OE5450- Term Project

Panel method to find Added Mass and Radiation Damping of Heaving Buoy

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Problem Statement

Using the frequency-domain boundary integral method with G = 1/r numerically solve the heave radiation problem of a vertical circular cylinder.

1. Cylinder diameter, D = 1 m
2. Cylinder draft, d = 3 m
3. Water depth, h = 10 m
4. Water depth, h = 10 m
5. Frequency, σ from 0.1 to 5 [rad/s]

and also compute the heave added-mass and damping with total number of panels N=5000 and 10000.

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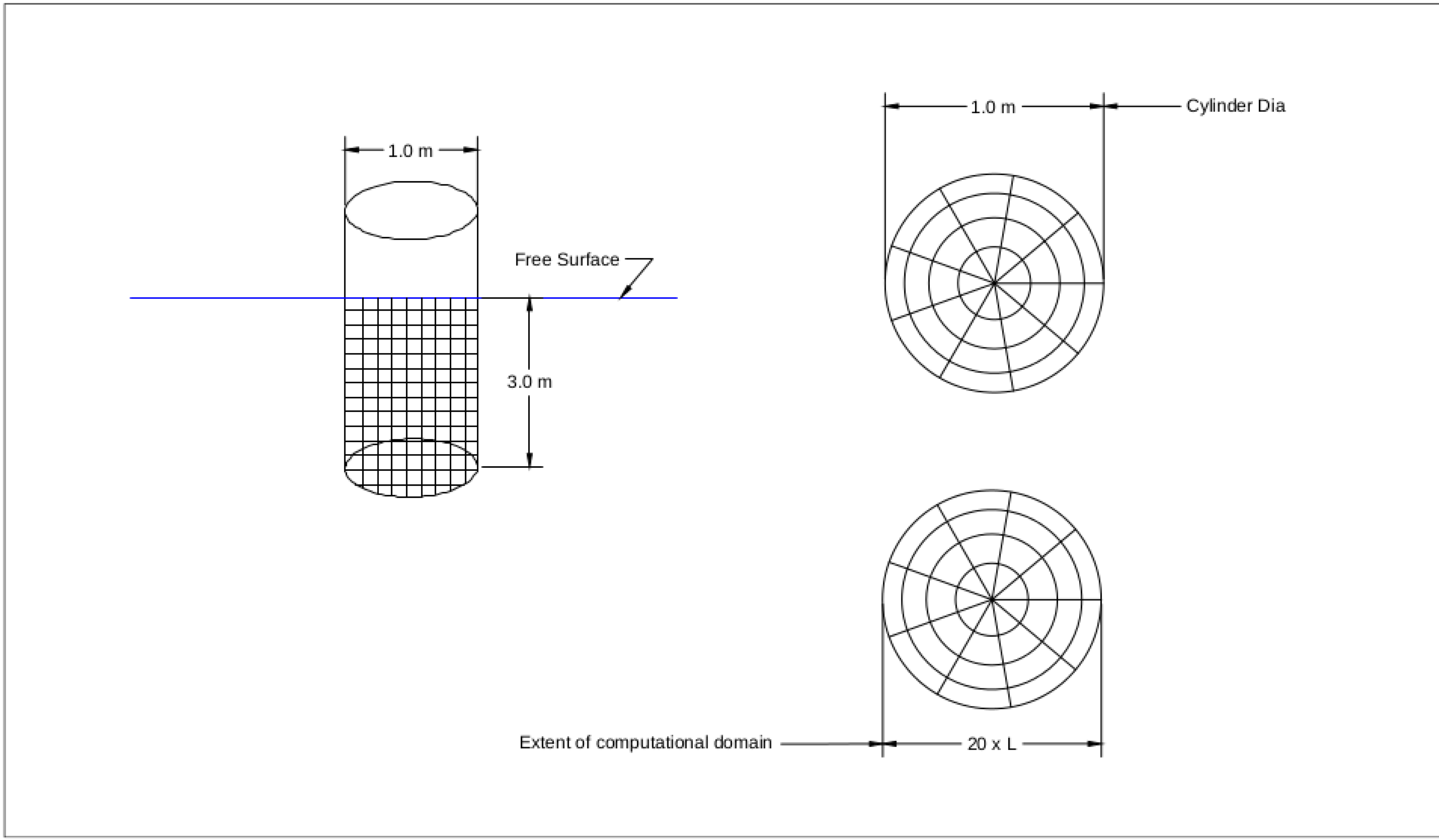
1.0 m
Free Surface
3.0 m
1.0 m
Cylinder Dia
Extent of computational domain
20 x L

Governing Equations

$$
\begin{aligned}
2\pi\varphi(P) + \int_{S_0} \varphi\Big(\frac{\partial}{\partial n}\frac{1}{r} dS_0\Big) \quad &+ \quad \int_{F_0} \varphi\Big(\frac{\partial}{\partial n}\frac{1}{r} - \frac{1}{r}\frac{\sigma^2}{g}\Big) dF_0 + \int_B \varphi\Big(\frac{\partial}{\partial n}\frac{1}{r}\Big) dB \\
&+ \quad \int_\Sigma \varphi\Big(\frac{\partial}{\partial n}\frac{1}{r} - \frac{1}{r} ik\Big) d\Sigma \;=\; \int_{S_0} \frac{1}{r} V_n dS_0
\end{aligned}
$$

$$
f_{jk} = -\sigma^2 \mu_{jk} - i\sigma\lambda_{jk}
$$

$$
f_{jk} = \rho \int_{S_0} \psi_j^r \frac{\partial \psi_k^r}{\partial n} dS_0
$$

$$
\mu_{jk} = \frac{\mathrm{Real}(f_{jk})}{-\sigma^2} \text{ and } \lambda_{jk} = \frac{Imag(f_{jk})}{-\sigma}
$$

Boundary Conditions

$$\nabla^2 \psi_j^r = 0, \text{ in } \forall$$

$$\nabla \psi_j^r \to 0, \text{ as } z \to -\infty$$

Free Surface Condition:

$$-\sigma^2 \psi_j^r + g \frac{\partial \psi_j^r}{\partial z} = 0, \text{ on } z = 0$$

Sommerfeld Radiation Condition:

$$-i\sigma \psi_j^r + \frac{\sigma}{K} \frac{\partial \psi_j^r}{\partial R} = 0, \text{ at } R \to \infty$$

n_total	n_body	sigma	mu	damping
20	8	0.628318	136.588	0.0109
500	200	0.628318	255.537	-0.019652
1125	450	0.628318	259.343	0.123192
1475	800	0.628318	261.899	0.121553
3125	1250	0.628318	261.469	-0.315908
3675	1800	0.628318	262.183	-0.313927
4152	1800	0.628318	263.062	-0.019075
10043	5000	0.628318	263.985	0.000283
14075	5000	0.628318	263.359	0.000553
9800	5000	5.026	257.71	-0.008731