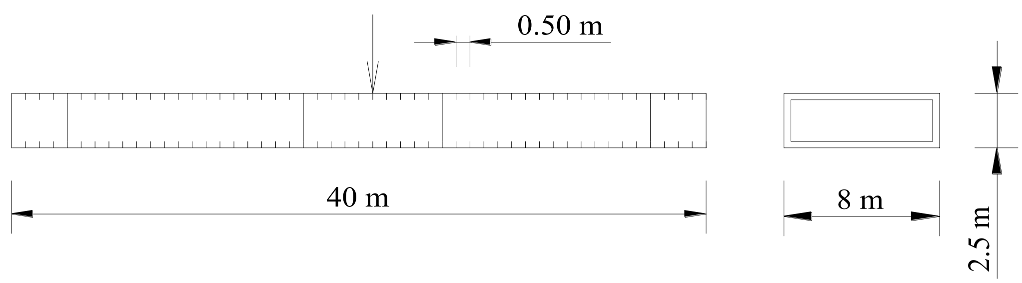
College of Maritime Engineering, and Biological, Oceanical and Natural Resource Sciences

Ship Structures II

Second evaluation **August 30th, 2017**

Student: ....

1.- You are asked to analyze the possibility of deck plate buckling of a box barge sailing in regular sinusoidal waves of 0.8 m in height, with the same length as that of the ship. Main dimensions of the vessel are: L: 40, B: 8, and D: 2.5 meters. Hull structure is simplified as shell plate and transverse frames, formed by steel angle with section 6x6x0.6 cm, separated 0.5 m. Weight of the ship is formed by 350 tons of steel of hull and cargo, which may be assumed as uniformly distributed, and, in the midship region there is a combination of machinery and miscellaneous weight of 50 tons, that may be considered as concentrated. (30)



Bottom plate: 7 mm	Side plate: 6 mm	Deck plate: 7 mm
Transverse frame spacing: 50 cm	Transverse frames: L60x60x6 mm	4 WT Bulkheads

Is it possible that the structure may fail because of shear? (10)

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

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 external pressure: $10T+0.12L$, *kN/m*^{2}. (15)

c.- According to DNV secondary stiffeners may support a 160 N/mm^2 normal stress, what dimensions (scantlings) would you recommend for them? (20)

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: $\sigma_{eq} = \sqrt{\sigma_1^2 - \sigma_1 \sigma_2 + \sigma_2^2}$. (15)

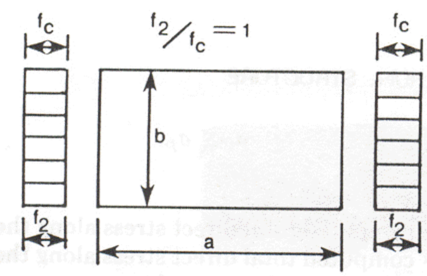
Buckling critical stress for plates in compression (DNV): $f_{crc}=f_t$.

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

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):

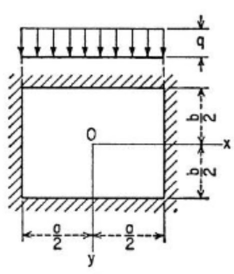


TABLE 35. DEFLECTIONS AND BENDING MOMENTS IN A UNIFORMLY LOADED RECTANGULAR PLATE WITH BUILT-IN EDGES (FIG. 91)

$\nu = 0.3$

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

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

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