International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

Vibration analysis of sandwich beam with different core patterns

Pranav N. Kulkarni[1], Sharayu U. Ratnaparkhi[2]

[1]*PG Scholar, Mechanical Design.RMD Sinhgad School of Engineering, Warje, Pune*
[2]*Asst. Professor, Mechanical Dept.RMD Sinhgad School of Engineering, Warje, Pune*

---***---

Abstract -Sandwich beams have number of preferences, for example, the high solidarity to weight proportion, adaptability, high bowing and clasping protections. Sandwich development results higher normal frequencies than none sandwich development likewise it built up a versatile tuned vibration safeguard. In this work, natural frequencies and mode shapes of sandwich beam structure is determined under various center arrangement (circular, hexagonal and square). The beam is investigated with the assistance of Finite component strategy. Sandwich beams are composite frameworks which are having high solidness to weight and solidarity to weight proportions and are utilized as light weight load bearing parts. The utilization of slender, solid skin sheets clung to thicker, lightweight center materials has permitted industry to construct solid, hardened, light, and sturdy structures. There are an ongoing turn of events and effective uses of sandwich beams for basic building and development. These incorporate fiber composite railroad sleepers, composite walers, and fiber composite substitution connect supports. Sandwich beam is dependent upon a gathered point load at the mid-range of the beam. A deliberate method is introduced for looking at the general execution of sandwich beams with different mixes of materials in the beam utilizing ANSYS software.

***Key Words*:**ANSYS, Modal analysis, Core arrangement

1.INTRODUCTION

Sandwich beams are composite frameworks having high firmness to-weight and Strength-to weight proportions and are utilized as light weight load bearing parts. The utilization of slim, solid skin sheets clung to thicker, lightweight center materials has permitted industry to assemble solid, firm, light, and tough structures. This investigation inspects the conduct of sandwich beams driven by the distinctive center setup and diverse center materials. Sandwich Beams are widely utilized in the development of aviation, natural, marine, car and other elite structures because of their high explicit solidness and quality, incredible weariness opposition, long sturdiness and numerous other better properties thought about than the ordinary metallic materials. All in all, these structures require high unwavering quality confirmation for which, the forecast of the most extreme burden that the structure can withstand. A sandwich organized composite is a unique class of composite materials that is manufactured by appending two slim yet hardened skins to a light weight yet thick center. The center material is regularly low-quality material, yet its higher thickness gave the sandwich composite high bowing solidness with generally speaking low thickness. The center is clung to the skins with a glue or with metals segments by brazingtogether. There are various kinds of sandwich structures. Ordinarily, materials, for example, steel and aluminum sheets are utilized for the skins. Auxiliary Sandwich is an exceptional type of composite including a mix of various materials that are attached to one another in order to use the properties of each different segment to the basic bit of leeway of the entire get together. Sandwich materials are oftentimes utilized any place high quality and low weight are significant rules. The most significant application is found in the vehicle business, for example, in the aviation, airplane, cars, railroad and marine ventures where a high solidness/weight and quality/weight proportion gives expanded compensation load limit, improved execution and lower vitality utilization. A sandwich structure comprises of three components, face sheets, center and the glue interface layer. The faces convey in-plane and bowing burdens, while the center oppose transverse shear powers and keep the facings set up.

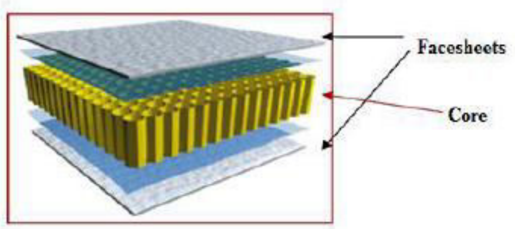


Fig. Sandwich panel beam

Sandwich beam is comprised of various layers. The external skins: If the sandwich is upheld on the two sides, and afterward worried by methods for a power in the beam, at that point the twisting second will present shear powers in the material. The shear powers bring about the base skin in strain and the top skin in pressure. The application regions of sandwich structures in damped structures for successful vibration damping, aerospace field, building Construction and naval ships

2. LITERATURE REVIEW

Maha M. A. Lashin et.al [1], in this paper it presents the normal frequencies and mode states of the sandwich beam structure under various limit conditions. Sandwich beams offer planners various points of interest, as the high solidarity to weight proportion, adaptability, high bowing and clasping protections. Sandwich development results higher natural frequencies than none sandwich developments, likewise it built up a versatile tuned vibration safeguard. Three models are made utilizing MSC-PATRAN/NASTRAN software, 1D beam, 2D shell and 3D strong. The outcomes for AL strong beam, CPVC strong beam, and AL-CPVC sandwich development beam were acquired and contrasted and the scientific outcomes. The outcomes show a decent understanding between the limited component models and diagnostic models for AL strong beam, CPVC strong beam with under 2% blunder. For AL-CPVC sandwich development beam the investigative arrangement is over foreseeing the normal frequencies with 27% for the principal mode and increments with expanding the quantity of modes to arrive at 40% at the fourth mode.

Yuanbin Wang et.al [2], In this paper it presents the vibration of a pivotally moving hyper flexible beam under simply supported condition. The kinematic of the pivotally moving beam have been portrayed by Eulerian-Lagrangian plan. In continuum mechanics outline, the limited distortion recipe and a higher request shear misshapening beam hypothesis are applied to depict the disfigurement of the pivotally moving hyperelastic beam. In these recipes the material boundary, shear misshapening and the geometric non-linearity have been considered. Through the Hamilton rule, the administering conditions of nonlinear vibration are acquired, where the transverse vibration is combined with the longitudinal vibration. At the point when the speed is a consistent, the basic speed and regular frequencies are dictated by unraveling the comparing straight conditions. It is inferred that that the basic speed of hyperelastic beam is bigger than that of direct Euler-Bernoulli beam. For the regular frequencies, we have similar ends. In conclusion, by the various scales technique, the main request expository arrangements of the balance condition of pivotally moving hyperelastic beam in the supercritical system are gotten.

Hu Ding et.al [3]in this examination it presents concentrate because of the multimodal versatile vibration of the fundamental structure on the nonlinear disengagement impact, nonlinear confinement of the transverse vibration of a pre-pressure flexible beam. Three direct springs are used to construct a nonlinear detachment framework, in which level springs are used to give non-linearity and to accomplish semi zero firmness. The transverse vibration of the bar is confined by the flexible help at the two finishes. The Galerkin truncation strategy (GTM) is utilized to illuminate the reaction of the constrained vibration. Aftereffects of the GTM are affirmed by using the limited distinction technique (FDM). It additionally delineates the adequacy of the proposed distinction strategy for nonlinear help structures. The numerical outcomes show that under specific conditions, the semi zero firmness disconnection framework may expand the transmission of high-request modular vibration of the versatile continuum. Besides, this work finds that the underlying pivotal pre-weight could be useful to vibration disconnection of versatile structures.

Beam R. Rimasauskiene et.al [4], in this article it presents the investigation on dynamic and inactive vibration control strategies for a meager walled composite beam were created and tentatively broke down. An MFC (Macro Fiber Composite) actuator was utilized, along with the attractive powers between two lasting cuboidal magnets (latent vibration control) for vibration damping applications. After the trials led with dynamic vibration control (MFC actuator), it was discovered that in all cases, the vibration damping of the investigated framework was a lot higher at its thunderous recurrence. In any case, because of the exploratory outcomes, it could be reasoned that dynamic and detached vibration control frameworks were productive for meager walled composite bar vibration plentifulness control. Approach for slim walled composite beam vibration control investigation was created and introduced in the article.

Jiajin Tian et. al [5], in this writing is available exploration on semi-explanatory model with the expectation of complimentary vibration examination of turning practically evaluated material (FGM) beams with porosities and twofold tightened cross area. The altered principle of blend is embraced to depict material properties of FGM beam with even and lopsided disseminations of the porosity stages. The administering conditions of movement are then determined by utilizing the changed variational strategy and multi space blended approximations. Correlations with the outcomes got from the current writing are given to check the current method. Parametric examinations are additionally completed to research the impacts of material property appropriation, porosity volume division, turn speed and different geometric boundaries upon the free vibration practices of the permeable pivoting FGM beam. The outcomes uncover that these boundaries have momentous impacts in the elements of the pivoting permeable FGM beams, and varieties of the volume part of porosity and material property circulation may bring about extending bowing and wind twisting vibration couplings of turning permeable FGM beams.

3. PROBLEM STATEMENT

Nowadays, it is observed that sandwich panel with different structure core section are enabled to absorb maximum energy for sudden impact. So, in present research circular, square and hexagonal structure are studied to obtain optimum core section for application.

4. OBJECTIVES

1. Design of different cross section (circular, hexagonal and square) core section in sandwich panel in CATIA software.
2. FEA analysis of different cross section (circular, hexagonal and square) core section in sandwich panel to determine mode shapes, natural frequencies and using modal analysis using ANSYS software.
3. Experimental analysis of sandwich panel using FFT analyzer technique (impact hammer test) to determine mode shapes, natural frequencies
4. Validation of experimental and numerical results.

5. METHODOLOGY

Step 1: - Initially research paper are studied to find out research gap for project then necessary parameters are studied in detail. After going through these papers, we learnt about vibration analysis of sandwich beam with different core patterns.
Step 2: - Research gap is studied to understand new objectives for project.
Step 3: - After deciding the components, the 3D Model and drafting will be done with the help of CATIA software.
Step 4: - The modal analysis of the components will be done with the help of ANSYS using FEA.
Step 5: - Experimental manufacturing of component and performing test as per objectives specified.
Step 6: - Comparative analysis between the experimental & analysis result.

Table. Material properties of steel

Properties of Outline Row 3: Structural Steel

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	7850	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
6	Isotropic Elasticity		
7	Derive from	Young's Modulus and Poi...	
8	Young's Modulus	2E+11	Pa
9	Poisson's Ratio	0.3	
10	Bulk Modulus	1.6667E+11	Pa
11	Shear Modulus	7.6923E+10	Pa

Table. Material properties of rubber

Properties of Outline Row 3: RUBBER

	A	B	
1	Property	Value	
2	Material Field Variables	Table	
3	Density	950	kg m^-3
4	Isotropic Elasticity		
5	Derive from	Young's Modulu...	
6	Young's Modulus	1.54	MPa
7	Poisson's Ratio	0.45	
8	Bulk Modulus	5.1333	MPa
9	Shear Modulus	0.53103	MPa

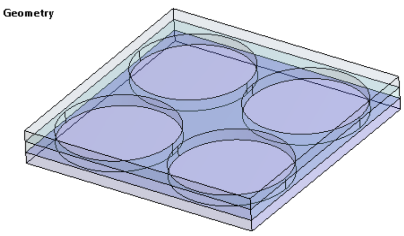


Fig. Geometry of circular imported in ANSYS

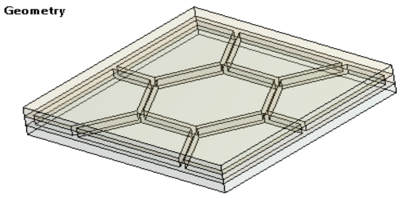


Fig. Geometry of hexagonal imported in ANSYS

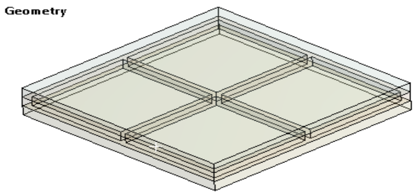
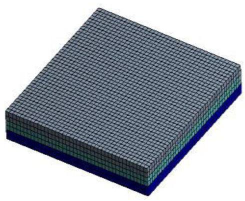
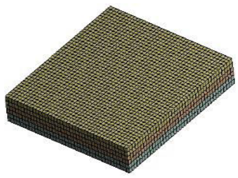


Fig. Geometry of square imported in ANSYS

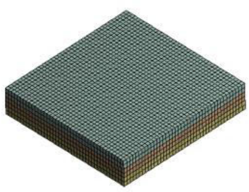
Mesh

In ANSYS meshing is performed as similar to discretization process in FEA procedure in which it breaks whole components in small elements and nodes. So, in analysis boundary condition equation are solved at this elements and nodes. ANSYS Meshing may be all-purpose, intelligent, automated high-performance product. It produces the foremost acceptable mesh for correct, economical metaphysics solutions. A mesh well matched for a selected analysis may be generated with one click for all elements in a very model. Full controls over the options accustomed generate the mesh are accessible for the skilled user who needs to fine-tune it. The ability of parallel processing is automatically accustomed reduce the time you have got to wait for mesh generation

Statistics	
Nodes	43662
Elements	7426

Statistics	
Nodes	41874
Elements	6980



Statistics	
Nodes	40922
Elements	6874

Fig. Details of meshing of circular, hexagonal and square

Boundary Condition

A boundary condition for the model is that the setting of a well-known value for a displacement or an associated load. For a specific node you'll be able to set either the load or the displacement but not each. The main kinds of loading obtainable in FEA include force, pressure and temperature. These may be applied to points, surfaces, edges, nodes and components or remotely offset from a feature.Fixed support is applied at bolting joint as per existing condition

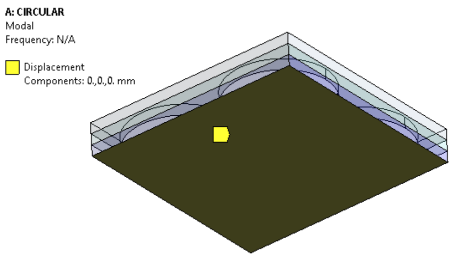


Fig. Boundary condition

In boundary condition fixed support is applied at base as per existing boundary conditions to determine mode shape and natural frequency.

Total Deformation

In finite element method the total deformation and directional deformation are general terms irrespective of software being used. Directional deformation may be place because the displacement of the system in a very particular axis or user defined direction. Total deformation is that the vector sum of all directional displacements of the systems.

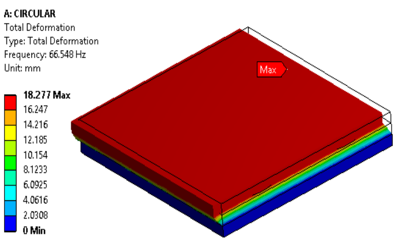


Fig. Mode shape 1

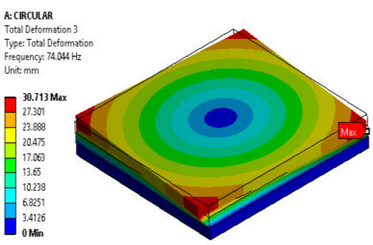


Fig. Mode shape 3

Table. Natural frequencies of circular core section

Tabular Data		
	Mode	Frequency [Hz]
1	1.	66.548
2	2.	66.554
3	3.	74.044
4	4.	160.74
5	5.	167.48

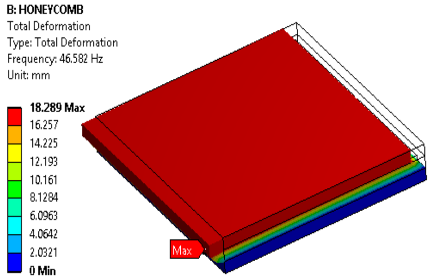


Fig. Mode shape 1

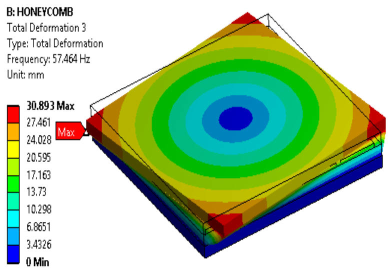


Fig. Mode shape 3

Table. Natural frequencies of honeycomb core section

Tabular Data		
	Mode	Frequency [Hz]
1	1.	46.582
2	2.	47.067
3	3.	57.464
4	4.	107.15
5	5.	123.57

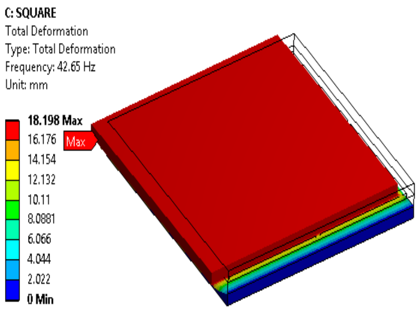


Fig. Mode shape 1

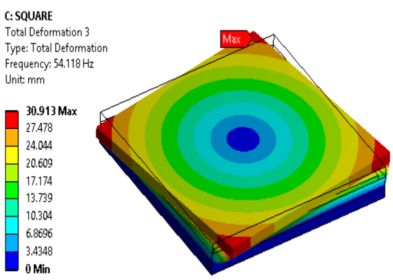


Fig. Mode shape 3

Table. Natural frequencies of square core section

Tabular Data

	Mode	Frequency [Hz]
1	1.	42.65
2	2.	42.65
3	3.	54.118
4	4.	97.506
5	5.	116.39

MODE NO	CIRCULAR CORE FREQ (hz)	HEXAGONAL CORE FREQ (hz)	SQUARE CORE FREQ (hz)
1	66.548	46.582	42.65
2	66.554	47.067	42.65
3	74.044	57.464	54.118
4	160.74	107.15	97.506
5	167.48	123.57	116.39

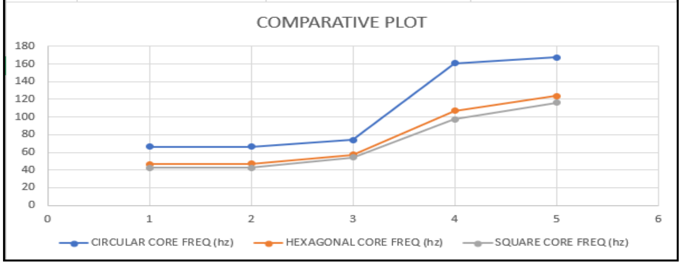


Fig. Comparative plot of core variations

6. CONCLUSION

- Modal analysis of different composite sandwich beam structure done with ANSYS software.
- It is observed that circular core has maximum Natural frequency than honeycomb core and square rubber core configuration.
- Circular core sandwich beam structure has maximum stiffness and maximum damping capacity.

REFERENCES

1.Free Vibration Analysis of Sandwich Beam Structure Using Finite Element Approach BY Maha M. A. Lashin, A. Okasha El-Nady

2.Free vibration analysis of sandwich beams using improved dynamic stiffness method S.M.R. Khalili, N. Nemati, K. Malekzadeh, A.R. Damanpack

3.Bifurcations and chaotic forced vibrations of cantilever beams with breathing cracks K. Avramova, S. Malyshev

4.Efficient attenuation of beam vibrations by inertial amplification Mateusz Beamys, Jakob S. Jensen, Niels M.M. Frandsen

5.Vibration of axially moving hyperelastic beam with finite deformation Yuanbin Wang, Hu Ding, Li-Qun Chen

6.Nonlinear isolation of transverse vibration of pre-pressure beams Hu Ding, Ze-Qi Lu, Li-Qun Chen

7.Transverse vibrations induced by longitudinal excitation in beams with geometrical and loading imperfections Si Mohamed Sah, Jon Juel Thomsen, Dmitri Tcherniak

8.Experimental Analysis of Active - Passive Vibration Control on Thin-Walled Composite Beam R. Rimašauskienė, V. Jūrėnas, M. Radzienski, M. Rimašauskas, W. Ostachowicz

9.A modeling method for vibration analysis of cracked beam with arbitrary boundary condition KwanghunKim ,Sok Kim , KyongjinSok , Chanil Pak , Kwangbok Han

10.Free vibration analysis of rotating functionally graded double-tapered beam including porosities Jiajin Tian, Zhenguo Zhang, Hongxing Hua