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

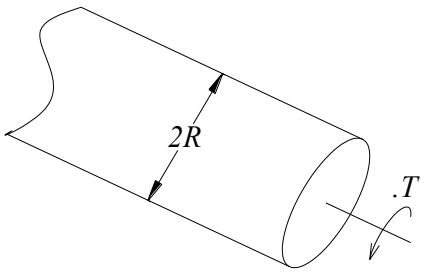
Ship Structures II

First Evaluation **June 25th 2018**

Student: .....

1.- You are asked to analyze the shear stress on a propulsion steel shaft of a fishing vessel which transmits a random torque with a Normal distribution. The diameter of the shaft is 6 inches, and the distribution of the torque has mean value of 23770 N-m, with standard deviation of 1200 N-m. Calculate the probability that the shear stress exceeds a value of 35 N/mm^2.

The shear stress in torsion is: $\tau_{xs} = \frac{T\,R}{J_p}$, where T is the torque, R is the shaft radius, and J_p is the polar moment of inertia of the section. (20)

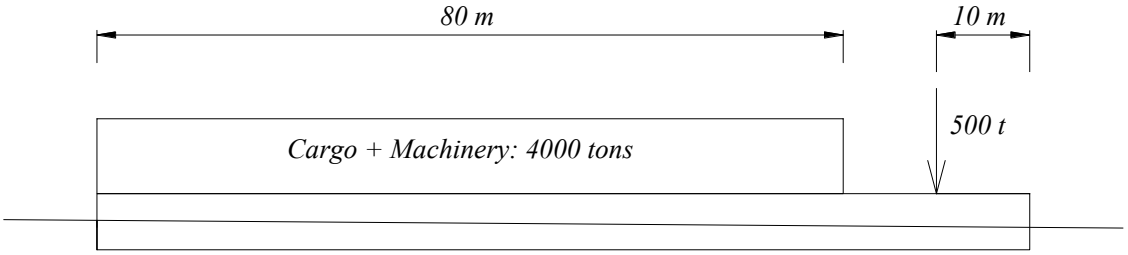


2.- During a period of 10 years, the following register on the number of cycles, n_i, classified according to the stress range, S_i, has been collected for a local structure of a ship.

Si, N/mm^2	n_i
33	5.00E5
29	1.00E6
14	1.50E6
4	1.04E6
1	8.60E5

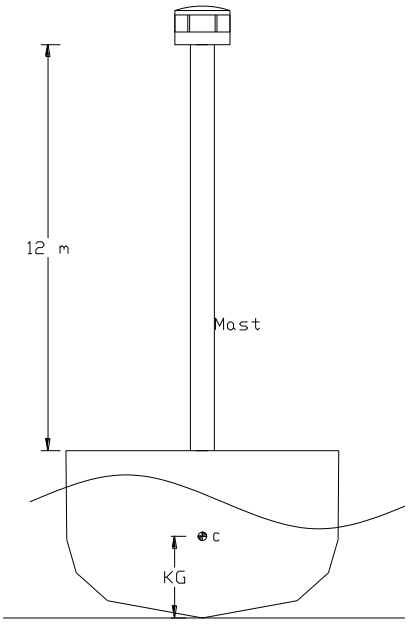
American Bureau of Shipping ship classification society provides the following information for the fatigue analysis of the structural element material (K_0=2.477E11, m=3.0, with units N/mm^2). Estimate the useful remainder life of the element. (15)

3.- Calculate and plot the bending moment distribution on the steel hull of a box barge (*L*: 100, *B*: 18, *D*: 7 m) when she navigates in sea water in hogging condition. The simplified weight distribution is shown in the figure.



Weight of the hull is 2000 tons, uniformly distributed on the length of the ship; weight of cargo and machinery is 4000 tons, uniformly distributed on the aft part of the ship, as shown in the figure. There is also machinery in the ship´s forward end, which can be assumed as a concentrated force of 500 tons.

4.- Estimate the **maximum dynamic stress** on a 12-m height steel mast of a fishing vessel which is sailing in beam waves. Main dimensions of the ship are: *L*: 80, *B*: 16, *D*: 9, *T*=7.8, *KG*=8.0, meters, and, C_B=0.65. The mast can be analyzed with a simplified model as a prismatic square steel tube of 1.2 m of side and 10 mm in thickness. At the top of the mast there is an observation cabin, with a weight of 3000 kgf. You may neglect the sway motion of the ship, and to estimate the inertial load, you also can neglect the dynamic deflection of the mast. Use the sign convention for beam bending employed in Solid Mechanics I.



To estimate the response of the ship in waves, from DNV formulations: amplitude and period of roll are 30.9º and 10.73 sec, respectively. Position of roll rotation axis can be estimated by the following expression: $Z = Mín\left[\frac{D}{4}+\frac{T}{2}\ ,\frac{D}{2}\right]$.

Rayleigh distribution: $f(r)=\frac{r}{\sigma_R{}^2}e^{-1/2(r/\sigma_R)^2}$, Normal distribution: $f(x)=\frac{1}{\sigma_X{}^2}e^{-1/2(x/\sigma_X)^2}$

Fatigue S-N curve: $N=\frac{K_0}{S^m}$

jrml/2018

I certify that during this exam I have complied with code of ethics of our university.

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