Assignment 8

(Due May 1)

Problem 8.1 & 8.2

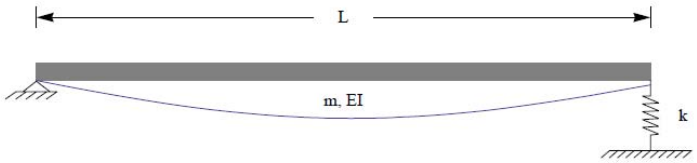
8.1

A uniform beam with mass per unit length m and stiffness EI is supported as shown. Using Rayleigh's method determine the approximate natural frequency. The fundamental mode shape for the beam is the static deflection of the beam caused by a uniformly distributed load.

$$\psi(x) = -\frac{x^4}{24\,EI} + \frac{L\,x^3}{12\,EI} - \frac{L^3\,x}{24\,EI} - \frac{x}{2\,k}$$

Use following numerical values.

m = 0.15528 lb–s^2/in^2; L = 360. in; EI = 30000000000 lb in^2; k = 200000 lb/in



8.2

A beam supports two machines as shown in the figure. The static deflection under the weight of the machines is measured as 10 mm downwards at the midspan and 1 mm upwards at the tip. Using Rayleigh's method estimate the natural frequency of the system. Neglect the mass of the beam itself.

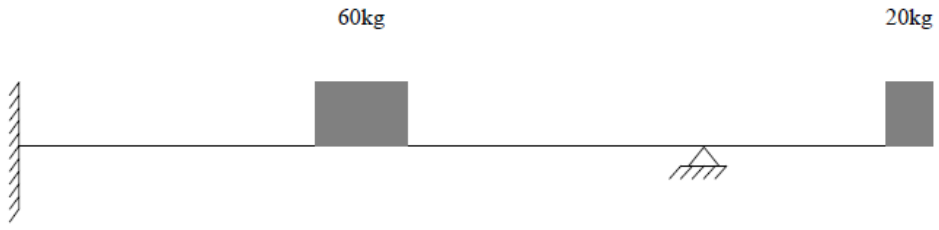


Figure 8.7. Beam supporting two machines

y(mid) = 0.01m; y(tip) = −0.001m