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Wave Setup Formulas

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List of 20 Wave Setup Formulas

Wave Setup

1) Beach Slope given Nonbreaking Upper Limit of Runup

Open Calculator

fx $$\beta = \frac{\pi}{2} \cdot \left(\frac{R}{H_o} \cdot (2 \cdot \pi)^{0.5} \right)^4$$

ex $$0.765587 = \frac{\pi}{2} \cdot \left(\frac{20\text{m}}{60\text{m}} \cdot (2 \cdot \pi)^{0.5} \right)^4$$

2) Breaker Depth Index given Set-down at Breaker Point at Still-Water Shoreline

Open Calculator

fx $$\gamma_b = \sqrt{\frac{8}{3} \cdot \left(\left(\frac{d_b}{\eta_s - \eta_b} \right) - 1 \right)}$$

ex $$0.335694 = \sqrt{\frac{8}{3} \cdot \left(\left(\frac{55\text{m}}{53.0\text{m} - 0.23\text{m}} \right) - 1 \right)}$$

3) Cross-Shore Component of Cross-Shore directed Radiation Stress

Open Calculator

fx $$S_{xx'} = \left(\frac{3}{16} \right) \cdot \rho_{water} \cdot [g] \cdot d \cdot H^2$$

ex $$17376.16 = \left(\frac{3}{16} \right) \cdot 1000\text{kg/m}^3 \cdot [g] \cdot 1.05\text{m} \cdot (3\text{m})^2$$

4) Deepwater Wave Height given Nonbreaking Upper Limit of Runup on Uniform Slope

Open Calculator

fx $$H_d = \frac{R}{(2 \cdot \pi)^{0.5} \cdot \left(\frac{\pi}{2} \cdot \beta\right)^{\frac{1}{4}}}$$

ex $$7.633201\text{m} = \frac{20\text{m}}{(2 \cdot \pi)^{0.5} \cdot \left(\frac{\pi}{2} \cdot 0.76\right)^{\frac{1}{4}}}$$

5) Deepwater Wave Height given Wave Runup above Mean Water Level

Open Calculator

fx $$H_d = \frac{R}{\varepsilon_{o'}}$$

ex $$6.024096\text{m} = \frac{20\text{m}}{3.32}$$

6) Mean Water Surface Elevation given Total Water Depth

Open Calculator

fx $$\eta' = H_c - h$$

ex $$29\text{m} = 49\text{m} - 20.0\text{m}$$

7) Nonbreaking Upper Limit of Runup on Uniform Slope

Open Calculator

fx $$R = H_d \cdot (2 \cdot \pi)^{0.5} \cdot \left(\frac{\pi}{2 \cdot \beta}\right)^{\frac{1}{4}}$$

ex $$18.03299\text{m} = 6.0\text{m} \cdot (2 \cdot \pi)^{0.5} \cdot \left(\frac{\pi}{2 \cdot 0.76}\right)^{\frac{1}{4}}$$

8) Set down for Regular Waves

Open Calculator

fx $$\eta'_o = \left(-\frac{1}{8}\right) \cdot \left(\frac{H^2 \cdot \left(2 \cdot \frac{\pi}{\lambda}\right)}{\sinh\left(4 \cdot \pi \cdot \frac{d}{\lambda}\right)}\right)$$

ex $$-0.514668\text{m} = \left(-\frac{1}{8}\right) \cdot \left(\frac{(3\text{m})^2 \cdot \left(2 \cdot \frac{\pi}{26.8\text{m}}\right)}{\sinh\left(4 \cdot \pi \cdot \frac{1.05\text{m}}{26.8\text{m}}\right)}\right)$$

9) Setdown at Breaker Point at Still-Water Shoreline

Open Calculator

fx $$\eta_b = \eta_s - \left(\frac{1}{1 + \left(\frac{8}{3 \cdot \Upsilon_{b'}^2}\right)}\right) \cdot d_b$$

ex $$0.24829\text{m} = 53.0\text{m} - \left(\frac{1}{1 + \left(\frac{8}{3 \cdot (7.91)^2}\right)}\right) \cdot 55\text{m}$$

10) Setup at Mean Shoreline

Open Calculator

fx $$\eta'_{max} = \eta_s + (d\eta' dx \cdot \Delta_x)$$

ex $$53.67764 = 53.0\text{m} + (0.012 \cdot 56.47)$$

11) Setup at Still-Water Shoreline

Open Calculator

fx $$\eta_s = \eta_b + \left(\frac{1}{1 + \left(\frac{8}{3 \cdot \Upsilon_{b'}^2} \right)} \right) \cdot d_b$$

ex $$52.98171\text{m} = 0.23\text{m} + \left(\frac{1}{1 + \left(\frac{8}{3 \cdot (7.91)^2} \right)} \right) \cdot 55\text{m}$$

12) Shoreward Displacement of Shoreline

Open Calculator

fx $$\Delta_x = \frac{\eta_s}{\tan(\beta) - d\eta'dx}$$

ex $$56.47602 = \frac{53.0\text{m}}{\tan(0.76) - 0.012}$$

13) Still Water Depth given Total Water Depth

Open Calculator

fx $$h = H_c - \eta'$$

ex $$20\text{m} = 49\text{m} - 29\text{m}$$

14) Surf Similarity Parameter given Wave Runup above Mean Water Level

Open Calculator

$$\varepsilon_{o'} = \frac{R}{H_d}$$

$$3.333333 = \frac{20\text{m}}{6.0\text{m}}$$

15) Total Water Depth

Open Calculator

$$H_c = h + \eta'$$

$$49\text{m} = 20.0\text{m} + 29\text{m}$$

16) Water Depth at Breaking given Setdown at Breaker Point at Still-Water Shoreline

Open Calculator

$$d_b = \frac{\eta_s - \eta_b}{\frac{1}{1+\left(\frac{8}{3\cdot\Upsilon_{b'}^2}\right)}}$$

$$55.01907\text{m} = \frac{53.0\text{m} - 0.23\text{m}}{\frac{1}{1+\left(\frac{8}{3\cdot(7.91)^2}\right)}}$$

17) Water Depth given Cross Shore Component

Open Calculator

$$d = \frac{S_{xx'}}{\left(\frac{3}{16}\right) \cdot \rho_{water} \cdot [g] \cdot H^2}$$

$$1.04999\text{m} = \frac{17376}{\left(\frac{3}{16}\right) \cdot 1000\text{kg/m}^3 \cdot [g] \cdot (3\text{m})^2}$$

18) Wave Height given Cross-Shore Component

Open Calculator

$$H = \sqrt{\frac{16 \cdot S_{xx'}}{3 \cdot \rho_{water} \cdot [g] \cdot d}}$$

$$2.999986\text{m} = \sqrt{\frac{16 \cdot 17376}{3 \cdot 1000\text{kg/m}^3 \cdot [g] \cdot 1.05\text{m}}}$$

19) Wave Height given Mean Water Surface Elevation Set down for Regular Waves

Open Calculator

$$H = \sqrt{\eta'_o \cdot 8 \cdot \frac{\sinh\left(4 \cdot \pi \cdot \frac{d}{\lambda}\right)}{2 \cdot \frac{\pi}{\lambda}}}$$

$$2.986363\text{m} = \sqrt{0.51\text{m} \cdot 8 \cdot \frac{\sinh\left(4 \cdot \pi \cdot \frac{1.05\text{m}}{26.8\text{m}}\right)}{2 \cdot \frac{\pi}{26.8\text{m}}}}$$

20) Wave Runup above Mean Water Level

Open Calculator

fx $$R = H_d \cdot \varepsilon_{o'}$$

ex $$19.92\text{m} = 6.0\text{m} \cdot 3.32$$

Variables Used

- **d** Water Depth *(Meter)*
- d_b Water Depth at Breaking *(Meter)*
- **dη'dx** Cross-Shore Balance Momentum
- **h** Still-Water Depth *(Meter)*
- **H** Wave Height *(Meter)*
- H_c Coastal Water Depth *(Meter)*
- H_d Deepwater Wave Height *(Meter)*
- H_o Deepwater Wave Height of Ocean *(Meter)*
- **R** Wave Runup *(Meter)*
- $S_{xx'}$ Coastal Cross-Shore Component
- **β** Beach Slope
- γ_b Breaker Depth Index
- Δ_x Shoreward Displacement of the Shoreline
- $\varepsilon_{o'}$ Deepwater Surf Similarity Parameter
- **η'** Mean Water Surface Elevation *(Meter)*
- η_b Set Down at the Breaker Point *(Meter)*
- η'_{max} Setup at the Mean Shoreline
- η'_o Mean Water Surface Elevation of Coast *(Meter)*
- η_s Setup at the Still-Water Shore Line *(Meter)*
- **λ** Wavelength of Coast *(Meter)*
- ρ_{water} Water Density *(Kilogram per Cubic Meter)*
- $Y_{b'}$ Coastal Breaker Depth Index

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **sinh**, sinh(Number)
  The hyperbolic sine function, also known as the sinh function, is a mathematical function that is defined as the hyperbolic analogue of the sine function.
- 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: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

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- **Methods to Predict Channel Shoaling Formulas**
- **Nearshore Currents Formulas**
- **Wave Setup Formulas**

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