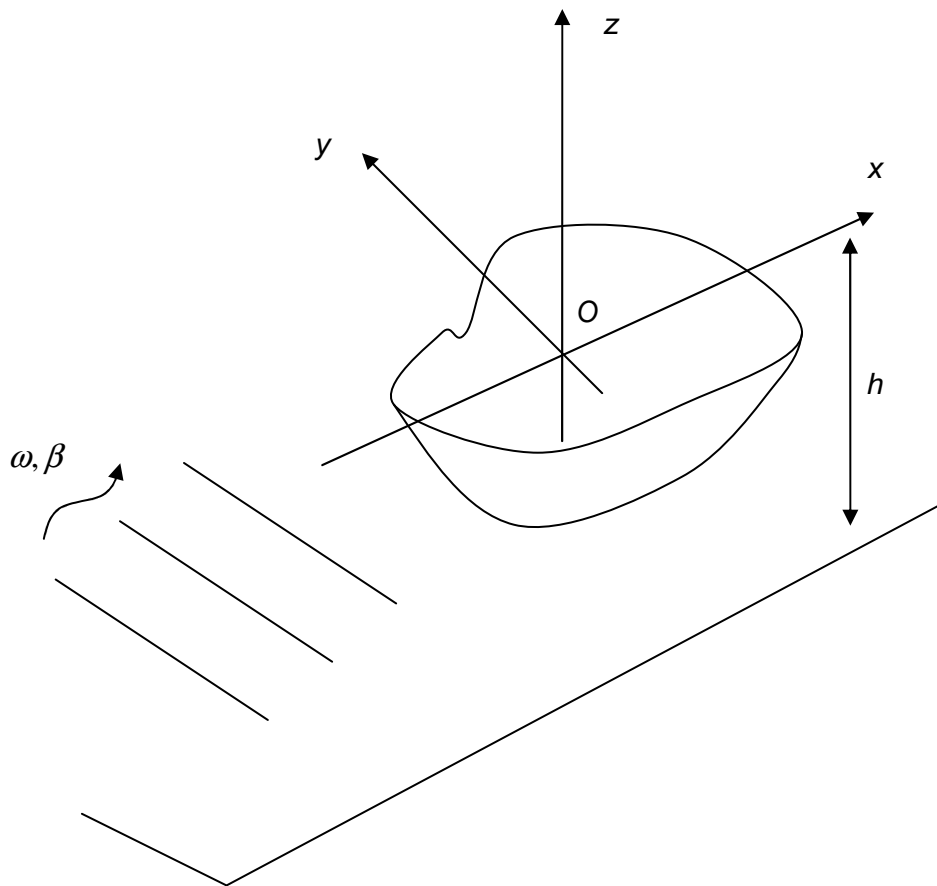


General notations and conventions



Units:

All units are SI units :

- Length is in meter
- Mass is in kg
- Time is in second
- Frequency (circular) is in rad/s
- Phase angle are in radian

Reference frame:

$O(0,0,0)$ is the origin of the reference frame. The horizontal plane $z = 0$ defines the free surface at rest. The vertical axis z is pointing upwards. 0 degrees wave direction means that the wave is propagating towards the x positive axis.

Notations:

- h is the water depth
- ω is the wave frequency
- k is the wave number
- β is the direction of incident wave propagation

- t is time
- (x, y, z) are coordinates in the Cartesian reference frame. (r, θ, z) are coordinates in the cylindrical reference frame.
- p denotes the pressure
- ϕ is a velocity potential
- \vec{V} is a velocity
- g is gravity
- A is the incident wave amplitude

Mathematical expressions for physical quantities:

- Phase of the incident wave elevation is 0 at origin. Incident wave elevation is given by:

$$\eta_I(x, t) = A \cos(k(x \cos \beta + y \sin \beta) - \omega t) = \Re \left(A e^{i(k(x \cos \beta + y \sin \beta) - \omega t)} \right)$$

with k solution of the dispersion relation $kg = \omega^2 \tan kh$.

- The excitation force relates to the incident wave according to:

$$F_{ex}(t) = \Re \left(A \tilde{F}_{ex}(\omega) e^{-i\omega t} \right) = \Re \left(A \left| \tilde{F}_{ex}(\omega) \right| e^{-i(\omega t - \angle \tilde{F}_{ex}(\omega))} \right)^1$$

- The incident wave potential is:

$$\phi_I(x, t) = \Re \left(-\frac{ig}{\omega} A f_0(z) e^{i(k(x \cos \beta + y \sin \beta) - \omega t)} \right)$$

with $f_0(z) = e^{kz}$ in deep water and $f_0(z) = \frac{\cosh(k((z+h)))}{\cosh(kh)}$ in intermediate water depth.

- The incident wave pressure field is:

$$p_I(x, t) = \Re \left(\rho g A f_0(z) e^{i(k(x \cos \beta + y \sin \beta) - \omega t)} \right)$$

- The incident wave velocity field is:

$$\circ \quad \vec{V}(M, t) = \Re \left(\frac{g}{\omega} A \begin{pmatrix} k \cos \beta \\ k \sin \beta \\ -ik \end{pmatrix} e^{kz} e^{i(k(x \cos \beta + y \sin \beta) - \omega t)} \right) \text{ in deep water.}$$

$$\circ \quad \vec{V}(M, t) = \Re \left(\frac{g}{\omega} A \begin{pmatrix} k \cos \beta \cosh(k((z+h))) \\ k \sin \beta \cosh(k((z+h))) \\ -ik \sinh(k((z+h))) \end{pmatrix} \frac{1}{\cosh(kh)} e^{i(k(x \cos \beta + y \sin \beta) - \omega t)} \right) \text{ in}$$

intermediate water depth.

¹ This equation shows that the phase angle of the excitation force in Nemoh is opposite to the one in Aquaplas.