Faculty of Maritime Engineering and Marine Sciences

Ship Dynamics

Quiz 2 – Ship response in the vertical plane July 09th, 2021

Open books (If you present Excel tables, they must be clearly explained)

1.- Why engineers place the origin of the reference system on midship section, despite the disadvantages that this brings?

2.- You are asked to analyze the response in regular waves, of a 80 m long ship with quadratic waterplane and vertical sides. Main dimensions are: *B*: 14 m, *D*: 7 m and *T*: 3.5 m. Beam varies along the length of the ship, with *x* measured from midships, positive forward according to:

$$B(x) = -0.00656x^2 - 0.0875x + 14$$

Using the reference system employed in class, calculate the static moment on the hull, when the ship rises 20 cm without rotation.

3.- Determine the non-dimensional damping coefficient ξ in **pure heave** of a box barge, that is with rectangular section along the length of the ship:

$$\xi = \frac{B_{33}}{2M'\omega_o}$$

where B_{33} is the damping coefficient, M' is the virtual mass and ω_o is the natural frequency of oscillation. Main dimensions of the vessel are: *L*: 60, *B*: 12, *D*: 4, and, *T*: 3 meters, and null trim. Clearly show the dimensional handling of the problem.

4.- The Froude-Krylov component of the excitation force exerted by a regular wave train coming from the bow of the ship is:

$$F_3^{FK} = \left[\rho g \zeta_o \int_{-L/2}^{L/2} dx\, B(x) e^{-kT(x)}\, e^{ikx} \right] e^{i\omega t}$$

where ρg is the specific weight of water, ζ_o, ω and k are the amplitude, frequency and number of the incident wave train, and, $B(x)$ and $T(x)$ are the beam and draft along the length of the ship.

Consider a box barge (L: 70 m, *B*: 14 m, *D*: 5 m and *T*: 3.5 m) receiving regular waves from the bow with an amplitude of 80 cm. If the ship advances with a velocity of 15 knots, determine the length of the waves for which the exciting force in heave is null; clearly show the dimensional handling of the problem. Comment on the result.

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