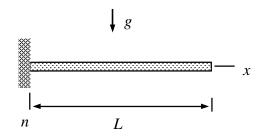
Assignment 1 (2p)

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



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

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

$$\frac{dN_{xx}}{dx} = 0 \qquad \text{in } (0, L) \qquad \text{and} \qquad N_{xx} = 0 \qquad \text{at } x = L$$

$$\frac{dQ_x}{dx} + \rho gt = 0 \qquad \text{in } (0, L) \qquad \text{and} \qquad Q_x = 0 \qquad \text{at } x = L$$

$$\frac{dM_{xx}}{dx} - Q_x = 0 \qquad \text{in } (0, L) \qquad \text{and} \qquad M_{xx} = 0 \qquad \text{at } x = L$$

Solutions to the stress resultants are

$$N_{xx}(x) = 0$$
,

$$Q_{x}(x) = \rho gt(L - x),$$

$$M_{xx}(x) = -\frac{\rho gt}{2} (L - x)^2.$$