EXPERIMENTAL & ANALYTICAL INVESTIGATION OF E GLASS EPOXY CANTILEVER BEAM FOR CRACK IDENTIFICATION.

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ABSTRACT

In many field like civil, mechanical, naval & aeronautical engineering beams are broadly used. So that crack identification is main issue as due to existence of cracks changes the physical characteristics of a structure. The vibration parameters such as natural frequency, mode shape, stiffness and modal damping affected by presence of crack performance of structure is also affected. This work is to model an inclined crack in a composite material (E Glass Epoxy) cantilever beam and analyze the model using FEA as well as experimental. This proposed method is based on natural frequencies and mode shape of the beam. The using specimen having cracks of different depth and position of FEA results are obtained. By using FFT analyzer experiment is carried out. In this experiment the relationship between the natural frequencies, crack position, crack seriousness has to be studied but the certain relation that to study between crack depth and natural frequency.

Keyword: -Crack detection, natural frequency, vibration based inspection, Non-Destructive Testing (NDT), Transverse Vibration.

1. INTRODUCTION

In the present day, composite materials are being used more often in many different engineering fields. In all field such as automobile, aerospace, naval, and civil industries all use composite materials. The popularity of composite materials are acquisition because of high strength, low weight, resistance to corrosion, impact resistance and high fatigue strength. To meet almost any application other advantages include ease of fabrication, flexibility in design, and variable material properties. The possibility to combine high strength and stiffness with low weight has also got the attention of the automobile industry.

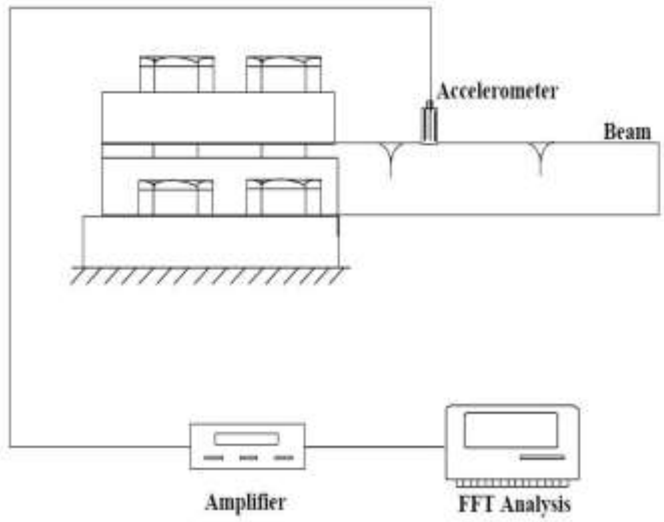
Beams like elements are principal constituents of many mechanical structures and its used widely in high speed machinery, aircraft and light weight structures. Such as robot arms, rotating machine parts, and helicopter and turbine blades which are widely used as movable elements in structural member of fiber-reinforced laminated beams. Similar to other structural components, beams are subjected to dynamic excitations. The basic requirement of engineers is to reduce the vibration of such structures. The first method to reduce the vibration of a structure is to move its natural frequencies away from frequency of excitation force. In beam structures the number of methods to identify the natural frequencies. In any continuous structure has infinite degrees of freedom, an infinite number of natural frequencies and the corresponding modal shapes. The vibration amplitude grows rapidly with time requiring a very low input energy if a structure vibrates with a frequency equal to a natural one. As a result, the structure either fails by overstressing, or the nonlinear effects limit the amplitude to a large value, leading to high-cycle fatigue damage.

2. METHODOLOGY

In this analysis the beam element is taken to carryout vibration analysis, because, In engineering design and construction the beam represents one of the most important structural members. The the examples of cantilever beam are mounting brackets, cranes. In conditioning based monitoring this method can be used, which results in reduce the loss of time and money. Crack is relatively new. Generally, for monitoring the crack mode frequencies are used because modal frequencies are properties of the whole component. In the component, the measurements of natural frequencies of machine component at two or more stages of its life offer the possibility of locating damage. If frequencies measured before the component put into service, subsequent frequency measurements could be used to test whether the structure is still sound or not. Due to crack at different locations & depth along the free length of the beam the analytical equation can be developed using the natural frequency. In the beam element as a model to represent the crack in the structure the method adopts weightless torsional spring. The severity of the crack indicated by the stiffness of the spring as here we have to measure the natural frequency. Without altering the results, Natural frequency which is global parameter can be measured at any location. So that this is the most convenient as it can be measured at any location e.g. bridges or large structures,but the alternate methods of energy are still cumbersome. In theoretical analysis the crack is simulated by a spring, connecting the two segments of the beam. The caracteristic equation obtained from the vibration analysis of Eluer-Bernoulli beam is manipulated to give the relationship between the stiffness & location of crack. By using finite element method the model of beam is generated. To begin with, natural frequencies for un-cracked beam found out by FEM and the results are compared with the experimental results. Crack has been developed of known dimensions at known location. Due to the induced crack the natural frequency is reduced. Plots of the spring stiffness verses crack location are obtained for the three lowest transverse modes using the derived relation. There common intersection point will give the crack location & corresponding stiffness. Further the crack size can be estimated from the standard relation between stiffness & crack size.

3. EXPERIMENT SETUP

In this experimental consists of the test instruments as shown in block diagram, the test specimens and a clamping fixture. The entire experimentation is depending on the cantilever condition of the beam under investigation. But the cross section of the beam is rectangular. The requirement of the cantilever condition is at the fixed end deflection as well as slope should be zero. In foundation for the clamping fixture a T-slotted machine bed is used as a to have very low frequencies. In experimental setup fixing the accelerometer at one location and impacting the structure at one point and move the accelerometer one points to another point of interest. The hammer impact on the end beam nearly constant force over a broad frequency range and is therefore capable of exciting all resonances in constant range. The modal parameters impart by Frequency Response Function (FRF). The instrument used for experimental analysis i.e. measurement of natural frequencies are FFT analyzer, accelerometer, impact hammer and related accessories. The dimension of e glass epoxy cantilever beam specimen are (400mm x 25mm x 10mm) with and without crack is subjected to number of experimentation has to be carried out for determining the natural frequencies. The structure under consideration to achieve reproducibly of first three natural frequencies. At end of the beam the accelerometer is attached. The impact hammer is used to vibrate the beam. Experimental modal analysis is carried out to determination of dynamics properties such as natural frequency and mode shapes. With the help of cutter or laser cutter cracks are developed at different location from fixed end. At different crack location crack depth the natural frequencies of first three models are noted.



4. CONCLUSION

1. Frequencies and mode shapes are two important parameters that determine location and crack size of the crack is observed.
2. The effect of various parameters like crack location, crack size, crack depth, crack inclination on the dynamic behavior of structures subjected to vibration .This are the some researchers have considered composite structures in their study to analyze.
3. Researchers are concentrate using Artificial Neural Network (ANN), fuzzy Logic and genetic Algorithm as an effective tool for damaged structures and vibration analysis.
4. The condition of experiment are significant on the dynamic behavior of the structure.

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