"VIBRATION REDUCTION OF CAR BONNET UNDER FIXED CONDITION"

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ABSTRACT

Vibration reduction of Car Bonnet under Fixed Condition is based on the phenomenon Noise, Vibration and Harshness (NVH). Noise, Vibration and Harshness, more commonly known as NVH, is an all-encompassing engineering discipline that deals with the objective and subjective structural dynamic and acoustic aspects of automobile design.

This involves integrating extensive modeling, Simulation, evaluation, and optimization techniques into the design process to ensure both noise and vibration comfort. New materials and techniques are also being developed so that the damping treatments are lighter, cheaper, and more effective.

The objective is to Design and 3D model using CAD tool CATIA V5 and then Finite Element Analysis (FEA) was done with the help of Hypermesh and finally by using solver ABAQUS for Fixed conditions. Vibrational reduction analysis was carried out using both the Finite Element Analysis and Experimental Analysis.

The experimental modal analysis was carried out with and without dampers for the Car Bonnet and also the validation of results was carried out. Finally, the results of Finite Element Analysis and Experimental analysis were matching with each other.

Keywords: Noise Vibration and Harshness (NVH); 3D Model, CATIA V5, Finite Element Analysis (FEA); Experimental Analysis; Modal Analysis; Hypermesh and ABAQUS.

INTRODUCTION

The car business is at present burning through a large number of dollars to enhance NVH execution. The new outline strategies are beginning to consider NVH issues all through the entire plan process. This includes coordinating broad displaying, Simulation, assessment, and improvement methods into the outline procedure to safeguard both clamor and vibration comfort. New materials and methods are additionally being created with the goal that the damping medicines are lighter, less expensive, and more compelling. Commotion, Vibration and Harshness, all the more normally known as NVH, is a sweeping building discipline that arrangements with the goal and subjective basic dynamic and acoustic parts of vehicle outline. The NVH build is occupied with the auxiliary powerful reaction of the vehicle from the total amassed framework down to the typical methods of the individual segments. As a vehicle is a moving powerful framework, its reaction to stochastic, time fluctuating sources of info is essential for wellbeing, quality, and solace of the travelers.

Car bonnet consist of the outer panel and inner stiffener panels and reinforcement members placed there between to increase the strength of said panel in localized area. The outer panel and inner stiffener panel are connected by hemming. Bonnet is a main component of front portion of the car which is used for many purposes. Bonnet is made aerodynamic in shape to reduce air effect. Also bonnet is used to decorate car and add luxurious look. Bonnet generally used to cover car engine, radiator and many other parts, therefore bonnet must be designed in such a way that all the maintenance parts should be easily accessible and it gives minimum hindrance to aerodynamic flow. While car is in running condition it experiences a resisting forces of air, hence bonnet of car must be aerodynamic.

For analysis, car bonnet of well-known manufacturer have been selected. Static load on the bonnet is identified. Finite element analysis of existing bonnet revealed the stress distribution on the bonnet. So an effort is made to modify the structure of existing bonnet so that the advantages of weight reduction along with safe stress can be obtained.

OBJECTIVES AND METHODOLOGY

In a car industry, now-a-days we are utilizing a few number of alterations, re-modifications, recently outlined segments or structure or machine components. At working condition these segments might be influenced by vibration related issues which prompts disappointment of the structure because of weariness or break.

In this manner every single segment of a machine must be broke down for better working condition and there are a few different ways to accomplish it, among them we choosed are

1. Experimental modular investigation
2. FEA or Harmonic investigation

Our present venture is centering towards finding the attributes of the accompanying

1. Mode shapes
2. Natural frequency
3. Damping element

OBJECTIVES

1. Generating the 3D modular of auto hood utilizing CATIA V5R20 programming device.
2. Importing the modular to HYPERMESH programming and lattice it.
3. Modal investigating.
4. Modifying the outline and rehashing a similar system for various trails.
5. Comparison of results.
6. Discussion and conclusion.

METHODOLOGY

The model made utilizing demonstrating apparatus, here we utilized CatiaV5 is and is fare to cross section, this is finished by Hyper mesh work and Optic Strut is the solver, Harmonic investigation is additionally done and trial examination is directed.

Model Demonstrating: Model of car Bonnet was extricated from Vehicle body outline examination library where all the geometry of car parts are accessible.

FE Examination: Numerical Analysis is an effective strategy for displaying complex structures and utilized as a plan device, by partitioning the structure into various little parts called as Finite components, every component has a limit point is called hub that are adjoining the components.

The limit condition embraced was settled at the both end and obliged for which Bonnet was compelled as pivoted toward one side and hooked at the opposite end.

EXPERIMENTAL MODAL ANALYSIS TEST ON CAR BONNET

1.) Fixed – Fixed condition: Bonnet without Stiffeners

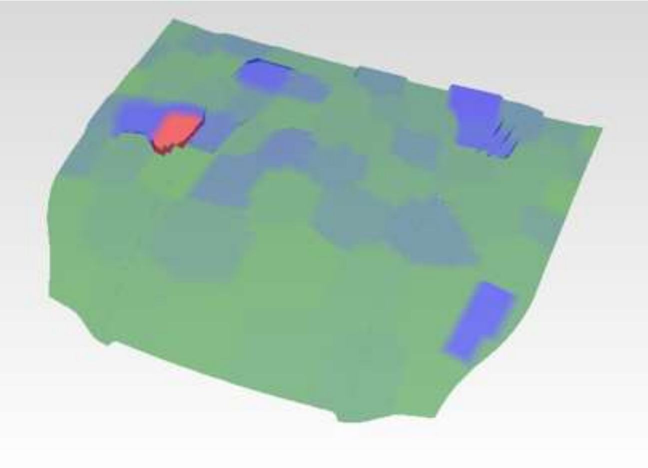

Fig.1.1: Frequency: 29.5 Hz, Damp: 3.15%

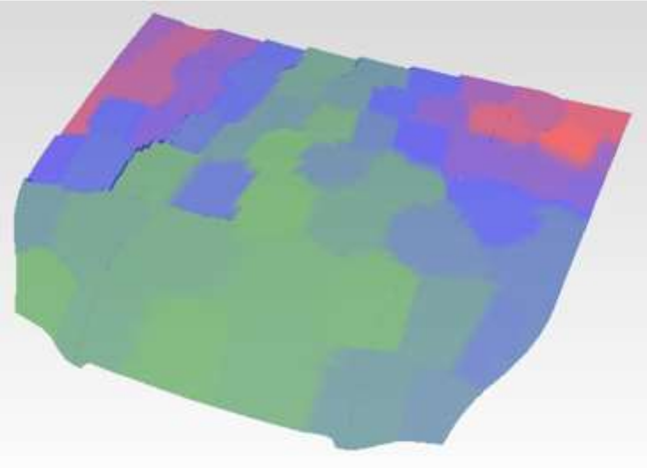

Fig.1.2: Frequency: 41 Hz, Damp: 3.94%

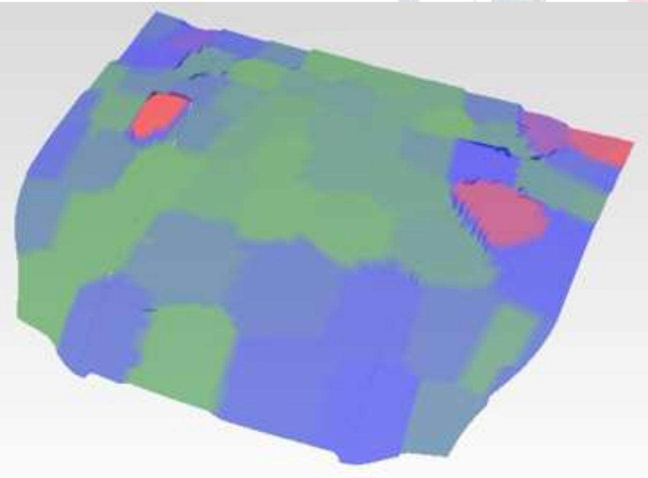

Fig.1.3: Frequency: 86.8 Hz, Damp: 0.618%

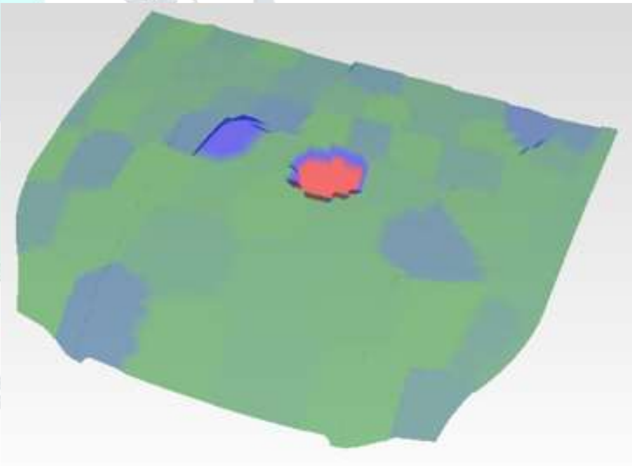

Fig.1.4: Frequency: 242 Hz, Damp: 0.538%

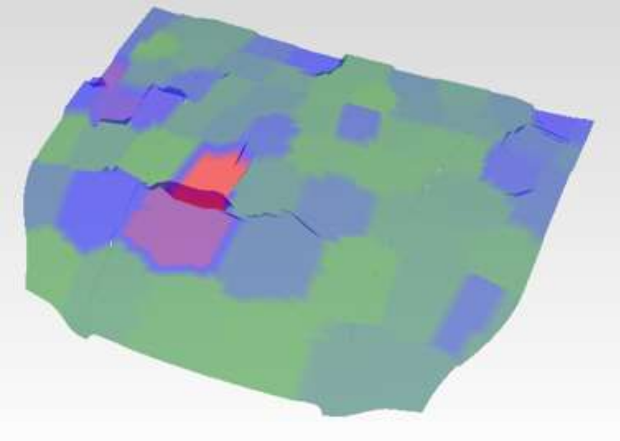

Fig.1.5: Frequency: 289 Hz, Damp: 1.02%

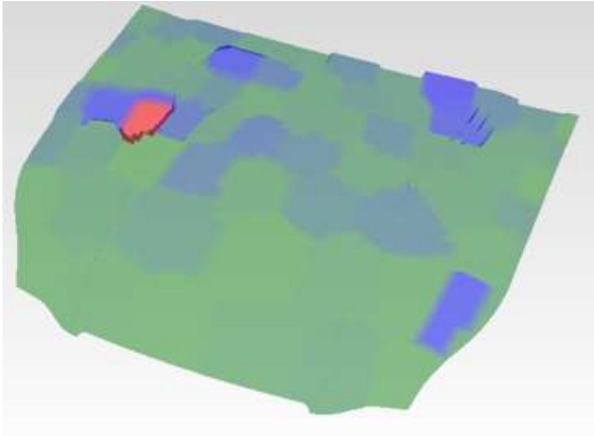

Fig.1.6: Frequency: 310 Hz, Damp: 0.871%

Select Shape	Frequency (or Time)	Damping	Units	Damping (%)
1	29.5	0.93	Hz	3.15
2	41	1.62	Hz	3.94
3	86.8	0.537	Hz	0.618
4	242	1.3	Hz	0.538
5	289	2.94	Hz	1.02
6	310	2.7	Hz	0.871

Table 1.1: Frequency, Damping Readings

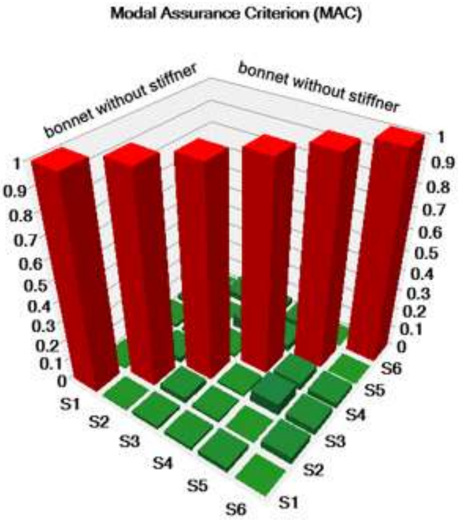

Fig.1.7: Modal Assurance Criterion

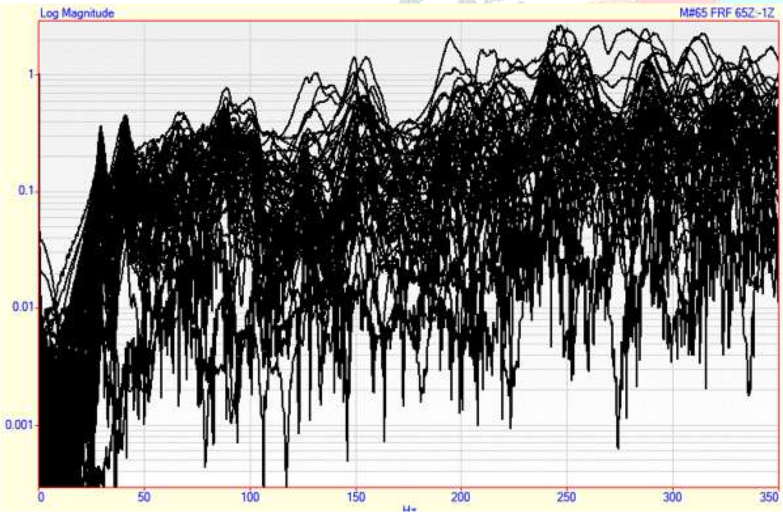

Fig 1.8: Schematic view of frequencies occurred at different points

2.) <u>Fixed – Fixed condition</u>: <u>Bonnet with Stiffeners</u>

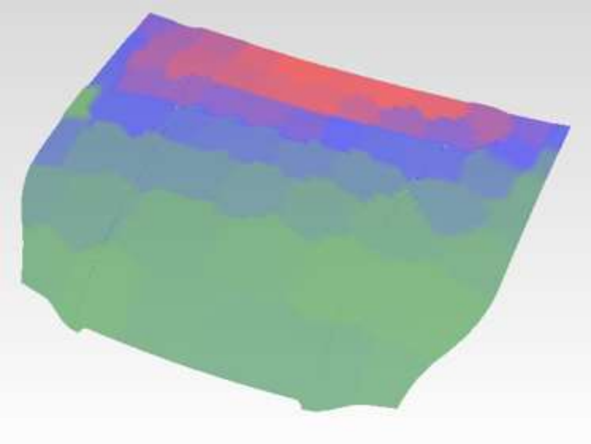

Fig.2.1: Frequency: 27.3 Hz, Damp: 2.25%

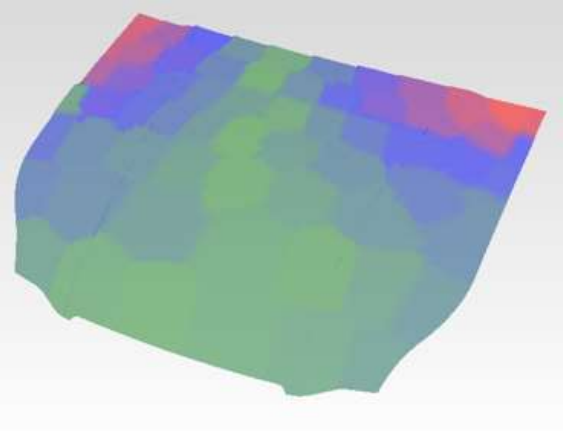

Fig.2.2: Frequency: 37.9 Hz, Damp: 3.6%

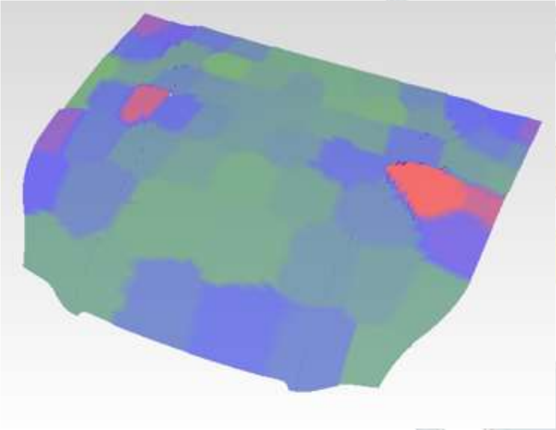

Fig.2.3: Frequency: 86.2 Hz, Damp: 3.37%

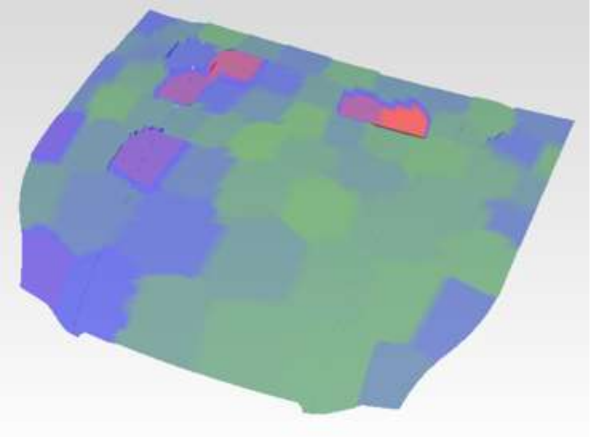

Fig.2.4: Frequency: 152 Hz, Damp: 1.79%

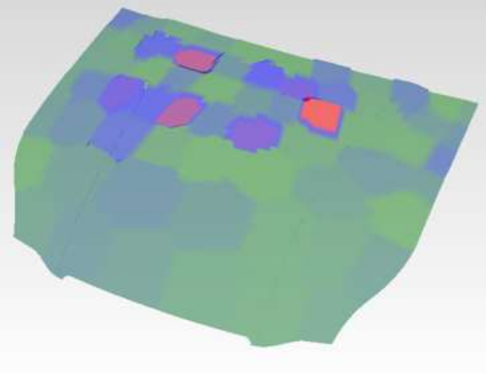

Fig.2.5: Frequency: 222 Hz, Damp: 1.06%

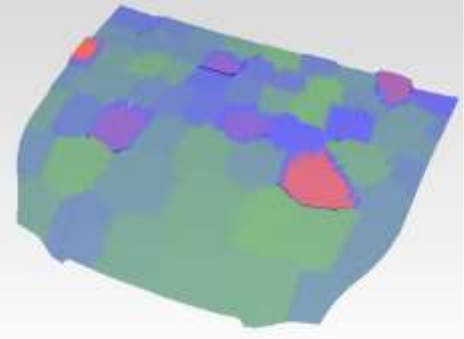

Fig.2.6: Frequency: 243 Hz, Damp: 0.939%

Select Shape	Frequency (or Time)	Damping	Units	Damping (%)
1	27.3	0.613	Hz	2.25
2	37.9	1.36	Hz	3.6
3	86.2	2.91	Hz	3.37
4	152	2.73	Hz	1.79
5	222	2.36	Hz	1.06
6	243	2.28	Hz	0.939

Table 2.1: Frequency, Damping Readings

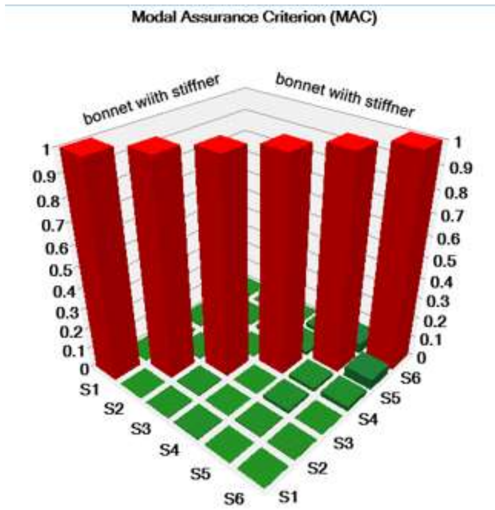

Fig.2.7: Modal Assurance Criterion

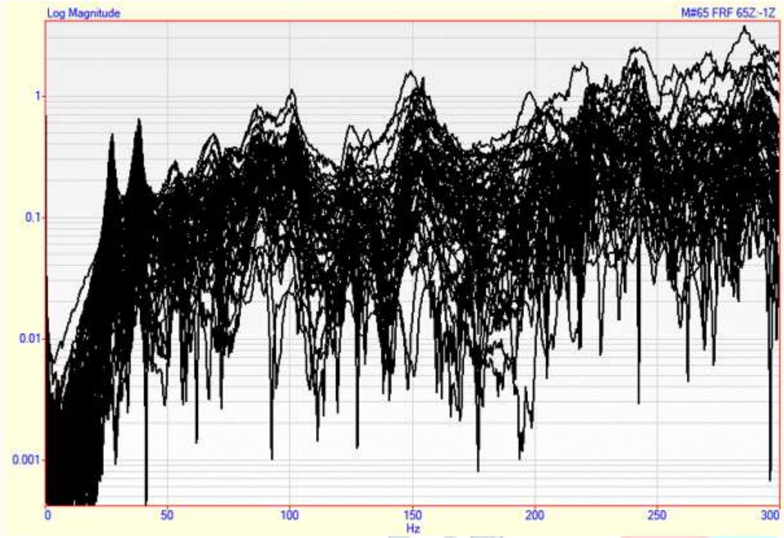

Fig 2.8: Schematic view of frequencies occurred at different points

FINITE ELEMENT MODAL ANALYSIS

1.) **Fixed – Fixed condition: Bonnet without Stiffeners**

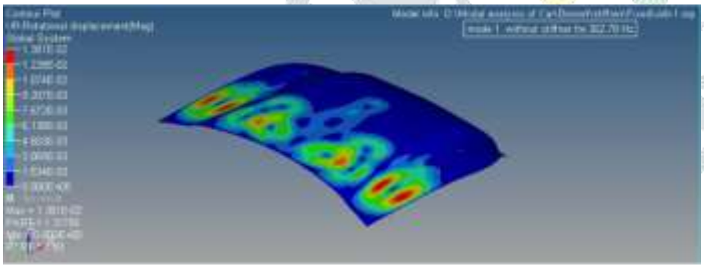

Fig.3.1: Bonnet Without Stiffener – Frequency: 302.78 Hz

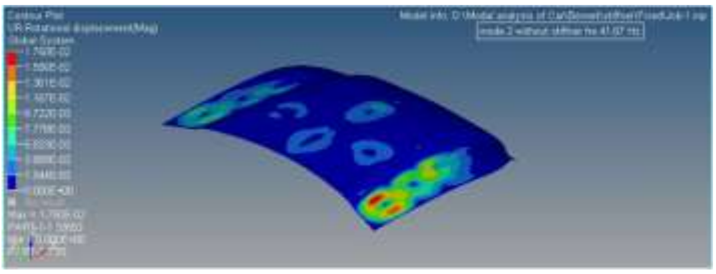

Fig. 3.2: Bonnet Without Stiffener – Frequency: 41.67 Hz

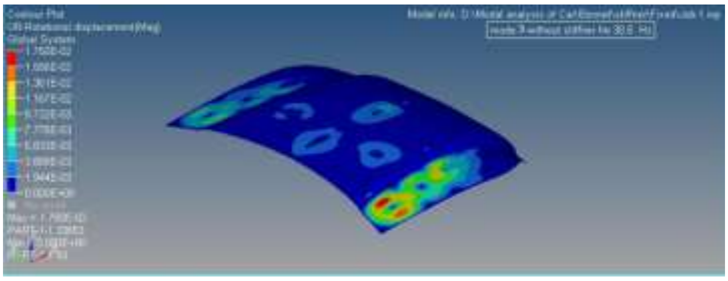

Fig. 3.3: Bonnet Without Stiffener – Frequency: 30.5 Hz

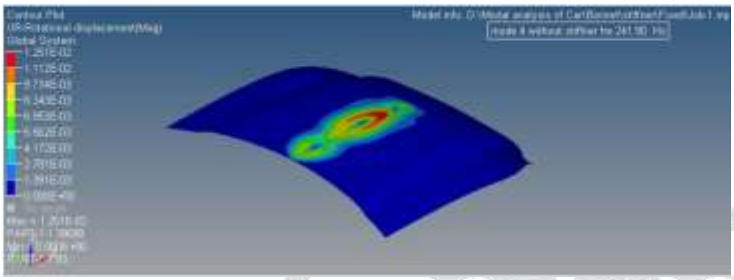

Fig. 3.4: Bonnet Without Stiffener – Frequency: 241.90 Hz

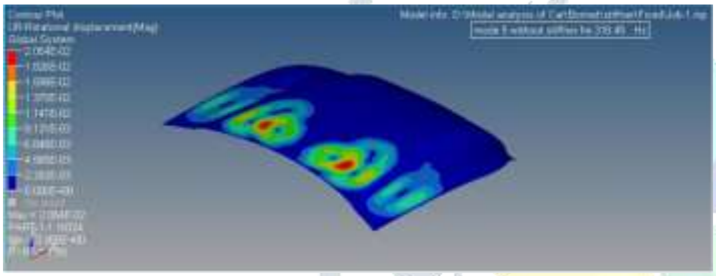

Fig. 3.5: Bonnet Without Stiffener – Frequency: 310.5 Hz

Select Shape	Frequency (or Time)	Damping	Units	Damping (%)
1	29.5	0.93	Hz	3.15
2	41	1.62	Hz	3.94
3	86.8	0.537	Hz	0.618
4	242	1.3	Hz	0.538
5	289	2.94	Hz	1.02
6	310	2.7	Hz	0.871

Table 3.1: Frequency, Damping Readings without Stiffeners

2.) <u>Fixed – Fixed condition: Bonnet with Stiffeners</u>

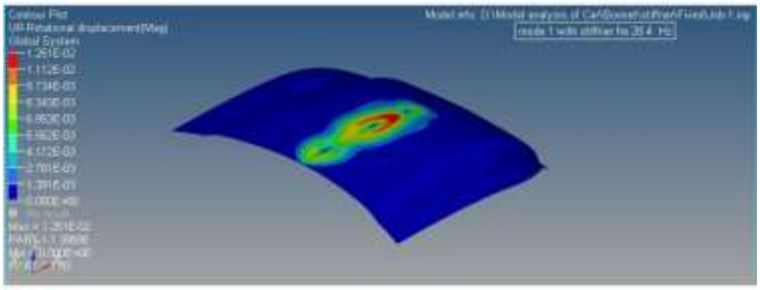

Fig.4.1: Bonnet With Stiffener – Frequency: 28.4 Hz

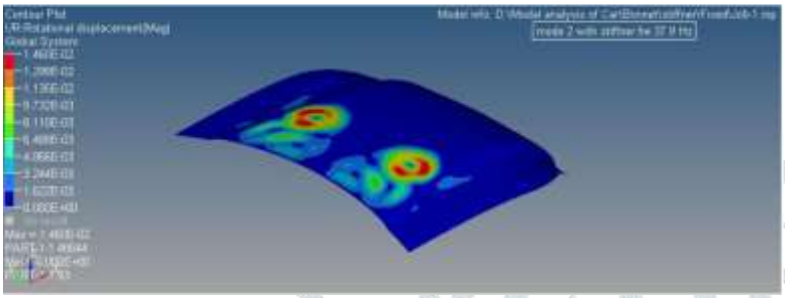

Fig.4.2: Bonnet With Stiffener – Frequency: 37.9 Hz

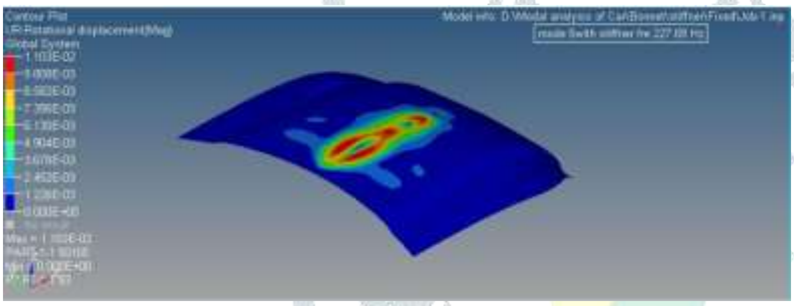

Fig.4.3: Bonnet With Stiffener – Frequency: 227.69 Hz

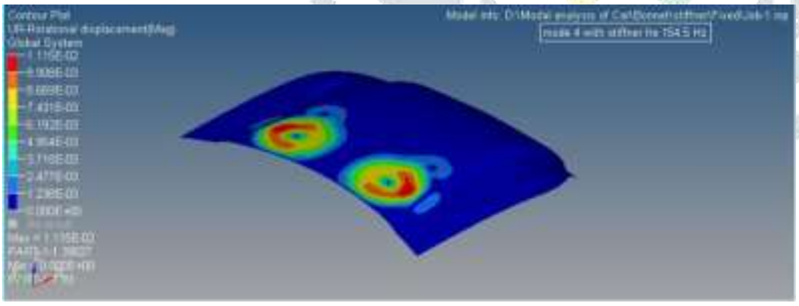

Fig.4.4: Bonnet With Stiffener – Frequency: 154.5 Hz

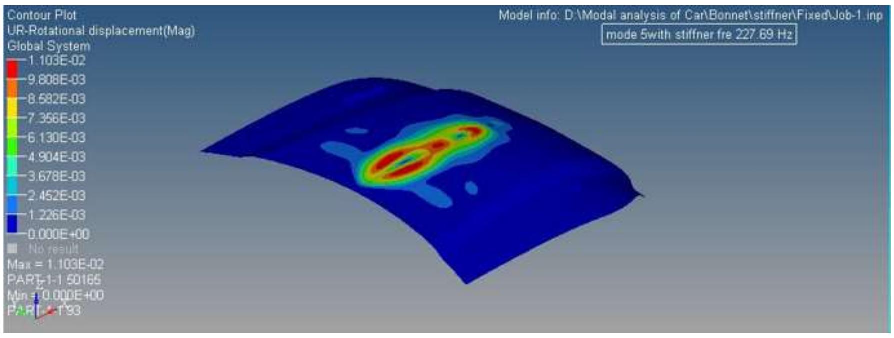

Fig.4.5: Bonnet With Stiffener – Frequency: 227 Hz

Select Shape	Frequency (or Time)	Damping	Units	Damping (%)
1	27.3	0.613	Hz	2.25
2	37.9	1.36	Hz	3.6
3	86.2	2.91	Hz	3.37
4	152	2.73	Hz	1.79
5	222	2.36	Hz	1.06
6	243	2.28	Hz	0.939

Table 4.1: Frequency, Damping Readings with Stiffeners

RESULTS AND DISCUSSION

The table shows the comparisons of the natural frequencies of conventional car bonnet for fixed – fixed condition without and with Stiffeners between Experimental modal analysis and FE analysis.

	Experimental Modal Analysis		FE Analysis	
	Without Stiffners	With Stiffners	Without Stiffners	With Stiffners
Mode shape	Natural Frequency (in Hz)	Natural Frequency (in Hz)	Natural Frequency (in Hz)	Natural Frequency (in Hz)
1	29.5	27.3	29.5	27.3
2	41	37.9	41	37.9
3	86.8	86.2	86.8	86.2
4	242	152	242	152
5	289	222	289	222
6	310	243	310	243

Table 5.1: Comparison of natural frequency results

CONCLUSION

The examination and enhancement of a conventional car bonnet based on NVH performance is examined by FE analysis. CATIA model is generated as an initial step later on it has been imported to HYPERMWSH to mesh. Then, modal analysis and harmonic analysis in a frequency range between 0-300 Hz. A mode shape of the analysis is removed and compared with experimental mode shape. Modal analysis of bonnet reveals that they are in target and results are obtained for different modes. In that first modes are local modes and remaining is global modes. The modal frequencies are obtained is >20 Hz Harmonic analysis is done without and with stiffeners for automotive car bonnet.

Thus, with stiffeners applied component shows better as compared to without stiffeners of car bonnet component.

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