# Ocean Wave Length, Celerity and Power (Linear Wave Theory)

Wavelength, celerity, group velocity, depth class, energy density and power per metre of crest for a regular wave of given period and height in any water depth.

**Method:** Linear (Airy) wave theory and the dispersion relation

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Wave period | 8.0000 | s |
| Water depth | 12.000 | m |
| Wave height | 1.5000 | m |
| Water density | 1,025.0 | kg/m³ |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Wavelength | 75.834 | m |
| Deep-water wavelength gT²/2π | 99.890 | m |
| Wave celerity L/T | 9.4792 | m/s |
| Group velocity | 7.3693 | m/s |
| Relative depth (deep above 0.5, shallow below 0.05) | 0.15824 | |
| Energy density ρgH²/8 | 2,827.1 | J/m² |
| Wave power per metre of crest | 20.834 | kW |
| Wave steepness | 0.019780 | |

**Notes for this case**

- Linear (Airy) wave theory, small-amplitude regular waves. Power P = E c_g per metre of crest (W/m) shown as kW per metre.

## Formula and method

$$L = \frac{gT^2}{2\pi}\tanh\frac{2\pi d}{L}, \quad c = \frac{L}{T}, \quad c_g = \frac{c}{2}\left(1 + \frac{2kd}{\sinh 2kd}\right), \quad P = \frac{\rho g H^2}{8} c_g$$

### Variables

| | | |
|---|---|---|
| $T$ | Wave period | s |
| $d$ | Water depth | m |
| $H$ | Wave height | m |
| $\rho$ | Water density | kg/m³ |
| $L$ | Wavelength | m |
| $L_0$ | Deep-water wavelength gT²/2π | m |
| $c$ | Wave celerity L/T | m/s |
| $c_g$ | Group velocity | m/s |
| $d/L$ | Relative depth (deep above 0.5, shallow below 0.05) | - |
| $E$ | Energy density ρgH²/8 | J/m² |
| $P$ | Wave power per metre of crest | W |
| $H/L$ | Wave steepness | - |

### Method and standards

Linear water wave theory.

### Assumptions and limits

- Small-amplitude regular waves, flat bed, no current.

### References

Linear (Airy) wave theory and the dispersion relation

## Report details

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|---|---|
| Report reference | FCC-1X1H-5PDD (the same inputs always give the same reference) |
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/mechanical/marine/water-wave-dispersion

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.