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Non-Linear Wave Theory Formulas

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List of 14 Non-Linear Wave Theory Formulas

Non-Linear Wave Theory

1) First Type of Mean Fluid Speed

fx $$U_h = C_f - v$$

Open Calculator

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

2) Mean Depth given Second Type of Mean Fluid Speed

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

Open Calculator

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

3) Mean Depth given Ursell Number

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

Open Calculator

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

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

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

Open Calculator

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

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

Open Calculator

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

ex
$$0.098798 = \frac{0.141063 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right) + 0.0095721 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right)^2 + 0.0077829 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right)^3}{1 + 0.078834 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right) + 0.0317567 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right)^2 + 0.0093407 \cdot \left(\frac{7\mathrm{m}}{10\mathrm{m}}\right)^3}$$

6) Second Type of Mean Fluid Speed

Open Calculator

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

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

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

Open Calculator

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

ex
$$50\mathrm{m/s} = \frac{500\mathrm{m^3/s}}{10\mathrm{m}}$$

8) Ursell Number

Open Calculator

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

ex
$$0.147 = \frac{3\mathrm{m} \cdot (7\mathrm{m})^2}{(10\mathrm{m})^3}$$

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

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

Open Calculator

ex $500m^3/s = 50m/s \cdot 10m$

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

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

Open Calculator

ex $500m^3/s = 10m \cdot (64m/s - 14m/s)$

11) Wave Height given Ursell Number

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

Open Calculator

ex $3m = \frac{0.147 \cdot (10m)^3}{(7m)^2}$

12) Wave Speed given First Type of Mean Fluid Speed

fx $v = C_f - U_h$

Open Calculator

ex $50m/s = 64m/s - 14m/s$

13) Wave Speed given Second Type of Mean Fluid Speed

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

Open Calculator

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

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14) Wavelength given Ursell Number

Open Calculator

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

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

Variables Used

- **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)*
- **λ_o** Deep-Water Wavelength *(Meter)*

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Constants, Functions, Measurements used

- 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

Check other formula lists

- Group Velocity, Beats, Energy Transport Formulas
- Linear Dispersion Relation of Linear Wave Formulas
- Non-Linear Wave Theory Formulas
- Shoaling, Refraction and Breaking Formulas

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5/17/2024 | 6:14:48 AM UTC

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