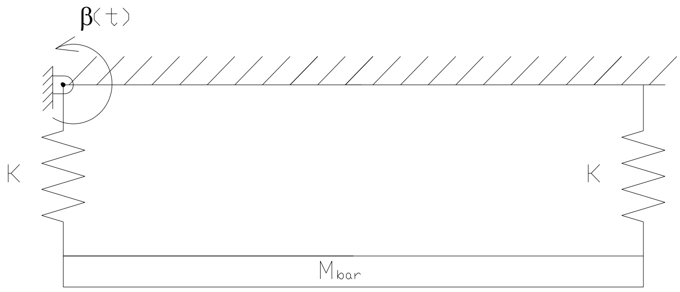
College of Maritime Engineering, and Biological, Oceanical and Natural Resource Sciences

Ship Vibrations

Second Evaluation August 31st, 2016

Student: ……………………………………………………………………………………

1.- Deduce the motion equations in the plane of a rigid bar, mass M_{bar}, and length L, when the support rotates harmonically pivoting on the left end, $\beta(t) = \beta_o \, exp(i\omega t - \alpha)$. The bar is suspended through two springs with stiffness K, see figure. Include only the parameters shown in the figure. (25)



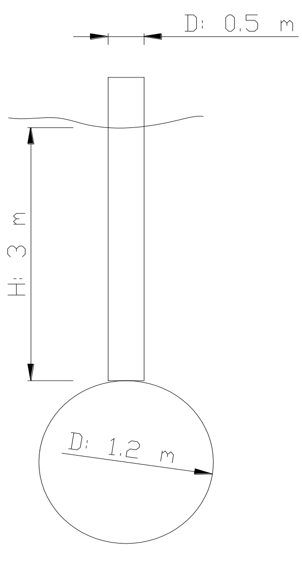
2.- The following table presents a Holzer forced calculation of an in-line system (Intern.System units) with excitation frequency ω=10 1/s.

i.- With the assumptions taken, calculate complex amplitud of vibration of the first disk, considering that the amplitud of excitation acting on last disk is 1.0E5 N-m; highlight in the attached table the information used in your calculations.

ii.- If the shaft between disks 1 and 2 is 10 cm in diameter, calculate vibratory shear stress amplitude developed in that element. (25)

i	J_i	Ci	$-J_i\omega^2+i\omega C_i$		Ui		$(-J_i\omega^2+i\omega C_i)U_i$		$\Sigma(-J_i\omega^2+i\omega C_i)U_i$		K_i	G_i	$[\Sigma(-J_j\omega^2+iwCj)Uj]/(K_k+iwG_k)$	
1	500	290	-5.00E+04	2.90E+03	0.00E+00	1.00E+00	-2.90E+03	-5.00E+04	-2.90E+03	-5.00E+04	1.00E+06	1.45E+02	-2.97E-03	-5.00E-02
2	500	290	-5.00E+04	2.90E+03	-2.97E-03	9.50E-01	-2.61E+03	-4.75E+04	-5.51E+03	-9.75E+04	1.00E+06	1.45E+02	-5.65E-03	-9.75E-02
3	1000	580	-1.00E+05	5.80E+03	-8.62E-03	8.53E-01	-4.08E+03	-8.53E+04	-9.59E+03	-1.83E+05	1.00E+06	2.90E+02	-1.01E-02	-1.83E-01
4	1000	580	-1.00E+05	5.80E+03	-1.87E-02	6.70E-01	-2.01E+03	-6.71E+04	-1.16E+04	-2.50E+05				

3.- The simplified model of a buoy is composed by a vertical cylinder, diameter D_{tube}: 0.5m, with a sphere attched to its lower end (D_{sph}: 1.2 m). Calculate its natural period in pure vertical oscillation, including hydrodynamic effects, and considering ideal fluid. Total weight of the buoy is 1.53 tons, and works around Galápagos Islands. (15)

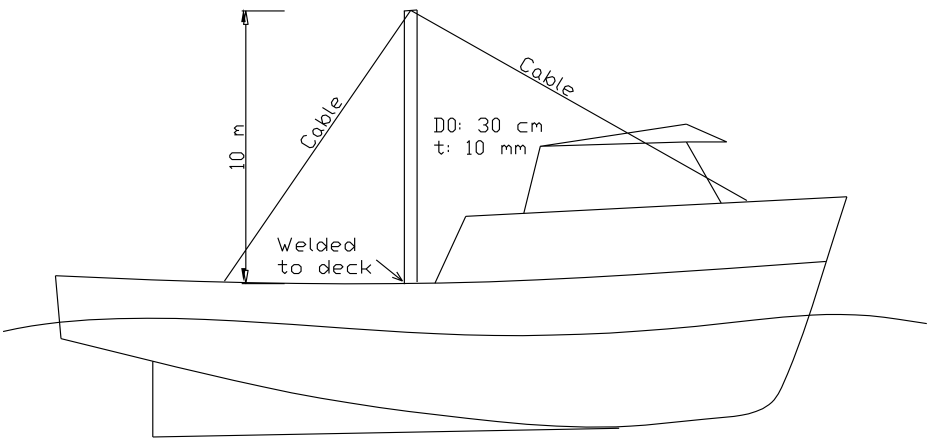


4.- You are asked to analyze the free vibration of a fishing vessel mast, built from an steel tube 30 cm of external diameter and 10 mm in thickness, and, 10 meter height. The mast is welded to the deck plate, and at the upper end is secured with cables, as it is shown in the attached figure. (35)

i. Sketch a model to analyze the vibration of the mast,

ii. Calculate its *second natural frequency*, and

iii. Plot its corresponding mode shape.



I certify that during this exam I have complied with the Code of Ethics of our university.

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jrml/2016