EXPERIMENT 6
MODES OF VIBRATION OF SIMPLY SUPPORTED PLATE

OBJECTIVES

This simulation experiment aims to study the modes of vibrations of a square plate simply supported on all edges.

INTRODUCUTION

In this simulation based experiment, the simply supported plate is considered as a distributed system, rather than a discrete system. The distributed systems are considered to be composed of infinite number of infinitesimal mass particles. Theoretically, they possess an infinite number of degrees of freedom (DOF). However, only the first few modes (say three or five) are much significant. It is thus not necessary to study the higher modes.

This computational model of a square plate simply supported on all edges (see Fig. 1) is based on distributed system. By using this online simulation, the user can easily determine the natural frequencies of plate as well as the corresponding mode shapes. In addition, there is an exercise for user. The user can plot a graph between natural frequency and length of plate keeping all others factors constant. Similarly, relation between natural frequency and the Young's modulus of elasticity can be studied.

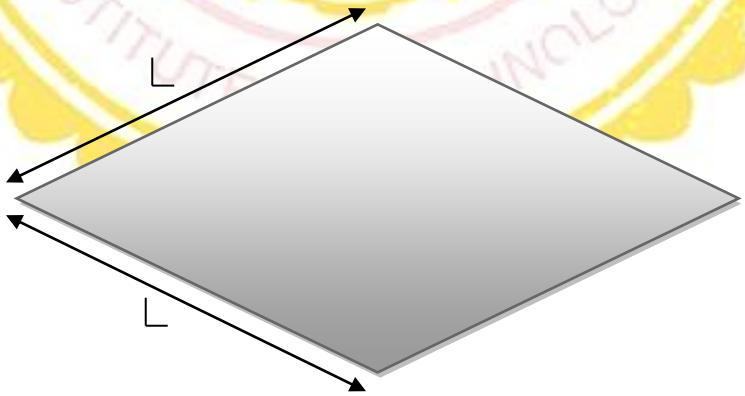

Fig. 1: Square plate simply supported on all four edges

THEORY

For simply supported plate, the frequencies f_n and the mode shapes $\phi(x,y)$ are given by (Mukhopadhyay, 2006)

$$f_n = \frac{\pi(m^2+n^2)}{2L^2}\sqrt{\frac{D}{\rho t}} \tag{1}$$

$$\phi(x,y) = \sin\left(\frac{n\pi x}{L}\right)\sin\left(\frac{m\pi y}{L}\right) \tag{2}$$

where, the parameter D is given by

$$D = \frac{Et^3}{12(1-\nu)} \tag{3}$$

where L is the length of the plate (assumed square) and n and m are the number of troughs/crests in x and y directions respectively. Further, E is the Young's modulus of elasticity, ρ the density, t the thickness of the plate and ν the Poisson's ratio. User can simulate different modes of vibration of simply supported plate and observe the vibration pattern.

REFERENCES

1. Chopra, A. (2001), Dynamics of Structures, Prentice Hall of India limited, New Delhi.

2. Mukhopadhyay, M. (2006), Structural Dynamics Vibrations and Systems, Ane Books India, New Delhi.

3. Paz, M. (2004), Structural Dynamics: Theory and Computations, 2nd ed., CBS Publishers and Distributors, New Delhi.