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Natural Frequency of Free Transverse Vibrations Due to a Point Load Acting Over a Simply Supported Shaft

التردد الطبيعي للاهتزازات الطولية تحت تأثير الحمل لنقطه واحده على العمود البسيط المثبت بطرق مختلفة

Consider a shaft AB of length l, carrying a point load W at C which is at a distance of l_1 from A and l_2 from B, as shown in Fig.1. A little consideration will show that when the shaft is deflected and suddenly released, it will make transverse vibrations. The deflection of the shaft is proportional to the load W and if the beam is deflected beyond the static equilibrium position then the load will vibrate with simple harmonic motion (as by a helical spring). If δ is the static deflection due to load W, then the natural frequency of the free transverse vibration is

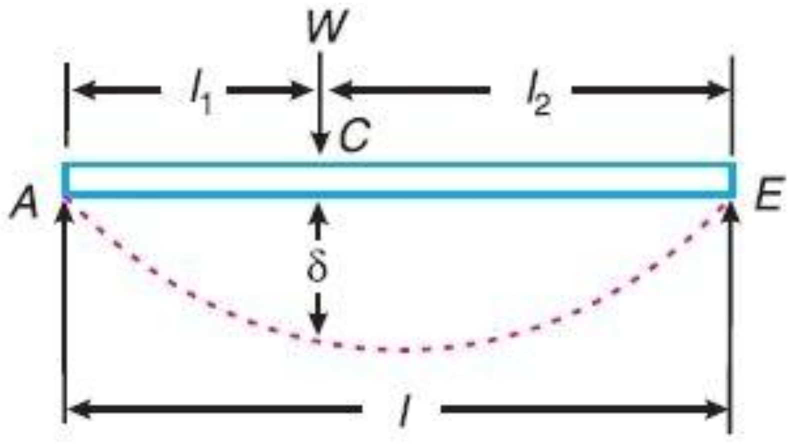


Fig. 1 Simply supported beam with a point load.

$$f_n = \frac{1}{2\pi}\sqrt{\frac{g}{\delta}} = \frac{0.4985}{\sqrt{\delta}} \text{ Hz} \qquad \text{. . . (Substituting, } g = 9.81 \text{ m/s}^2\text{)}$$

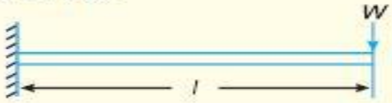
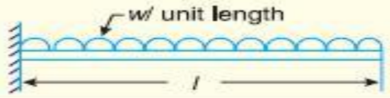
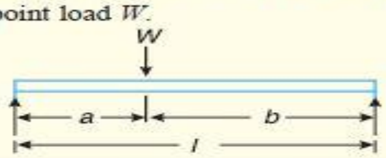
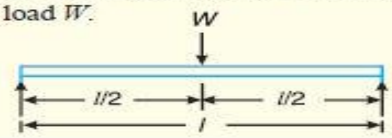
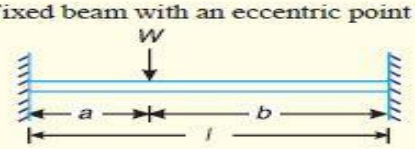
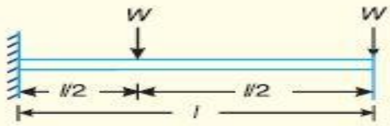
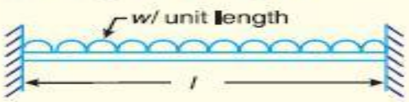
$$t_p = \frac{1}{f_n}$$

$$\omega_n = \sqrt[2]{\frac{g}{\sigma}}$$

Some of the values of the static deflection for the various types of beams and under various load conditions are given in the following table .

Table.1. Values of static deflection (δ) for the various types of beams and under various load conditions.

جدول رقم(1)حساب التشويه الاستاتيكي للأعمدة حسب نوع الحمل والتثبيت العمود .

S.No.	Type of beam	Deflection (δ)
1.	Cantilever beam with a point load W at the free end. 	$\delta = \frac{Wl^3}{3EI}$ (at the free end)
2.	Cantilever beam with a uniformly distributed load of w per unit length. 	$\delta = \frac{wl^4}{8EI}$ (at the free end)
3.	Simply supported beam with an eccentric point load W. 	$\delta = \frac{Wa^2b^2}{3EIl}$ (at the point load)
4.	Simply supported beam with a central point load W. 	$\delta = \frac{Wl^3}{48EI}$ (at the centre)
5.	Simply supported beam with a uniformly distributed load of w per unit length. 	$\delta = \frac{5}{384} \times \frac{wl^4}{EI}$ (at the centre)
6.	Fixed beam with an eccentric point load W. 	$\delta = \frac{Wa^3b^3}{3EIl}$ (at the point load)
7.	Fixed beam with a central point load W. 	$\delta = \frac{Wl^3}{192EI}$ (at the centre)
8.	Fixed beam with a uniformly distributed load of w per unit length. 	$\delta = \frac{wl^4}{384EI}$ (at the centre)