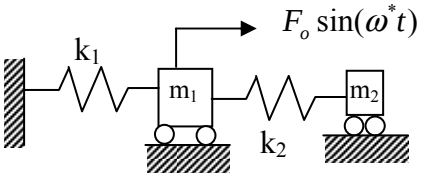
ME 588 Homework 4, Fall 2007

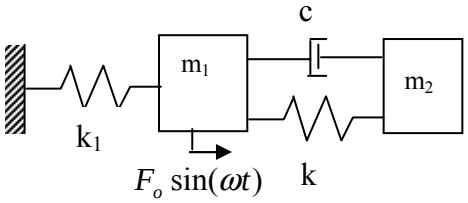
1. The dynamic vibration absorber shown is "tuned" for minimum displacement of the main mass, m_1. Find the expression for the new natural frequencies of the total system as a function ω^* and the mass ratio m_1/m_2. Show that one of these frequencies will always be less than ω^* while the other will always be greater than ω^*.



$$\omega^* = \sqrt{m_1 / k_1}$$

2. It is known that the response curve for the primary mass of a damped vibration absorber system will always pass through two particular points regardless of the amount of damping in the system. Assuming that one criterion for the design of an effective vibration damper is that the amplitude of response associated with each of the two points be the same, show that it is necessary that

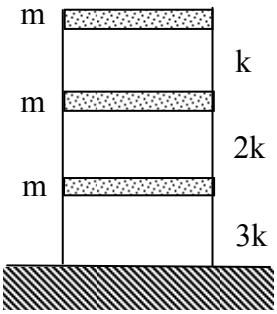
$$k/k_1 = m_1 m_2 / (m_1 + m_2)^2$$



3. A three-story steel-frame building can be approximated as three equal concentrated masses and three masses springs of lateral spring constants 3k, 2k, and k. During lateral vibration of the structure it is assumed that the floors move parallel to each other so that the shearing action predominates. The spring constants define the shearing force per unit lateral displacement; i.e. the horizontal shearing force on the top floor is k times the relative displacement between the top and middle floors.

a) Find the natural frequencies of small lateral vibrations

b) Find the mode shapes associated with the natural frequencies.



4. Problem 7.6