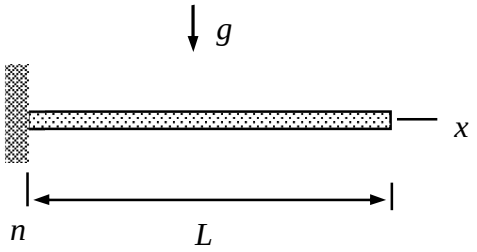
Name_____ Student number_____

Assignment 1 (2p)

Find the stress resultants of the plate strip of length L, width H, and thickness t which is loaded by its own weight. Density of the plate material is ρ. Assume that the resultants do not depend on y. Use the plate equilibrium equations in the Cartesian system



$$\left\{\begin{array}{l}\dfrac{\partial N_{xx}}{\partial x}+\dfrac{\partial N_{xy}}{\partial y}+b_x\\ \dfrac{\partial N_{yy}}{\partial y}+\dfrac{\partial N_{xy}}{\partial x}+b_y\end{array}\right\}=0 \quad \text{and} \quad \left\{\begin{array}{l}\dfrac{\partial Q_x}{\partial x}+\dfrac{\partial Q_y}{\partial y}+b_n\\ \dfrac{\partial M_{xx}}{\partial x}+\dfrac{\partial M_{xy}}{\partial y}-Q_x\\ \dfrac{\partial M_{yy}}{\partial y}+\dfrac{\partial M_{xy}}{\partial x}-Q_y\end{array}\right\}=0 \quad \text{in} \quad (0,L)\times(0,H).$$

Solution

In plate strip problem, the resultants do not depend on y and $Q_y = N_{xy} = M_{xy} = 0$. The differential equations that are not satisfied automatically and their boundary conditions at the free end simplify to

$\dfrac{dN_{xx}}{dx}=0$	in $(0,L)$	and	$N_{xx}=0$	at $x=L$
$\dfrac{dQ_x}{dx}+\rho g t=0$	in $(0,L)$	and	$Q_x=0$	at $x=L$
$\dfrac{dM_{xx}}{dx}-Q_x=0$	in $(0,L)$	and	$M_{xx}=0$	at $x=L$

Solutions to the stress resultants are

$N_{xx}(x)=0$, ←

$Q_x(x)=\rho g t(L-x)$, ←

$M_{xx}(x)=-\dfrac{\rho g t}{2}(L-x)^2$. ←