Vibrational Analysis of Natural Fiber Composite Internal Interior Panel of Dashboard by using FFT Analyzer

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Abstract - *A dashboard (additionally called run, instrument board (IP), or sash) is control board found legitimately in front of vehicle's driver, showing instrumentation and controls for the vehicle's activity. Inside boards can be made of wide range of kinds of materials, everyone is picked for an alternate reason. In the course of recent decades, the inside vehicle board has gotten considerably more consideration, as specialists concentrated on lessening the heaviness of vehicles to expand eco-friendliness. The inside boards might be made out of a solitary bit of shaped plastic, or a few bits of plastic. As different territories of car producing have developed, inside boards have from being produced using bits of metal, to thin bits of cardboard, to shaped plastics, fiberglass and wood. The goal of task is to build up a reasonable model of inner dashboard board for vehicle, to direct modal analysis investigation of inside board by limited component strategy, to look at the exhibition of jute fiber material with recently suggested materials of inward entryway board. The inside boards of dashboard were utilized to build up the geometric model of the inner inside board by CATIA V5 R20 software. This 3-D geometric model was imported to utilizing ANSYS Workbench 19.0. Modal analysis investigation of inside board will be finished utilizing ANSYS software. Test approval done utilizing FFT analyzer and effect hammer. After that the similar investigation will be completed between the exploratory and examination results and after that the outcome and end will be drawn.*

***Key Words*: FEA, FFT, Modal analysis, Composite materials.**

1. INTRODUCTION

Using bio-based materials in vehicle parts was first contemplated by the author of the Ford Motor organization in mid 1930s. Enlivened by the ranchers' situation, Henry Ford looked for methods for monetarily enabling them and having soil as the down to earth wellspring of vehicle parts and fills appeared to be doable. Additionally, in a mission for earth agreeable light-bodied vehicles, these materials offered a guarantee of weight and emanations guideline. This had a body including generally soy tar strengthened hemp, sisal, and wheat straw composites this had its weight 66% that of an ordinary vehicle with a motor running on hemp oil fuel. The oil wealth at that point and the unexpected dive of the car business into the Second World War accompanied requirement for profoundly automated vehicles influencing the advancement of this exploration. The year 1957 saw a significant achievement for bio-composites in the car with the East German assembled a Trabant vehicle having a monocoque development with the rooftop, boot cover, hood, wings, and entryways fabricated from a thermosetting phenolic pitch reinforced with cotton. Acrylonitrile butadiene styrene (ABS) (compound recipe $(C_8H_8)_x{\cdot}(C_4H_6)_y{\cdot}(C_3H_3N)_z$) is a common thermoplastic polymer. Its glass change temperature is roughly 105 °C (221 °F). ABS is undefined and hence has no evident liquefying point. ABS is a terpolymer made by polymerizing styrene and acrylonitrile within the sight of polybutadiene. The extents can differ from 15 to 35% acrylonitrile, 5 to 30% butadiene and 40 to 60% styrene. A bio-composite is a composite material shaped by a network (pitch) and a support of normal strands. These sorts of materials regularly mirror the structure of the living materials associated with the procedure keeping the fortifying properties of the lattice that was utilized, however continually giving biocompatibility. The network is essential to shield the filaments from natural corruption and mechanical harm, to hold the strands together and to move the heaps on it. Also, biofibers are the key parts of bio composites, which are gotten from natural inceptions, for example fibers from crops (cotton, flax or hemp), recycled wood, waste paper, crop processing byproduct or recovered cellulose fiber (thick/rayon). The enthusiasm for bio composites is quickly developing as far as modern applications (automobiles, railway coach, aviation, military applications, development, and bundling).

2. LITERATURE REVIEW

Navdeep Kumar et al. [1] In this paper it presents composite material for dashboard. This work manages sinewy bio composites arranged by utilizing weed and poly (lactic corrosive) strands and utilizing checking and pressure forming forms. The tractable, bowing and effect properties of the bio composites were found to increment at first with the expansion of annoy fiber content till 50 wt% and reduction a short time later. It is presumed that the thermo gravimetric examination surmised that the warm steadiness of the bio composites expanded with the expansion of bother fiber content. The bio composites displayed great biodegradability and their biodegradability expanded with the expansion of vex fiber content. The bio composite arranged with equivalent

weight extent of bother and poly (lactic corrosive) indicated high potential for car dashboard board application. The expansion in elasticity at higher chamber speed was ascribed to the special arrangement of more filaments along the longitudinal pivot (bearing of applied heap) of the bio composites. The thermo gravimetric analysis inferred that the bio composites were thermally enough stable and their thermal stability increased with the increase of nettle fibre content. Author shows the result that the dynamic mechanical analysis suggested that the bio composites were extremely good in terms of dynamic mechanical properties.

Michael T. Krush et al. [2] In this paper it speaks to showcasing of execution improved dashboard. In this work, they examine how deals capacities and execution observing by means of advertising dashboards impact an association's sense making. The aftereffects of this investigation propose that business capacity and the utilization of advertising dashboards contribute legitimately, yet additionally have an intuitive impact, featuring the significance of incorporating the two deals and promoting tasks. They discover proof that sense making impacts cost control and improve client relationship execution, recommending that sense making can possibly at the same time impact both cost effectiveness and development. In the first place, observational testing bolsters first and second theories. The outcomes mirror that a specialty unit's business ability and promoting dashboard endeavors legitimately and decidedly impact its sense making. In a related way, our outcomes fortify a special point of view that lines up with asset-based hypothesis. The outcomes exhibit the reciprocal impacts these two explicit advertising assets have on sense making. The positive communication of these two factors recommends that the utilization of promoting dashboards uplifts the impact deals ability has on sense making. As a result, advertising dashboards may give the reliable data over the association that adequately helps in upgrading the business power's endeavors in producing learning inside the firm.

Venkat Pisipati et al. [3] In this paper it presents wellbeing of heat considered. It presents impact by limited material models. Engine vehicle security guidelines are getting the opportunity to be all the more requesting with time. For car insides, instrument board (IP) head impact insurance is a key prerequisite of the Federal Motor Vehicle Safety Standard (FMVSS) 201. To guarantee consistence of this prerequisite, head impact tests are led at 12 and 15 mph for execution check. PC recreation has gotten progressively common as the essential improvement device because of the huge decrease in time and cost that it offers. LS-DYNA offers a wide assortment of material models, and material sort 024 is one of the most well-known ones. In spite of the fact that it was at first created for metals, it is normally utilized for polymers too. LS-DYNA likewise offers a few other material models explicitly created to mimic polymers, for example, material sorts 019, 089, 123, to give some examples. The essential goal of this examination is to think about different LS-DYNA material models for polymers - MAT 024, MAT 019, MAT 089 and MAT123, and prescribe the proper model to use for foreseeing head impact execution.

Jatin M. Patel et al. [4], In this paper it presents vehicle body board is chosen as an objective weight decrease part. This can be accomplished either utilizing high quality low weight material or by utilizing low weight composite sandwich board. Car industry is quickly going. On other hand clients have rigid interest of mileage, superior requiring little to no effort. Aluminum composite (Aluminum skin, polyethylene center and epoxy gum) material being light and solid, it is thought as an elective material. By utilizing this doubly bend sandwich board, required solidness can be accomplished with diminished thickness and weight. In numerous applications, the sheet metal parts don't convey any critical burden. These parts give just an ensuring or isolating shield. In the event that insurance or partition is the capacity required, it isn't generally fundamental that the part be made of a solitary sheet metal. The achievement of a vehicle maker in this decade will be controlled by this capacity to meet the necessities of the client. The external body board zone of the vehicles is a factor in a few of these necessities. Body board can expand mileage through weight decrease. This report depicts an explanatory strategy to foresee the exhibition of a body board dependent on shape and material properties.

3. PROBLEM STATEMENT

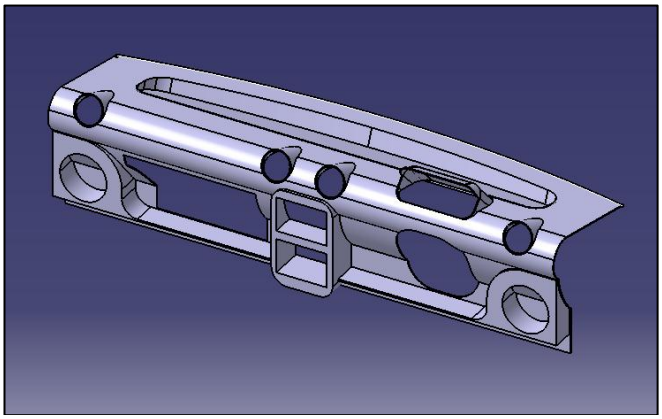
The inside board of a vehicle dashboard is ordinarily made of various materials. Instrument Panel was made with generally plastics, fiberglass. Common strands being eco-accommodating, lightweight, solid, and minimal effort have just begun to supplant glass and mineral fillers in various designing applications in autos, so advance inward inside board with assistance of jute fiber material.

4. METHODOLOGY

Step 1:- Initially research papers are studied to find out research gap for project then necessary parameters are studied in detail. After going through these papers, learnt about weight optimization using composite material.
Step2:- Research gap is studied to understand new objectives for project.
Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of software.
Step 4: - The components will be manufactured and then testing using FFT technique.
Step 5: -The testing will be carried out and then the result and conclusion will be drawn.

5. DESIGN

5.1 CAD Part in CATIA Software



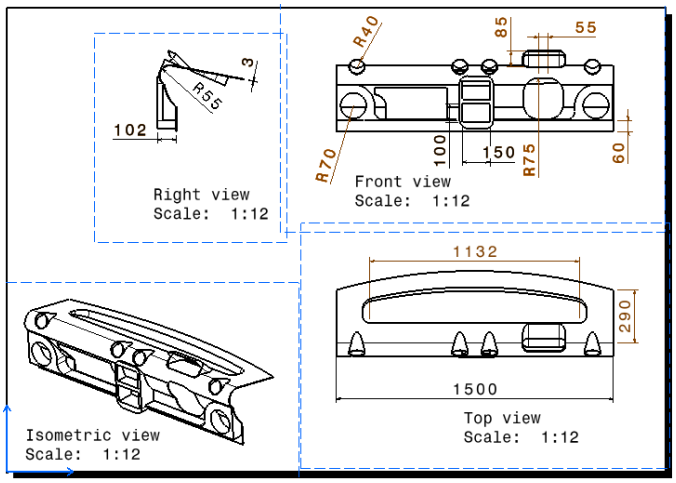


Fig.1. CATIA and drafting of dashboard

Properties of Outline Row 3: Polyethylene

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	950	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
6	Isotropic Elasticity		
7	Derive from	Young's Modulu...	
8	Young's Modulus	1.1E+09	Pa
9	Poisson's Ratio	0.42	
10	Bulk Modulus	2.2917E+09	Pa
11	Shear Modulus	3.8732E+08	Pa

Table.1. Material Properties

5.2 Finite Element Analysis

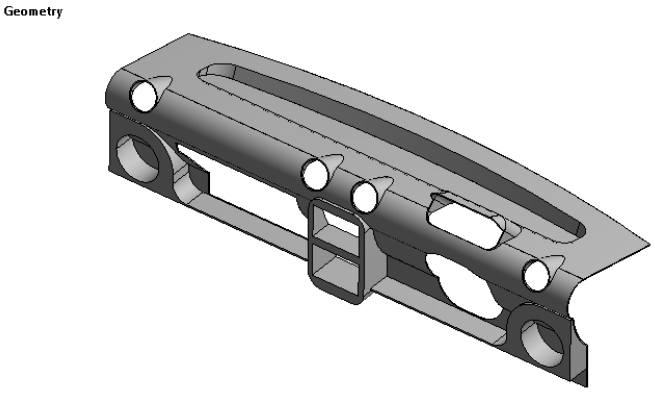


Fig. 3. CATIA model imported in ANSYS

5.3 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 is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient multiphysics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model. Full controls over the options used to generate the mesh are available for the expert user who wants to fine-tune it.

Statistics	
Nodes	199793
Elements	105742

Fig. 4. Details of meshing

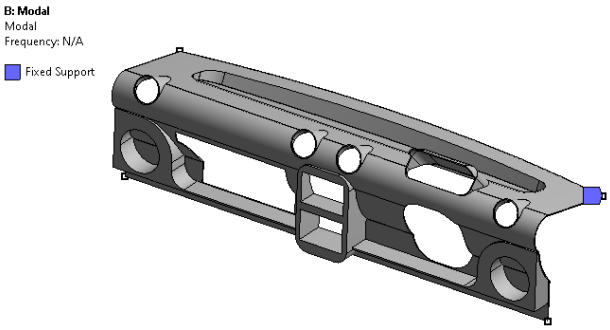


Fig.5. Boundary condition

To perform modal analysis and determine mode shape along with respective natural frequency fixed support is applied at 4 vertices as per existing boundary condition where the dashboard is mounted with nut bolt arrangement.

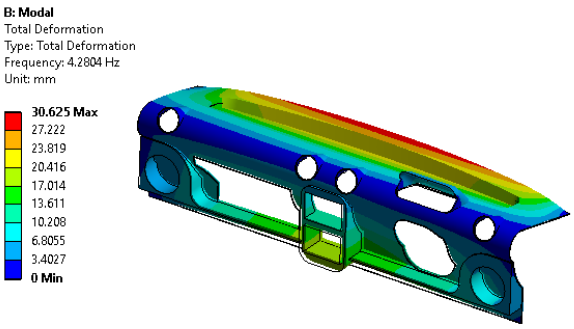


Fig. 6. Mode shape 1

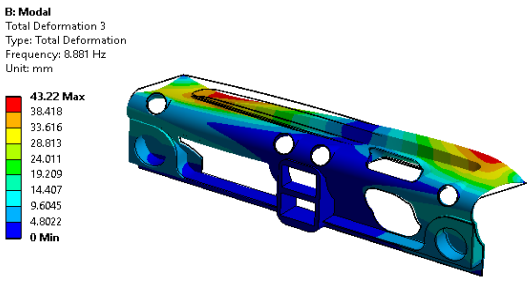


Fig. 7. Mode shape 3

Tabular Data

	Mode	Frequency [Hz]
1	1.	4.2804
2	2.	5.3781
3	3.	8.881
4	4.	11.026
5	5.	14.278
6	6.	15.155

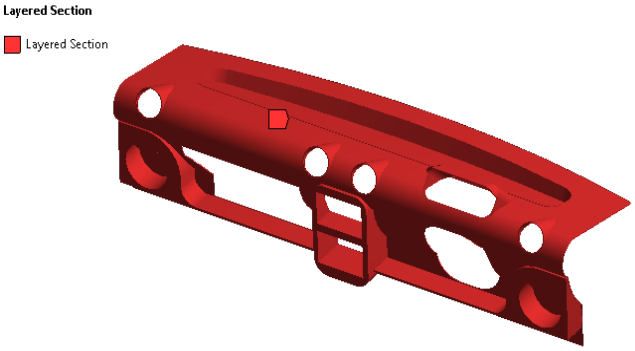
Table.2. Tabular data of mode shape frequency

5.4 Modal Analysis of Dashboard of Composite Jute Epoxy Material

Properties of Outline Row 3: JUTE EPOXY

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	1330	kg m^-3
4	Isotropic Elasticity		
5	Derive from	Young's Modulus...	
6	Young's Modulus	2.65E+10	Pa
7	Poisson's Ratio	0.35	
8	Bulk Modulus	2.9444E+10	Pa
9	Shear Modulus	9.8148E+09	Pa

Table.3. Composite material properties



Material	Thickness (mm)	Angle (°)
JUTE EPOXY	1	0
JUTE EPOXY	1	45
JUTE EPOXY	1	90

Fig.8. Layup of composite material on dashboard

Composite Jute Epoxy material properties inserted in the ANSYS Software with total 3 mm thickness for three different orientation angles 0, 30, 90 degrees.

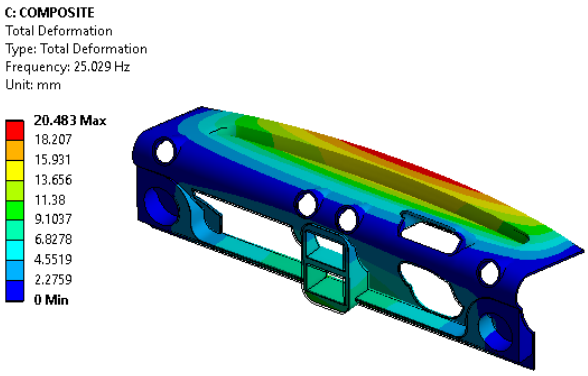


Fig.9. Mode shape 1

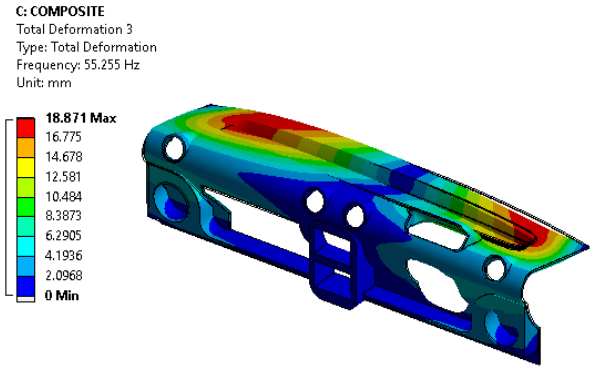


Fig.10. Mode shape 3

Tabular Data

	Mode	Frequency [Hz]
1	1.	25.029
2	2.	32.158
3	3.	55.255
4	4.	65.166
5	5.	92.464
6	6.	100.61

Table.4. Tabular data of mode shape frequency

6. EXPERIMENTAL TESTING

Fast Fourier Transform

The experimental validation is done by using FFT (Fast Fourier Transform) analyzer. The FFT spectrum analyzer samples the input signal, computes the magnitude of its sine and cosine components, and displays the spectrum of these measured frequency components. The advantage of this technique is its speed. Because FFT spectrum analyzers measure all frequency components at the same time, the technique offers the possibility of being hundreds of times faster than traditional analog spectrum analyzers.

Impact Hammer Test

Hammer impacts produce a broad banded excitation signal ideal for modal testing with a minimal amount of equipment and set up. The "double hit" applies two impulses to the structure, one initially and one time delayed. Both the temporal and spectral characteristics of the "double hit" input and output are significantly different from a "single hit". The input force spectrum for the "double hit" no longer has the wide band constant type characteristics of a single hit. The relationship of the system's parameters with respect to data capture requirements is evaluated. The effects of exponential windowing are developed to examine the effects on the estimated spectra and modal parameters. Finally, the "double hit" phenomena is examined by combining the results from the single degree-of-freedom system excited by two impulses, one of which is time delayed. The results from these related studies are combined to provide insight into data acquisition guidelines for structural impact testing.

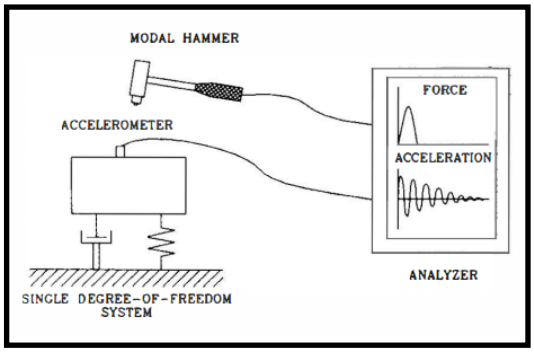


Fig.11. Block diagram of FFT

Fig.12. Experimental Set up

7. EXPERMENTAL RESULTS

Initially fixture is designed according to existing boundary condition as per FEA results.

FFT consists of impact hammer, accelerometer, data acquisition system in which each supply is applied to DAS and laptop with DEWSOFT software to view FFT plot.

Accelerometer is mounted at surface as per high deformation observed in FEA results along with initial impact of hammer is placed for certain excitation to determine frequency of respective mode shapes.

After impact FFT plot are observed on laptop and comparison of FEA and experimental results are analyzed.

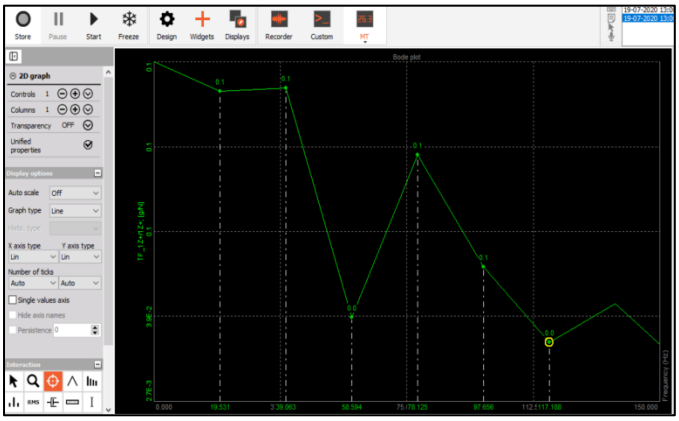


Fig.13. FFT plot

MODE SHAPE	FEA	EXPERIMENTAL
1	25.02	19.53
2	32.15	39.06
3	55.25	58.59
4	65.16	78.12
5	92.46	97.65
6	100.61	117.18

Table.5. Comparison of FEA and FFT results of composite dashboard

8. CONCLUSIONS

In present investigation modal analysis of the dashboard made up of ABS material is done and respective results are drawn. In second case we have performed modal analysis of the same dashboard made up of Composite Jute-Epoxy resin and results are drawn.

When we compare the results between these two, we can conclude that the natural frequency of the dashboard made up of composites with three different orientation angles is higher than the conventional dashboard made up of ABS material hence it has more restriction to the resonance.

From experimental testing it is observed that FFT results are almost similar to composite dashboard obtained by numerical analysis.

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