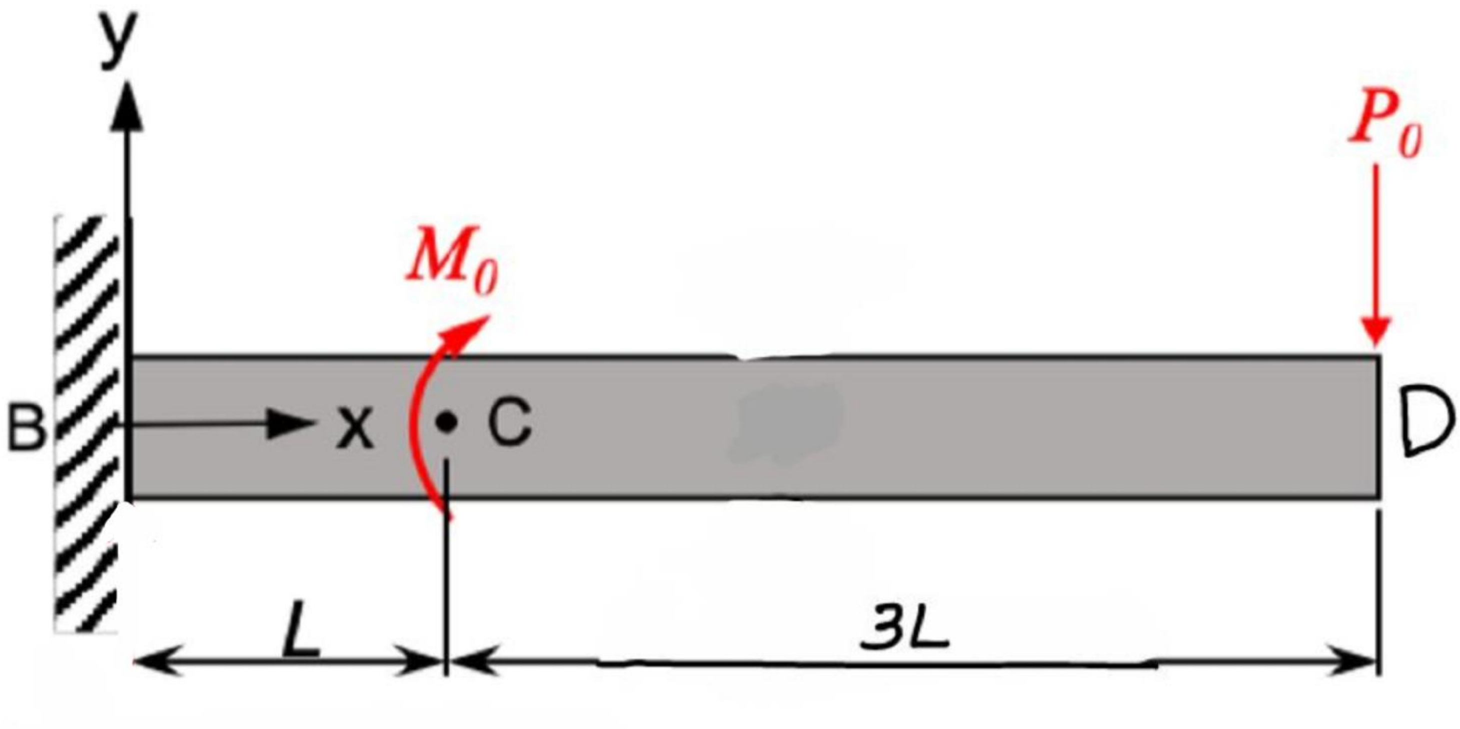
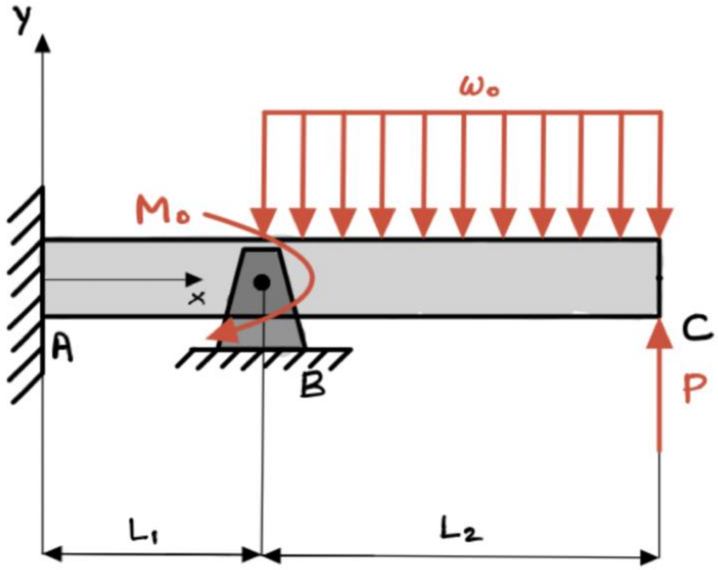
Problem 7.1 ***(10 points)*** The beam shown below has a Young's modulus E and second area moment of inertia I. Determine the following using the second-order integration method: Give your answers in terms of E, I, L, P_0 and M_0

(a) Bending moment M(x) along the length of the beam.
(b) The slope of the beam θ(x).
(c) The deflection of the beam v(x).



Problem 7.2 ***(10 points)*** A cantilever beam ABC with a circular cross section has a roller support at B and is subjected to a uniformly distributed loads w_0 between B and C, a concentrated load P at C, and an external couple M_0 at B. Using the **superposition method,** determine:

(a) The reaction at point B.
(b) The analytical expression for the deflection of the beam v_x.
(c) The deflection at point C.

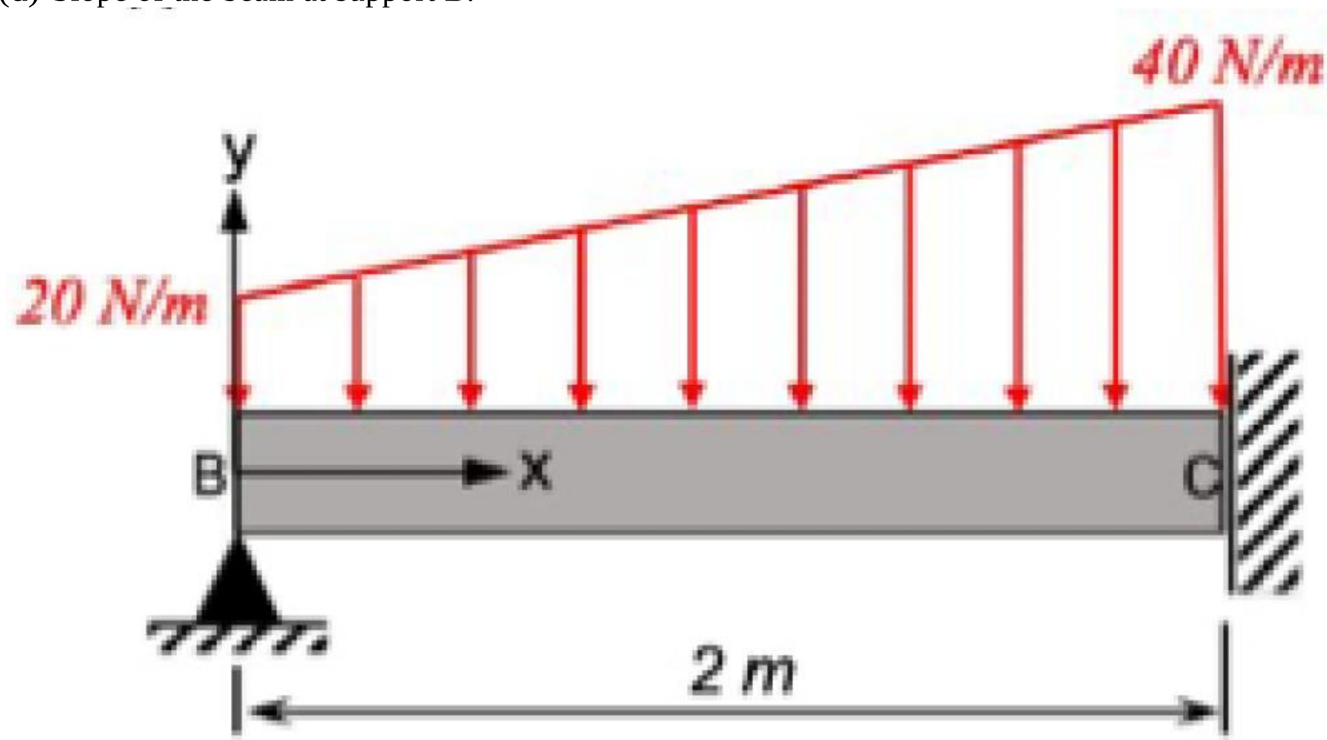


Data: L_1= 1 m, L_2= 2 m, cross section diameter d = 40 mm, E = 200 GPa, P = 150 N, M_0= 100 N.m, and w_0= 80 N/m.
Note: Please refer to the superposition tables on the blog for necessary beam deflection equations.

Problem 7.3 ***(10 points)***

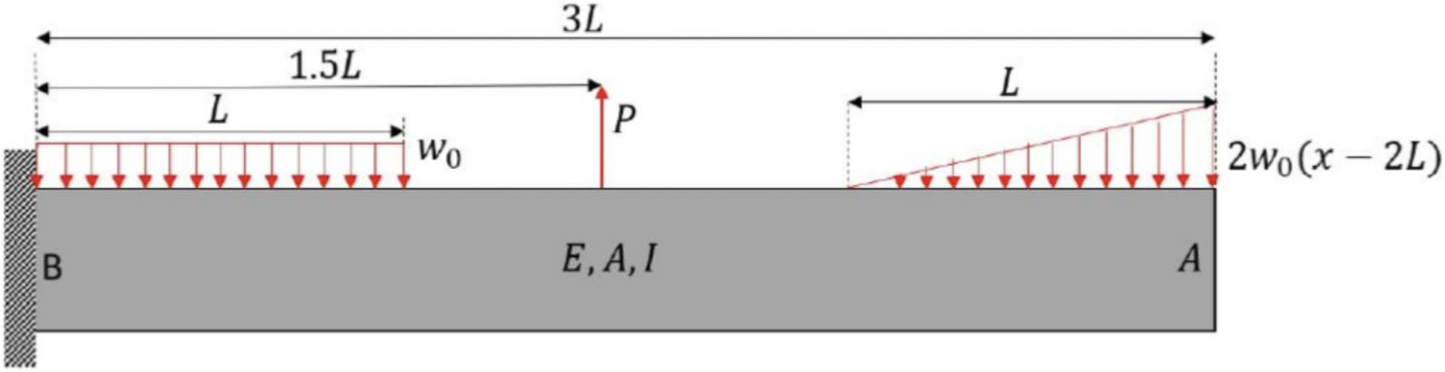
A The beam shown below has a Young's modulus of 50 GPa and has a square cross-section of side length 1 cm. Determine the following using the second-order integration approach:

(a) Bending moment M(x) along the length of the beam.
(b) Slope of the beam $\vartheta(x)$.
(c) The deflection of the beam v(x).
(d) Slope of the beam at support B.



Problem 7.4 ***(5 points)***

1. Consider the cantilevered beam with distributed loads as shown below.



Select the general form that the equation for flexural energy due to bending will take (note that $f_i(x)$ represents some continuous function M(x) / (2EI) for the length of integration):

(a) $U = \int_0^L f_1(x)dx + \int_L^{2L} f_2(x)dx + \int_{2L}^{3L} f_3(x)dx$

(b) $U = \int_0^L f_1(x)dx + \int_L^{1.5L} f_2(x)dx + \int_{1.5L}^{3L} f_3(x)dx$

(c) $U = \int_0^L f_1(x)dx + \int_L^{1.5L} f_2(x)dx + \int_{1.5L}^{2L} f_3(x)dx + \int_{2L}^{3L} f_4(x)dx$

(d) $U = \int_0^L f_1(x)dx + \int_0^{1.5L} f_2(x)dx + \int_0^{2L} f_3(x)dx + \int_0^{3L} f_4(x)dx$