THE EXPERIMENTAL STUDY ON VISCOELESTIC MATERIAL DAMPERS AND MODAL ANALYSIS OF CAR ROOF INCORPORATING WITH DIFFERENT SHAPE VISCOELASTIC DAMPER

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Abstract –

- Roof is one of the vital component in the passenger car.
- It not only provides safety against the outside obstacles.
- Which are disturbing driver and passengers and also it gives supports against the wind.
- Also offers aerodynamic effects while in motion.
- Roof will vibrate due to wind force and by the less strong or weak reinforcement, this can be overcome by adding some damping element.
- The experimental modal analysis was carried out with and without dampers for the roof and the validation of results was carried out.
- The results of Finite Element and Experimental analysis were agreeing with each other.

INTRODUCTION

- Recent development in Automotive and Aeronautical industries resulted in manufacturing the vehicles which produce less Noise and Vibrations by its body panels. The Noise, Vibration & Harshness (NVH) generated by the vehicle for many more reasons such as rpm of the engine and road surface conditions. Automotive industries are more concerned to improve NVH performance, and spending millions of dollars on it.
- Noise, vibration and harshness generally termed as NVH, deals with the objectives and subjective structural dynamic and acoustic aspects of automobile design. The NVH engineer deals with the structural dynamic response of the vehicle from the complete assembled system down to the normal modes of the individual components.
- Whenever vehicle is in motion it experience stochastic, time varying input important for safety, quality and comfort of the passenger. Majority of the new design processes concerning throughout the design involves combination of extensive modelling, simulation, evaluation and optimizations techniques. This ensures the both noise and vibration comfort. Developing and/or modification of old materials and techniques but viscoselastic damping is a smoother, cheaper and more effective way for improving NVH.
- Mechanical dampers are now widely used for vibration control of stay cables. They are regularly installed close to cable lower anchorage connecting cable to bridge deck with a support. For short cables, they might be installed inside the cable guide pipe, called internal dampers as compared to external dampers with a support.
- Viscoelastic dampers utilize high damping from Viscoelastic materials to dissipate energy through shear deformation. Viscoelastic materials are highly influenced by parameters like temperature, frequency, dynamic strain rate, time effects such as creep and relaxation, aging, and other irreversible effects. Hence selecting a proper viscoelastic material is the key. This paper presents an overview of literature related to the viscoelastic materials used in viscoelastic dampers. The review includes different materials like asphalt, rubber, polymer and glassy substances. There have been few investigations on these materials, its advantages and disadvantages are discussed and detailed review is carried out.
- The repetitive motion like earthquake waves causes fatigue and reduction of the performance of the structure. The energy released can cause high amount of damage to all components of the structure. Thus it is the need to reduce vibrations or maintaining the performance of the structure for life safety and economic loss.

1. Problem Statement

- Topology optimization technique to find optimal damping material distributions to reduce the resonance peak response in the frequency response problem, which cannot be achieved using existing criteria.

2. OBJECTIVE AND METHODOLOGY

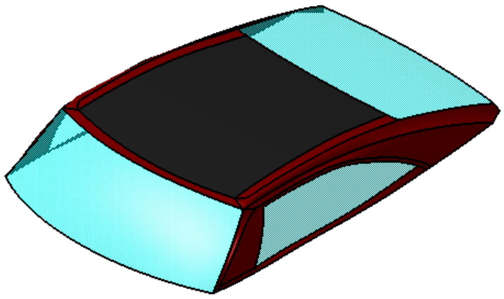
3.1 Objective-

1. Understand the effect of topology optimization to maximize the damping effect subject to constraint on maximum allowable volume of damping material.
2. Modeling of exist sheet metal structures of a car roof in CATIA V5 software.
3. Modal and Harmonic analysis of sheet metal structures by using ANSYS 19 software.
4. To manufacturing of optimized sheet metal structures of an car roof.
5. To perform experimental testing of existing and optimized model of optimized sheet metal structures using FFT and impact hammer test.
6. Experimental testing and correlating results.

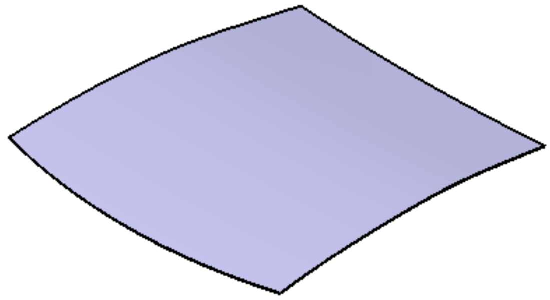
a. Methodology-

- Step 1: - I started the work of this project with literature survey. I gathered many research papers which are relevant to this topic. After going through these papers, we learnt car roof part subjected vibrations.
- Step2: - After that the car roof shape which is required for our project are decided.
- Step 3: - After deciding the components, the 3D Model and drafting will be done with the help of CATIA software.
- Step 4: - The Analysis of the car roof will be done with the help of ANSYS using FEA.
- Step 5: - The Experimental Testing will be carried out with the help of FFT analyzer.
- Step 6: - Comparative analysis between the experimental & analysis result will be done and then the result & conclusion will be drawn.

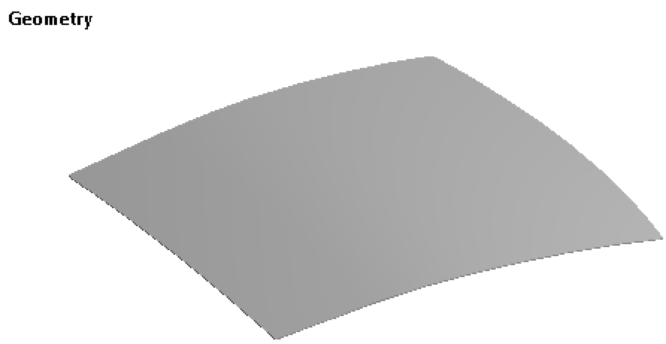
CONCEPT CAD MODEL



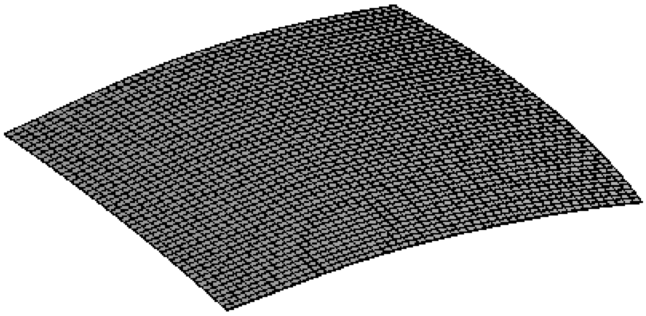
ROOF CAD MODEL



MODAL ANALYSIS

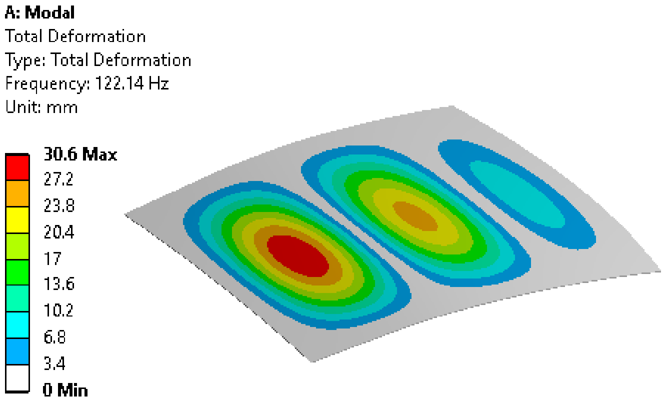


MESHING DETAILS

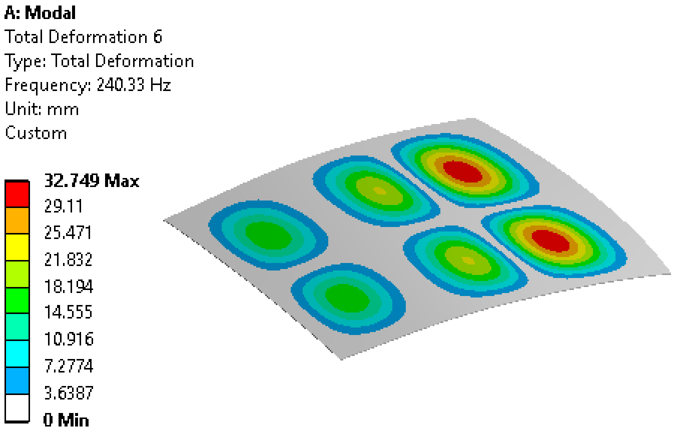


RESULTS

MOD ESHAPE 1

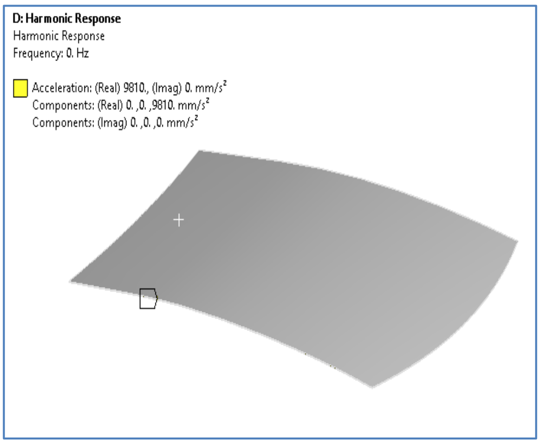


MODE SHAPE 2

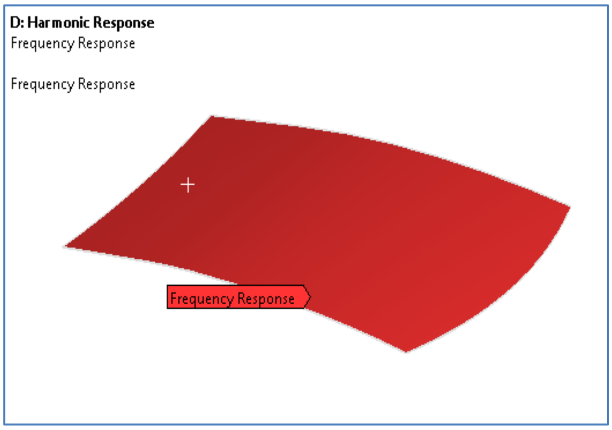


	Mode	Frequency [Hz]
1	1.	122.14
2	2.	155.87
3	3.	176.86
4	4.	181.25
5	5.	217.22
6	6.	240.33

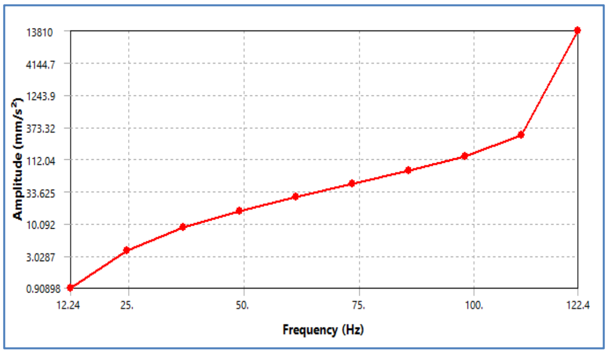
HARMONIC RESPONSE



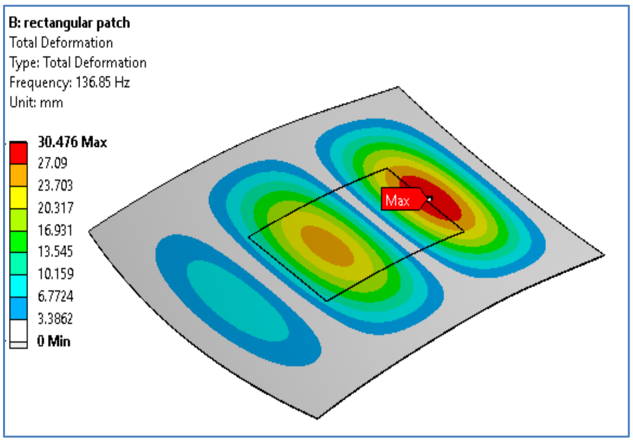
FREQUENCY RESPONSE



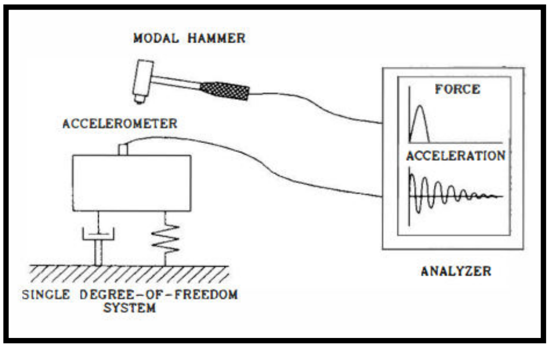
FREQUENCY RESPONSE RESULT

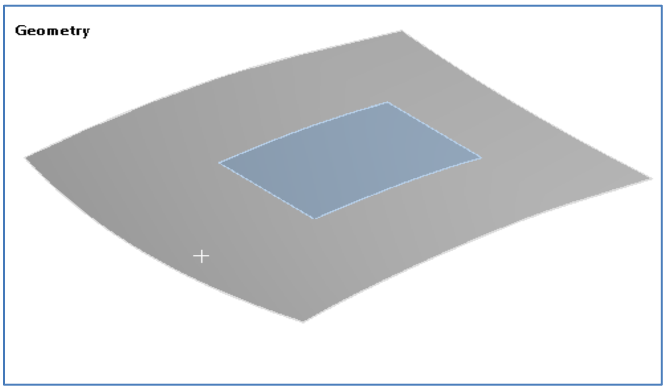


ANALYSIS WITH RECTANGULAR PATCH OF VISCOELASTIC MATERIAL

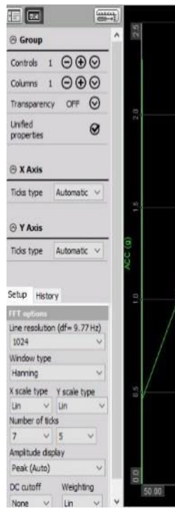


EXPERIMENTAL





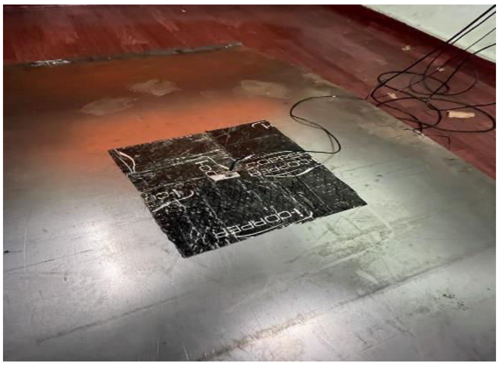
EXPERIMENTAL RESULT



COMPARISON

MODE SHAPE	FEA	EXPERIMENTAL
1	86	68
2	103.56	97.66
3	143.94	136.7

EXPERIMETNAL PROCEDURE



CONCLUSION:

- In this report we develop the cad model of car roof with reference of research paper using CATIA software.
- We find out the natural frequency of the car roof using ANSYS software using MODAL analysis tool.
- In present research car roof is designed and modal analysis have been performed to reduce vibration created in engine inside it.
- Modal and harmonic analysis have been performed to determine optimum shape viscoelastic patch namely rectangular shape.
- In experimental testing FFT and FEA results are almost in similar range for setup natural frequency.
- In experimental it is observed that maximum acceleration of rectangular and without patch is in 402.54 and 585.63 mm/s2 respectively.

3. ACKNOWLEDGEMENT

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