A Review Paper on - Analysis of Crack Failure of RCC Beam Using Fem

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Abstract— The most common structural defect is the existence of a crack. Cracks are present in structures due to various reasons. The presence of a crack could not only cause a local variation in the stiffness but it could affect the mechanical behavior of the entire structure to a considerable extent. Cracks may be caused by fatigue under service conditions as a result of the limited fatigue strength. They may also occur due to mechanical defects. Another group of cracks are initiated during the manufacturing processes. Generally they are small in sizes. Such small cracks are known to propagate due to fluctuating stress conditions. If these propagating cracks remain undetected and reach their critical size, then a sudden structural failure may occur. Hence it is possible to use natural frequency measurements to detect cracks. In this paper we are presenting review of literatures related to our topic.

Keywords: Analysis, Beam, Failure, Strength, Cracks, Stress

I. Introduction

Beams are the critical structural members subjected to bending, torsion and shear in all type of structures. Similarly, columns are also used as various important elements subjected to axial load combined with/without bending and are used in all type of structures considering from building to bridge as piers or abutments. Therefore, extensive research works are being carried out throughout world on retrofitting of concrete beams and columns with externally bonded FRP composites. Several investigators took up concrete beams and columns retrofitted with carbon fiber reinforced polymer (CFRP)/ glass fiber reinforced polymer (GFRP) composites in order to study the enhancement of strength and ductility, durability, effect of confinement, preparation of design guidelines and experimental investigations of these members. The results obtained from different investigations regarding enhancement in basic parameters like strength/stiffness, ductility and durability of structural members retrofitted with externally bonded FRP composites, though quite encouraging, still suffers from many limitations. This needs further study in order to arrive at recognizing FRP composites as a potential full proof structural additive.

Composite structures are widely used in aerospace applications as well as civil engineering structure which made many researchers to study various aspects of their structural behavior. As these composite materials are subjected to various types of damage, mostly cracks and delamination which results in local change of the stiffness of element for such materials and also affects their dynamic characteristics. This problem has been a subject of many papers, but only few papers have been devoted to change in dynamic characteristics of composite structural elements. The reviews on cracked composite beam with respect to the present work are taken and studied for further work.

II. Review on Vibration of Cracked Composite Beam

Prathamesh et. al. (2013) studies the vibration analysis of beam with an open edge crack. The vibration analysis is done for the simply supported beam with different crack location and crack depths the results of their analysis are compared with the previous studies. They have shown the variation of natural frequencies due to crack at various locations with varying crack depths. In addition they had done the vibration analysis of cantilever beam with different crack locations and crack depths. They performed the analysis by using ABAQUS software.

Mogal et. al. (2012) performs the vibration analysis of cantilever beam with two open transverse cracks. They have shown that the presence of cracks in the structure decreases the natural frequencies of vibration. They also show that the natural frequencies and the mode shapes changes are depend upon the crack locations and crack depths. The results the obtained numerically are compared with the results they obtained from simulation.

Chopade & Barjibhe (2013) worked on free vibration analysis of fixed free beam with theoretical and numerical approach method. They investigate the mode shape frequencies by using finite element method. They obtained the equation for mode shape frequency theoretically and they use ANSYS program for the numerical studies. After numerical and theoretical studies for the fixed free beam are done, the results are compared with each other and the percentage error between the numerical and theoretical studies is taken out.

Keiichi & Masaru (2004) analyze the vibration problem of reinforced concrete beam members including bond-slip of the reinforcements. They introduced a displacement field to formulate the vibration problem of reinforced concrete beam members including bond slip of reinforcement. They derives a finite element formulation of the problem and concludes with numerical examples with selected bond moduli and damping resulting from bond-slip, to examine the effects of bond-slip on the bending vibration of reinforced concrete beams.

S.H.Sawant (2013) studies the experimental verification of transverse vibrations of free-free beam. He proposed a setup which is suitable for the laboratory experiment. He performed the experiment by using simple apparatus in order to compare the theoretical, numerical and practical profile of a free-free thin steel beam. He also determines the value of young's modulus analytically. Finally theoretical, analytical and practical results are compared with eachother.

AlevKacar et. al. (2011) worked on free vibration analysis on variable Winkler elastic foundation by using the differential transform method. They perform a free vibration of an Euler- Bernoulli beam resting on a variable Winkler foundation and the elastic coefficient of the foundation is variable along the beam major axis. They considered constant, linear and parabolic variations for three different boundary conditions that is for simply supported, clamped and cantilever beams. They solved the governing differential equations by using differential transform method.

Lu &Law (2009) studied such effect from multiple cracks in a finite element in the dynamic analysis and local damage identification. The finite beam element was formulated using the composite element method with a one-member–one-element configuration with cracks where the interaction effect between cracks in the same element was automatically included. The accuracy and convergence speed of the proposed model in computation were compared with existing models and experimental results. The parameter of the crack model was found needing adjustment with the use of the proposed model.

Kisa (2003) investigated the effects of cracks on the dynamical characteristics of a cantilever composite beam, made of graphite fibre-reinforced polyamide. The finite element and the component-mode synthesis methods were used to model the problem. The cantilever composite beam divided into several components from the crack sections. The effects of the location and depth of the cracks, and the volume fraction and orientation of the fibers on the natural frequencies and mode shapes of the beam with transverse non-propagating open cracks, were explored. The results of the study leaded to conclusions that, presented method was adequate for the vibration analysis of cracked cantilever composite beams, and by using the drop in the natural frequencies and the change in the mode shapes, the presence and nature of cracks in a structure can be detected.

Hamada (1998) studied the variations in the Eigen nature of cracked composite beams due to different crack depths and locations. A numerical and experimental investigation has been made. The numerical finite element technique was utilized to compute the eigen pairs of laminated composite beams through several states of cracks. The model was based on elastic-plastic fracture mechanics techniques in order to consider the crack tip plasticity in the analysis. The model has been applied to investigate the effects of state of crack, lamina code number, boundary condition on the dynamic behavior of composite beams.

Wang & Inmana (2002) investigated the free vibration of a cantilever beam, made of unidirectional fiber-reinforced composite, of high aspect ratio and with an open edge crack is. The beam model is based on the classical lamination theory; the crack modeled with the local flexibility method such that the cantilever beam could be replaced with two intact beams with the crack as the additional boundary condition. It was demonstrated that changes of eigen- frequencies and corresponding mode shapes depend on not only the crack location and ratio, but also the material properties (fiber orientation, fiber volume fraction).

Gaith (2011) implemented a continuous cracked beam vibration theory for the lateral vibration of cracked Euler–Bernoulli beams with single-edge open cracks. In his study, the crack identification for simply supported graphite/epoxy fiber-reinforced composite beams is considered. The effects of crack depth and location, fiber orientation, and fiber volume fraction on the flexibility and consequently on natural frequency and mode shapes for cracked fiber- reinforced composite beams are investigated

III. Conclusion

Here authors observed the analysis of beams and cracks generated over the beams due to load condition but none of the author presents the utilization of admixtures or frp technique to strengthen the beam.

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