International Conference on Ideas, Impact and Innovation in Mechanical Engineering (ICIIIME 2017)
Volume: 5 Issue: 6

ISSN: 2321-8169
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Study of Vibrational Behavior of Smart Composite Plates

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Abstract

Now- a-days Composite or Laminated Materials are widely used in Automobile as well as Aerospace purpose due to their comparatively high mechanical properties. The main uses of laminated plates are on the outer surface of Aerospace and Spacecraft. So these materials should possess very good vibrational and strength behaviors so as to sustain in different kinds of environments. In this research work there is investigation on the damping behavior for these materials. An attempt is to be made to reduce the vibration by analyzing different composite plates also for the different structures.

Key words:Composite, Laminated plates, Vibration

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Introduction

Composite structures, beam, plates, and shells are commonplace in many sectors of the automotive and aircraft industries. Use of such structures is now being considered for naval applications because of the potential for improved strength to weight ratio and resistance to harsh environments. In this project work the prediction of transient response and natural frequencies is to be done on the laminated composite materials. As composite materials are widely used in many fields, there is a need for accurate prediction of dynamic characteristics so that they can be designed against the failure due to various types of dynamic loads.

Composite: Two or more chemically different constituents combined macroscopically to yield a useful material. Composite materials are lighter, stronger, wear resistance, rust free, temperature resistance.

Classification of Composites:

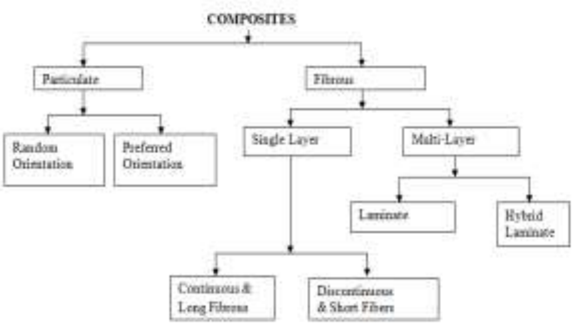

Fig: Classification of Composite

Problem Definition

Now-a-days vibration is very important factor for study in many fields because vibration cause many undesirable effects on instruments. To reduce the effect of vibration is the main purpose of this project work.

Literature Survey

A lot of research is going on to reduce the vibration of outer body of aerospace, aircraft and cars. These parts are called BIW Parts. Vibration is most unwanted thing in the automobile industry.

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RastgaarAagaah M., et al, (2004), studied that natural frequencies of square laminated composite plates for different supports at edges are presented. Using a third order shear deformation theory of plates (TSDT), which is categorized in equivalent single layer theories, a new set of linear equations of motion for square multi-layered composite plates has been derived. Laminated plates are supposed to be either angle ply or cross ply. Moreover, FEM is used to solve the equations and find the fundamental natural frequencies.

Shiuh-Chuan Her, et al, (2012), explained that Piezoelectric materials can be used as actuators for the active vibration control of smart structural systems. In this work, piezoelectric patches are surface bonded to a composite laminate plate and used as vibration actuators. A static analysis based on the piezoelectricity and elasticity is conducted to evaluate the loads induced by the piezoelectric actuators to the host structure. The loads are then employed to develop the vibration response of a simply supported laminate rectangular plate excited by piezoelectric patches subjected to time harmonic voltages. An analytical solution of the vibration response of a simply supported laminate rectangular plate under time harmonic electrical loading is obtained and compared with finite element results to validate the present approach.

Experimental Method

In this research there is use of simple plates and sandwich structure of materials alluminium and mild steel and the vibrational behavior is to be seen for the same.

In this research there is dividation the methodology in two steps as below.

Stage 1) In the stage 1 find the general natural frequencies of platesfor simply supported condition. The equipment for modal test is as shown in fig.1.

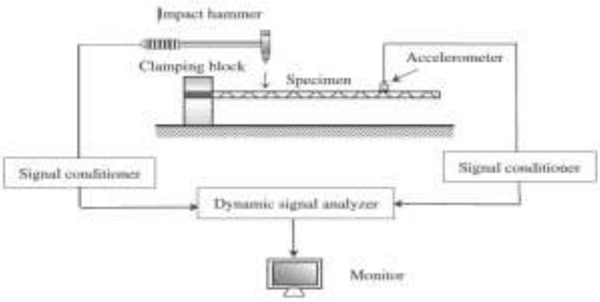


Fig .1 The equipment for modal experiment

Stage 2) In the stage 2 construct the sandwich structures as shown in fig. 2 and find the general natural frequencies for simply supported condition.

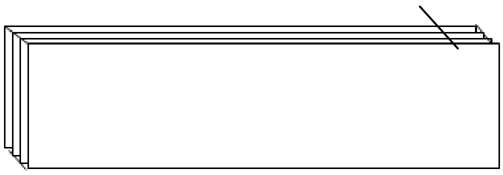


Fig. 2 Laminated structure of plate.

Plate Specification

There are two materials plates are used in this research. Their specifications are as follows:

Materials : 1) Aluminum

2) Mild Steel

Specifications: 1) Length of plate: 100 mm

2) Width of plate:50 mm

3) Thickness of plate:9 mm

Results of Experimental Work for Frequency Response

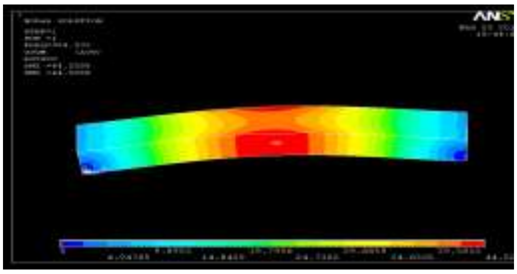
SR. NO.	Alluminium Plate	Mild Steel Plate	Laminate Plates			
			al-al-al structure	ms-ms-ms structure	al-ms-al structure	ms-al-ms structure
1	960.53	941.73	961.90	960.43	815.71	1022.8
2	1775.9	1760.5	1770.3	1770.3	1499.9	1849.5
3	2252.2	2206.2	2253.3	2225.2	1827.3	2418.0
4	6534.1	6433.7	6505.2	6542.4	5550.4	6611.4

Software Analysis by Using Ansys

1)For alluminium plate

For simply supported condition

First step



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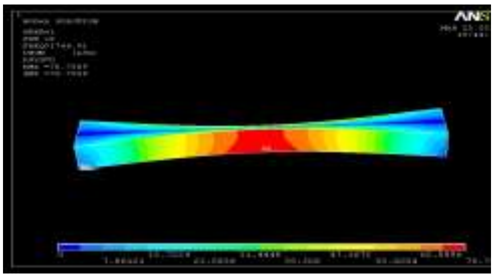

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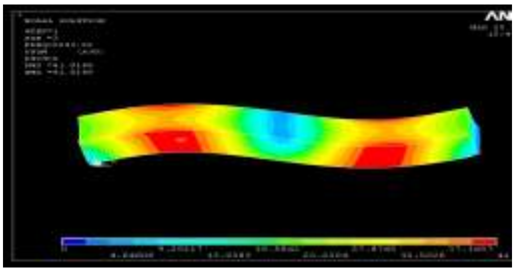


Final step

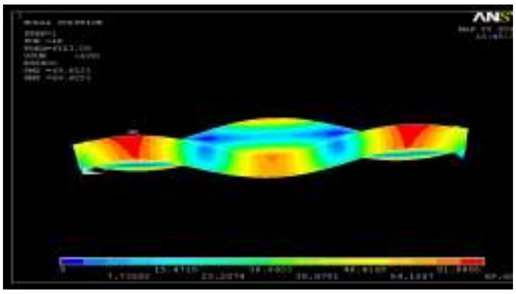
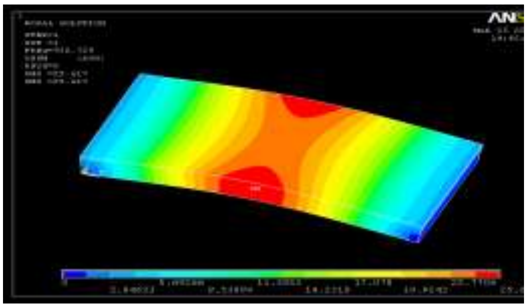


Fig. 3Ansys photograph for simple alluminium plate for measurement of natural frequencies at simply supported condition.

2)For mild steel plate.

For simply supported condition

First step



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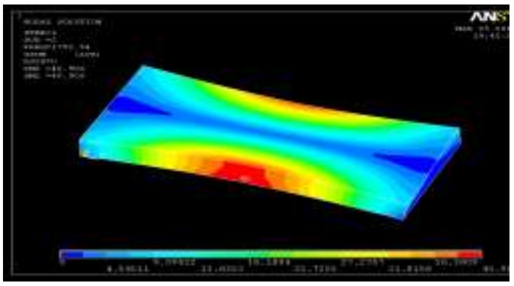

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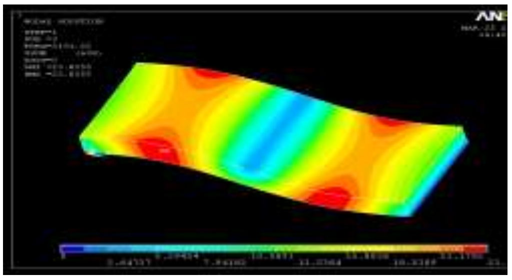

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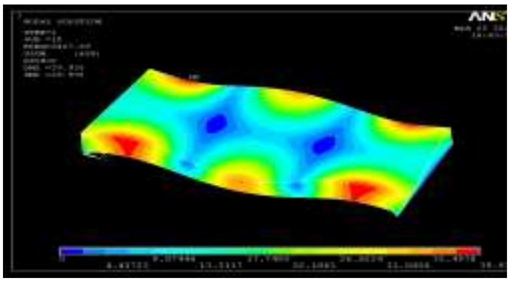


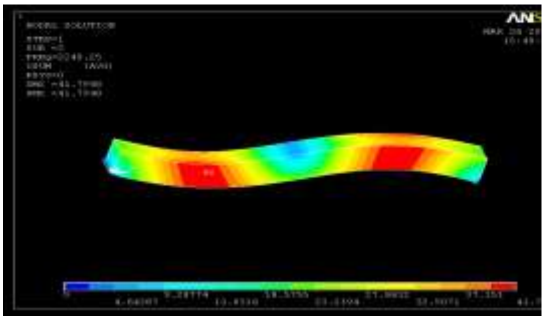
Fig. 4Ansys photograph for mild steel for measurement of natural frequencies at simply supported condition.

3) For laminated structure.

A) For al-al-al plated structure

For simply supported condition

First step



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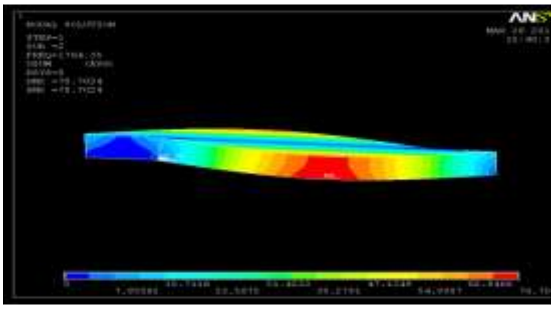
Second step



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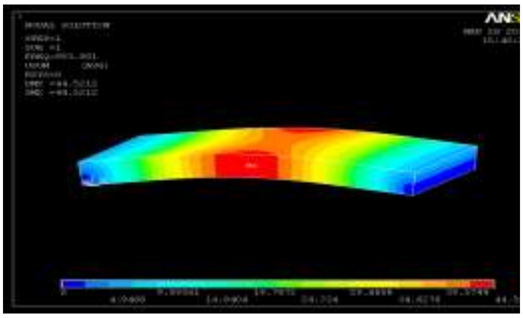

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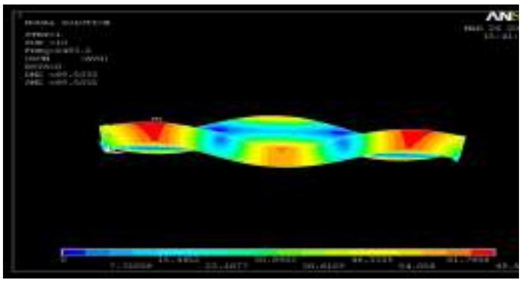
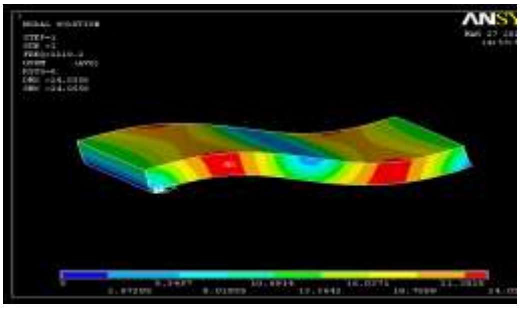


Fig. 5Ansys photograph for laminateplate of al-al-al materialfor measurement of natural frequencies at simply supported condition.

B) For ms-ms-ms plated structure

For simply supported condition:- First step



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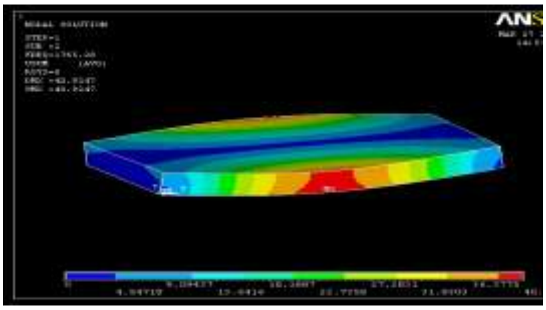

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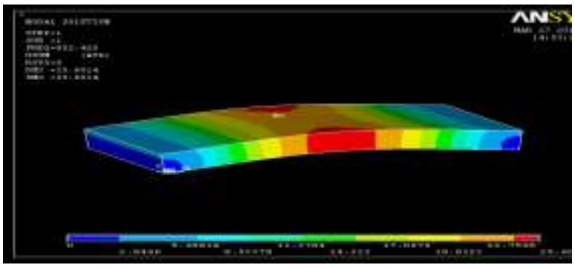


Final step

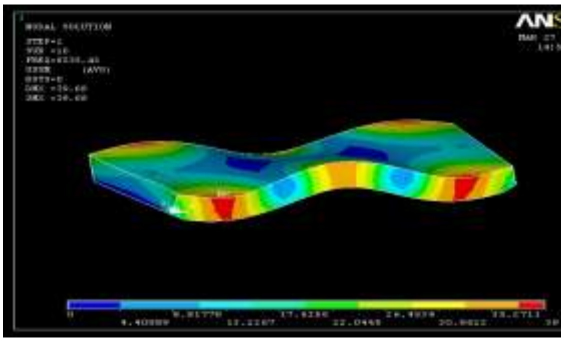
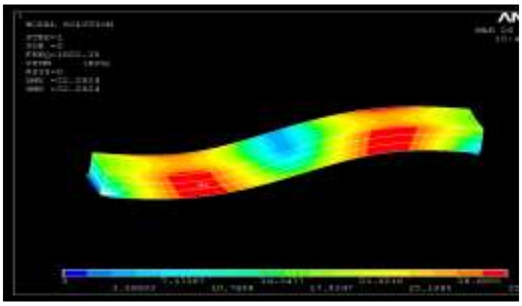


Fig. 6Ansys photograph for laminate plate of ms-ms-ms material structure for measurement of natural frequencies at simply supported condition.

C) For al-ms-al plated structure

For simply supported condition

First step



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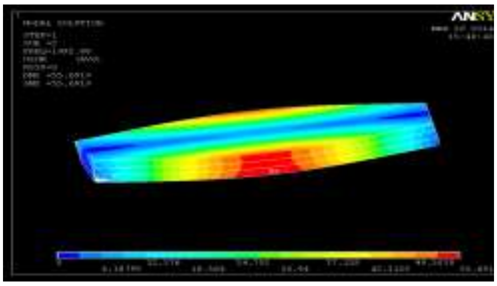

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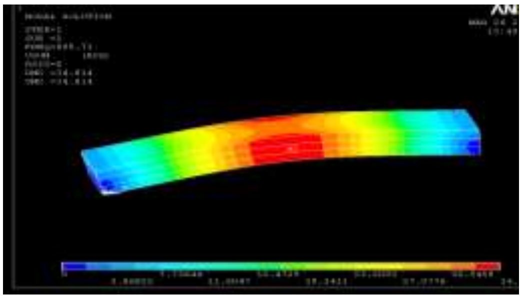

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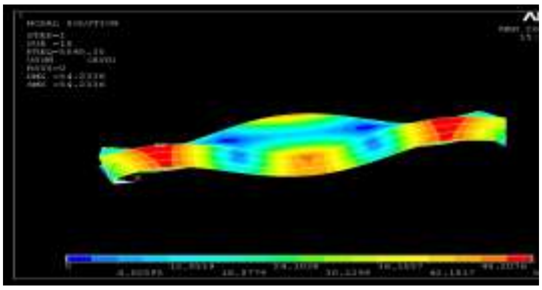
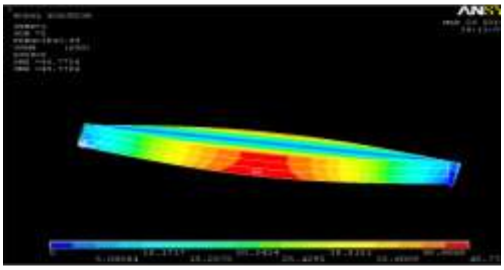


Fig. 7Ansys photograph for laminate plate of al-ms-al material structure for measurement of natural frequencies at simply supported condition.

D) For ms-al-ms plated structure

For simply supported condition

First step



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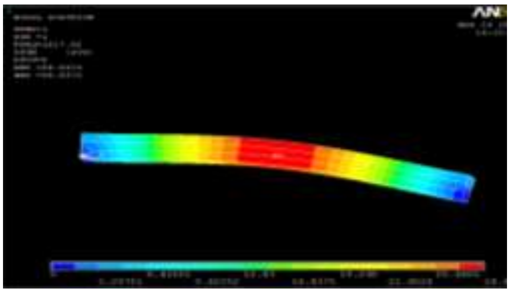

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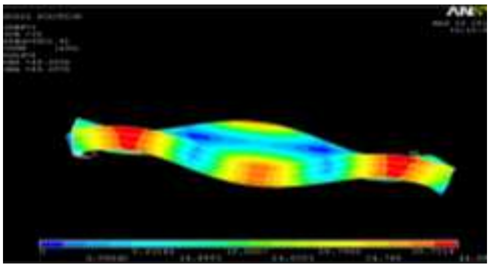

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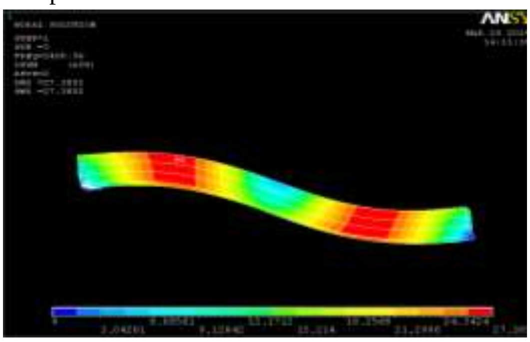

Fig. 8Ansys photograph for laminate plate of ms-al-ms material structure for measurement of natural frequencies at simply supported condition.

RESULTS OF SOFTWARE WORK FOR FREQUENCY

SR. NO.	Al Plate	Mild Steel Plate	Laminate Plates			
			al-al-al structure	ms-ms-ms structure	al-ms-al structure	ms-al-ms structure
1	954.53	932.73	953.90	952.43	800.71	1017.8
2	1766.9	1752.5	1764.3	1765.3	1492.9	1843.5
3	2243.2	2191.2	2240.3	2219.2	1822.3	2401.0
4	6523.1	6427.7	6493.2	6535.4	5545.4	6601.4

CONCLUSION

From above work, readings and result tables it is clear that the laminated structures are better in damping effect in simply supported condition. From above four laminated structuresit is clear that al-ms-al laminated structure is better in damping effect.

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