Quiz 1

Problem 1:
A cantilever beam of length l and bending rigidity EI is loaded by a concentrated moment $\overline{M}$ at its tip.
a) Plot the distribution of shear force and bending moment
b) Find the shape of the deformed beam
c) Derive the amplitude of the tip displacement w_0

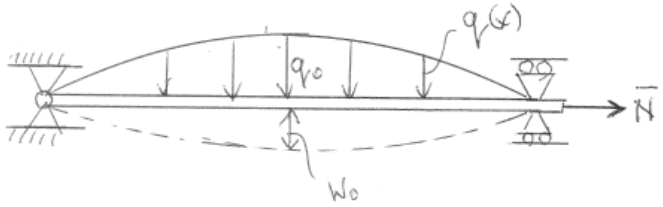
Extra Credit: Calculate the horizontal component of the displacement u_0, assuming moderately large deflection of the beam.

Problem 2:
A slender elastic beam is pin-pin supported and subjected to sinusoidal distributed line load q(x):

$$q(x) = q_0 \sin\left(\frac{\pi x}{l}\right)$$

where q_0 is the load intensity and l is the length of the beam. The beam is restrained is restrained from axial motion at one end and is supported by rollers on the other.

In addition to the transverse load, there is a given axial load of $\overline{N}$ applied to the end of the beam with rollers.



a) Write the governing equation of moderately large deflection theory
b) Prove that the sinusoidal deflection shape satisfies the governing equation
c) Find the expression of the deflection at the center of the beam in terms of the vertical load intensity q_0 and horizontal load intensity $\overline{N}$.
d) Discuss all limiting cases of axial load $\overline{N}$, negative, zero, and positive.
e) Plot the relationship between the central deflection and the axial force with all other parameters held constant.

Problem 3:
Explain the difference between the shear force (for infinitesimal deflection) and effective shear force (for finitely moderately large deflections).

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