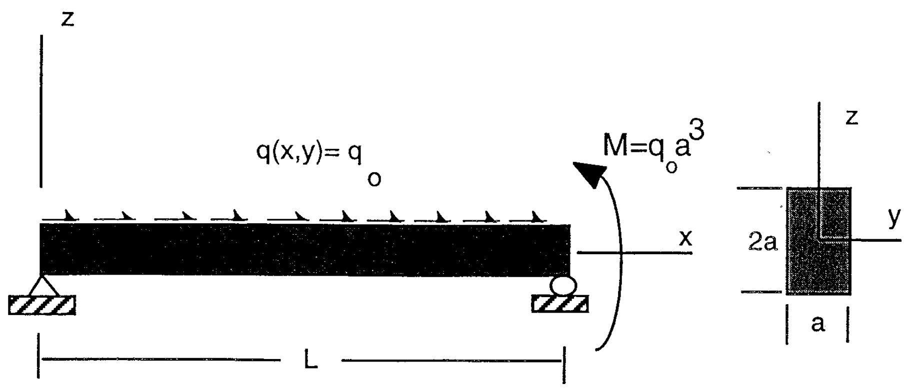
AE323 – Spring 2019 – Homework 4
Wednesday February 13, 2019
Due on Friday February 22, 2019, at class time

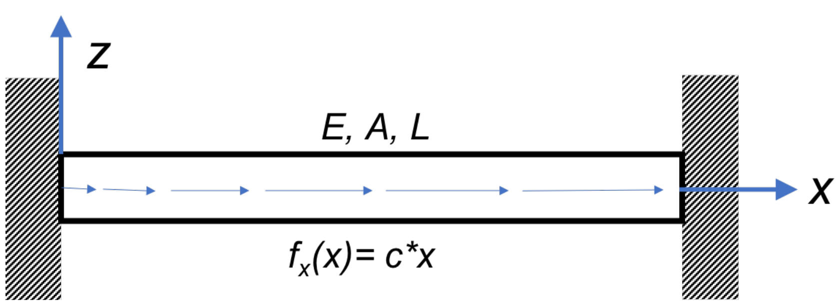
Problem 1

Derive the displacements of the neutral axis of a simply supported beam subjected to a shearing traction $q(x,y) = q_o$ (given in Pa) acting uniformly along the top surface of the beam, and to a concentrated moment applied at $x=L$ equal to $M=q_o a^3$ (in Nm). Assume a Young's modulus E and neglect the effect of gravity. The beam cross-section is rectangular, as indicated in the figure below. Put your solution in a non-dimensional form.



Problem 2

Consider the axially loaded bar problem shown below. Compute the distribution of axial displacement u and axial stress σ_{xx} in the bar. Put your solution for both u and σ_{xx} in a non-dimensional form. Indicate where the absolute value of the axial stress is maximum.

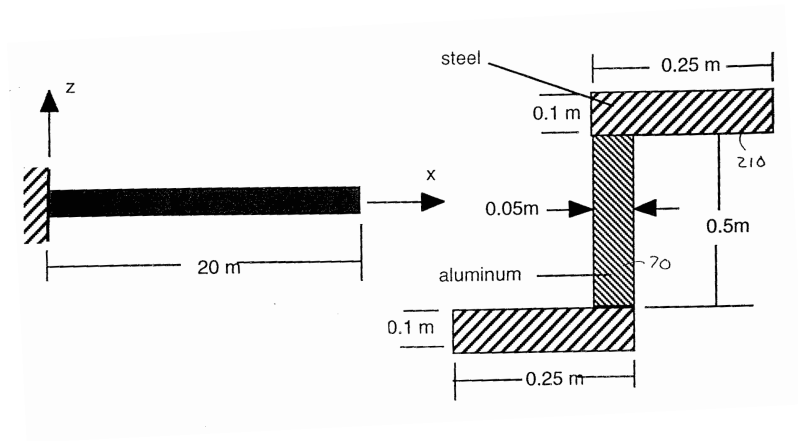


Problem 3

Consider the bimaterial cantilever beam shown in the figure below. The beam is made of steel (ρ=7800 kg/m^3 and E=210 GPa) and aluminum (ρ=2800 kg/m^3 and E=70 GPa).

Write down (but do NOT solve) the equilibrium equations and boundary conditions for the deflections v and w of the beam under its own weight, assuming that the acceleration of gravity g=10 m/s^2. Compute all the quantities (moments of inertia, distributed force, …) entering the equations and boundary conditions.

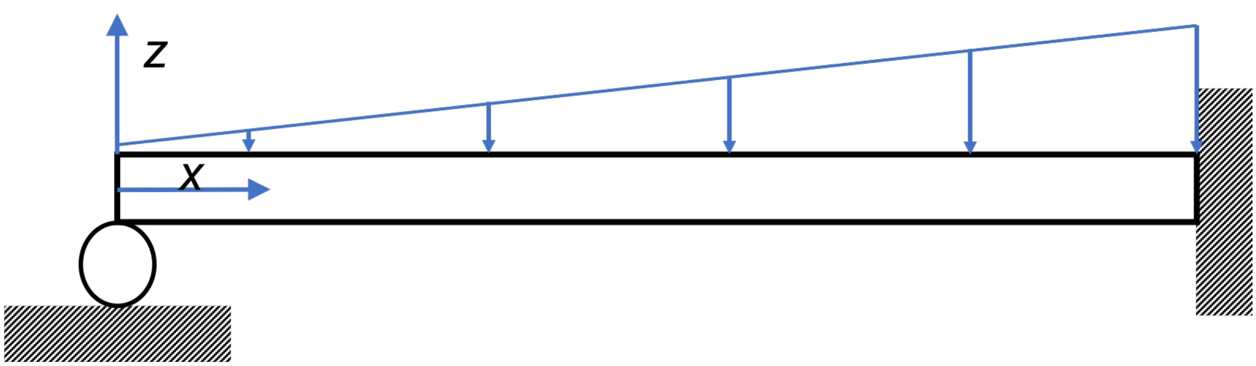
Also compute and plot the shear (V_z in N) and moment (M_y in Nm) diagrams.



Problem 4

Consider the beam bending problem shown in the equation below. The beam is of length *L*, moment of inertia *I*, (symmetric) cross-section area *A*, and is subjected to a linearly increasing transverse load with maximum amplitude *q* (given in N/m).

Write and solve the BVP describing the equilibrium of the beam in terms of the z-deflection of the neutral axis. Put your solution in a non-dimensional form.



Problem 5

A cylindrical beam of length L and radius r shown below is held by the rigid support and spun around the z-axis at the angular rotation rate Ω. The beam has a Young's modulus E and a density ρ. Compute the distributed axial force $f_x(x)$ and solve for the axial displacement *u(x).* Put your displacement and stress solutions in a non-dimensional form.