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Review on Euler- Bernoulli Beam subjected to Partially Distributed Load

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ABSTRACT: This paper investigates the dynamic behavior of beams most especially the Euler-Bernoulli beam with structural damping coefficient subjected to Partially Distributed Moving Loads. The governing Partial differential equation is solved using analytical-numerical method. It is observed that as damping increases keeping the fixed length of the beam constant.

KEYWORDS: Euler-Bernoulli Beam, Partially distributed load, Moving Load, Damping.

I. INTRODUCTION

Vibration is mostly defined as oscillating motion. Beam is a piece of horizontal structure that is usually supported at both ends. It can be in form of wood, metal or plastic, this is concerned with the theory describing the respond of elastic structure under the influence of partially distributed moving loads. The primary aim of this paper is to study the vibration of beams traversed by uniformly distributed moving loads. Then, the flexural motion of elastic structure will be analyzed.

Vibration of beams due to moving loads is a field of interest in mechanical, industrial and civil engineering. Vibrations of this kind occur in running, railways, bridges, beam subjected to pressure waves and piping systems subjected to two phases flow. The most obvious example of structure subjected to partially distribute moving loads is railway bridges. Furthermore, there is a form of interaction between the motion of the bridge and suspension of the vehicle. The moving loads may be roughly divided into three groups; moving oscillators, moving mass and moving forces [1, 2, 3, 4]. Esmailzeal, E. studied the vibrations of beams due to a moving arbitrary force. He considered the effects of beam damping, boundary conditions and the speed of the moving load [5]. Some load applied statically especially if the riding surface is uneven [6,7,8]. In general, there are two types of theory of flexural motion of elastic structure.

(i) the thick-structure theory which account for the effect of shear deformation and rotatory inertia while, (ii) the classical thin structures neglects the effects of shear information and rotatory inertial. This paper has therefore been motivated by the above stated observation. An investigation into the dynamic response of a Bernoulli-beam resting on a Winkler foundation subjected to partially distributed moving load is presented, the resulting coupled partial differential equation is solved using finite difference method [6,7].

Damping is the process by which vibration steadily diminishes in amplitude while the beam is non-prismatic.

When loads act on a structure, they produce stress and deformations. Loads could be of constant or variable magnitudes. They could also be static or dynamic. Dynamic loads are generally functions of time which may or not continually change position.

The problem of carrying out a dynamic of structures under moving loads is known as moving load problem, such moving load problem are of practical importance. The most obvious examples of structure subjected to moving load is highway and railways bridges.

There are two classes of moving loads problem, the first class consist of problem involving a concentrated forces (masses) moving with a specified velocity, while the other class deals with the problem of Vibration analysis of structure due to Partially distributed moving forces (masses)[8,9].

II. GOVERNING EQUATION

Consider a non-prismatic Euler-Bernoulli Beam of length L resting on Winkler foundation and traversed by uniform partially distributed moving mass. The resulting vibrational behavior of this system is described by the following equation.

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$$\frac{EI}{M_1} w_{xxxx}(x,t) + \frac{\lambda_0}{m_i} wt^{(x,t)} + \frac{k}{m_i} w_u(x,t) + w_{tt}(x,t)$$
$$= \frac{1}{\in}\left[-m_g - \frac{md^2w}{dt^2}\left\{H\left(x-\in+\frac{\in}{2}\right) - H\left(x-\in-\frac{E}{2}\right)\right\}\right]$$

Where,

$$\gamma_0(x,t) = \frac{1}{\in}\left[-m_g - m\frac{d^2w}{dt^2}\left\{H\left(\in+\frac{\in}{2}\right) - H\left(x-\in+\frac{\in}{2}\right)\right\}\right]$$

Where,

$$w(x,t) = \sum_{i=1}^{\infty} X_i(x), \lambda_j(t)$$

and

$$\gamma_0(x,t) = \sum_{i=1}^{\infty} X_i(x), \lambda_j(t)$$

Over the condition, $w(0,t) = w(\pi,t) = w_{xx}(0,t) = w_{xx}(\pi,t) = 0.$

$$\frac{EI}{M_1} W_{xxxx}^{(x,t)} + \frac{\lambda_0}{m_i} W_t^{(x,t)} + \frac{K}{M_i} w(x,t) + W_{tt}(x,t)$$
$$= \frac{1}{\in}\left[-M_g - m\frac{d^2w}{dt^2}\left\{H\left(x-\in+\frac{\in}{2}\right) - H\left(x-\in-\frac{E}{2}\right)\right\}\right]$$

Where $W(x,t) = \sum_{i=1}^{\infty} X_i(x), \gamma_j(t)$, λ_0 Is viscous Damping Co-efficient, K is Coefficient of Winkler foundation (force per length square). M_i is mass of the beam. X is the axial coordinate, t is Time, u is velocity, E is Modulus of Elasticity, M is of the load , EI is the flexural rigidity of the beam , I is Moment of inertia, g is Acceleration due to gravity, $W(x,t)$ is the lateral deflection of the beam measured upward from its equilibrium position when unloaded.

III. CONCLUSION

The purpose of this paper is to obtain the insight knowledge of Euler-Bernoulli Beam from the available literature and accordingly to develop the formulation. As obtained the results searched from literature, one can observe that the fixed length of the load increase as the amplitude of the deflection increases. Also, the time, t, increases with an increase in the amplitude of the deflection. It was observed that the amplitude of the deflection increases as the value of r increases. From the formulation as above, an Euler-Bernoulli beam resting on Winkler foundation to partially distributed load may be analysed.

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