MASSACHUSETTS INSTITUTE OF TECHNOLOGY

13.10J/1.573J/13.014/1.052

Problem Set 12

Assign : Nov. 20, 2000 (for 13.014/1.052)
Nov. 20, 2000 (for 13.10J/1.573J)
Due : Nov. 28, 2000 (for 13.014/1.052)
Nov. 29, 2000 (for 13.10J/1.573J)

For undergraduates : 17.4, 17.37 and Problem 1 below.

For graduates : 17.9, 17.30, 17.37 and Problem 2 below.

1. A rod of length L is installed in fixed supports with force P applied as shown in Figure 1. Young's modulus of elasticity is E and the moment of inertia of the cross section is I. Show that the first critical buckling load P_{cr} is given by

$$P_{cr} = \frac{4\pi^2 EI}{L^2} \tag{1}$$

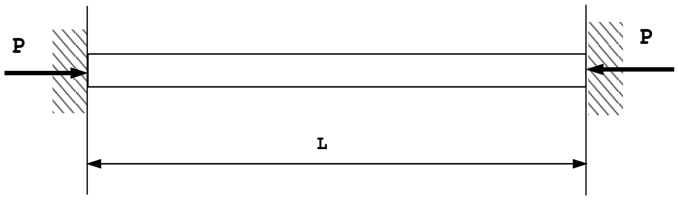
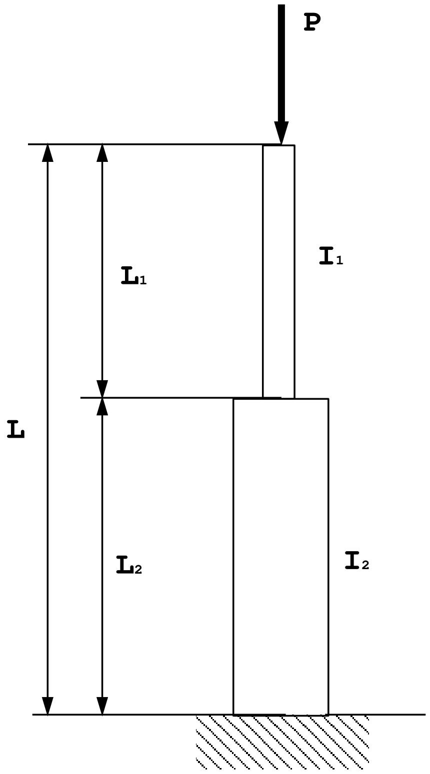


Figure 1: A diagram for Problem 1

HINT : Use the 4th order O.D.E for column under compression making sure you apply all four boundary conditions.

2. Find critical load P for a column fixed at the bottom and free at the top and consisting of two prismatic portions with moments of inertia I_1 and I_2 as shown in Figure 2. Young's modulus of elasticity is E for the entire column. Work with differential equations.



A diagram for Problem 2