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A REVIEW ON VIBRATION ANALYSIS OF A STEPPED CIRCULAR AND SQUARE BEAM WITHAND WITHOUT ABSORBERS

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ABSTRACT

Beams with variable cross-sectional and material properties square measure oftimes employed in physical science engineering, applied science and engineering (e.g., rotor shafts, beams, columns and functionally rankedbeams). Stepped beam-like structures square measure wide employed in varied engineering fields, likemechanism arm and tall building, etc. Beams square measure a standout amongst the foremost typically used structural elements at intervals varied structural components in varied engineering applications and skill a good accumulation of static and part hundreds. Fracture could produce in beam like structures due to such hundreds. The progressions of cracks will severely decrease the stiffness of a component and more cause the failure of the whole structure. Fractures or totally different blotch in a very element of structural sort impact its conduct dynamically and remodel the coagulate and damping properties. Hence, the frequency occurred naturally and mode pattern of the structure hold knowledge concerning the position and measurements of the defect. The natural frequencies square measure decides of steeped beam in cantilever position while not damper. The frequenciessquare measure decides for 3 totally different materials like steel, Copper, Aluminum. During this thesis the study of cantilever beam with damper conjointly carried out and therefore the results square measure compared with natural frequency of beam while not damper.

I INTRODUCTION

Many developments are administrated so as to do to quantify the consequences created by dynamic loading. samples of structures wherever it's significantly necessary to think about dynamic loading effects area unit the development of tall buildings, long bridges underneath wind-loading conditions and buildings in earthquake zones, etc. Dynamic structures subjected to periodic masses compose a really necessary a part of industrial machineries. one in all the most important issues in these machineries is that the fatigue and also the cracks initiated by the fatigue. These cracks area unit the foremost necessary reason for accidents and failures in industrial machinery. Additionally, existing of the cracks might cause vibration within the system. Therefore associate correct and comprehensive investigation regarding vibration of cracked dynamic structures looks to be necessary.

In case of a free vibration study of a structure the most objective is to work out the natural frequencies resembling varied modes of vibration of the system. Many completely different completely different} techniques and methodologies are adopted for this purpose by different researchers. Vibration investigation of a beam is a crucial and peculiar subject of study in engineering science. All real physical structures, once subjected to masses or displacements, behave dynamically. The extra inertia forces, from Newton's second law, area unit capable the mass times the acceleration. If the masses or displacements area unit applied terribly slowly then the inertia forces is neglected and a static load analysis is even. Hence, dynamic analysis may be a easy extension of static analysis.

On the bottom of those investigations the cracks is known well before and acceptable measures is taken to forestall a lot of harm to the system attributable to the high vibration level. Typical things wherever it's necessary to think about a lot of exactly the response created by dynamic loading area unit vibrations attributable to instrumentation or machinery, impact load created by traffic, snatch loading of cranes, impulsive load created by blasts, earthquakes or explosions. Therefore it's important to check the dynamic nature of structures. Engineering structures area unit designed to face up to the masses they're expected to be subject to whereas in commission. Among them Beams area unit a standout amongst the foremost sometimes utilized structural elements among varied structural parts in various engineering applications and skill a good mixture of static and component masses. Beams area unit wide used as structural elements in engineering applications and additionally give a basic model for several engineering applications. craft wings, eggbeater rotor blades, ballistic capsule antennae, and mechanism arms area unit all samples of structures which will be sculpturesque with beam-like parts. Beam type structures area unit being usually utilized in steel formed structure and producing of machines.

Beams with variable crosswise and/or material properties area unit oft utilized in physics engineering (e.g., rotor shafts and functionally stratified beams), engineering science (e.g., mechanism arms and crane booms), and engineering (e.g., beams, columns, and steel composite floor slabs within the single direction loading case). Stepped beam-like structures area unit wide utilized in varied engineering fields, like mechanism arm and tall building, etc. so there's a necessary that construction ought to firmly work throughout its service amount. But, wreck initiates a failure span on structure. the moment changes introduced into a structure, either purposely or accidentally that ends up in adverse result this or future performance of that structure is outlined as harm. Harm is one in all the necessary aspects in structural analysis as a result of safety reason in addition as economic process of the industries

1.1. Overview

Beams are fundamental models for the structural elements of many engineering applications and have been studied extensively. There are many examples of structures that may be modeled with beam-like elements, for instance, long span bridges, tall buildings, and robot arms, beams as well as the presence of cracks in the structural components can have a significant influence on the dynamic responses of the whole structure; it can lead to the catastrophic failure of the structure. To predict the Failure, vibration monitoring can be used to detect changes in the dynamic responses and/or dynamic characteristics of the structure. Knowledge of the effects of cracks on the vibration of the structure is of importance. Efficient techniques for the forward analysis of cracked beams are required. In this thesis various techniques or approaches that can analyze the vibration of beams or structures with or without cracks.

1.2. Historical Prospective

Beams are fundamental models for the structural elements of many engineering applications and have been studied extensively. There are many examples of structures that may be modeled with beam-like elements, for instance, long span bridges, tall buildings, and robot arms. The vibration of Euler–Bernoulli beams with one step change in cross-section has been well studied. Jang and Bert (1989) derived the frequency equations for combinations of classical end supports as fourth order determinants equated to zero. Balasubramanian and Subramanian (1985) investigated the performance of a four-degree-of-freedom per node element in the vibration analysis of a stepped cantilever.

1.3. Introductions to vibration

Vibrations are time dependent displacements of a particle or a system of particles with respect to an equilibrium position. If these displacements are repetitive and their repetitions are executed at equal interval of time with respect to equilibrium position the resulting motion is said to be periodic. One of the most important parameters associated with engineering vibration is the natural frequency.. Each structure has its own natural frequency for a series of different modes which control its dynamic behavior. Whenever the natural frequency of a mode of vibration of a structure coincides with the frequency of the external dynamic loading, this leads to excessive deflections and potential catastrophic failures. This is the phenomenon of resonance. An example of a structural failure under dynamic loading was the well-known Tacoma Narrows Bridge during wind induced vibration.

Every structure which is having some mass and elasticity is said to vibrate. When the amplitude of these vibrations exceeds the permissible limit, failure of the structure occurs. To avoid such a condition one must be aware of the operating frequencies of the materials under various conditions like simply supported, fixed or when in cantilever conditions.

II CLASSIFICATION OF VIBRATION

Vibration can be classified in several ways. Some of the important classifications are as follows:

2.1 Free and forced vibration

If a system, after an internal disturbance, is left to vibrate on its own, the ensuing vibration is known as free vibration. No external force acts on the system. The oscillation of the simple pendulum is an example of free vibration. If a system is subjected to an external force (often, a repeating type of force), the resulting vibration is known as forced vibration. The oscillation that arises in machineries such as diesel engines is an example of forced vibration. If the frequency of the external force coincides with one of the natural frequencies of the system, a condition known as resonance occurs, and the system undergoes dangerously large oscillations. Failures of such structures as buildings, bridges, turbines and airplane have been associated with the occurrence of resonance.

2.2 Undammed and damped vibration

If no energy is lost or dissipated in friction or other resistance during oscillation, the vibration is known as undamped vibration. If any energy lost in this way, however, it is called damped vibration. In many physical systems, the amount of damping is so small that it can be disregarded for most engineering purposes. However, consideration of damping becomes extremely important in analyzing vibratory system near resonance.

2.3 Linear and nonlinear vibration

If all the basic components of vibratory system—the spring, the mass and the damper—behave linearly, the resulting vibration is known as linear vibration. If however, any of the basic components behave non-linearly, the vibration is called nonlinear vibration.

III INTRODUCTION TO BEAM

A beam is generally considered to be any member subjected to principally to transverse gravity or vertical loading. The term transverse loading is taken to include end moments. There are many types of beams that are classified according to their size, manner in which they are supported, and their location in any given structural system.

IV LITERATURE REVIEW

[1]. M. Behzad, a. Meghdari, a. Ebrahimi-Mechanical Engineering Department, Sharif University of Technology, Tehran, Asian nation studied during this paper that the equations of motion associate degreed corresponding boundary conditions for bending vibration of a beam with an open edge crack has been developed by implementing the Hamilton principle. the same Euler-Bernoulli beam has been employed in this study. The natural frequencies of this beam are calculated exploitation the new developed model in conjunction with the Galerkin projection technique. The crack has been sculptural as never-ending disturbance perform in displacement field that may well be obtained from fracture mechanics. The results show that the natural frequencies of a cracked beam cut back by increasing crack depth. there's a superb agreement between the in theory calculated natural frequencies and people obtained exploitation the finite component technique

[2]. Z.R. Lu, M. Huang and J.K. Liu national leader University P.R. China build the analysis by exploitation new approach i.e. CME in Vibration Analysis of Beams with and while not Cracks exploitation the Composite component Model. Beams are basic models for the structural components of the many engineering applications and are studied extensively. There ar several samples of structures that will be sculptural with beam-like components, for example, long span bridges, tall buildings, and mechanism arms. The vibration of Euler–Bernoulli beams with one step amendment in cross-sectional has been well studied.

[3]Chandra Kishen, et al. has studied the fracture behavior of cracked beams and columns exploitation finite component analysis. Assumptive that failure happens because of crack propagation once the mode I stress intensity issue reaches the fracture toughness of the fabric, the failure load of cracked columns are determined for various crack depths and slenderness ratios.

[4]Sahin M. et al. presents a harm detection formula employing a combination of worldwide (changes in natural frequencies) and native (curvature mode shapes) vibration-based analysis knowledge as input in artificial neural networks (ANNs) for location and severity prediction of harm in beam-like structures. A finite component analysis tool has been accustomed acquire the dynamic characteristics of intact and broken cantilever steel beams for the primary 3 natural modes. totally different completely different} harm eventualities are introduced by reducing the native thickness of the chosen components at different locations on finite component model (FEM) of the beam structure.

5]Douka E.et al. have investigated the influence of 2 thwart wise open cracks on the entiresonances of a double cracked cantilever beam each analytically and through an experiment. it's shown that there's a shift within the entiresonances of the cracked beam reckoning on the placement and size of the cracks. These entiresonances changes, complementary with natural frequency changes, are often used as extra info carrier for crack identification in double cracked beams.

[6]Yoona Han-Ik et al. have investigated the influence of 2 open cracks on the dynamic behavior of a double cracked merely supported beam each analytically and through an experiment. The equation of motion comes by exploitation the Hamilton's principle and analyzed by numerical technique. The merely supported beam is sculptural by the Euler-Bernoulli beam theory.

[7]Papadopoulos et al. have used a technique is applied in rotating cracked shafts to spot the depth and also the location of a thwart wise surface crack. An area compliance matrix of various degrees of freedom is employed to model the thwart wise crack in a very shaft of circular cross section, supported obtainable expressions of the strain intensity factors and also the associated expressions for the strain energy unharness rates.

V OBJECTIVE OF THE STUDY

To study the free undulation analysis of uniform cantilever beams of varied cross sections like rectangular and circular, stepped beams and study the results of position of steps, Step depth and variety of step gift within the beams..

The objective of this analysis is to review and simulate the vibration characteristics of a vibration of a cantilever beam while not and with hooked up absorbers, supported the analysis, there are many objectives that require realizing.

i. To see the vibration reduction of one vibration absorbent material attach to a beam

ii. To research the result of mass and damping on the absorbent material performance.

iii. To see the result of attaching vibration absorbent material to cut back vibration level of a cantilever beam.

VI CONCLUSION

The vibration behavior of circular and rectangular uniform as well as stepped beams is influenced bythe geometry, material, location and size. The paper study shows that various authors works on vibration analysis of beams with and without cracks

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