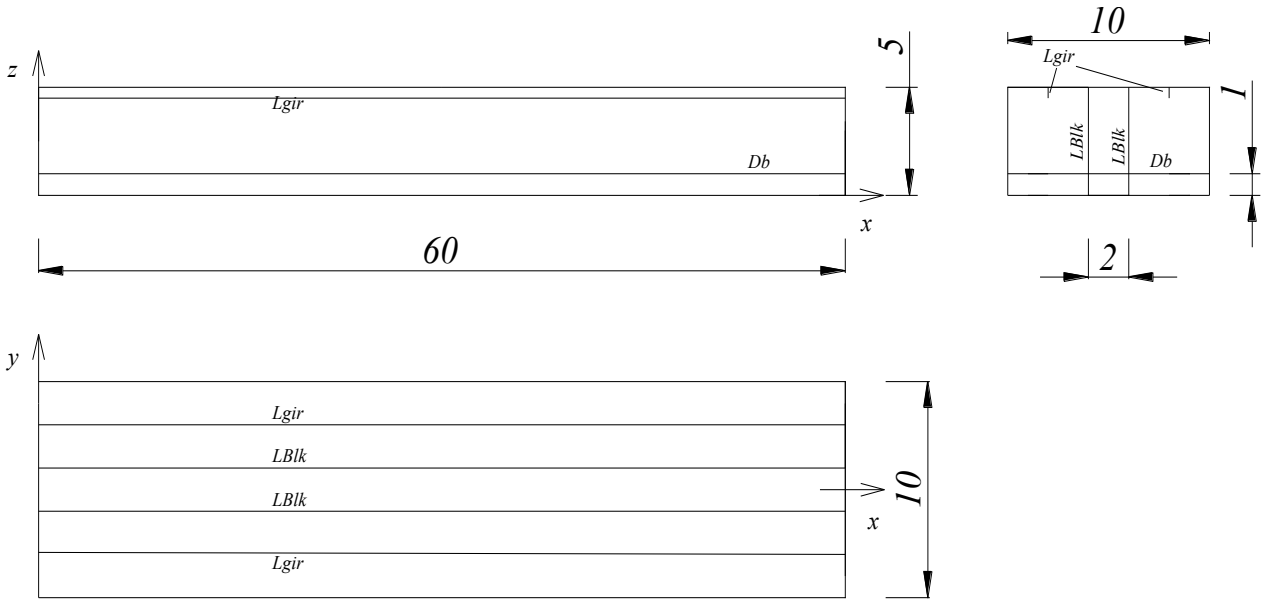
College of Maritime Engineering, and Biological, Oceanical and Natural Resource Sciences

Ship Structures II

Second evaluation **August 27th, 2018**

Student: .....

1.- Calculate the possibility of buckling of the deck plates in a transversely framed steel box barge with the following dimensions, *L*: 60, *B*: 10, and, *D*: 5 m, which transports 1300 tons of load plus consumables, and has a light weight of 200 t. In a simplified manner, you may consider the weight as uniformly distributed. The ship is sailing in sinusoidal waves of amplitude and length of 1 and 60 m, respectively. The hull has two longitudinal bulkheads separated 2 m between them and double bottom of 1 m height, and is formed with 6 mm plating at the bottom, and 5 mm on the other parts, after subtracting the corrosion allowance; to support deck load there are two longitudinal girders at midpoint of span. Transverse frames are separated 55 cm. In a simplified way, no other longitudinal reinforcements need to be considered. (40)



2.- In a primary estimation of ship from problem 1, the shear stress distribution on the section shows a null value at a point located 2.0 m on each side from center line of the deck, calculate the maximum shear force that may be applied on the hull section. Consider an allowable shear stress of 105 N/mm^2. (25)

3.- You have to complete the preliminary design of a watertight bulkhead of a ship with the following main dimensions: Δ: 2700 tons, and, *L*: 80, *B*: 12, *D*: 6 and *T*: 4 meters. The wbkh has one transversal girder and several vertical stiffeners. The design process has already selected the thickness of the plating, 6.0 mm (with no corrosion allowance), and you have to select the number and characteristics of the stiffeners. To simplify the calculations take the stiffeners as flat bars of the same thickness as the plate of the bulkhead. If you need to combine stresses, consider a maximum value of 200 *N/mm^2* for the equivalent von Mises stress: $\sigma_{eq} = \sqrt{\sigma_1^{\,2} - \sigma_1 \sigma_2 + \sigma_2^{\,2}}$. (35)

Useful formulations:

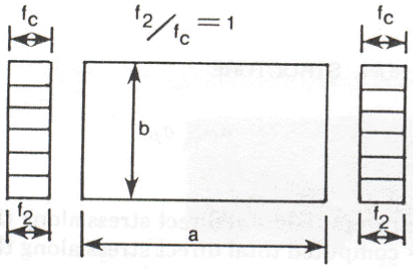
Buckling critical stress for plates in compression (DNV): $f_{crc}=f_t$.

$$f_t = f_e, \quad f_e/f_y \le 0.75, \qquad f_t = f_y\left(1-\frac{3\,f_y}{16\,f_e}\right), \quad fe/fy > 0.75,$$

where the reference stress is: $f_e = 1.88E6\left(\frac{t}{b}\right)^2 K$, kg/cm^2, t and b in mm

(A) For plate panels between stiffeners;

Type of Loading	Description	K
1. For evaluating f_{crc}:		corresponding to axial compression and bending



where $a/b \ge 1.0$ - - - - - - - - 4

where $a/b < 1.0$ - - - - - - - - $\left(\frac{a}{b}+\frac{b}{a}\right)^2$

Bending of isotropic rectangular plates, (Timoshenko):

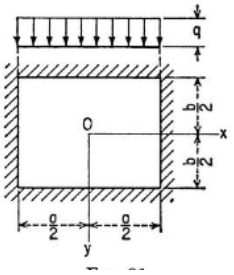


TABLE 35. DEFLECTIONS AND BENDING MOMENTS IN A UNIFORMLY LOADED RECTANGULAR PLATE WITH BUILT-IN EDGES (FIG. 91)

$\nu = 0.3$

b/a	$(w)_{x=0,y=0}$	$(M_x)_{x=a/2,y=0}$	$(M_y)_{x=0,y=b/2}$	$(M_x)_{x=0,y=0}$	$(M_y)_{x=0,y=0}$
1.0	$0.00126qa^4/D$	$-0.0513qa^2$	$-0.0513qa^2$	$0.0231qa^2$	$0.0231qa^2$
1.1	$0.00150qa^4/D$	$-0.0581qa^2$	$-0.0538qa^2$	$0.0264qa^2$	$0.0231qa^2$
1.2	$0.00172qa^4/D$	$-0.0639qa^2$	$-0.0554qa^2$	$0.0299qa^2$	$0.0228qa^2$
1.3	$0.00191qa^4/D$	$-0.0687qa^2$	$-0.0563qa^2$	$0.0327qa^2$	$0.0222qa^2$
1.4	$0.00207qa^4/D$	$-0.0726qa^2$	$-0.0568qa^2$	$0.0349qa^2$	$0.0212qa^2$
1.5	$0.00220qa^4/D$	$-0.0757qa^2$	$-0.0570qa^2$	$0.0368qa^2$	$0.0203qa^2$
1.6	$0.00230qa^4/D$	$-0.0780qa^2$	$-0.0571qa^2$	$0.0381qa^2$	$0.0193qa^2$
1.7	$0.00238qa^4/D$	$-0.0799qa^2$	$-0.0571qa^2$	$0.0392qa^2$	$0.0182qa^2$
1.8	$0.00245qa^4/D$	$-0.0812qa^2$	$-0.0571qa^2$	$0.0401qa^2$	$0.0174qa^2$
1.9	$0.00249qa^4/D$	$-0.0822qa^2$	$-0.0571qa^2$	$0.0407qa^2$	$0.0165qa^2$
2.0	$0.00254qa^4/D$	$-0.0829qa^2$	$-0.0571qa^2$	$0.0412qa^2$	$0.0158qa^2$
∞	$0.00260qa^4/D$	$-0.0833qa^2$	$-0.0571qa^2$	$0.0417qa^2$	$0.0125qa^2$

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

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jrml/2018