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Linear Dispersion Relation of Linear Wave Formulas

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List of 12 Linear Dispersion Relation of Linear Wave Formulas

Linear Dispersion Relation of Linear Wave

1) Angular Frequency of Wave

Open Calculator

fx $\omega_c = \sqrt{[g] \cdot k \cdot \tanh(k \cdot d)}$

ex $1.375055\text{rad/s} = \sqrt{[g] \cdot 0.2 \cdot \tanh(0.2 \cdot 10\text{m})}$

2) Dimensionless Wave Speed

Open Calculator

fx $v = \frac{v_{p'}}{\sqrt{[g] \cdot d}}$

ex $50.00579\text{m/s} = \frac{495.2\text{m/s}}{\sqrt{[g] \cdot 10\text{m}}}$

3) Guo Formula of Linear Dispersion Relation

Open Calculator

$$kd = \left(\omega^2 \cdot \frac{d}{[g]}\right) \cdot \left(1 - \exp\left(-\left(\omega \cdot \sqrt{\frac{d}{[g]}^{\frac{5}{2}}}\right)^{-\frac{2}{5}}\right)\right)$$

ex

$$14.87764 = \left((6.2\text{rad/s})^2 \cdot \frac{10\text{m}}{[g]}\right) \cdot \left(1 - \exp\left(-\left(6.2\text{rad/s} \cdot \sqrt{\frac{10\text{m}}{[g]}^{\frac{5}{2}}}\right)^{-\frac{2}{5}}\right)\right)$$

4) Guo Formula of Linear Dispersion Relation for Wave Number

Open Calculator

$$k = \left(\frac{\omega_c^2 \cdot d}{[g]}\right) \cdot \frac{1 - \exp\left(-\left(\omega_c \cdot \sqrt{\frac{d}{[g]}^{\frac{5}{2}}}\right)^{-\frac{2}{5}}\right)}{d}$$

ex

$$0.222819 = \left(\frac{(2.04\text{rad/s})^2 \cdot 10\text{m}}{[g]}\right) \cdot \frac{1 - \exp\left(-\left(2.04\text{rad/s} \cdot \sqrt{\frac{10\text{m}}{[g]}^{\frac{5}{2}}}\right)^{-\frac{2}{5}}\right)}{10\text{m}}$$

5) Radian Frequency of Waves

Open Calculator

$$\omega = 2 \cdot \frac{\pi}{T}$$

ex $$6.202552\text{rad/s} = 2 \cdot \frac{\pi}{1.013}$$

6) Relative Wavelength

Open Calculator

$$\lambda_r = \frac{\lambda_o}{d}$$

$$0.7\text{m} = \frac{7\text{m}}{10\text{m}}$$

7) Velocity of Propagation in Linear Dispersion Relation

Open Calculator

$$C_v = \sqrt{\frac{[g] \cdot d \cdot \tanh(k \cdot d)}{k \cdot d}}$$

$$6.875275\text{m/s} = \sqrt{\frac{[g] \cdot 10\text{m} \cdot \tanh(0.2 \cdot 10\text{m})}{0.2 \cdot 10\text{m}}}$$

8) Velocity of Propagation in Linear Dispersion Relation given Wavelength

Open Calculator

$$C_v = \sqrt{\frac{[g] \cdot d \cdot \tanh\left(2 \cdot \pi \cdot \frac{d}{\lambda''}\right)}{2 \cdot \pi \cdot \frac{d}{\lambda''}}}$$

$$6.873787\text{m/s} = \sqrt{\frac{[g] \cdot 10\text{m} \cdot \tanh\left(2 \cdot \pi \cdot \frac{10\text{m}}{31.4\text{m}}\right)}{2 \cdot \pi \cdot \frac{10\text{m}}{31.4\text{m}}}}$$

9) Wave Number for Steady Two-dimensional Waves

Open Calculator

$$k = \frac{2 \cdot \pi}{\lambda''}$$

$$0.200101 = \frac{2 \cdot \pi}{31.4\text{m}}$$

10) Wave Number of Convenient Empirical Explicit Approximation

Open Calculator

fx $$k = \left(\frac{\omega_c^2}{[g]}\right) \cdot \left(\coth\left(\left(\omega_c \cdot \sqrt{\frac{d}{[g]}^{\frac{3}{2}}}\right)^{\frac{2}{3}}\right)\right)$$

ex $$0.458653 = \left(\frac{(2.04\text{rad/s})^2}{[g]}\right) \cdot \left(\coth\left(\left(2.04\text{rad/s} \cdot \sqrt{\frac{10\text{m}}{[g]}^{\frac{3}{2}}}\right)^{\frac{2}{3}}\right)\right)$$

11) Wave Period given Radian Frequency of Waves

Open Calculator

fx $$T = 2 \cdot \frac{\pi}{\omega}$$

ex $$1.013417 = 2 \cdot \frac{\pi}{6.2\text{rad/s}}$$

12) Wavelength given Wave Number

Open Calculator

fx $$\lambda'' = \frac{2 \cdot \pi}{k}$$

ex $$31.41593\text{m} = \frac{2 \cdot \pi}{0.2}$$

Variables Used

- C_v Velocity of Propagation *(Meter per Second)*
- **d** Coastal Mean Depth *(Meter)*
- **k** Wave Number for Water Wave
- **kd** Linear Dispersion Relation
- **T** Wave Period
- **v** Wave Speed *(Meter per Second)*
- $v_{p'}$ Propagation Velocity *(Meter per Second)*
- λ_o Deep-Water Wavelength *(Meter)*
- λ_r Relative Wavelength *(Meter)*
- λ'' Deep Water Wavelength of Coast *(Meter)*
- ω Wave Angular Frequency *(Radian per Second)*
- ω_c Angular Frequency of Wave *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **coth**, coth(Number)
  The hyperbolic cotangent function, denoted as coth(x), is defined as the ratio of the hyperbolic cosine to the hyperbolic sine.
- Function: **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.
- 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: **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: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency 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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