Chapter 1
Free Vibration of Single Degree of Freedom Linear Oscillator

ABSTRACT

This chapter is dedicated to understanding and studying a didactic case represented by a free vibration of a linear oscillator with a single degree of freedom. Mathematical equations of the problem will be detailed as well as the solution that goes with single degree of freedom oscillator for translational vibration for all cases: free undamped oscillator, as well as free damped oscillator, and torsional free undamped vibration passing by critical, subcritical, and over damping system. At the end of the chapter, some examples will be treated.

INTRODUCTION

This chapter is devoted solely to the development of all equations concerning construction of an analytical as well as mathematical model of a free vibration system linear oscillator.

All structures are complex because a structure contains several elements, the simplest element contains two nodes and each node has six degree of freedom (dof), three displacements and three rotations. The goal is to try to minimize the number of these equations.

To reduce the number of equations, we will make a simple mathematical model that will reflect as much as possible the real structure shown in Figure 1.

In this case, a column with the same physical and mechanical characteristics replaces the metallic structure, and the mass M replaces the platform (see Figure 2).

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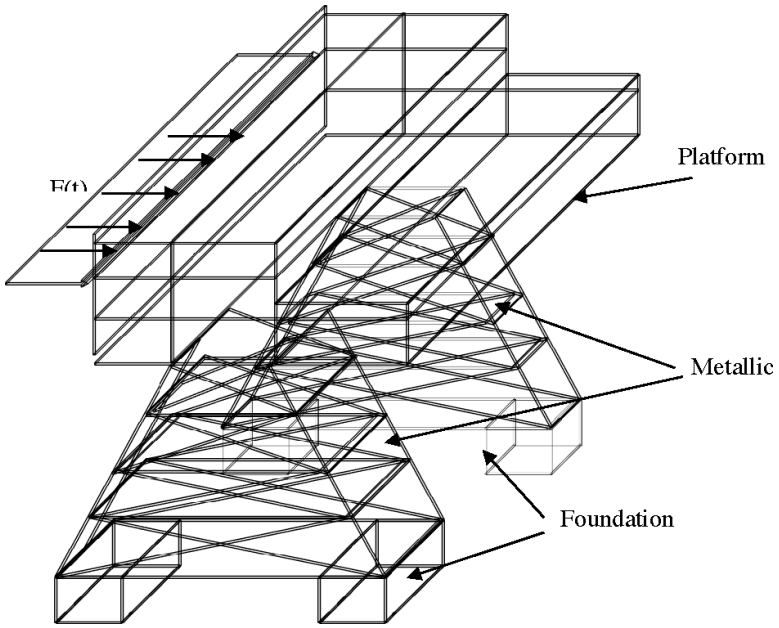
Figure 1. Complex structure



DYNAMIC MOTION EQUATION OF A FREE UNDAMPED OSCILLATOR

The simplest vibrating mechanical system is constituted by a point mass m, subject to frictionless displacement on an axis Ox. The spring force of a stiffness K and a neglected mass is the only force exerted on this mass (see figure 2). This system has a single degree of freedom because the position of the mass m is represented by a single variable U(t) which is the variation of m with respect to its equilibrium position.

Figure 2. Simplest model (mass stiffness)