall Trap Volume *(Cubic Centimeter)*
- **Vs** Active Sediment Volume *(Cubic Centimeter)*
- **W** Beach Width *(Meter)*
- **WTR** Seawall Trap Ratio
- **φ** Fetch Parameter
- φ_{br} Angle of Wave Incidence *(Degree)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- 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.
- Function: **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.
- Function: **tanh**, tanh(Number)
  The hyperbolic tangent function (tanh) is a function that is defined as the ratio of the hyperbolic sine function (sinh) to the hyperbolic cosine function (cosh).
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Centimeter (cm^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
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion

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