Chapter 3
Multi-Degrees of Freedom System and Hydrodynamic Principle

ABSTRACT

A system with one degree of freedom is far from reality, because we do not take into account all the degrees of freedom. In order to be close to the reality, it is necessary to use a system with several degrees of freedom. Efforts in this chapter are concentrated to the study of multi-degrees of freedom system, whether for a free undamped and forced damped system, by detailing the modal superposition method as well as a coupled coordinates. We finish the chapter with hydrodynamic study using Hozner method as well as some applications.

INTRODUCTION

A system with one degree of freedom is far from reality, because we do not take into account all the degree of freedom. In more complicated structures, it is necessary to use a system with several degrees of freedom, to obtain a satisfactory dynamic model. A real system, generally comprises several masses, connected together by elements of the spring and damper type, in general, there is six degree of freedom for each node three displacements and three rotations. This chapter is devoted solely to the development of all equations concerning construction of an analytical as well as mathematical model of free, forced damped and undamped multi-degrees of freedom vibration linear system linear at the end the hydrodynamic study is detailed using Hozner method .

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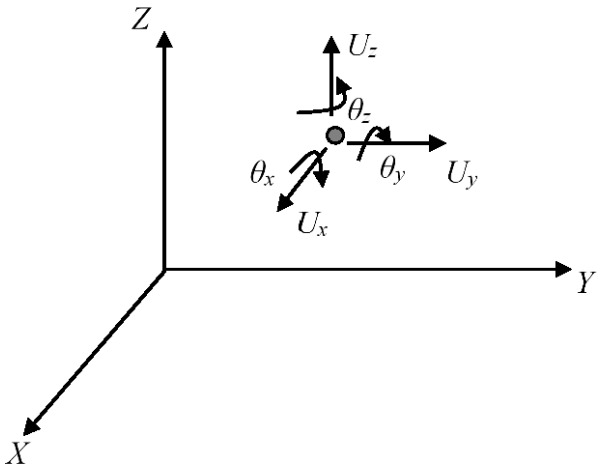
Figure 1. Six space degree of freedom



In the case of an undamped free vibration the equation of motion of a single degree of freedom system (SDOF) is*:* $M\ddot{U} + K\,U = 0$ is it supposed.

$U(t) = Ge^{st} = A\cos\omega t + \beta\sin\omega t$

We found

$$U(t) = \sqrt{U(0)^2 + \left(\frac{\dot{U}(0)}{\omega}\right)^2}\cos\left(\omega t - \theta\right)$$

With

$$\theta = \tan^{-1}\left(\frac{\dfrac{\dot{U}(0)}{\omega}}{U(0)}\right)$$

On the other hand, for a system with several degrees of freedom we have to manipulate matrices and vectors because the equation of motion becomes.

$$\left[M\right]\left\{\ddot{U}\right\} + \left[K\right]\left\{U\right\} = 0$$