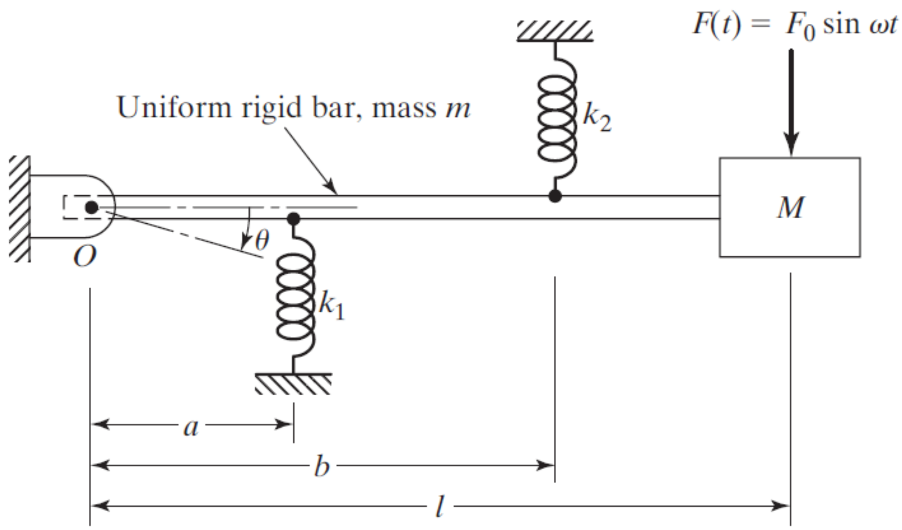
3.9 A spring-mass system with $m = 10$ kg and $k = 5000$ N/m is subjected to a harmonic force of amplitude 250 N and frequency ω. If the maximum amplitude of the mass is observed to be 100 mm, find the value of ω.

3.24 Derive the equation of motion and find the steady-state response of the system shown in Fig. 3.44 for rotational motion about the hinge O for the following data: $k_1 = k_2 = 5000$ N/m, $a = 0.25$ m, $b = 0.5$ m, $l = 1$ m, $M = 50$ kg, $m = 10$ kg, $F_0 = 500$ N, $\omega = 1000$ rpm.



3.28 Consider a spring-mass-damper system with $k = 4000$ N/m, $m = 10$ kg, and $c = 40$ N-s/m. Find the steady-state and total responses of the system under the harmonic force $F(t) = 200 \cos 20t$ N and the initial conditions $x_0 = 0.1$ m and $\dot{x}_0 = 0$.

3.58 A uniform bar of mass m is pivoted at point O and supported at the ends by two springs, as shown in Fig. 3.59. End P of spring PQ is subjected to a sinusoidal displacement, $x(t) = x_0 \sin \omega t$. Find the steady-state angular displacement of the bar when $l = 1$ m, $k = 1000$ N/m, $m = 10$ kg, $x_0 = 1$ cm, and $\omega = 10$ rad/s.

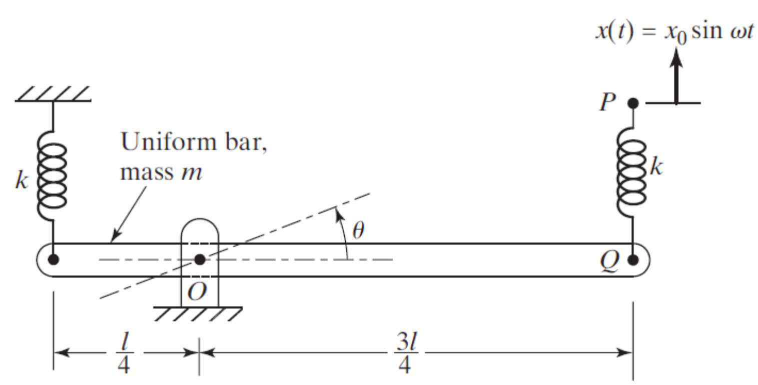


FIGURE 3.59

3.64 One of the tail rotor blades of a helicopter has an unbalanced mass of $m = 0.5$ kg at a distance of $e = 0.15$ m from the axis of rotation, as shown in Fig. 3.62. The tail section has a length of 4 m, a mass of 240 kg, a flexural stiffness (EI) of 2.5 MN-m^2, and a damping ratio of 0.15. The mass of the tail rotor blades, including their drive system, is 20 kg. Determine the forced response of the tail section when the blades rotate at 1500 rpm.

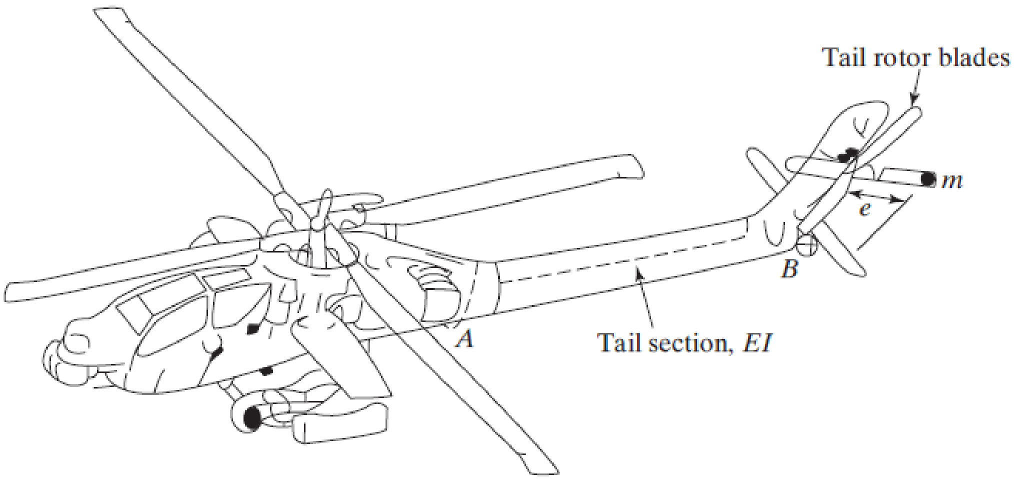


FIGURE 3.62

3.80 The mass of a spring-mass system, with $m = 15$ kg and $k = 25$ kN/m, vibrates on a horizontal surface under a harmonic force of magnitude 200 N and frequency 20 Hz. Find the resulting amplitude of steady-state vibration. Assume the coefficient of friction between the mass and the horizontal surface as 0.25.