Faculty of Maritime Engineering and Marine Sciences

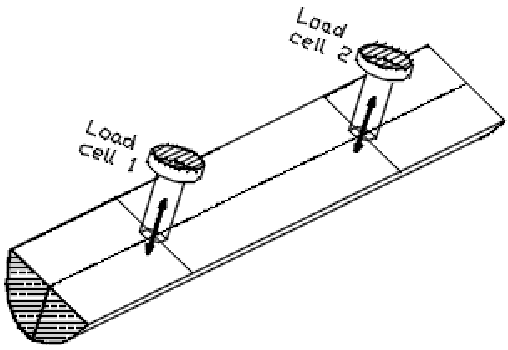
Ship Dynamics

Quiz 2 – Ship response in the vertical plane **July 03th, 2023**

Student: .... **Student ID:** ....

Closed books

1.- To determine the hydrodynamic characteristics of a ship, a tube with constant transverse section is forced to oscilate vertically. Dimensions of the tube are: L: 1.0 m, B: 0.2 m, T: 0.1 m and section coefficient: 0.7. The vertical motion is harmonic: $5 \cos\omega t$ [mm], with a frequency of 1 Hz. The required force to produce this oscillation is recorded with two load cells, and after combining them this function is $5.74 \cos(\omega t - 32^o)$ [Newtons]. Calculate added mass and damping sectional characteristics, a_{33} and b_{33}, from the results of this experiment. (60)



The following procedure is suggested:

i. Deduce the equation of motion of the floating tube.
ii. Calculate the hydrostatic derivatives.
iii. Solve for the required hydrodynamic characteristics
iv. Present results in the required format.

2. The tube from the previous problem is now fixed as it receives regular waves from the bow, with the same frequency. Estimate the Froude-Krylov component of the pitch-motion excitation moment which you expect to be exerted by the regular wave train. From the class notes, the F-K component of the excitation force is:

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

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 wave amplitude of 3 cm. (30)

3. The following expression is an approximation of the component of the fluid velocity, normal to the hull surface: $\frac{\partial \phi_I}{\partial z} N_3$, where ϕ_I is the velocity potential of the incident waves. Deduce it, from its definition, emphasizing on the simplifications that are required. (10)

jrml/2023

I certify that during this exam I have complied with the code of ethics of ESPOL:

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