MECA H 303:
Kinematics and dynamics of machines

Part: Dynamics and vibrations

Exercise session 2: 03/12

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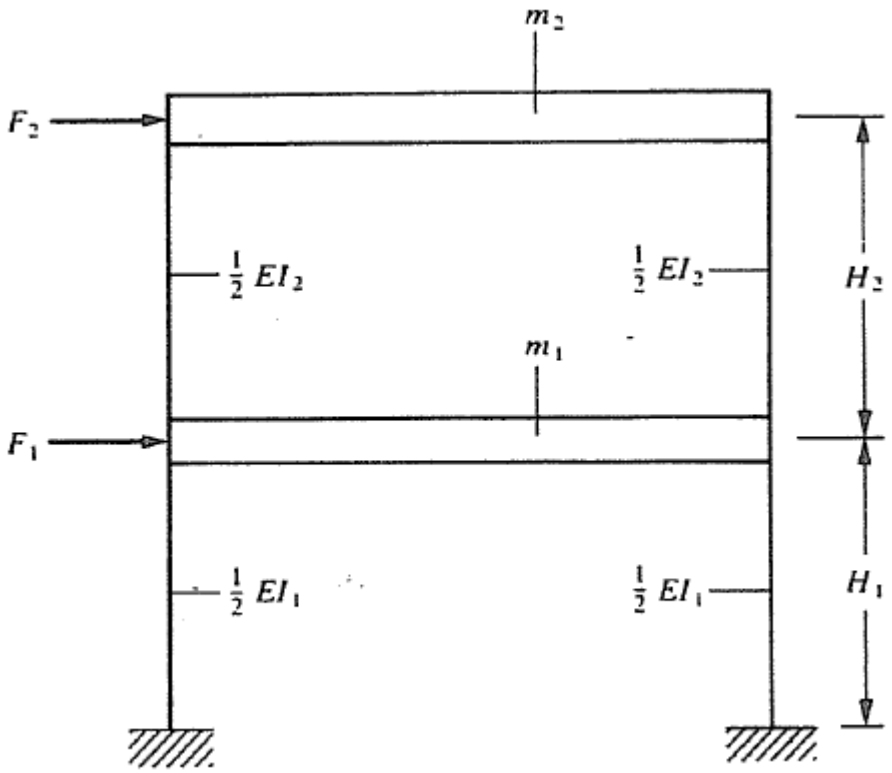
P2.1



Stiffness of a fixed-fixed beam:

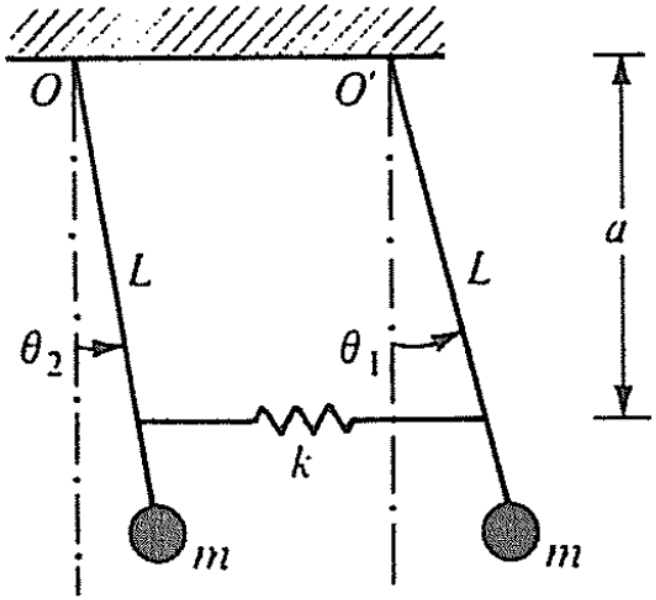
$$k = \frac{12EI}{H^3}$$

Derive the differential equations for the horizontal translation of the masses

Calculate the natural frequency of each mass

- Assume all Inertias are equal; assume only horizontal movement of masses.
- Apply m1 = m2; I1 = I2; H1 = H2

P2.2 – Beat Phenomenon



Initial conditions:

$\theta_1(0) = \theta_0$

$\theta_2(0) = \dot{\theta}_1(0) = \dot{\theta}_2(0) = 0$

$$\omega_{ave} = \frac{\omega_2 + \omega_1}{2} \qquad \frac{\omega_B}{2} = \frac{\omega_2 - \omega_1}{2}$$

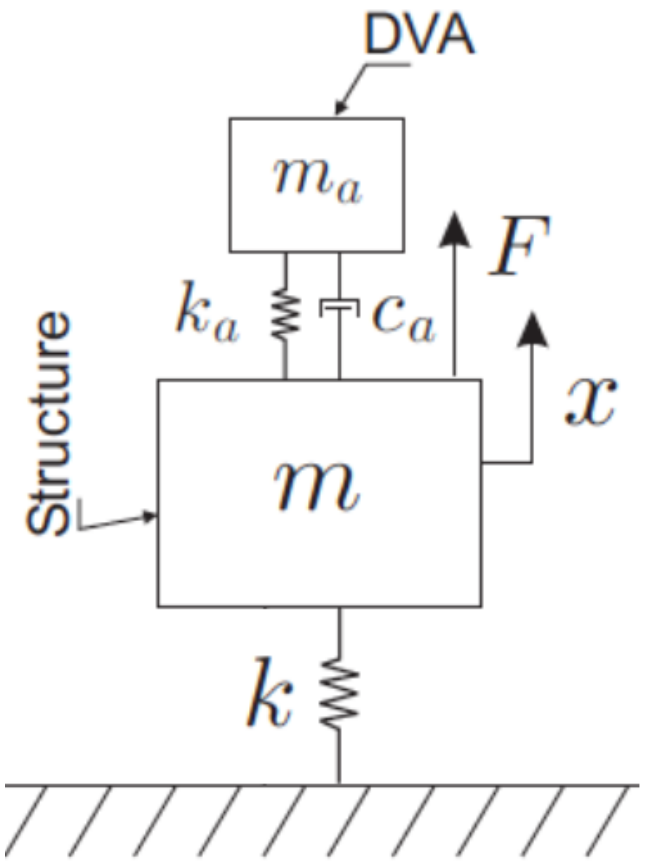
Show that with the initial conditions the amplitude can be expressed as:

$$\theta_1(t) \cong \theta_0 \cos \tfrac{1}{2}\omega_B t \cos \omega_{ave} t$$

$$\theta_2(t) \cong \theta_0 \sin \tfrac{1}{2}\omega_B t \sin \omega_{ave} t$$

- Using trigonometric relations and the assumption that $ka^2 << mgL$
- Apply simplification of small angles

P2.3 – Design of a DVA



M = 10kg
M_a = 1 kg
K = 3 kN/m

- Find the optimal values of c_a and k_a and calculate the maximum amplification