Important Solitary Wave Formulas PDF

Formulas
Examples
with Units

List of 17
Important Solitary Wave Formulas

1) Celerity of Solitary Wave Formula

Evaluate Formula

Formula

$$C = \sqrt{[g] \cdot \left(H_w + D_w \right)}$$

Example with Units

$$24.0539\,\text{m/s} = \sqrt{9.8066\,\text{m/s}^2 \cdot \left(14\,\text{m} + 45\,\text{m} \right)}$$

2) Elevation above Bottom given Pressure Beneath Solitary Wave Formula

Evaluate Formula

Formula

$$y = y_s - \left(\frac{p}{\rho_s \cdot [g]} \right)$$

Example with Units

$$4.92\,\text{m} = 5 - \left(\frac{804.1453\,\text{Pa}}{1025\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2} \right)$$

3) Empirical Relationship between Slope and Breaker Height-to-Water Depth Ratio Formula

Evaluate Formula

Formula

$$HD_{ratio} = 0.75 + \left(25 \cdot \text{m} \right) - \left(112 \cdot \text{m}^2 \right) + \left(3870 \cdot \text{m}^3 \right)$$

Example

$$1.2362 = 0.75 + \left(25 \cdot 0.02 \right) - \left(112 \cdot 0.02^2 \right) + \left(3870 \cdot 0.02^3 \right)$$

4) Maximum Velocity of Solitary Wave Formula

Evaluate Formula

Formula

$$u_{max} = \frac{C \cdot N}{1 + \cos\left(M \cdot \frac{y}{D_w} \right)}$$

Example with Units

$$6.024\,\text{m/s} = \frac{24.05\,\text{m/s} \cdot 0.5}{1 + \cos\left(0.8 \cdot \frac{4.92\,\text{m}}{45\,\text{m}} \right)}$$

5) Pressure Beneath Solitary Wave Formula

Evaluate Formula

Formula

$$p = \rho_s \cdot [g] \cdot \left(y_s - y \right)$$

Example with Units

$$804.1453\,\text{Pa} = 1025\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot \left(5 - 4.92\,\text{m} \right)$$

6) Total Wave Energy per Unit Crest Width of Solitary Wave Formula

Evaluate Formula

Formula

$$E = \left(\frac{8}{3\cdot\sqrt{3}}\right)\cdot\rho_s\cdot[g]\cdot H_w^{\frac{3}{2}}\cdot D_w^{\frac{3}{2}}$$

Example with Units

$$2.4E{+}8\,\text{J/m} = \left(\frac{8}{3\cdot\sqrt{3}}\right)\cdot 1025\,\text{kg/m}^3\cdot 9.8066\,\text{m/s}^2\cdot 14\,\text{m}^{\frac{3}{2}}\cdot 45\,\text{m}^{\frac{3}{2}}$$

7) Volume of Water above Still Water Level per Unit Crest Width Formula

Evaluate Formula

Formula

$$V = \left(\left(\frac{16}{3}\right)\cdot D_w^{\,3}\cdot H_w\right)^{0.5}$$

Example with Units

$$2608.4478\,\text{m}^2 = \left(\left(\frac{16}{3}\right)\cdot 45\,\text{m}^{\,3}\cdot 14\,\text{m}\right)^{0.5}$$

8) Water Depth given Celerity of Solitary Wave Formula

Evaluate Formula

Formula

$$D_w = \left(\frac{C^2}{[g]}\right) - H_w$$

Example with Units

$$44.9806\,\text{m} = \left(\frac{24.05\,\text{m/s}^{\,2}}{9.8066\,\text{m/s}^2}\right) - 14\,\text{m}$$

9) Water Depth given Total Wave Energy per Unit Crest Width of Solitary Wave Formula

Evaluate Formula

Formula

$$D_w = \left(\frac{E}{\left(\frac{8}{3\cdot\sqrt{3}}\right)\cdot\rho_s\cdot[g]\cdot H_w^{\frac{3}{2}}}\right)^{\frac{2}{3}}$$

Example with Units

$$44.4199\,\text{m} = \left(\frac{2.4E{+}8\,\text{J/m}}{\left(\frac{8}{3\cdot\sqrt{3}}\right)\cdot 1025\,\text{kg/m}^3\cdot 9.8066\,\text{m/s}^2\cdot 14\,\text{m}^{\frac{3}{2}}}\right)^{\frac{2}{3}}$$

10) Water Depth given Volume of Water within Wave above Still Water Level Formula

Evaluate Formula

Formula

$$D_w = \left(\frac{(V)^2}{\left(\frac{16}{3}\right)\cdot H_w}\right)^{\frac{1}{3}}$$

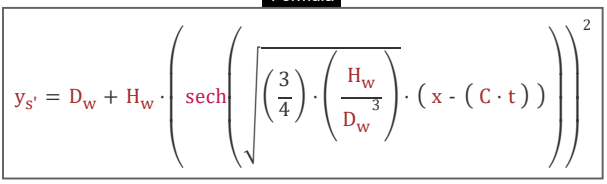
Example with Units

$$45\,\text{m} = \left(\frac{(2608.448\,\text{m}^2)^{\,2}}{\left(\frac{16}{3}\right)\cdot 14\,\text{m}}\right)^{\frac{1}{3}}$$

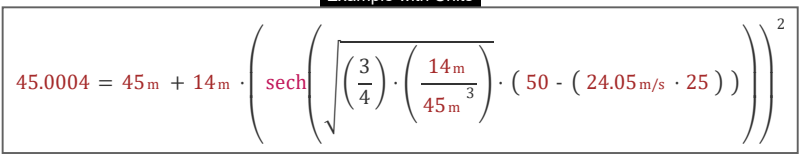
11) Water Surface above Bottom Formula

Evaluate Formula

Formula



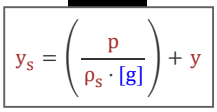
Example with Units



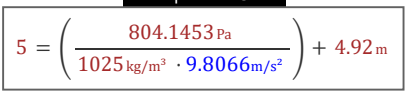
12) Water Surface above Bottom given Pressure Beneath Solitary Wave Formula

Evaluate Formula

Formula



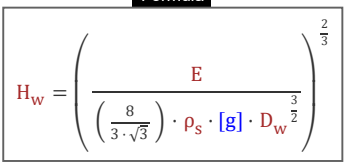
Example with Units



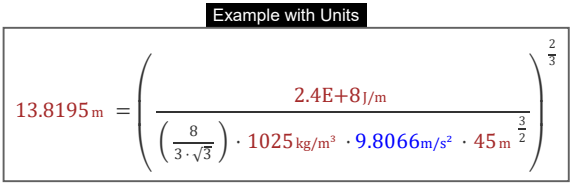
13) Wave Height for Total Wave Energy per Unit Crest Width of Solitary Wave Formula

Evaluate Formula

Formula



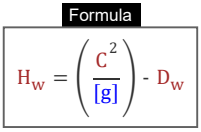
Example with Units



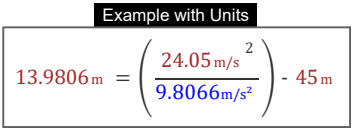
14) Wave Height given Celerity of Solitary Wave Formula

Evaluate Formula

Formula



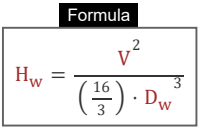
Example with Units



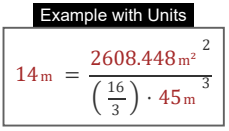
15) Wave Height given Volume of Water within Wave above Still Water Level Formula

Evaluate Formula

Formula



Example with Units



16) Wave Height of Unbroken Wave in Water of Finite Depth Formula

Evaluate Formula

Formula

$$H_w = D_w \cdot \left(\frac{\left(0.141063 \cdot \left(\frac{L}{D_w}\right)\right) + \left(0.0095721 \cdot \left(\frac{L}{D_w}\right)^2\right) + \left(0.0077829 \cdot \left(\frac{L}{D_w}\right)^3\right)}{1 + \left(0.078834 \cdot \left(\frac{L}{D_w}\right)\right) + \left(0.0317567 \cdot \left(\frac{L}{D_w}\right)^2\right) + \left(0.0093407 \cdot \left(\frac{L}{D_w}\right)^3\right)} \right) \cdot a_s$$

Example with Units

$$14.0103\,\text{m} = 45\,\text{m} \cdot \left(\frac{\left(0.141063 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)\right) + \left(0.0095721 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)^2\right) + \left(0.0077829 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)^3\right)}{1 + \left(0.078834 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)\right) + \left(0.0317567 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)^2\right) + \left(0.0093407 \cdot \left(\frac{90\,\text{m}}{45\,\text{m}}\right)^3\right)} \right) \cdot 1.106\,\text{m}$$

17) Wavelength of Regions of Validity Stokes and Cnoidal Wave Theory Formula

Evaluate Formula

Formula

$$L_w = D_w \cdot \left(21.5 \cdot \exp\left(-1.87 \cdot \left(\frac{H_w}{D_w}\right)\right)\right)$$

Example with Units

$$540.7395\,\text{m} = 45\,\text{m} \cdot \left(21.5 \cdot \exp\left(-1.87 \cdot \left(\frac{14\,\text{m}}{45\,\text{m}}\right)\right)\right)$$

Variables used in list of Solitary Wave Formulas above

- a_s Solitary Wave Amplitude *(Meter)*
- **C** Celerity of the Wave *(Meter per Second)*
- D_w Water Depth from Bed *(Meter)*
- **E** Total Wave Energy per Unit Crest Width *(Joule per Meter)*
- H_w Height of the Wave *(Meter)*
- HD_{ratio} Breaker Height-to-Water Depth Ratio
- **L** Length of Water Wave *(Meter)*
- L_w Water Wave Length *(Meter)*
- **m** Wave Slope
- **M** Function of Wave Height
- **N** Function of H/d as N
- **p** Pressure Under Wave *(Pascal)*
- **t** Temporal (Progressive Wave)
- u_{max} Maximum Velocity of Solitary Wave *(Meter per Second)*
- **V** Volume of Water per Unit Crest Width *(Square Meter)*
- **x** Spatial (Progressive Wave)
- **y** Elevation above the Bottom *(Meter)*
- y_s Ordinate of the Water Surface
- $y_{s'}$ Water Surface Ordinate
- ρ_s Density of Salt Water *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Solitary Wave Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: **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.
- Functions: **sech**, sech(Number)
  The hyperbolic secant function is a hyperbolic function that is the reciprocal of the hyperbolic cosine function.
- 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: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Energy per Unit Length** in Joule per Meter (J/m)
  Energy per Unit Length Unit Conversion

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