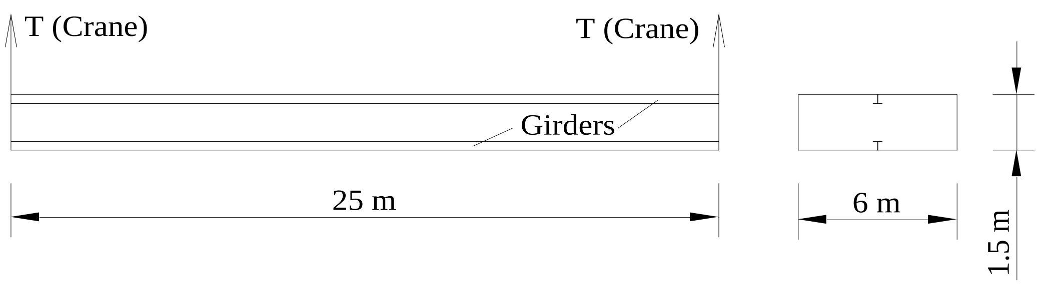
Faculty of Maritime Engineering and Marine Sciences

Ship Structures II

Second evaluation **Jan. 29th, 2020**

Student: ....

1.- Primary bending of a steel box barge with the following dimensions is to be analyzed: *L*: 25 m, *B*: 6 m, and *D*: 1.5 m, when the vessel is suspended from its ends by a crane. Hull structure includes two longitudinal girders welded to the bottom and deck plate. Total light weight of the vessel is 50 tons. Calculate hull maximum deflection, assuming weight distribution is uniform. (30)



Bottom plate: 5 mm Long.Girders: I_c: 1000cm^4, *A*: 24cm^2, d_m: 15cm (from web bottom)
Side plate: 4 mm Deck plate: 4 mm
Transverse frame spacing: 50 cm Transverse frames: L60x60x5 mm

2.- If the framing system of ship in problem 1 is transversal, with deck frames (L60x60x5 mm) separated 50 cm, is it possible that deck plates may buckle in the above described situation? (20)

3.- The structure of a ship, *L*: 80 m, *B*: 12 m, *D*: 6 m and *T*: 4 m is to be designed. It has transverse framing and simple bottom, with a distribution that includes 2 longitudinal bulkheads and 6.0 m of separation between transverse bulkheads. Any other assumption is to be explained.

a.- Rationally select spacing for primary and secondary stiffeners, and prepare a scheme of the primary structure. (10)

b.- Calculate thickness for bottom plating with a 120 N/mm^2 allowable stress. Use the following formulation to estimate pressure: $10T+0.12L$, kN/m^2. (10)

c.- According to DNV secondary stiffeners may support a 160 N/mm^2 normal stress, what dimensions (scantlings) would you recommend for them? (15)

d.- Evaluate the possibility of failure of the *bottom plate* considering a combination of stresses. Clearly show the point of analysis. Use a *-100 N/mm*^{2} value for the primary normal stress. Equivalent von Mises stress is: $\sigma_{eq} = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau^2}$. (15)

Useful formulations:

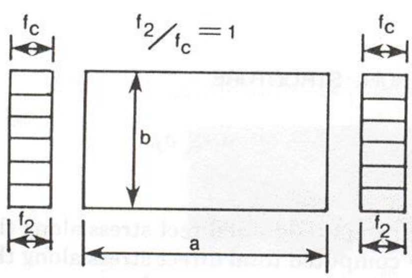
Buckling critical stress for plates in compression (Taggart, ed., SDC, 1980): $f_{crc}=f_t$.

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

where the reference stress is: $f_e = 1.88E6\left(\frac{t}{b}\right)^2 K, \quad kg/cm^2$, 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 $a/b \geqq 1.0$ - - - - - - - 4

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

Bending of isotropic rectangular plates, (Timoshenko):

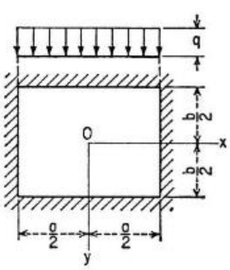


TABLE 35. DEFLECTIONS AND BENDING MOMENTS IN A UNIFORMLY LOADED RECTANGULAR PLATE WITH BUILT-IN EDGES (FIG. 91)

$\nu = 0.3$

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	$0.00254qa^4/D$	$-0.0829qa^2$	$-0.0571qa^2$	$0.0412qa^2$	$0.0158qa^2$
∞	$0.00260qa^4/D$	$-0.0833qa^2$	$-0.0571qa^2$	$0.0417qa^2$	$0.0125qa^2$

jrml/2019-20

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

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