# Important Non-Linear Wave Theory Formulas PDF

Formulas
Examples
with Units

## List of 14
### Important Non-Linear Wave Theory Formulas

### 1) First Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$U_h = C_f - v$$

Example with Units

$$14\,\text{m/s} = 64\,\text{m/s} - 50\,\text{m/s}$$

### 2) Mean Depth given Second Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$d = \frac{V_{rate}}{C_f - U_h}$$

Example with Units

$$10\,\text{m} = \frac{500\,\text{m}^3/\text{s}}{64\,\text{m/s} - 14\,\text{m/s}}$$

### 3) Mean Depth given Ursell Number Formula

Evaluate Formula

Formula

$$d = \left(\frac{H_w \cdot \lambda_o^2}{U}\right)^{\frac{1}{3}}$$

Example with Units

$$10\,\text{m} = \left(\frac{3\,\text{m} \cdot 7\,\text{m}^2}{0.147}\right)^{\frac{1}{3}}$$

### 4) Mean Depth in Stokes' Second Approximation to Wave Speed if there is no Mass Transport Formula

Evaluate Formula

Formula

$$d = \frac{V_{rate}}{v}$$

Example with Units

$$10\,\text{m} = \frac{500\,\text{m}^3/\text{s}}{50\,\text{m/s}}$$

## 5) Relative Height of Highest Wave as Function of Wavelength Obtained by Fenton Formula

Evaluate Formula

Formula

$$Hmd = \frac{0.141063 \cdot \left(\frac{\lambda_o}{d}\right) + 0.0095721 \cdot \left(\frac{\lambda_o}{d}\right)^2 + 0.0077829 \cdot \left(\frac{\lambda_o}{d}\right)^3}{1 + 0.078834 \cdot \left(\frac{\lambda_o}{d}\right) + 0.0317567 \cdot \left(\frac{\lambda_o}{d}\right)^2 + 0.0093407 \cdot \left(\frac{\lambda_o}{d}\right)^3}$$

Example with Units

$$0.0988 = \frac{0.141063 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right) + 0.0095721 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right)^2 + 0.0077829 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right)^3}{1 + 0.078834 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right) + 0.0317567 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right)^2 + 0.0093407 \cdot \left(\frac{7\,\text{m}}{10\,\text{m}}\right)^3}$$

## 6) Second Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$U_h = C_f - \left(\frac{V_{rate}}{d}\right)$$

Example with Units

$$14\,\text{m/s} = 64\,\text{m/s} - \left(\frac{500\,\text{m}^3\text{/s}}{10\,\text{m}}\right)$$

## 7) Stokes' Second Approximation to Wave Speed if there is no Mass Transport Formula

Evaluate Formula

Formula

$$v = \frac{V_{rate}}{d}$$

Example with Units

$$50\,\text{m/s} = \frac{500\,\text{m}^3\text{/s}}{10\,\text{m}}$$

## 8) Ursell Number Formula

Evaluate Formula

Formula

$$U = \frac{H_w \cdot \lambda_o^2}{d^3}$$

Example with Units

$$0.147 = \frac{3\,\text{m} \cdot 7\,\text{m}^2}{10\,\text{m}^3}$$

## 9) Volume Flow Rate in Stokes' Second Approximation to Wave Speed if there is no Mass Transport Formula

Evaluate Formula

Formula

$$V_{rate} = v \cdot d$$

Example with Units

$$500\,\text{m}^3\text{/s} = 50\,\text{m/s} \cdot 10\,\text{m}$$

## 10) Volume Flow Rate per unit Span Underneath Waves given Second Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$V_{rate} = d \cdot \left(C_f - U_h\right)$$

Example with Units

$$500\,\text{m}^3\text{/s} = 10\,\text{m} \cdot \left(64\,\text{m/s} - 14\,\text{m/s}\right)$$

## 11) Wave Height given Ursell Number Formula

Evaluate Formula

Formula

$$H_w = \frac{U \cdot d^3}{\lambda_o^2}$$

Example with Units

$$3\,\text{m} = \frac{0.147 \cdot 10\,\text{m}^3}{7\,\text{m}^2}$$

## 12) Wave Speed given First Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$v = C_f - U_h$$

Example with Units

$$50\,\text{m/s} = 64\,\text{m/s} - 14\,\text{m/s}$$

## 13) Wave Speed given Second Type of Mean Fluid Speed Formula

Evaluate Formula

Formula

$$C_f = U_h + \left(\frac{V_{rate}}{d}\right)$$

Example with Units

$$64\,\text{m/s} = 14\,\text{m/s} + \left(\frac{500\,\text{m}^3/\text{s}}{10\,\text{m}}\right)$$

## 14) Wavelength given Ursell Number Formula

Evaluate Formula

Formula

$$\lambda_o = \left(\frac{U \cdot d^3}{H_w}\right)^{0.5}$$

Example with Units

$$7\,\text{m} = \left(\frac{0.147 \cdot 10\,\text{m}^3}{3\,\text{m}}\right)^{0.5}$$

## Variables used in list of Non-Linear Wave Theory Formulas above

- $C_f$ Fluid Stream Velocity *(Meter per Second)*
- **d** Coastal Mean Depth *(Meter)*
- $H_w$ Wave Height for Surface Gravity Waves *(Meter)*
- **Hmd** Relative Height as a function of Wavelength
- **U** Ursell Number
- $U_h$ Mean Horizontal Fluid Velocity *(Meter per Second)*
- **v** Wave Speed *(Meter per Second)*
- $V_{rate}$ Rate of Volume Flow *(Cubic Meter per Second)*
- $\lambda_o$ Deep-Water Wavelength *(Meter)*

## Constants, Functions, Measurements used in list of Non-Linear Wave Theory Formulas above

- Measurement: **Length** in Meter (m)
  *Length Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second ($m^3/s$)
  *Volumetric Flow Rate Unit Conversion*

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