INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 3 - V7I3-1552)
Available online at: https://www.ijariit.com

Modal analysis of jute reinforced structures

Revannath P. Nale
revanale@gmail.com
Sinhagad Institute of Technology, Lonavala, Pune

P. D. Kulkarni
pdkulkarni.sit@sinhgad.edu
Sinhagad Institute of Technology, Lonavala, Pune

S. M. Gaikwad
smgaikwad.sit@sinhgad.edu
Sinhagad Institute of Technology, Lonavala, Pune

ABSTRACT

Recently the use of natural fibres as reinforcement has increased in many polymers showing at industrial applications and research work. As per todays environmental scenario natural fibres are playing important role due to its biodegradability, high strength, low cost and corrosion resistance as compared with conventional materials. In this paper study is carried out on jute fibres as a best natural fibre. Due to jute fibres having superior properties jute have gained interest in composites. Jute fibres are better compared with synthetic fibres like glass, Kevlar etc. which are made manually. This article presents the modal analysis of jute reinforced composite with resin as a matrix material.

Keywords— *Natural fibres, reinforcement, epoxy resin, composite.*

1. INTRODUCTION

Since from last few years ago, natural fibre composites showing their importance in a structural material. The natural fibres like banana, sisal, coir, jute etc. overcomes the limitations of the conventional fibers having low cost, low weight, higher specific modulus, biodegradability, and renewability. The basic concepts of composite material were known from long times, but nowadays the research is going on advanced composite materials like carbon epoxy, Kevlar epoxy and boron epoxy which can be used for modern engineering applications. Renewable fibres like banana, coir, jute, sisal, palm fibres etc., are extracted from stem/fruit/leaf of plants. Among from all the above these fibre jute has an advantage over the mentioned fibres. Jute can be available both in fibre/strand and mat form. Jute fibres have sufficient strength and stiffness.

Due to ease of availability, presence of mechanical properties these fibres keep the interest and curiosity to research on it. Natural fibre composites can be alternative for synthetic fibres with reinforcement due to the advantages such as low density, low cost, biodegradability, renewability, high specific strength. Natural fibres as a reinforcement used in composites for various engineering applications.

The mechanical properties are a function of temperature for naturally woven coconut sheath.

The main objective of this paper is to reinforce corrugated plates and to optimize their fundamental frequencies. A free vibration analysis of different shape of plates like sinusoidal and trapezoidal corrugated plates carried out using modal analysis. In order to demonstrate the results of modeling the corrugated plates as orthotropic flat plates in studying the free vibration characteristics, a comparison between the results of the finite element analysis (FEA) model and experimental models is made and optimization examples has studied to provide a guide for design engineers.

2. LITERATURE REVIEW

[1] Akash D. A., In this paper study is given related to transverse vibration analysis of hybrid jute-sisal fabric reinforced polyester composites. The technique used to prepare the laminate is hand lay-up using untreated woven jute and sisal as reinforced materials and polyester resin as a matrix material. In the analysis, a frequency domain model is used along with Frequency Response Function (FRF) measurements obtained from the plate. FFT analyser is used for measurements.

[2] Madhu Vani, This paper gives the automotive use of natural fibres. The composites are used in the construction, automobile and aerospace industries. Natural fibre composites are emerging as low-cost, lightweight and superior alternatives to synthetic fibre composites. This study related to the development of bio-degradable composites using Epoxy resin and Sisal/Jute fibres. The fibres are chemically treated at different percentages of NaOH i.e., 3%, 6% and 9%. Tensile and flexural strength of the composites were determined using UTM. The natural frequencies of the cantilever composite beam were determined analytically using Euler's theory and numerically using Ansys 15.0. From the results, the results agree close to each other.

[3] Arulmurugan S., In this research paper, the exfoliation of Nano clay in the polyester matrix investigated using Atomic

Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) to evaluate the optimum parameters (frequency and time) in ultra-sonic technique. The weight percentage (1, 3, 5 and 7) of Nano clay is then mixed with polyester resin at optimum parameters. The mechanical properties and free vibration characteristics are investigated to determine the optimum clay percentage in the matrix. Further, with the optimum clay weight percentage, jute fibres of various weight percentages (5, 10, 15, 20, 25 and 30) has used to prepare the composite. The ASTM standard is used to determine the tensile, flexural, impact and free vibration characteristic of composite. The results of 5% addition of Nano clay and 15% jute fibre increase the mechanical and vibration behavior of the composites.

[4] K.T.B Padal, this paper represents the study of jute Nano fibre reinforced composites for damping by the use of a suitable interlayer. The interlayer is used to improve the damping capacity of the composites, with a lowering of the stiffness values. In this work, for reinforcement jute Nano fibres were used in epoxy resin matrix composites to develop jute Nano-fibre reinforced composite. The composites has prepared using 50 wt% of glass fibre and 50 wt.% of epoxy resin content. The Nano-fibres are reinforced in different weight percentages with epoxy matrix to prepare Nano-0fibre composites. Mechanical properties of the Nano fibre composites have compared with the base composite. The tensile strength of Nano composite has increased to 96% with the 3wt. % Nano fibre reinforcement as compared to the base composite.

[5] Sushmita, This paper explains the properties of natural fibres with reinforcement. Natural fibres having their low cost, high specific strength, recyclability are finding more applications in automotive, aerospace, bio-medical, and sports equipment. In the present work, hybrid sandwich composites using Jute and Glass fibres in Polyester polymer, namely: Jute-Glass-Jute (JGJ) and Glass-Jute-Glass (GJG), has prepared by curing under pressure using compression moulding technique. The prepared sandwich composites were subjected to tensile and flexural testing. The vibration and damping characteristics has studied using free vibration and forced vibration tests.

[6] Madhusudan Reddy K, Recent trends practicing in the industries evidenced the natural fibres use like jute, pine apple, Gongura etc. instead of the synthetic fibres. Vibration characteristics of jute fabric reinforced composites are investigated in this paper. Experimental values and numerical values using FEM package ANSYS. The natural frequency of jute fabric hybrid polymer matrix composite is calculated under fixed condition.

[7] Samuel C.R. Furtado, This paper is related to, current research on vegetable fibres in automotive components is increased. The automobile companies look for vegetable fibres as a substitute for conventional fibre-reinforced composite materials. The vegetable fibres have lower density and lower strength than glass fibres. The natural frequencies and the damping values for both configurations are compared. The work presented in this paper, the natural frequency values for a jute fibre reinforced composite bonnet are compared with glass a fibre-reinforced composite bonnet. According to other authors, it is expected that the jute fibre-reinforced bonnet will present a higher damping value.

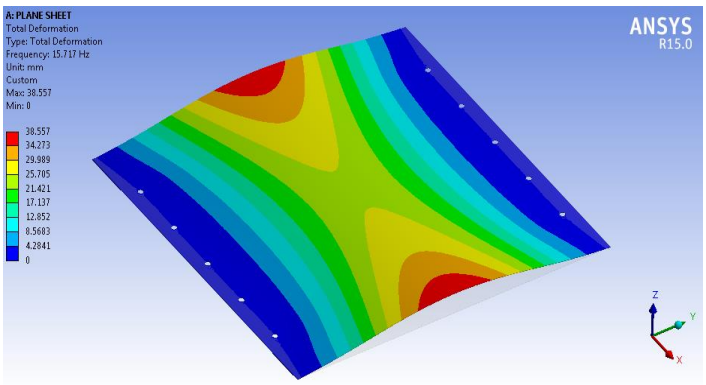
3. FEA OF METAL SHEETS WITH REINFORCED JUTE FIBRE

- **Sheet Metals Modal Analysis.**
- **Sheet Metals analysis.**

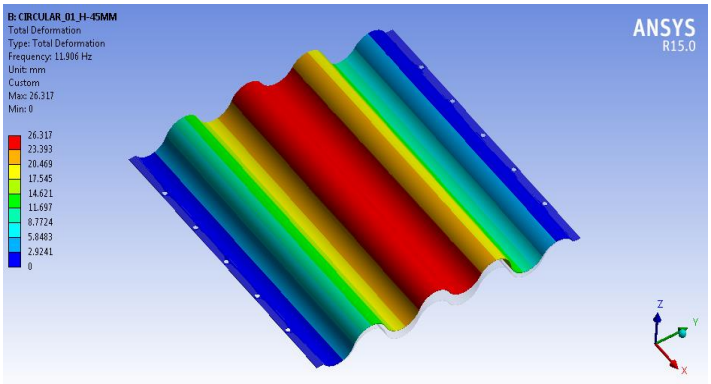
The basic three steps of FEA process are
a) Preprocessing phase
b) Processing phase
c) Post-processing phase

Modal analysis usually done to determine the natural frequencies and mode shapes of a structure. The natural frequencies and mode shapes are important parameters in the design of a structure for dynamic loading conditions.

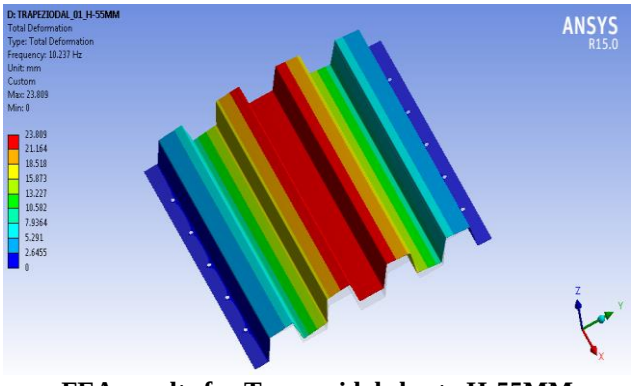
• Properties of Material: The values of young's modulus, poisons ratio, density, and yield strength for steel as follows,
Material- Structural Steel
1. Young's Modulus- 200 GPa
2. Poisons Ratio- 0.3
3. Density- 7850 kg/m^3
4. Yield Strength- 520 MPa



FEA results for plane sheet

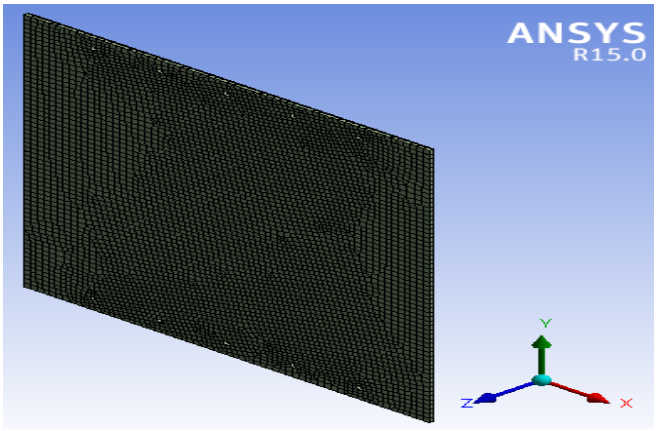


FEA results for Circular sheet _H-45MM

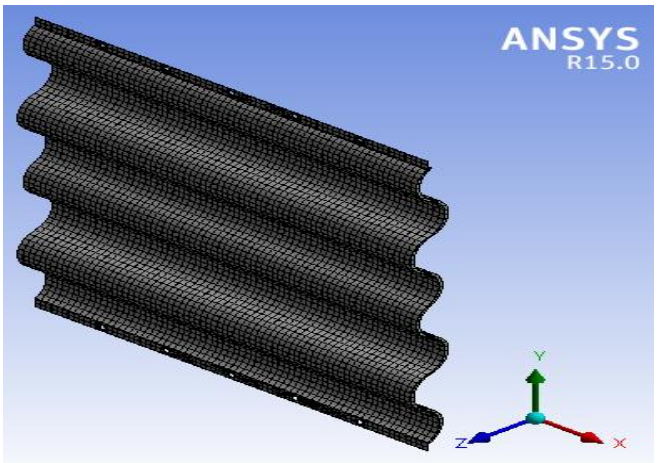


FEA results for Trapezoidal sheet _H-55MM

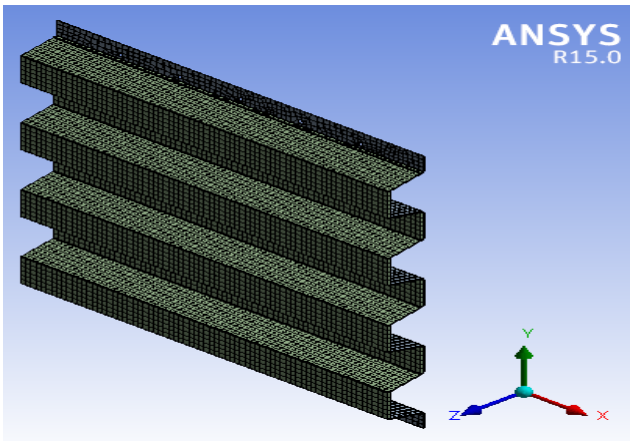
4. MESHING



Meshing of Plane sheet with Reinforcement

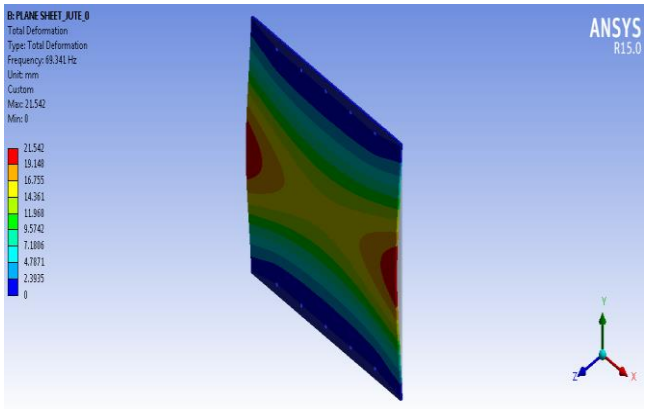


Meshing of Circular with reinforcement

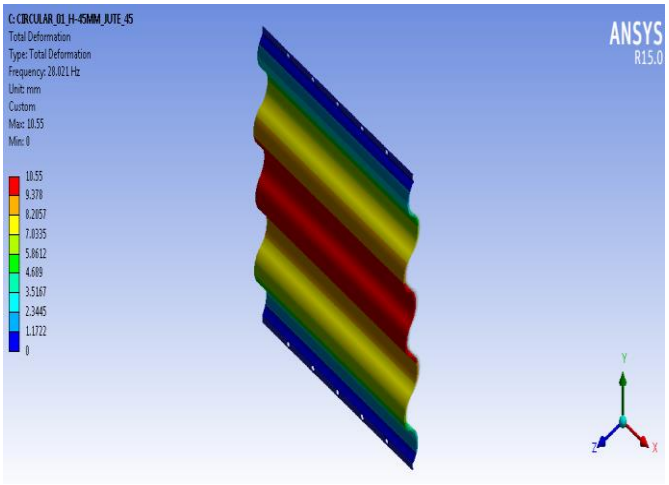


Meshing of Trapezoidal with reinforcement.

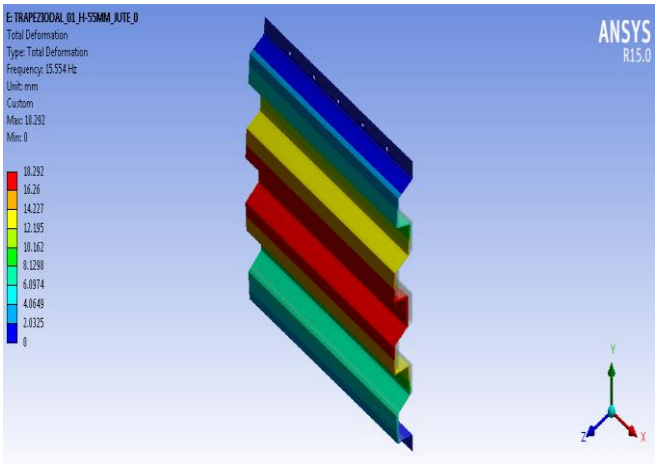
5. RESULTS WITH REINFORCEMENT



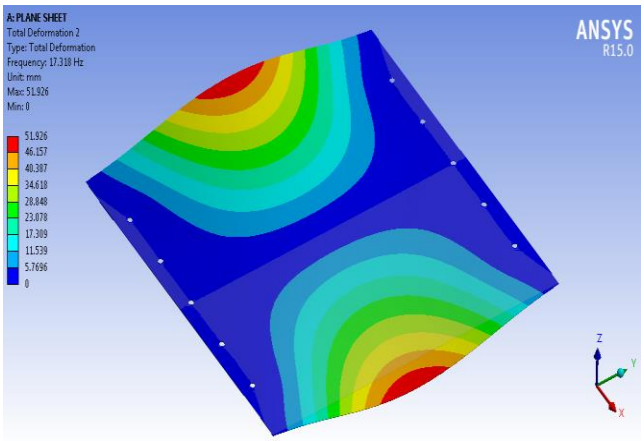
Mode-1. Plane sheet with Reinforcement



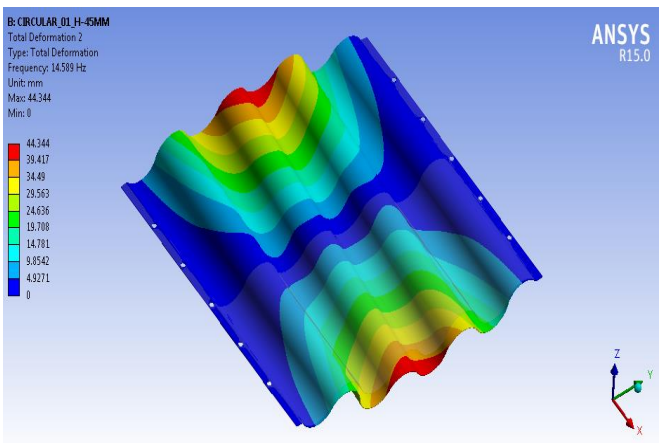
Mode-1. Circular Sheet with reinforcement



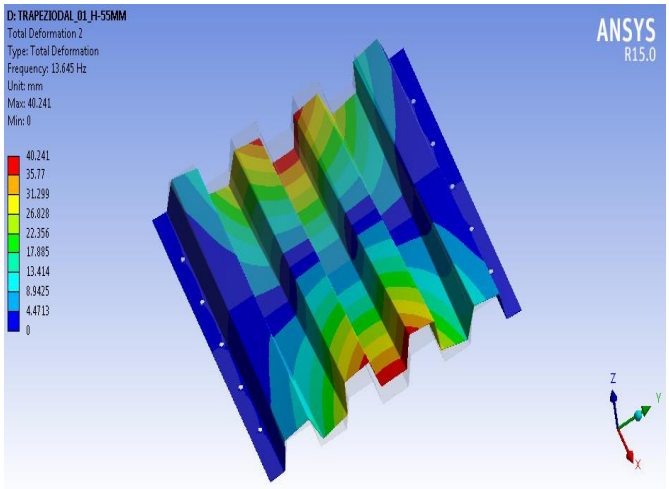
Mode-1. Trapezoidal Sheet with reinforcement.



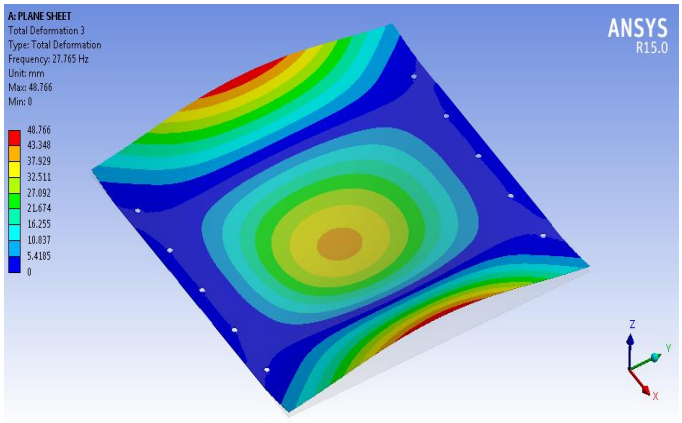
Mode-2. Plane Sheet with reinforcement.



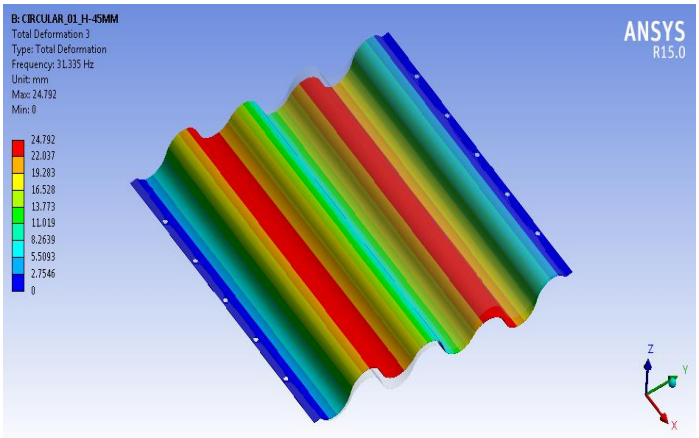
Mode-2. Circular Sheet with reinforcement.



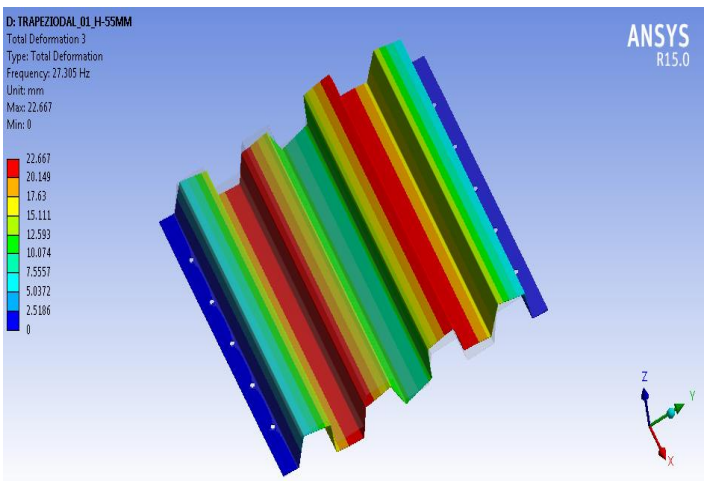
Mode-2. Trapezoidal Sheet with reinforcement.



Mode-3. Plane Sheet with reinforcement.



Mode-3. Circular Sheet with reinforcement.

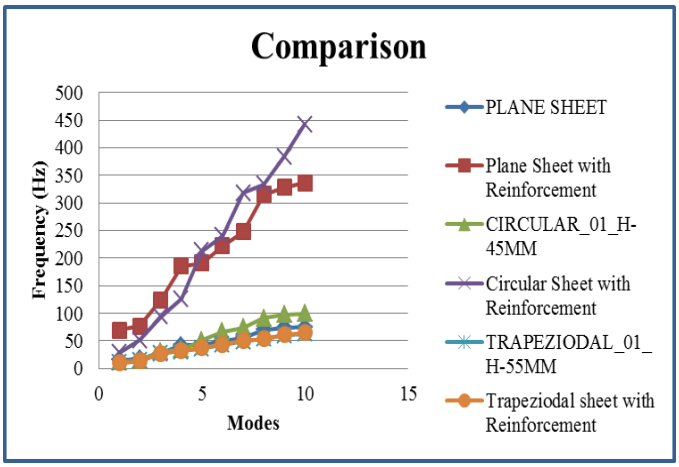


Mode-3. Trapezoidal Sheet with reinforcement.

	Plane Sheet	Circular Sheet	Trapezoidal Sheet
	F (Hz)	F (Hz)	F (Hz)
Mode-1	15.71	11.9	10.23
Mode-2	17.31	14.58	13.64
Mode-3	27.7	31.33	27.30
Mode-4	41.78	33.9	31.62
Mode-5	42.88	51.58	36.39
Mode-6	49.89	66.48	42.61
Mode-7	55.86	73.89	49.4
Mode-8	70.9	91.72	53.85
Mode-9	74.15	97.93	60.65
Mode-10	75.08	99.75	63.38

F=Frequency in Hz

6. COMPARISON OF RESULTS



7. RESULTS AND DISCUSSION

- Circular sheet with reinforcement of jute is stiffer than the circular sheet without reinforcement, since the natural frequency is highest.
- Plane sheet with reinforcement of jute is stiffer than the plane sheet without reinforcement, since the natural frequency range is higher.
- Trapezoidal sheet with reinforcement is stiffer than the trapezoidal sheet without reinforcement, since the natural frequency is high.

8. CONCLUSION

From above results it's been concluded that,

- The strength of circular sheet with reinforcement is highest with having lower mass.
- The strength of plane sheet with reinforcement is higher with having lower mass.
- The strength of trapezoidal sheet with reinforcement is higher with having lower mass.

Among all the Circular plate with reinforcement is showing the highest natural frequency with lower mass of sheet.

ACKNOWLEDGMENT

The authors wish to express their gratitude to Sinhgad Institute of Technology, Lonavala. Interdependence is more valuable than independence. I would like to thank our gratitude to all those who gave me the possibility to complete this work. I deeply indebted to my guide Prof. P D Kulkarni & HOD and all teaching and non-teaching faculty members of Department of Mechanical Engineering, S.I.T., Lonavala who always help

me, gave proper suggestions and encouraged me at all time and guided me for writing this paper.

REFERENCES

[1] Nabeel Alshabatat, "Design of Corrugated Plates for Optimal Fundamental Frequency", Hindawi Publishing Corporation Advances in Acoustics and Vibration Volume 2016.

[2] G.Cheng, "Some aspects of truss topology optimization" Structural Optimization 10, 173-179 Q Springer-Verlag 1995.

[3] P.M. Mohite, C.S. Upadhyay, *"Adaptive finite element based shape optimization in laminated composite plates",* Computers and Structures 153 (2015) 19–35.

[4] Hamdi E. Ahmed, "Optimization of Thermal Design of Ribbed Flat-Plate Fin Heat Sink", Applied Thermal Engineering 2016.

[5] Seongyeol Goo, Semyung Wang, Jaeyub Hyun, Jaesoon Jung, "Topology optimization of thin plate structures with bending stress constraints", Computers and Structures 175 (2016) 134–143.

[6] Marek Pawelczyk and Stanislaw Wrona,"Impact of boundary conditions on shaping frequency response of a vibrating plate - modeling, optimization, and simulation", Institute of Automatic Control, Silesian University of Technology Akademicka 16, 44-100 Gliwice, Poland.

