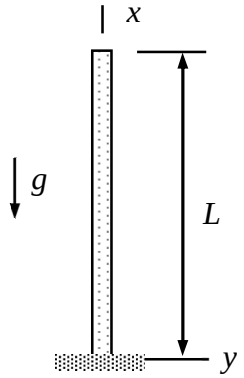
Name_____ Student number_____

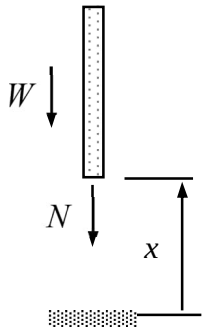
Assignment 1



The column of the figure is loaded by its own weight. Determine stress σ_{xx}, strain ε_{xx} and displacement u_x as functions of x. Cross-sectional area A and density ρ of the material are constants. Assume that stress and strain are related by Hooke's law $\sigma_{xx} = E\varepsilon_{xx}$.

Solution template

Let us start with the axial force N by considering the equilibrium of the column part shown



Weight of the column part $W =$ _____

Equilibrium equation _____ $= 0$

Axial force $N =$ _____

Stress at x follows from definition "force divided by the area" as directed area and force are aligned in the present problem.

Stress $\sigma_{xx} =$ _____ .

Strain at x follows from the stress-strain relationship $\sigma_{xx} = E\varepsilon_{xx}$.

Strain $\varepsilon_{xx} =$ _____ .

Displacement of the column at x follows from the definition of strain (strain-displacement relationship) $\varepsilon_{xx} = du_x / dx$ to be considered as an ordinary first order differential equation to displacement u_x. Let the integration constant be C.

Generic solution to displacement $u_x =$ _____

Displacement is known to vanish at $x = 0$. Elimination the integration constant by using the boundary condition $u_x(0) = 0$ gives the displacement for the problem.

Displacement $u_x =$ _____ .