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Study on Dynamic Behavior of Composite Beam with Different Cross Section

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Abstract:- The use of composite materials in various fields of civil engineering construction such as Building, Bridge, and other high performance engineering applications because of composite material are light in weight, having high performance material, strength material and stiffness. The construction using composite material is easy. This system is also created in MATLAB environmental to study various impact factors. The impact factor of various parameters on cross section of beam and different boundary condition of the beam and the effect of the length of beam. The study deals with the free vibration of laminated composite beam, Two-node finite element of three degrees of freedom and rectangular section are the free vibration analysis of the laminated composite beam.
Keywords: - Composite, Vibration, laminated, Beam

1. INTRODUCTION

1.1 General

The use of composite beam in various civil engineering constructions such as Building, Bridge, and other high performance engineering applications because of composite material are light in weight, having high performance material, strength material and stiffness. Similarly the composite material is subjected to various types of damages, mostly cracks and delimitation.

These materials are especially broadly utilized as a part of circumstances where a substantial quality to-weight proportion is required. So also to isotropic materials, composite materials are subjected to different sorts of harm, generally splits and delimitation. These outcomes in neighborhood changes of the firmness of elements for such materials and therefore their dynamic qualities are modified. This issue is surely knew if there should be an occurrence of building elements made of isotropic materials, while information concerning the impact of weakness breaks on the dynamics of composite elements are rare in the accessible writing.[1]

1.2 Purpose and Objectives of Study

The main objective of study is comparison of beam with conventional and composite material using finite element method.

A first order shear deformation theory based on finite element model is developed for studying the free vibration, The influence of shape of the beams, boundary conditions, number of layers, fiber orientations and aspect ratio on the free vibration of composite beams are investigated experimentally also examined numerically[2]

2. METHODOLOGY

The assumptions made in the analysis are:

i. The analysis is linear. This implies constitutive relations in generalized Hook's law for the materials are linear.

ii. The Euler–Bernoulli beam model is assumed.

iii. The damping has not been considered in this study. [1]

Governing Equation

The differential equation of the bending of a beam with a mid-plane symmetry (Bij = 0) so that there is no bending-stretching coupling and no transverse shear deformation (Exz= 0) is given by [1]

$$IS_{11}\frac{d^4w}{dx^2} = q.x$$

Thus, the natural vibration equation of a mid-plane symmetrical composite beam is given by;[2]

$$IS_{11}\frac{d^4\omega}{dx^4} + \rho A\frac{\partial^2\omega(x,t)}{\partial x^2} = 0$$

Mathematical Modeling

The model chosen is a cantilever composite beam

- Cross-section= A
- Width = B
- Length= L
- Height= H
- Angle between Fibers and axis = 'α'

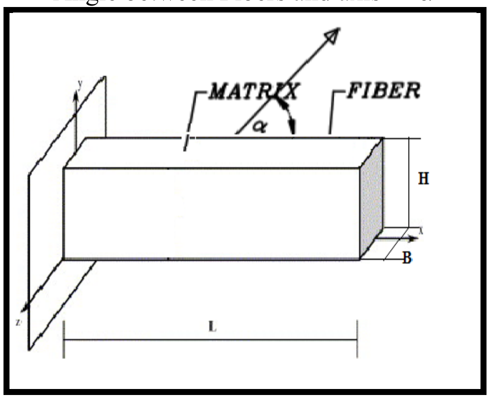

Figure:- Schematic diagram cantilever composite beam

3. VIBRATION STUDY ANALYSIS

Mass and stiffness matrices of each beam element are used to form global mass and stiffness matrices. The dynamic response of a beam for a conservative system can be formulated by means of Lagrange's equation of motion in which the external forces are expressed in terms of time-dependent potentials and then performing the required operations the entire system leads to the governing matrix equation of motion[2]

$$M\,q + K_e - P(t)K_g\;q = 0$$

where "q" is the vector of degree of freedoms. *e g M,K ,K* are the mass, elastic stiffness and geometric stiffness matrices of the beam. The periodic axial force[2]

$$P\;t = P_o + P_t Cos\Omega t$$

where Ω is the disturbing frequency, the static and time dependent components of the load can be represented as a fraction of the fundamental static buckling load Pcr hence putting [2]

$$Pt = \alpha P_{cr} + \beta P_{cr}\;Cos\,\Omega t$$

In this analysis, the computed static bucking load of the composite beam is considered the reference load. Further the above equation reduces to other problems as follows.

i. Free vibration with α = 0, β = 0 and ω = Ω/2 the natural frequency[2]

$$K_e - \omega^2 M\;q = 0$$

ii. Static stability with α = 1, β = 0, Ω = 0

$$K_e - P_{cr}K_g\;q = 0$$

4. CONCLUSION

- By using coposte material the structure should be light in weigth
- The natural frequencies of different boundary conditions of composite beam have been reported. The program result shows in general a good agreement with the existing literature.[1]
- It is found that natural frequency is minimum for clamped –free supported beam and maximum for clamped-clamped supported beam.[2]

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