Important Wave Prediction Formulas PDF

Formulas
Examples
with Units

List of 15
Important Wave Prediction Formulas

1) Predicting Waves in Deep Water Formulas

1.1) Significant Wave Height from Bretschneider Empirical Relationships Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0527\,\text{m} = \frac{25\,\text{m/s}^2 \cdot 0.283 \cdot \tanh\left(0.0125 \cdot \left(\frac{9.8066\,\text{m/s}^2 \cdot 2\,\text{m}}{25\,\text{m/s}^2}\right)^{0.42}\right)}{9.8066\,\text{m/s}^2}$$

1.2) Significant Wave Period from Bretschneider Empirical Relationships Formula

Evaluate Formula

Formula

$$T = \frac{U \cdot 7.54 \cdot \tanh\left(0.077 \cdot \left(\frac{[g] \cdot F_l}{U^2}\right)^{0.25}\right)}{[g]}$$

Example with Units

$$0.6227\,\text{s} = \frac{25\,\text{m/s} \cdot 7.54 \cdot \tanh\left(0.077 \cdot \left(\frac{9.8066\,\text{m/s}^2 \cdot 2\,\text{m}}{25\,\text{m/s}^2}\right)^{0.25}\right)}{9.8066\,\text{m/s}^2}$$

1.3) Water Depth given Wavelength, Wave Period and Wave Number Formula

Evaluate Formula

Formula

$$d = \frac{a\tanh\left(\frac{L \cdot \omega}{[g] \cdot T}\right)}{k}$$

Example with Units

$$2.1575\,\text{m} = \frac{a\tanh\left(\frac{0.4\,\text{m} \cdot 6.2\,\text{rad/s}}{9.8066\,\text{m/s}^2 \cdot 0.622\,\text{s}}\right)}{0.2}$$

1.4) Wave Number given Wavelength, Wave Period and Water Depth Formula

Evaluate Formula

Formula

$$k = \frac{atanh\left(\frac{L \cdot \omega}{[g] \cdot T}\right)}{d}$$

Example with Units

$$0.2007 = \frac{atanh\left(\frac{0.4\,m \cdot 6.2\,rad/s}{9.8066\,m/s^2 \cdot 0.622\,s}\right)}{2.15\,m}$$

2) Wave Statistics Relationships Formulas

2.1) Average of Waves based upon Rayleigh Distribution Formula

Evaluate Formula

Formula

$$H' = 0.886 \cdot H_{rms}$$

Example with Units

$$39.87 = 0.886 \cdot 45\,m$$

2.2) Average of Waves given Significant Wave Height Formula

Evaluate Formula

Formula

$$H' = \frac{H_s}{1.596}$$

Example with Units

$$40.7268 = \frac{65\,m}{1.596}$$

2.3) Probability of Exceedance of Wave Height Formula

Evaluate Formula

Formula

$$P_H = \left(e^{-2}\right) \cdot \left(\frac{H}{H_s}\right)^2$$

Example with Units

$$0.205 = \left(e^{-2}\right) \cdot \left(\frac{80\,m}{65\,m}\right)^2$$

2.4) Root Mean Square Wave Height Formula

Evaluate Formula

Formula

$$H_{rms} = \frac{\sigma_H}{0.463}$$

Example with Units

$$49.676\,m = \frac{23}{0.463}$$

2.5) Root Mean Square Wave Height given Average of Waves based upon Rayleigh Distribution Formula

Evaluate Formula

Formula

$$H_{rms} = \frac{H'}{0.886}$$

Example with Units

$$45.1467\,m = \frac{40}{0.886}$$

2.6) Root Mean Square Wave Height given Significant Wave Height based on Rayleigh Distribution Formula

Evaluate Formula

Formula

$$H_{rms} = \frac{H_s}{1.414}$$

Example with Units

$$45.9689\,m = \frac{65\,m}{1.414}$$

2.7) Significant Wave Height given Average of Waves Formula

Evaluate Formula

Formula

$$H_s = 1.596 \cdot H'$$

Example with Units

$$63.84\,\text{m} = 1.596 \cdot 40$$

2.8) Significant Wave Height of Record based upon Rayleigh Distribution Formula

Evaluate Formula

Formula

$$H_s = 1.414 \cdot H_{rms}$$

Example with Units

$$63.63\,\text{m} = 1.414 \cdot 45\,\text{m}$$

2.9) Significant Wave Height of Record for Probability of Exceedance Formula

Evaluate Formula

Formula

$$H_s = \frac{H}{\left(\frac{P_H}{e^{-2}}\right)^{0.5}}$$

Example with Units

$$65.0008\,\text{m} = \frac{80\,\text{m}}{\left(\frac{0.205}{e^{-2}}\right)^{0.5}}$$

2.10) Standard Deviation of Wave Height Formula

Evaluate Formula

Formula

$$\sigma_H = 0.463 \cdot H_{rms}$$

Example with Units

$$20.835 = 0.463 \cdot 45\,\text{m}$$

2.11) Wave Height of Record for Probability of Exceedance Formula

Evaluate Formula

Formula

$$H = H_s \cdot \left(\frac{P_H}{e^{-2}}\right)^{0.5}$$

Example with Units

$$79.999\,\text{m} = 65\,\text{m} \cdot \left(\frac{0.205}{e^{-2}}\right)^{0.5}$$

Variables used in list of Wave Prediction Formulas above

- **d** Water Depth *(Meter)*
- F_l Fetch Length *(Meter)*
- **H** Wave Height *(Meter)*
- **H'** Average of All Waves
- H_{dw} Wave Height for Deep Water *(Meter)*
- H_{rms} Root Mean Square Wave Height *(Meter)*
- H_s Significant Wave Height *(Meter)*
- **k** Wave Number for Water Wave
- **L** Wavelength *(Meter)*
- P_H Probability of Exceedance of Wave Height
- **T** Wave Period *(Second)*
- **U** Wind Speed *(Meter per Second)*
- σ_H Standard Deviation of Wave Height
- **ω** Wave Angular Frequency *(Radian per Second)*

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

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- constant(s): **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Functions: **atanh**, atanh(Number)
  The inverse hyperbolic tangent function returns the value whose hyperbolic tangent is a number.
- Functions: **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: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

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