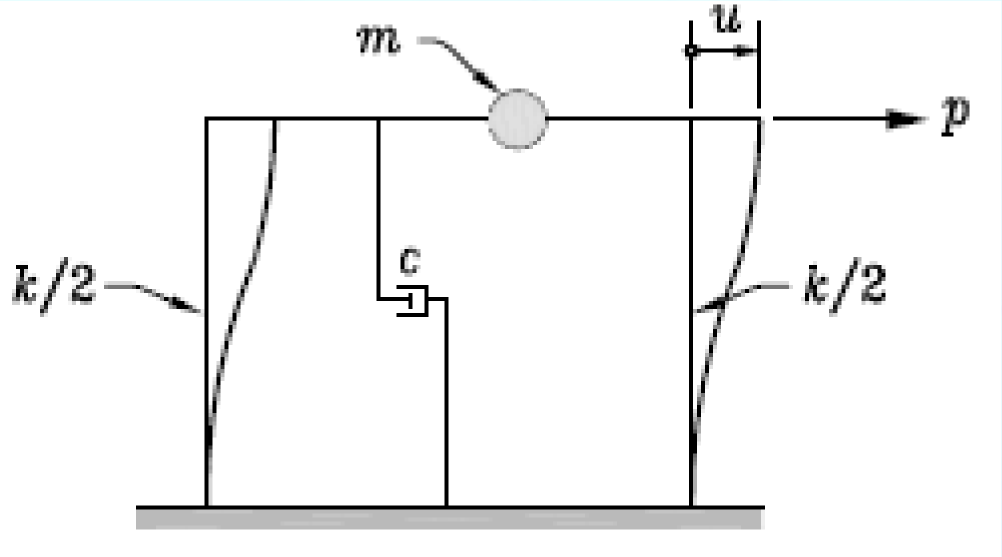
A one-story structure being tested in a laboratory is idealized by an infinitely rigid beam supported by two columns. The columns are considered flexible laterally but rigid axially. The mass of the columns is negligible when compared to the total mass m = 2500kg, which is concentrated at the level of the roof. A free vibration test is carried out in which the mass is displaced laterally by 6 mm and released instantaneously. The maximum displacement after 2 second at the end of four cycles is 3 mm. Compute



(a) The damping coefficient ξ,

(b) The damped angular frequency ω_d.

(c) The equivalent lateral stiffness of the frame k.

(d) The damping constant c,

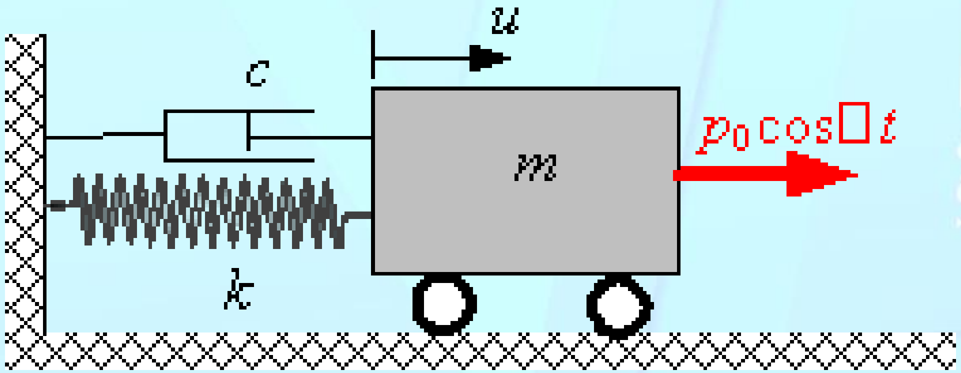
(e) The maximum displacement after 5 cycles.

A Structure having a mass of 120 kg and a translational stiffness of 36000 N/m is excited by a harmonic force with magnitude P_0=500 N and an operating frequency of 2 Hz. The damping ratio for the structure is 0.05. For the steady-state vibration determine

(a) The amplitude of the steady-state displacement

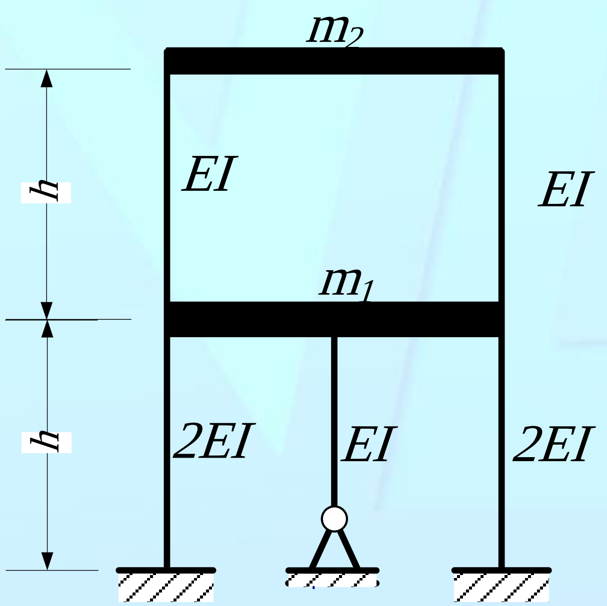
(b) Its phase with respect to the exciting force, and

(c) The maximum velocity of the response.



The shear frame shown in figure is constructed of rigid girders and flexible columns.

1. Find the lateral stiffness k_1 and k_2 of the two stories.
2. Write the general matrix equation of lateral free vibration of the frame.
3. Find the natural frequencies of the frame.
4. Find the vibration modes, then draw a small sketch for every mode respecting the boundary conditions.



$m_1 = 2m_2 = 36000$ kg

$EI/h^3 = 900$ kN/m

An undamped spring-mass system having a mass of m =5 kg and a spring of constant of k =2.88 N/mm is excited by a harmonic force with magnitude P_0=120 N and an operating frequency Ω=18 rad/sec.

If the initial displacement is 16 mm and the initial velocity is 120 mm/sec, determine

(a) The frequency ratio

(b) The amplitude of the steady state forced response

(c) The displacement of the mass at t=3 sec