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ABSTRACT

Composite beams and beam like elements are principle constituents of many structures and used widely in high speed machinery aircraft and light weight structure and may cause serious failure of the structure. Local flexibility matrix is used to obtain the additional boundary conditions of the beam in cracked area. A variety of parameter studies are carried out to see the effects of various changes in the laminate parameters on the natural frequences. This study shows that the highest difference in frequencies occur when the value of the fiber orientation equal to zero degree. The increase of the beam length result in a decrease in the natural frequencies of the composite beam and also shows that an increase of the depth of the cracks leads to a deacrease in the value of natural frequenices

Keywords: crack location, crack depth, composite beam, prevent crack, vibration analysis, FEA, composite Material

INTRODUCTION

Composite beams are constructed from more than one material to increase stiffness or strength (or to reduce cost). Common composite type beams include I-beam where the flange are soil wood members (sometime referred to as ''engineered I – Beam'') Structural member that are made up of two or more different materials are known as composite elements. The main benefits of composite elements is that the properties of each materiaL can be combined to from a single unit that performs better overall than its separate constituent parts. The suitability of a particular composite material depends on the nature of application and needs.

AIM OF COMPOSITE BEAMS

Composite beams can cover for large space without the need of any intermediate columns. Composite construction is fast because of using rolled steel and pre – fabricated components than cast-in-situ concrete.

EXPERIMENTAL ANALYSIS

The instrument used for experimental analysis i.e. measurement of natural frequencies are Fast Fourier transform (FFT) analyzer, accelerometer, impact hammer and related accessories. The Glass FRP cantilever beam specimen with dimensions (300mm x 25mm x 10mm) with and without crack is subjected to no. of experimentation is carried out for determining the natural frequencies. To achieve reproducibly first three natural frequencies of the structure under consideration. The accelerometer is attached to end of the beam. The impact hammer is used to excite beam. Experimental modal analysis is carried out to determination of dynamics properties such as natural frequency and mode shapes. Cracks are developed at different location from fixed end with the help of cutter. The natural frequencies of first three models are noted with different crack location crack depth.

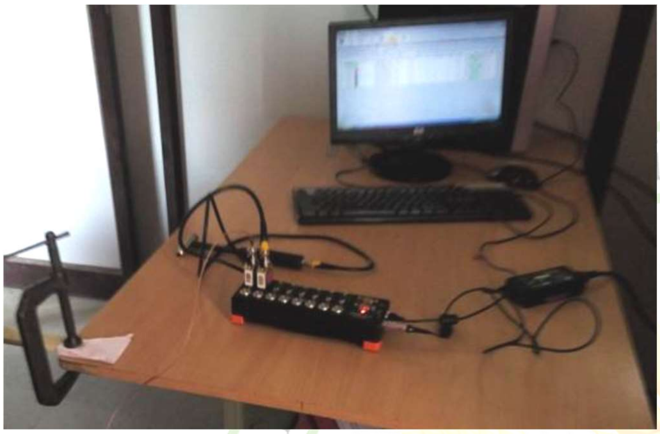


Figure 1: Experimental set up for detection of a cantilever beam with crack

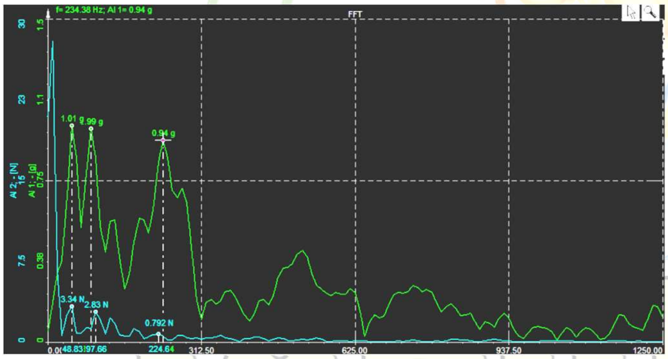


Figure 2: Impact Hammer at Middle position of Beam 1 (60mm from free end) at crack depth 0.1mm

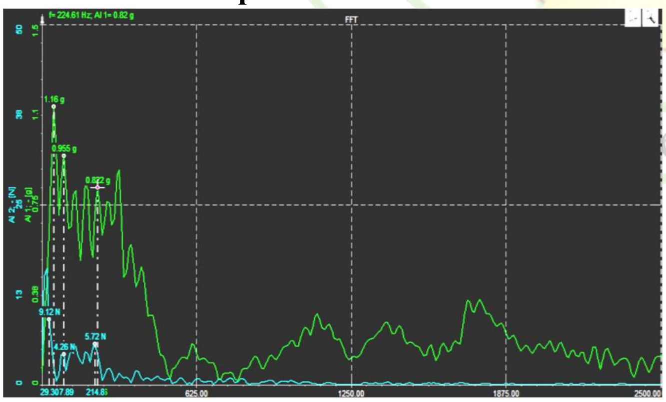
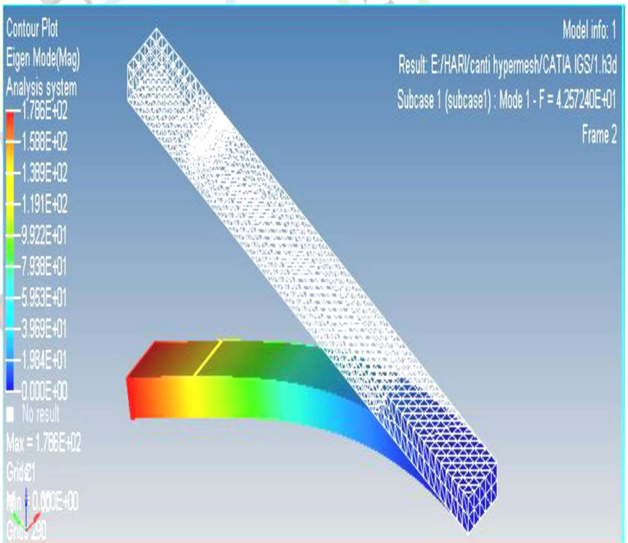


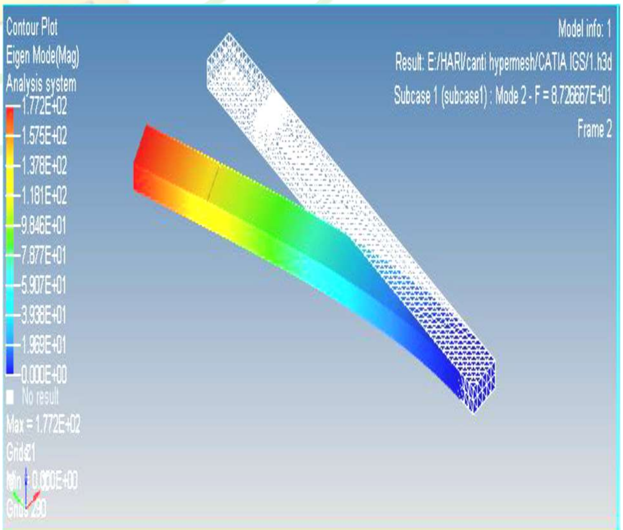
Figure 3: Impact Hammer at Middle position of Beam 2(120mm from free end) at crack depth 0.1mm

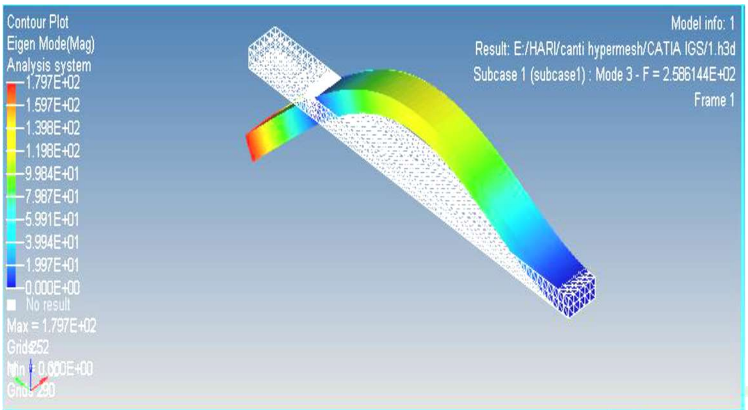
FINITE ELEMENT ANALYSIS

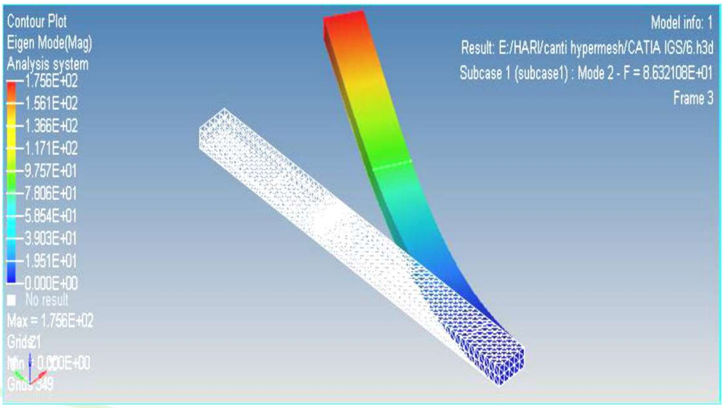
Finite Element Analysis is performed using Hypermesh as pre and post processor. While Optistruct is used as a Solver. The model of beam with and without crack is generated and used for Finite Element Analysis. The modal analysis of uncracked and cracked cantilever beam to determine the natural frequencies and mode shapes at different crack depth and different crack location is carried out.

Crack is created at 60 mm from free end (β = 0.8) and the crack depth is maintained of 1 mm (a/h =0.1

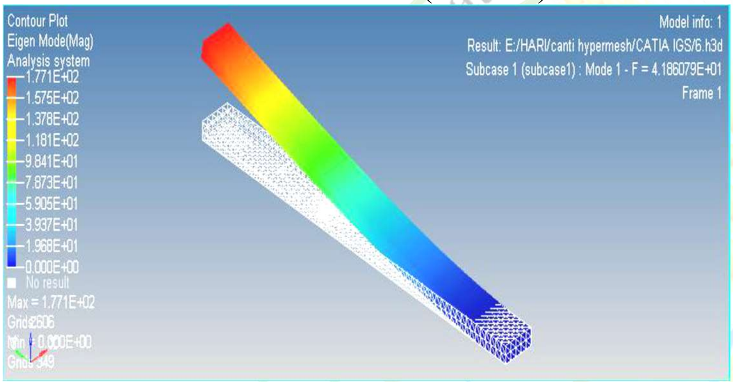








Crack is created at 120 mm from free end (β = 0.6) and the crack depth is maintained of 1 mm (a/h =0.1)



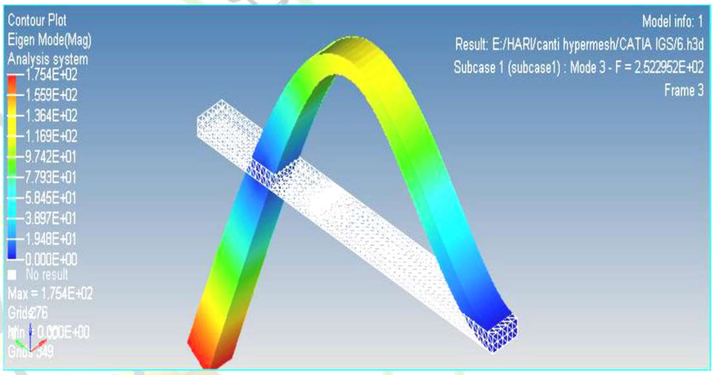


Table 1 : Consolidated Result of FEA

Case no	Actual		Natural frequencies FEA (HZ)			Natural frequencies from test (HZ)		
	Location ß	Size a/h	Mode no .1	Mode no .2	Mode no .3	Mode no .1	Mode no .2	Mode no .3
Uncracked beam			42.48	86.71	265.5	58.59	117.2	263.7
1	0.2	0.1	42.57	87.26	258.61	48.83	87.89	234.38
2	0.2	0.2	42.063	86.84	258.47	48.83	97.66	244.1
3	0.2	0.3	42.07	87.315	256.5	48.83	87.89	333.3
4	0.2	0.4	41.95	87.41	252.8	48.87	87.89	224.6
5	0.2	0.5	41.97	87.41	251.2	48.83	97.65	244.14
6	0.4	0.1	41.86	86.32	251.6	48.86	87.75	224.6
7	0.4	0.2	42.072	86.35	245.31	48.83	87.83	224.6
8	0.4	0.3	41.56	86.25	237.11	48.98	87.86	224.89
9	0.4	0.4	41.145	86.54	229.89	48.87	87.68	244.56
10	0.2	0.1	41.244	86.192	228.6	48.83	87.65	244.1
11	0.2	0.2	42.42	86.192	228.25	48.83	87.88	224.1
12	0.2	0.3	42.65	86.281	228.68	48.86	87.89	234.4

PREVENTION OF CRACK

To prevent cracks due to moisture movements

1) Select materials having small moisture eg. Brick, lime stone, marble etc
2) Plan for proper expansion/ control slip joints.
3) For brick work 2 weeks time in summer and 3 weeks time in winter should be allowed before using from the date of removal from kilns.
4) Delay plastering work till masonary dried after proper curing.

To prevent cracks due to elastic deformation

1) When large spans cannot be avoided, deflection of slabs or beams could be reduced by increasing depth of slabs and beams so as to increase their stiffness.
2) Adoption of bearing arrangement and provisition of a groove in plaster at the junction of wall and ceiling will be of some help in mitigating the cracks.
3) Allow adequate time lag between work of wall masonary and fixing of tiles.

Techniques for Treatment of cracks.

a) Surface filling methods.
b) Cementitious grouting method.
c) Epoxy resin grout.
d) Crack stitchin

CONCLUSION

The composite material has high strength also it should be more flexible in machineries and construction structures to be capable of with standing high levels of stress and strain. The cracks introduce are saw cut while efforts were made to simulate the hair line cracks, but saw cut after polishing gets widen and may remove more mass leading to further reduction in natural frequency and causing the variation in experimental results. Cracks is near to fixed and it imparts more reduction in natural frequency.

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