Noise and Vibration Analysis of Car Hood Using FEA and Experimental Method

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Abstract- **Up degree of ride quality and comfertebility of the vehicle is the most essential for the travellers. These two things should be possible by the lessening of vibration and by enhancing the weariness life of the parts are concerned. Commotion can likewise be diminished with the decrease of vibration. Here in our task, the outcomes as vibration of auto entryway must be produced by the 2 techniques that are FEA and EMA and these outcomes are looked at. Basically our task head towards the era of vibration attributes, for example, recurrence, damping variables and displaying from FEA technique. Where we display the entryway with the utilization of the product known as CATIA. At that point this is removed by HYPERMESH programming for cross section the part. ABAQUS solver tackles the cross section part with limit conditions. The following stage is the place we take the attributes aftereffects of auto entryway by the strategy EMA where the utilization of FFT analyzer with the mix of ME Scope programming is made. At that point the correlation of these consequences of FEA and EMA assumes an essential part for the determination of vibration attributes for the enhancement.**

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Keywords: **catia, hyper mesh, ABAQUS, frequency.**

INTRODUCTION

The automotive industry is currently spending millions of dollars to improve NVH performance. The new design methods are starting to consider NVH issues throughout the whole design process. This involves integrating extensive modeling, simulation, evaluation, and optimization techniques into the design process to insure both noise and vibration comfort. New materials and techniques are also being developed so that the damping treatments are lighter, cheaper, and more effective.

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. The NVH engineer is interested in the structural dynamic response of the vehicle from the complete assembled system down to the normal modes of the individual components. As a vehicle is a moving dynamic system, its response to stochastic, time varying inputs is important for safety, quality, and comfort of the passengers.

One specific area of study within NVH is vehicle acoustics. Sound plays an important part in the development of a motor vehicle. Certain aspects of noise produced by a vehicle are controlled by governmental regulations, for example pass-by sound levels or exhaust sound emission. Other aspects of sound are controlled specifically within the individual company as a method of quality control. Meeting the constantly increasing, and complex needs of the consumer is also a key concern of the NVH program for any vehicle and deserves some specific attention.

Some of the methods used to control noise, vibration, and harshness include the use of different carpeting treatments, the addition of rubber or asphalt material to car panels, gap sealant, and the injection of expandable foam into body panels. The carpeting treatments include varying types of foam padding combined with different weights of rubber-backed carpet. The overall result of this technique is a mass-spring system that acts as a vibration absorber. The rubber or asphalt materials are attached to various car panels to add damping and mass loading to reduce vibration levels and the rattling sounds from the panels. Sealant is applied to close gaps in order to increase the transmission loss from the engine, wind, and road noise sources to the vehicle interior. Expandable foam injected between panels, such as the dashboard and firewall, helps to add stiffness and vibration absorption.

All of these current methods are effective at reducing sound and vibration levels in a vehicle at higher frequencies. However, some of the treatments become almost ineffective at lower frequencies below 200 Hz. The treatments also add a substantial amount of weight to the vehicle, thus affecting its fuel economy, as well as adding cost. Choosing the correct product for your application can be really easy if you properly identify the noise from the start.

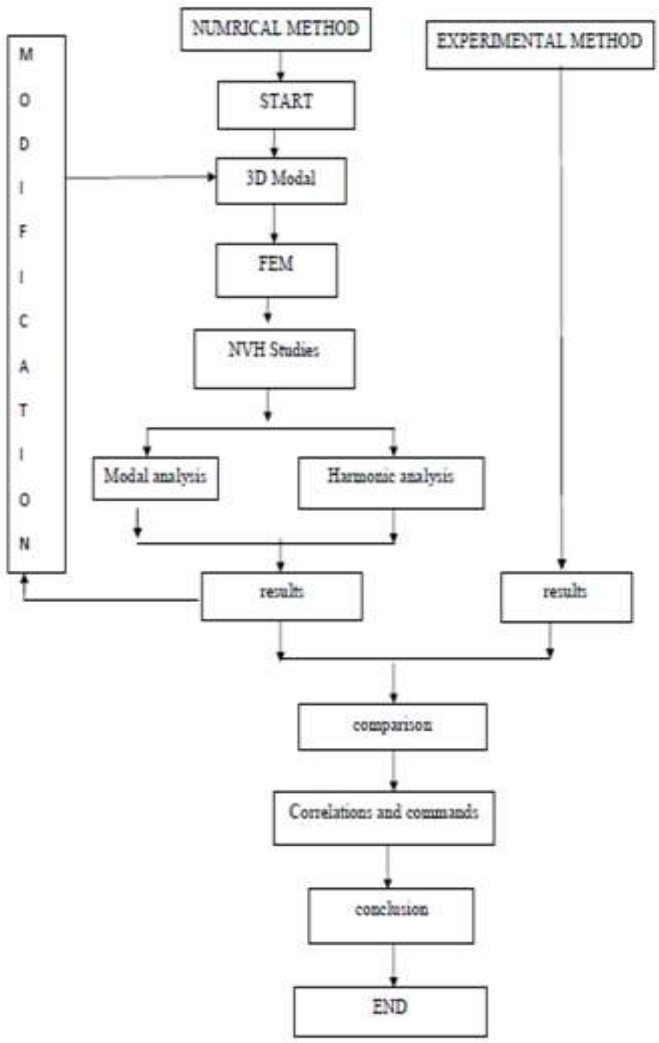
There are many contributors to automotive noise and the noise exists across a wide bandwidth of frequencies. To effectively reduce the noise floor within a vehicle, a combination of materials must be used. This technique will result in a greatly reduced installation time, a serious reduction in the amount of added weight to the vehicle and bunch of money saved in your wallet. When trying to reduce or eliminate various types of automotive noise, it is often necessary to utilize a variety of specialized noise control materials. In the present work a numeric method using finite element is done to evaluate NVH characteristics of the hood.

METHODOLOGY

Methodology is define as the successive step by step process of manufacturing or designing of component or solving problem etc.

Here in our project we are analyzing the hood by two methodologies those are FEA and EMA.

- ❖ In this FEA analysis method we proceeding by the following steps
  - o Creating 3D modal
  - o Meshing
  - o Analysis
  - o Post-processing
  - o Result
- ❖ In EMA method following are the steps used
  - o Car hood
  - o Marking required number of points
  - o Hitting on the marked points by hammer
  - o Data analysis
  - o Extracting frequencies, damping factor and mode shapes.
  - o Results



WORK CARRIED OUT IN FINITE ELEMENT METHOD.

Geometry

Figure 1: Catia Model of Automotive car Hood

The primary requirement of the FEA is the geometry of the part which is generated by using the software known as CATIA V5 R20, CATIA is as multiplatform CAD/CAM/CAE software suite developed by the French company Dassault system. This software helps used in the creation of the geometry very accurately with the use friendly commands for the better modal.

Meshing

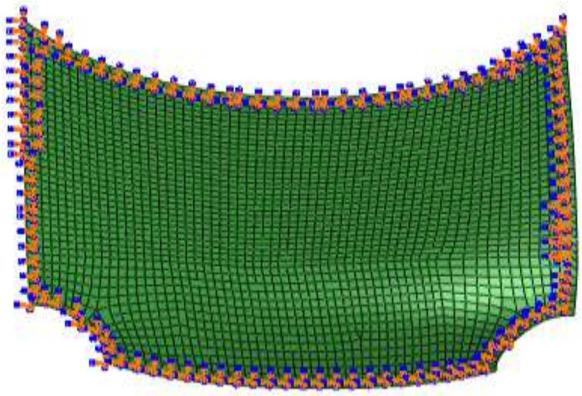


Figure 2Meshed Model of Automotive car Hood

The approximation of geometry domain in the form polygonal or polyhedral mesh is known as mesh generation. In 3-D meshing used in FEA contains tetrahedral, pyramids, prisms or hexahedral. Meshing can be defines as discretization for 1-D, 2-D and 3-D.

The HYPERMESH tool is used for meshing of hood. Finite element quality is the suitable which is used for meshing. 15205 and 15190 are the total number of elements and nodes respectively used for the generation of FE modal.

Table: 1 List Of Number Of Nodes And Elements During Meshing

Nodes	19862
Elements	19882
Mesh type	P-SHELL

Table : 2 Shows The List Of Material Properties Of Steel.

Properties	Values
Young's modulus	210E3 N/mm^2
Density	7.9E-6 kg/mm^3
Poisson's ratio	0.3
Thickness	1.5 mm

Numerical Analysis

The external vibration which is excreted on the structure deforms the structure which can be described by the method known as modal analysis. The deformation of the structure is in the form of number of well deformed wave like shapes or of the form of modes. Each mode exhibits its own frequency, mode shape and damping factor.

Here we are determining the frequency, mode shape and damping factor for the structure on the basis of different conditions like

- **free-free condition**

The above condition we have to deal with damper and without damper. Ultimately we have to compare the results of FEA and EMA for the optimization.

FE METHODE RESULTS ON FREE-FREE CONDITION WITHOUT DAMPER

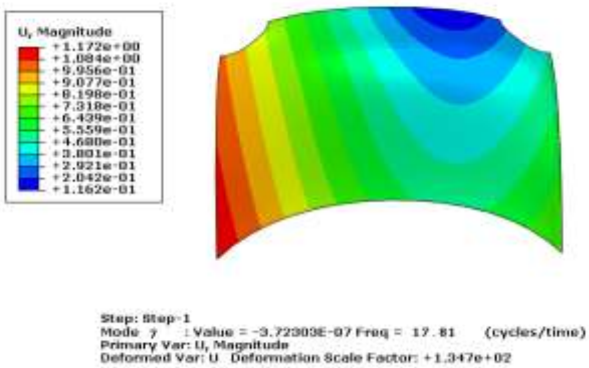


Figure 3: 7th Mode Shape And Frequency Is 17.81 Hz In Free-Free Condition Without Damper.

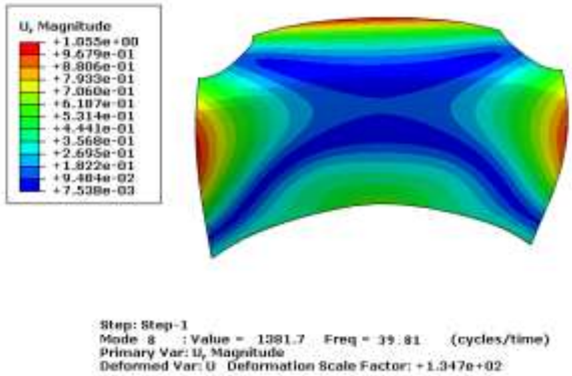


Figure 4: 8th Mode Shape And Frequency is 39.80 Hz in Free-Free Condition Without Damper.

Table: 3 Shows Frequencies Of Free- Free Mode Without Damper

Without damper	
Mode shape number	Frequency(Hz)
7	17.81
8	39.80

FE METHOD RESULTS ON FREE-FREE CONDITION WITH DAMPER

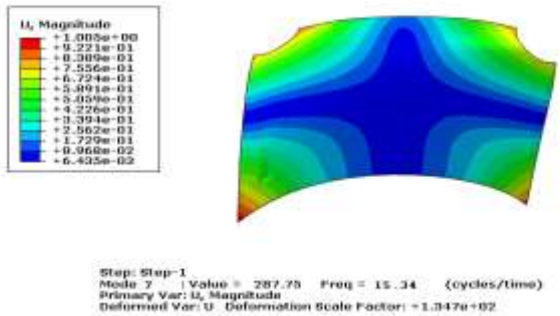


Figure 5: 7th Mode Shape And Frequency Is 15.34 Hz In Free-Free Condition With Damper.

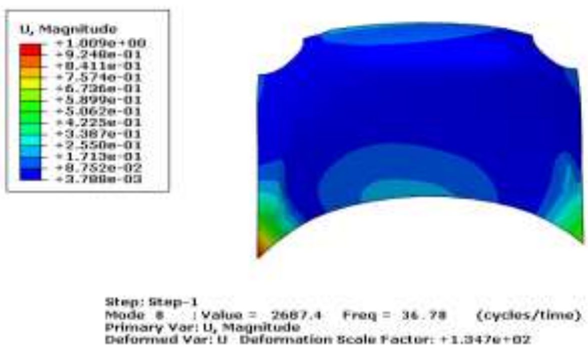


Figure 6: 8thMode Shape And Frequency Is 36.78 Hz In Free-Free Condition With Damper

Table: 4 Shows Frequencies Of Free- Free Mode With Damper

With Damper	
Mode Shape Number	Frequency(Hz)
7	15.34
8	36.78

WORK CARRIED IN EXPERIMENTAL ANALYSIS

Figure 7: Shows The Experimental setup Of Car hood.

Experimental modal analysis, also known as modal analysis or modal testing, deals with the determination of natural frequencies damping ratios, and mode shapes through vibration testing. Two basic ideas are involved:

In the wake of hanging the hoodtop part, on the surface of section meant the centers to quantify the trademark frequencies (there are 132 centers set apart in the hoodtop surface). A littler than normal accelerometer is changed at certain reference point (here reference point is 132) for the plan of FRF's estimation. Accelerometer is connected with DSA (Digital Signal Analyzer) through channel and other channel to pound. The whole setup is connected with Laptop or PC to finish the examination, in Laptop or PC the ME scope programming should presented right on time before start of examination. This approaches of trial is showed up in figure underneath

RESULTS ON FREE-FREE CONDITION WITHOUT DAMPER

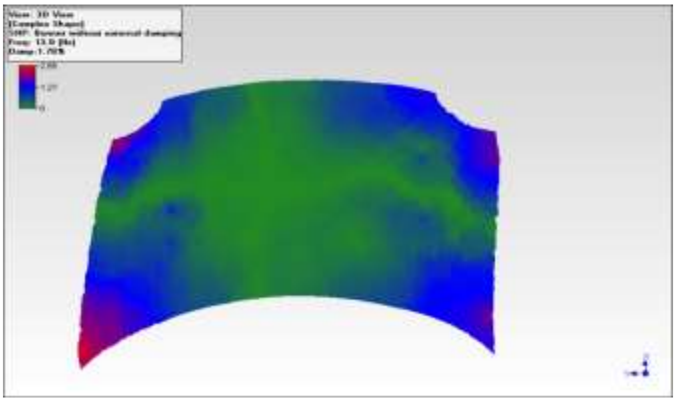


Figure 8: 7th Mode Shape And Frequency Is 13.9 Hz In Free-Free Condition Without Damper.

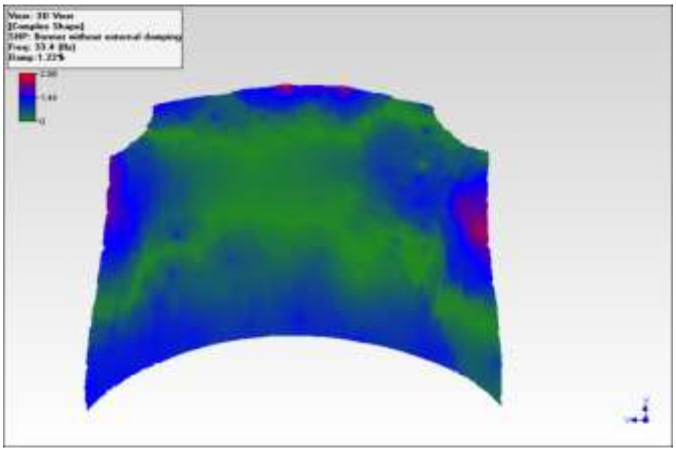


Figure 9: 8th Mode Shape And Frequency Is 33.4 Hz In Free-Free Condition Without Damper.

Table: 5: Shows Frequencies Of Free- Free Mode Without Damper

Without Damper	
Mode Shape Number	Frequency(Hz)
7	13.9
8	33.4

RESULTS ON FREE-FREE CONDITION WITH DAMPER

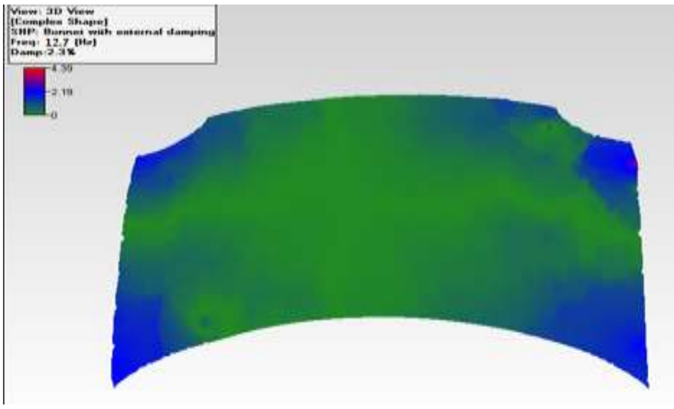


Figure 10: 7th Mode Shape And Frequency Is 12.7 Hz In Free-Free Condition With Damper.

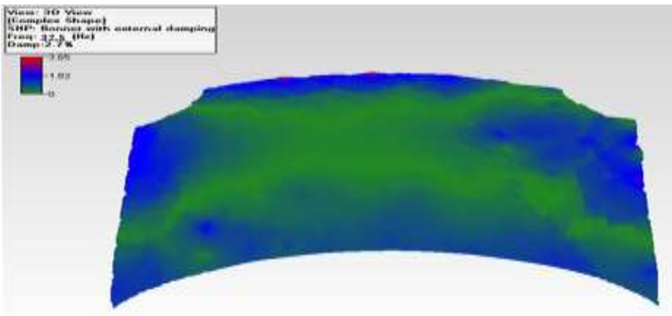


Figure 11: 8thMode Shape And Frequency Is 32.5 Hz In Free-Free Condition Without Damper.

Table: 6: Shows Frequencies of Free -Free Mode with Damper

With Damper	
Mode Shape Number	Frequency(Hz)
7	12.7
8	32..5

CONCLUSION

- Under free-free condition the basic frequency were very less up to mode six for hood indicating the rigid body motion of the structure those modes includes three translatory and Rotational modes in respective axis that is X, Y&Z
- Effectively, the modifications done on the rib structure of the bonnet have resulted in reduced displacement response for unit force input; however, as a natural fallout, the additional ribs result in increased acceleration values.
- The auxiliary vibration excitations of car vehicle are created by a wide range of sources. In our task we have consider one of the key component of car vehicle that is car floor model vibration excitation under free condition. Firstly the displaying is refined for the car floor model in CATIA and coincided in HYPERMESH then the FEM modular examination was conveyed out utilizing Abaqus as a solver. Also, exploratory modular examination was led utilizing FFT analyser. To got the aftereffects of modular parameters by FEM and FFT examination of without stiffener condition. To accept the FEM results with FFT examination results. To enhance the modular parameters by including stiffener in the structure T-segment are welded on the deterministic supplementary vibration floor region. Again both FEM and FFT examination was led of with stiffener condition. At last got the outcomes and it's accepted.

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