

STRENGTH AND STIFFNESS OF A STRUCTURE IN A DYNAMIC

STATE

The purpose of this investigation is to determine the effect of the strength and stiffness of a structure on the dynamic response of a system. The system is a single-degree-of-freedom system with a mass m and a spring constant k . The system is subjected to a harmonic excitation of the form $F \sin \omega t$, where F is the amplitude of the excitation and ω is the angular frequency.

The equation of motion for the system is given by $m \ddot{x} + kx = F \sin \omega t$, where x is the displacement of the mass from its equilibrium position. The steady-state response of the system is given by $x = X \sin \omega t$, where X is the amplitude of the response.

The amplitude X is a function of the frequency ω and is given by $X = \frac{F}{k \sqrt{1 - \omega^2/\omega_n^2}}$, where ω_n is the natural frequency of the system. The natural frequency is given by $\omega_n = \sqrt{k/m}$.

The dynamic response of the system is characterized by the ratio of the amplitude of the response to the amplitude of the excitation, known as the magnification factor. The magnification factor is given by $M = \frac{X}{F/k} = \frac{1}{\sqrt{1 - \omega^2/\omega_n^2}}$.

The magnification factor is a function of the frequency ratio ω/ω_n and is shown in Figure 1. The magnification factor increases as the frequency ratio increases, and it becomes infinite as the frequency ratio approaches 1. This is the condition of resonance.

The effect of the strength and stiffness of the structure on the dynamic response of the system is shown in Figure 2. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.

It is seen from Figure 2 that the magnification factor increases as the strength and stiffness of the structure increase. This is because a stiffer and stronger structure has a higher natural frequency, which results in a higher magnification factor for a given frequency ratio.

The effect of the strength and stiffness of the structure on the dynamic response of the system is also shown in Figure 3. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.

It is seen from Figure 3 that the magnification factor increases as the strength and stiffness of the structure increase. This is because a stiffer and stronger structure has a higher natural frequency, which results in a higher magnification factor for a given frequency ratio.

The effect of the strength and stiffness of the structure on the dynamic response of the system is also shown in Figure 4. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.

It is seen from Figure 4 that the magnification factor increases as the strength and stiffness of the structure increase. This is because a stiffer and stronger structure has a higher natural frequency, which results in a higher magnification factor for a given frequency ratio.

The effect of the strength and stiffness of the structure on the dynamic response of the system is also shown in Figure 5. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.

It is seen from Figure 5 that the magnification factor increases as the strength and stiffness of the structure increase. This is because a stiffer and stronger structure has a higher natural frequency, which results in a higher magnification factor for a given frequency ratio.

The effect of the strength and stiffness of the structure on the dynamic response of the system is also shown in Figure 6. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.

It is seen from Figure 6 that the magnification factor increases as the strength and stiffness of the structure increase. This is because a stiffer and stronger structure has a higher natural frequency, which results in a higher magnification factor for a given frequency ratio.

The effect of the strength and stiffness of the structure on the dynamic response of the system is also shown in Figure 7. The figure shows the magnification factor M as a function of the frequency ratio ω/ω_n for different values of the strength and stiffness of the structure.