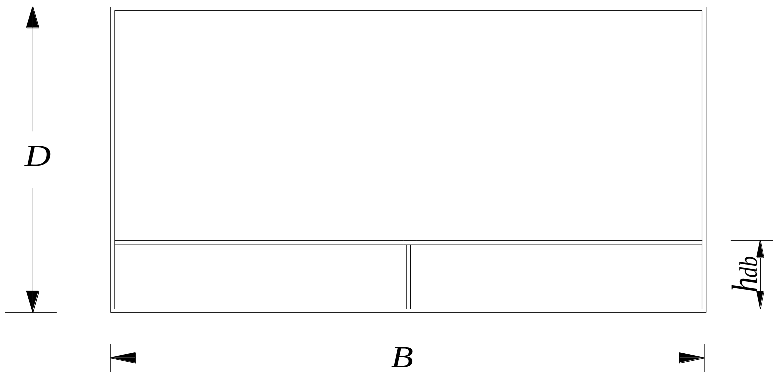
College of Maritime Engineering, and Biological, Oceanical and NN.RR. Sciences

Ship Structures I

1st Evaluation November/22/2018

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

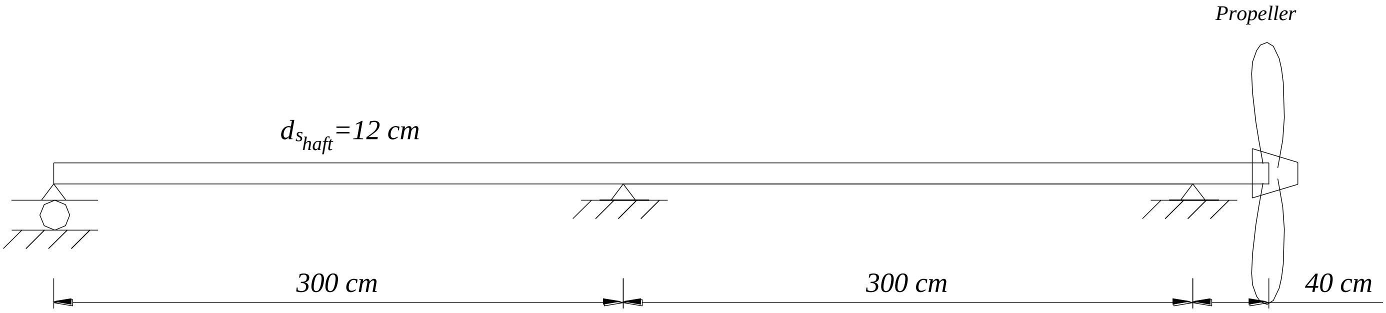
1.- Shear stresses in bending: you are asked to analyze the combined stresses (normal and shear) in a box barge with double bottom, which has the following main dimensions *L*: 45, B: 10, *D*: 4, *T*: 2.5, Δ: 1025, in meters and tons respectively. The double bottom of 1 m in height, includes a vertical keel. The bending moment and shear force acting on the hull section are: 10000 kN-m and 2000 kN, respectively. Calculate the principal stress (maximum) in each of the following positions: i.- deck at centerline, ii.- top of the side, and iii.- neutral axis of the section; use Mohr circle. (35)



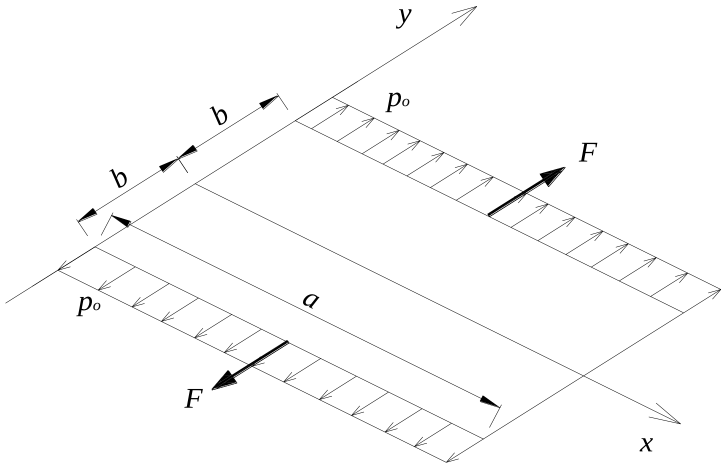
t_{deck}: 6 mm
t_{bott}: 8 mm
t_{dbot}: 7 mm
t_{side}: 7 mm
t_{vkeel}: 8 mm

2.- Energy methods: you are asked to analyze the shafting system of a Galápagos islands passenger ship, 600 shp@1800 rpm, with reduction gear of 4.05:1. The system includes three supports, an intermediate and two in the shaft tunnel, and the shaft is made of steel with a constant diameter of 12 cm. In the overhanging end of the shaft it is installed a Michigan Wheel propeller of diameter of 1.2 m, pitch ratio of 0.75, 4-bladed, *DAR*: 0.75 and 200 kg of weight. Specific weight of steel is 76400 N/m^3.

You have to use Rayleigh-Ritz energy method, so propose a function to approximate the deflection of the shaft, $\tilde{v}(x)$, and estimate the maximum deflection of the shaft. (35)



3.- Plane stress: On a rectangular steel plate 8 mm in thickness, pairs of concentrated and distributed forces are applied simultaneously as shown in the figure. The plate has dimensions of *a*: 2 m, and *2b*: 0.80 m, you are asked to calculate the final thickness in the center point of the plate, using one term for the distribution of the load on the edges. Each force *F* acting at center of the plate is 1000 kN, and the uniformly distributed force per unit length p_o is 500 N/mm. Does your answer make sense? (30)



Formulations of Mohr's circle:

$$\sigma_\theta = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta .$$

For plane stress with sinusoidal load on opposite edges:

$$C_1 = \frac{2A}{\alpha^2} \frac{senh\alpha b + \alpha b \cosh \alpha b}{senh 2\alpha b + 2\alpha b}, \qquad C_4 = -\frac{2A}{\alpha^2} \frac{\alpha senh \alpha b}{senh 2\alpha b + 2\alpha b}.$$

$$\sigma_x(x,y) = \sum_{m=1}^{\infty} 2q_m sen\, \alpha_m x \left[\frac{(\alpha_m b \cosh \alpha_m b - senh\, \alpha_m b)\cosh \alpha_m y - \alpha_m y\, senh\, \alpha_m b\, senh\, \alpha_m y}{senh 2\alpha_m b + 2\alpha_m b} \right]$$

$$\sigma_y(x,y) = \sum_{m=1}^{\infty} -2q_m sen\, \alpha_m x \left[\frac{(\alpha_m b \cosh \alpha_m b + senh\, \alpha_m b)\cosh \alpha_m y - \alpha_m y\, senh\, \alpha_m b\, senh\, \alpha_m y}{senh 2\alpha_m b + 2\alpha_m b} \right]$$

$$\tau_{xy}(x,y) = \sum_{m=1}^{\infty} -2q_m \cos \alpha_m x \left[\frac{\alpha_m b \cosh \alpha_m b\, senh\, \alpha_m y - \alpha_m y\, senh\, \alpha_m b \cosh \alpha_m y}{senh 2\alpha_m b + 2\alpha_m b} \right]$$

jrml/2018

I declare that during this exam I have fulfilled the Code of Ethics of our university.

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