Important Parametric Spectrum Models Formulas PDF

Formulas
Examples
with Units

List of 16
Important Parametric Spectrum Models Formulas

1) Dimensionless Time Formula

Evaluate Formula

Formula

$$t' = \frac{[g] \cdot t_d}{V_f}$$

Example with Units

$$111.142 = \frac{9.8066\,\text{m/s}^2 \cdot 68\,\text{s}}{6\,\text{m/s}}$$

2) Fetch Length given Frequency at Spectral Peak Formula

Evaluate Formula

Formula

$$F_l = \frac{\left(V_{10}^{\,3}\right) \cdot \left(\left(\frac{f_p}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}\right)}{[g]^2}$$

Example with Units

$$2\,\text{m} = \frac{\left(22\,\text{m/s}^3\right) \cdot \left(\left(\frac{0.013162\,\text{kHz}}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}\right)}{9.8066\,\text{m/s}^2{}^2}$$

3) Fetch Length given Scaling Parameter Formula

Evaluate Formula

Formula

$$F_l = \frac{V_{10}^{\,2} \cdot \left(\left(\frac{\alpha}{0.076}\right)^{-\left(\frac{1}{0.22}\right)}\right)}{[g]}$$

Example with Units

$$2.0034\,\text{m} = \frac{22\,\text{m/s}^2 \cdot \left(\left(\frac{0.1538}{0.076}\right)^{-\left(\frac{1}{0.22}\right)}\right)}{9.8066\,\text{m/s}^2}$$

4) Frequency at Spectral Peak Formula

Evaluate Formula

Formula

$$f_p = 3.5 \cdot \left(\frac{[g]^2 \cdot F_l}{V_{10}^{\,3}}\right)^{-0.33}$$

Example with Units

$$0.0132\,\text{kHz} = 3.5 \cdot \left(\frac{9.8066\,\text{m/s}^2{}^2 \cdot 2\,\text{m}}{22\,\text{m/s}^3}\right)^{-0.33}$$

5) JONSWAP Spectrum for Fetch-limited Seas Formula

Evaluate Formula

Formula

$$E_f = \left(\frac{\alpha \cdot [g]^2}{(2 \cdot \pi)^4 \cdot f^5}\right) \cdot \left(\exp\left(-1.25 \cdot \left(\frac{f}{f_p}\right)^{-4}\right) \cdot \gamma\right)^{\exp\left(-\frac{\left(\left(\frac{f}{f_p}\right)-1\right)^2}{2 \cdot \sigma^2}\right)}$$

Example with Units

$$2.9\text{E-}22 = \left(\frac{0.1538 \cdot 9.8066\,\text{m/s}^2}{(2 \cdot 3.1416)^4 \cdot 8\,\text{kHz}^5}\right) \cdot \left(\exp\left(-1.25 \cdot \left(\frac{8\,\text{kHz}}{0.013162\,\text{kHz}}\right)^{-4}\right) \cdot 5\right)^{\exp\left(-\frac{\left(\left(\frac{8\,\text{kHz}}{0.013162\,\text{kHz}}\right)-1\right)^2}{2 \cdot 1.33^2}\right)}$$

6) Maximum Controlling Parameter for Angular Distribution Formula

Evaluate Formula

Formula

$$s = 11.5 \cdot \left(\frac{2 \cdot \pi \cdot f_p \cdot V_{10}}{[g]}\right)^{-2.5}$$

Example with Units

$$2.5\text{E-}5 = 11.5 \cdot \left(\frac{2 \cdot 3.1416 \cdot 0.013162\,\text{kHz} \cdot 22\,\text{m/s}}{9.8066\,\text{m/s}^2}\right)^{-2.5}$$

7) Phillip's Equilibrium Range of Spectrum for Fully Developed Sea in Deep Water Formula

Evaluate Formula

Formula

$$E_\omega = b \cdot [g]^2 \cdot \omega^{-5}$$

Example with Units

$$0.001 = 0.1 \cdot 9.8066\,\text{m/s}^2{}^2 \cdot 6.2\,\text{rad/s}^{-5}$$

8) Scaling Parameter Formula

Evaluate Formula

Formula

$$\alpha = 0.076 \cdot \left(\frac{[g] \cdot F_l}{V_{10}^2}\right)^{-0.22}$$

Example with Units

$$0.1539 = 0.076 \cdot \left(\frac{9.8066\,\text{m/s}^2 \cdot 2\,\text{m}}{22\,\text{m/s}^2}\right)^{-0.22}$$

9) Shape Factor for Higher Frequency Component Formula

Evaluate Formula

Formula

$$\lambda_2 = 1.82 \cdot \exp\left(-0.027 \cdot H_s\right)$$

Example with Units

$$0.3147 = 1.82 \cdot \exp\left(-0.027 \cdot 65\,\text{m}\right)$$

10) Significant Wave Height given Significant Wave Height of Lower and Higher Frequency Components Formula

Evaluate Formula

Formula

$$H_s = \sqrt{H_{s1}^2 + H_{s2}^2}$$

Example with Units

$$65.1153\,\text{m} = \sqrt{48\,\text{m}^2 + 44\,\text{m}^2}$$

11) Significant Wave Height of Higher Frequency Component Formula

Evaluate Formula

Formula

$$H_{s2} = \sqrt{H_s^2 - H_{s1}^2}$$

Example with Units

$$43.8292\,\text{m} = \sqrt{65\,\text{m}^2 - 48\,\text{m}^2}$$

12) Significant Wave Height of Lower Frequency Component Formula

Evaluate Formula

Formula

$$H_{s1} = \sqrt{H_s^2 - H_{s2}^2}$$

Example with Units

$$47.8435\,\text{m} = \sqrt{65\,\text{m}^2 - 44\,\text{m}^2}$$

13) Weighing Factor for Angular Frequency Lesser than or Equal to One Formula

Evaluate Formula

Formula

$$\varphi = 0.5 \cdot \omega^2$$

Example with Units

$$19.22 = 0.5 \cdot 6.2\,\text{rad/s}^2$$

14) Wind Speed at Elevation 10m above Sea Surface given Frequency at Spectral Peak Formula

Evaluate Formula

Formula

$$V = \left(\frac{F_l \cdot [g]^2}{\left(\frac{f_p}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}} \right)^{\frac{1}{3}}$$

Example with Units

$$0.0188\,\text{m/s} = \left(\frac{2\,\text{m} \cdot 9.8066\,\text{m/s}^2{}^2}{\left(\frac{0.013162\,\text{kHz}}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}} \right)^{\frac{1}{3}}$$

15) Wind Speed at Elevation 10m above Sea Surface given Scaling Parameter Formula

Evaluate Formula

Formula

$$V_{10} = \left(\frac{F_l \cdot [g]}{\left(\frac{\alpha}{0.076}\right)^{-\frac{1}{0.22}}} \right)^{0.5}$$

Example with Units

$$21.9813\,\text{m/s} = \left(\frac{2\,\text{m} \cdot 9.8066\,\text{m/s}^2}{\left(\frac{0.1538}{0.076}\right)^{-\frac{1}{0.22}}} \right)^{0.5}$$

16) Wind Speed given Maximum Controlling Parameter for Angular Distribution Formula

Evaluate Formula

Formula

$$V_{10} = [g] \cdot \frac{\left(\frac{s}{11.5}\right)^{-\frac{1}{2.5}}}{2 \cdot \pi \cdot f_p}$$

Example with Units

$$21.8334\,\text{m/s} = 9.8066\,\text{m/s}^2 \cdot \frac{\left(\frac{2.5\text{E-}5}{11.5}\right)^{-\frac{1}{2.5}}}{2 \cdot 3.1416 \cdot 0.013162\,\text{kHz}}$$

Variables used in list of Parametric Spectrum Models Formulas above

- **b** Constant B
- E_f Frequency Energy Spectrum
- E_ω Phillip's Equilibrium Range of Spectrum
- **f** Wave Frequency *(Kilohertz)*
- F_l Fetch Length *(Meter)*
- f_p Frequency at Spectral Peak *(Kilohertz)*
- H_s Significant Wave Height *(Meter)*
- H_{s1} Significant Wave Height 1 *(Meter)*
- H_{s2} Significant Wave Height 2 *(Meter)*
- **s** Controlling Parameter for the Angular Distribution
- **t'** Dimensionless Time
- t_d Time for Dimensionless Parameter Calculation *(Second)*
- **V** Wind Speed *(Meter per Second)*
- V_{10} Wind Speed at Height of 10 m *(Meter per Second)*
- V_f Friction Velocity *(Meter per Second)*
- **α** Dimensionless Scaling Parameter
- **γ** Peak Enhancement Factor
- λ_2 Shape Factor for Higher Frequency Component
- **σ** Standard Deviation
- **φ** Weighing Factor
- **ω** Wave Angular Frequency *(Radian per Second)*

Constants, Functions, Measurements used in list of Parametric Spectrum Models Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[g]**, 9.80665 *Gravitational acceleration on Earth*
- 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: **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: **Time** in Second (s) *Time Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Frequency** in Kilohertz (kHz) *Frequency Unit Conversion*
- Measurement: **Angular Frequency** in Radian per Second (rad/s) *Angular Frequency Unit Conversion*

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