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Damping Test on Jute Fiber and Graphene Composites Reinforced with Epoxy Resin

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Abstract- The main aim of this study is to evaluate material damping factor, frequency, phase angle and magnitude of the composite plate of jute fiber and graphene composites reinforced with epoxy resin. The jute-graphene fiber laminations are prepared by hand lay-up technique. Jute fiber and graphene as reinforced materials and epoxy resin as a matrix material used in the research. Cantilevered rectangular composite plate of jute graphene reinforced epoxy having required dimensions of 300x300x5 mm. Damping factor can be varied by taking three different combinations of jute fiber graphene and epoxy resin.

Index terms – Damping test, Jute fiber, Graphene, Epoxy resin, Fast Fourier Technique

1. INTRODUCTION

The Fast Fourier Transformer Technique (FFT) is a fundamental measurement. In which it consists characteristics namely natural frequency, damping factor, phase angle and also modes shape. We have conducted five test i.e bending, twisting, double bending and combination of bending and twisting. The procedure will be repeated by vibrating body to transformers which consists of piezoelectric transducer and electrical signals (voltage and current). Which is transferred to amplifier unit their after display unit and this signal will be transferred to analyser unit. This experiment has been conducted in Lab view 2009 software. This software has been categorised into two channels hammer and accelerometer channels. Damping test specimen is as shown in Figure 1 and in Figure 2 experimental setup as shown, a matrix of 7x6 (42 nodes). The maximum output ranges from 1000 to 1500 volts by graphs are acceleration vs time and force vs time. The impact force of the hammer will be within the 4-6 KN will be taken. Below 6 KN or above 4 KN of frequency will not be accepted and the rebounding frequency cannot be accepted. Through damping test we can find the ultimate failure of the material by producing vibration with the help of some external equipment. Now a advanced construction like bridges were tested with the help of this process.

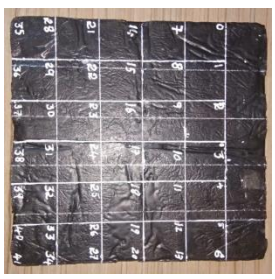


Fig.1. Damping test specimen Fig.2. Experimental setup

2. METHODOLOGY

For various compositions the stages involved in hand lay-up process are as follows: Initially take a mould of required dimension according to ASTM standard 300x300x5 mm. We should cut the fibers as per the requirement and wax should be taken certain amount and it used as a releasing agent in the die. Jute fiber and graphene composites reinforced with epoxy resin taken according to rule of mixture. For this test taken two case studies of epoxy 80% and 85%. After pouring the materials in the die for curing 24 hours have to keep.

Table 1.Fiber combination

Sl.No.	Reinforcement Fiber	Matrix	Method
1	Jute (15%)+ Graphene (5%)	Epoxy Resin (LY-556) – 80%	Hand Layup
2	Jute (10%)+ Graphene (5%)	Epoxy Resin (LY-556) – 85%	

3. EXPERIMENTATION

The damping factor and natural frequency of e composite plate consists of 42 nodes can be calculated by using Lab view 2009 software. Natural frequencies, damping factor, mode shapes and phase angle for various composites were obtained for various combinations.

Table 2. Jute+Graphene+Epoxy resin composition

PMC	Mode number	Frequency Hz	Material damping factor	Magnitude $\frac{m^2}{n}$ - N	Phase angle Degree
Jute (15%)+ Graphene (5%)	1	26.17	3.210	0.0434	133.4
	2	54.06	2.198	0.0138	30.8
	3	79.57	2.186	0.0344	21.9
	4	126.46	1.732	1.1733	94.9
	5	150.76	3.248	1.0406	112.6

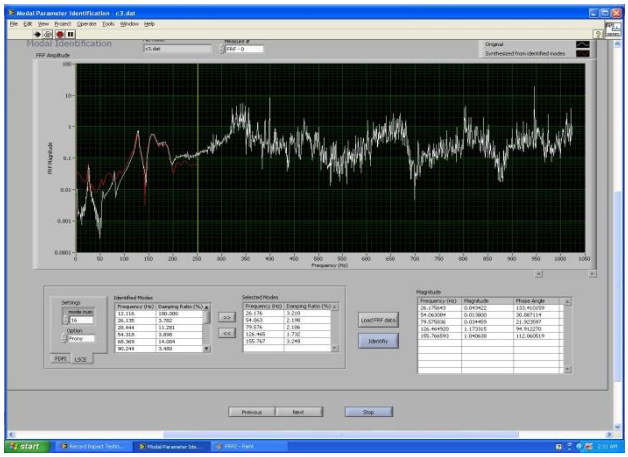


Fig 3.FRF Jute+Graphene+Epoxy resin

Table 3. Jute+Graphene+Epoxy resin composition

PMC	Mode number	Frequency Hz	Material damping factor	Magnitude $\frac{m^2}{n}$ - N	Phase angle Degree
Jute (10%)+ Graphene (5%)	1	19.6	1.5	0.0534	113
	2	43.1	2.2	0.0102	31
	3	116.6	1.5	0.0455	25
	4	149.8	1.1	1.2748	95
	5	274.5	1.2	1.2472	114

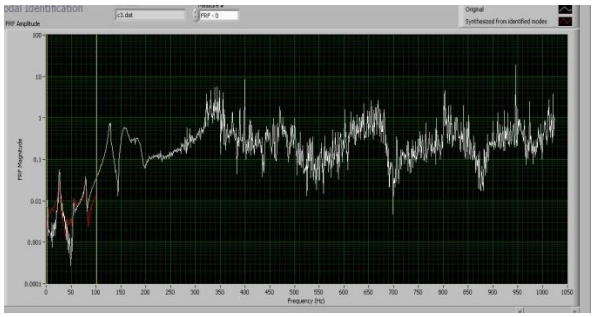


Fig 4.FRF Jute+Graphene+Epoxy resin

4. RESULT AND DISCUSSION

Table 3 and table 2 shows required values for the above mentioned frequency, material damping factor, magnitude and phase angle of composite plate. The natural frequency has been noted as (274.5 Hz) which indeed has highly increases in Jute fiber (10%)+ Graphene (5%) + Epoxy resin has been taken 85% composite plate shown in table.3 and in another case the natural frequency is noted down as (150.76 Hz) which is comparatively low in 15% Jute+ 5% Grapheme+ 80% Epoxy resin.

4.1 Modes shapes for 15% jute + 80% epoxy + 5% graphene

Mode Shape – 1
Damping Factor – 3.210
Frequency – 26.17 Hz

Mode Shape – 2
Damping Factor – 3.210
Frequency – 26.17 Hz

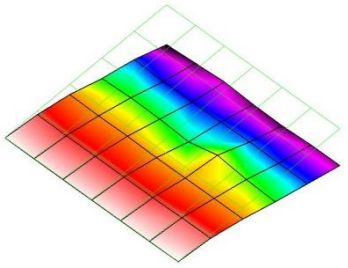


Fig.5. Bending

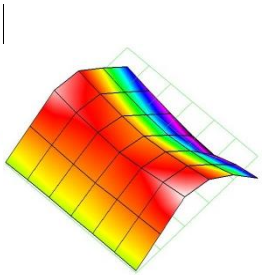
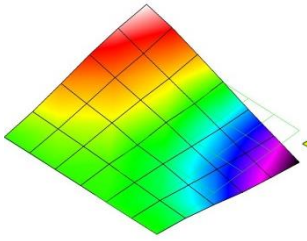


Fig.6. Twisting

Mode Shape – 3
Damping Factor – 2.186
Frequency – 79.57 Hz

Mode Shape – 4
Damping Factor – 1.732
Frequency – 126.46 Hz



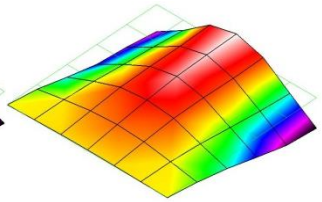


Fig.7. Double Bending Fig.8. Combination of Bending and Twisting

Mode Shape – 5
Damping Factor – 3.248
Frequency – 150.76

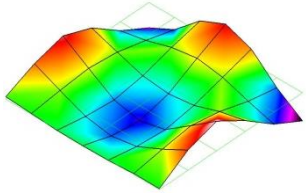


Fig.9. Complex mode

4.2 Modes shapes for 10% jute + 85% epoxy + 5% graphene

Mode Shape – 1
Damping Factor – 1.5
Frequency – 19.6 Hz

Mode Shape – 2
Damping Factor – 2.2
Frequency – 43.1 Hz

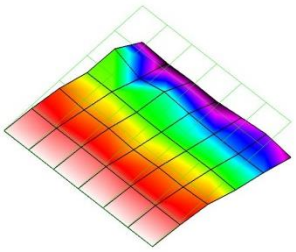


Fig.10. Bending

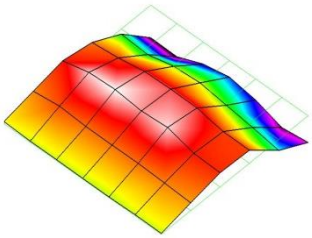
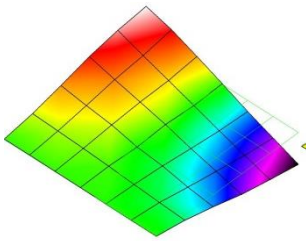


Fig.11. Twisting

Mode Shape – 3
Damping Factor – 1.5
Frequency – 116.6 Hz

Mode Shape – 4
Damping Factor – 1.1
Frequency – 149.8 Hz



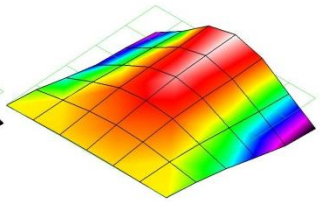


Fig.12. Double Bending Fig.13. Combination of Bending and Twisting

Mode Shape – 5
Damping Factor – 1.2
Frequency – 274.5 Hz

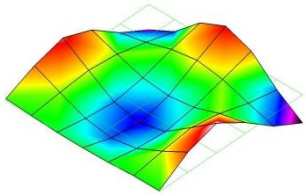


Fig.14. Complex mode

5. CONCLUSION

Mainly Natural frequency, damping factor and mode shapes are experimentally determined by using Fast Fourier Transformer Technique (FFT) analyser. This work shows that successful fabrication of the different composition of jute fiber, graphene and epoxy resin composite materials are prepared by using hand lay-up technique. Damping test and natural frequency high for the combination15% jute + 80% epoxy + 5% graphene and 10% jute + 85% epoxy + 5% graphnene. The modal analysis for prepared specimen was carried out to find first natural frequencies, damping factor and corresponding mode shapes, for undertaken composition

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