Question #81302, Engineering / Mechanical Engineering

A machine f mass 1000 kg is supported on springs which deflect 8 mm under static load with negligible damping of the machine vibrates with an amplitude of 5 mm when subjected to a vertical harmonic force at 80 percent of the resonant frequency. When the damper is fitted it is found that the resonant amplitude is 2 mm. Find (I) Amplitude of the damping force and (ii) damping co-efficient

Solution

i) Amplitude of the damping force:

$$F = c\omega x_d$$

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{\frac{W}{\delta}}{m}} = \sqrt{\frac{\frac{mg}{\delta}}{m}} = \sqrt{\frac{g}{\delta}}$$

$$F = c\sqrt{\frac{g}{\delta}}x_d$$

$$F = 31516\sqrt{\frac{9.81}{0.008}}0.002 = 2207\ N.$$

ii) The damping co-efficient:

$$c = 2\sqrt{mk}\zeta = 2\sqrt{\frac{mW}{\delta}}\zeta = 2\sqrt{\frac{mmg}{\delta}}\zeta$$

$$X = \frac{x_{st}}{1-\beta^2} \rightarrow 5 = \frac{x_{st}}{1-0.8^2}$$

$$x_{st} = 1.8\ mm.$$

$$\frac{x_d}{x_{st}} = \frac{1}{2\zeta}$$

$$\frac{2}{1.8} = \frac{1}{2\zeta} \rightarrow \zeta = 0.45$$

$$c = 2\sqrt{\frac{(1000)^2(9.81)}{0.008}}0.45 = 31516\frac{Ns}{m}$$