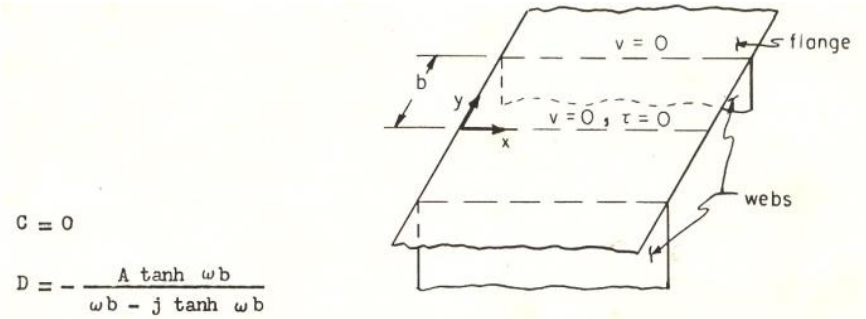
College of Maritime Engineering, and Biological, Oceanical and Natural Resource Sciences

Ship Structures I

2nd Evaluation February/13/2017

Student: ……

1.- For case III analyzed by Prof. Schade, plate welded to multiple webs, *considering only one term of the series expansion,* what is the effectiveness of the plate welded to the stiffeners? Consider the following geometry *b*: 0.40 and *L*: 1.8 m, stiffeners: *H*x*t*: 10x.8 cm, and that the material is steel.



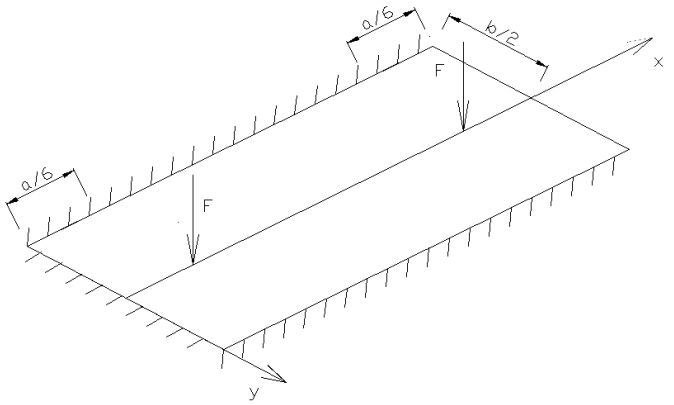
The plane stress solution is: $F(x,y)=\{(A_n+C_n\omega y)\cosh\omega y+(jC_n+D_n\omega y)senh\,\omega y\}sen\,\omega x$,

where: *F* is the Airy stress function, $\omega = n\pi / L$, and, $j=\dfrac{(1-\nu)}{(1+\nu)}$. (30)

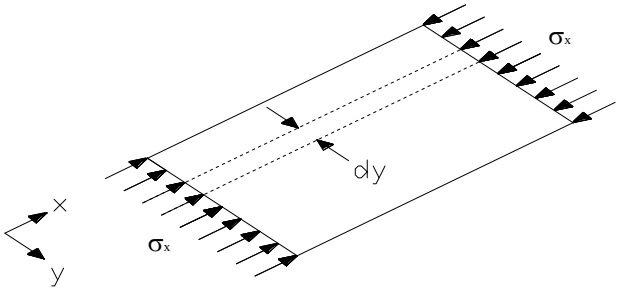
2.- Consider an steel plate clamped on all its edges with main dimensions: 2.0x1.0 m, and 8 mm in thickness. When the plate supports a uniform pressure of +1 kg/m^2 downwards, applying Timoshenko's method, the following equations must be solved for the moments on the edges (in both sides of the equation, the term *D* for the bending stiffness of the plate was cancelled):

$$\begin{bmatrix} 0.1238 & 0.1623 \\ 0.3512 & 0.04297 \end{bmatrix}\begin{Bmatrix} M_1 \\ N_1 \end{Bmatrix} = -\begin{Bmatrix} 0.0197 \\ 0.0326 \end{Bmatrix}[kg-m]$$

Now, the load is replaced by a couple of concentrated loads *F*, at positions *a*/6 from the ends. Determine the maximum forces *F*, that may be applied on the plate with a safety factor of 1.5 on the yield stress of the material of the plate. For any series, use one term for its expansion. (45)



3.- Consider steel plate simply supported on all its edges, with compressive stress in the *y*-edges as shown in the figure. If the load reaches its critical value, determine and plot the final shape of the plate in the *x-y* plane, if the final amplitude of the buckled plate *W* is 2 cm. Consider the following values: *a*: 60 cm, *b*: 120 cm, and *t*: 5 mm. (25)



Useful relations:

Simply supported plate with sinusoidal distribution of moment along x-edges, with: $\alpha_m = m\pi b/(2a)$*:*

$$w_1(x,y) = \sum_{m=1}^{\infty} \frac{a^2 M_m}{2\pi^2 m^2 D \cosh\alpha_m} sen\frac{m\pi x}{a}\left(\alpha_m \tanh\alpha_m \cosh\frac{m\pi y}{a} - \frac{m\pi y}{a} senh\frac{m\pi y}{a}\right)$$

For the analysis of Plate buckling:

$$\frac{dU}{dA} = \frac{D}{2}\left\{\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2}\right)^2 - 2(1-\nu)\left[\frac{\partial^2 w}{\partial x^2}\frac{\partial^2 w}{\partial y^2} - \left(\frac{\partial^2 w}{\partial x \partial y}\right)^2\right]\right\}, \qquad \frac{dW_e}{dx} = \frac{1}{2}\sigma t\left(\frac{\partial w}{\partial x}\right)^2$$

Jrml/2017

I certify that during this examination I have complied with the *Code of Ethics of ESPOL*:

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