A Review on Car Bonnet Internal Rib Structure

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Abstract- *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. 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. The reinforcements consist of a structure made up of a base material of plastic or aluminum and an insert material of hard metal. Loads are transferred to the panel through the metal insert material and dissipated to the panel members through the base structure.*

The inner stiffener panel provides strength and the outer panel is just a metal cover or skin to protect the system below it. This paper provides review on car bonnet internal rib structure. By changing rib structure stiffness of a bonnet can be increased.

In our project we are going to perform modal analysis on existing bonnet made of MS material of a Scoda car. Efforts will be taken towards increasing strength of bonnet by analyzing different rib structure. The outcome will give us the best rib structure to be used. Experimental testing will be carried out to validate results.

Keywords- Bonnet, Rib structure, Stiffness, Topology optimization.

I. INTRODUCTION

Transportation is an important criterion in assessing the development of different countries, but it can be harmful, too. Pedestrians and cyclists are among the most vulnerable road users. The hood (US and Canada) or bonnet (most Commonwealth countries) is the hinged cover over the engine of motor vehicles that allows access to the engine compartment (or trunk on rear-engine and some mid-engine vehicles) for maintenance and repair. In British terminology, hood refers to a fabric cover over the passenger compartment of the car (known as the 'top' in the US). In many motor vehicles built in the 1930s and 1940s, the resemblance to an actual hood or bonnet is clear when open and viewed head-on; in modern vehicles it continues to serve the same purpose but no longer resembles a head covering. Steel hoods are usually made of an upper body and an inner body. The inner body is used for structural strength and the upper body is used for aerodynamic and style purposes. The most important cases which influence the design of the hood inner body are: hood durability, hood closing endurance, hood slam test(misuse),lateral stiffness for mounted hood, hood stiffness for bending and torsion, denting and buckling ,hood fluttering, manufacturing requirements for drawing, hood performance for high speed and low speed crashes, and hood surface quality.

Car bonnet consist of the upper panel and inner stiffener panel and reinforcement members placed there between to increase the strength of said panel in localized area. The reinforcements consist of a structure made up of a base material of plastic or aluminum and an insert material of hard metal. Loads are transferred to the panel through the metal insert material and dissipated to the panel members through the base structure. The inner stiffener panel provides strength and the outer panel is just a metal cover or skin the underneath of the bonnet is covered with sound absorbing material.

II. RESEARCH ELABORATIONS

Christoph Kerkeling, Joachim Schäfer, Dr. Grace-Mary Thompson[1]: Requirements of bonnet, hood concepts, hood hinge concepts are stated. Then, how the hood design could become compatible with the pedestrian protection requirements. The impact of the hood design parameters on the head impact performance are shown and different concept solutions are presented. Different hinge concepts and their impact on the head impact performance are shown.

Mukesh Chaudhari [2]: The author uses Hypermesh and Ls-Dyna software. To protect the pedestrian these systems must be implemented to all the manufactures of automobile vehicles. This study analyses and proposes a method of identifying the most effective values for the bonnet reinforcement thickness and the bonnet skin thicknesses to protect pedestrians while maximizing the bonnet stiffness. The method presented in this study uses the regression technique to design constraints for the optimization problem. The proposed algorithm identifies numerous critical positions on the bonnet surface with respect to pedestrian safety.

Ramesh C. K, Dr. Srikari S., Suman M. L. J[3]: The head impact analysis on the present hood of the car was done to study the response of the adult head form at two different locations. Structural and modal analysis for the same present hood assembly was done to observe the local and global stiffness. In order to reduce the head injury of the pedestrian the local stiffness over the area of head impact has to be reduced thus the new design of hood inner panel was focused on that and the structural and modal analysis was done for the new design.

Jagdish Patil [4]: This study analyzes the effects of the bonnet skin and bonnet reinforcement thicknesses on pedestrian head injury by performing simulations of headform-impactor-to-bonnet tests according to the Addendum 126, Regulation No. 127, Entry into force November 17, 2012 (US) regulations for different thicknesses. Many spot on the bonnet surface are considered to enhance pedestrian kindliness by using this method. Moreover, a bonnet with the best possible thicknesses is not only pedestrian friendly but also as rigid as possible. Based on the proposed method, this study presents steps for optimizing the bonnet skin and bonnet reinforcement thicknesses using a particular automobile model.

Mohd ridzwanil hanif bin ruslan[5] studies that among the materials used for the fabrication of automotive hood such as Aluminum Alloy, Magnesium Alloy, Carbon fiber and natural fiber is Kenaf Fiber reinforced Polypropylene. This project overall is discussed about the potential of natural fiber composite in automotive industry to develop the automotive hood. The main objective in this project is to determine the appropriate material to be used in fabricating automotive hood.

Jay Bang, Jan Christian Thomas[6] The use of hood latch systems is vital to all automotive companies that produce cars, trucks or other vehicles. The design of such part needs thorough investigation of professional engineers to make sure that it is safe to use as well as safe for holding the hood to the chase. In this project the given concept design of a hood latch system was used in an optimization process.

Kiran Kausadikar, Pankaj Bhirud, Chetan Khadsare[7] This paper highlights optimization work done on bonnet to meet severe load case targets as part of durability requirement at initial and final design phase considering pedestrian design needs. Topology optimization of bonnet inner panel at initial conceptual phase and topology optimization of anti-flutter adhesive at final design phase to meet bonnet durability requirements using OptiStruct is presented.

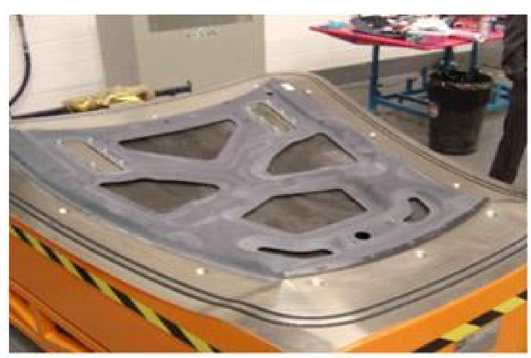
Gondhalekar A. C., Kundra T. K., Modak S.V[8]: This paper presents the dynamic design of a complex automobile structure via Finite Element Model Updating. Dynamic design aims at achieving the desired dynamic characteristics namely natural frequencies, mode shapes and damping ratios by introducing a suitable structural modification. The dynamic design of an automobile bonnet is attempted. A finite element model of bonnet is prepared. The details of joints and small intricacies are not modeled at this stage. Experimental Modal analysis is performed on the bonnet to extract modal properties. The results from experimental modal analysis are used to update the FE model of bonnet. Mass modifications are attempted to reduce first three natural frequencies of bonnet.

Mr. Ashish M. Ganeshpure[9]: The author in this paper has used 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.

III. OBJECTIVES

The main objective in this paper is to present work of different authors on the bonnet. Another objective is also to determine the appropriate internal rib structure to be used in fabricating automotive hood.

IV. DIFFERENT INNER (RIB) PANEL STRUCTURE DESIGN



VI. CAD MODEL GENERATION

As the geometrical details were not available, measurements are taken on bonnet to create its geometric model in CATIA for FE analysis. Below figure shows different views of the bonnet of skoda car.

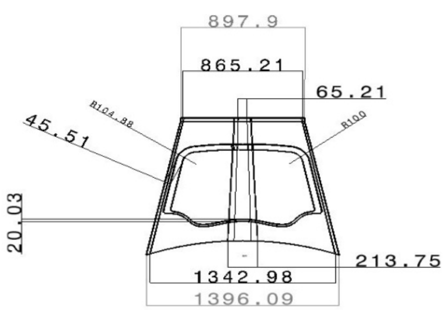


Fig: 2D drawing of a bonnet

- As shown in fig. Bonnet model was created in CATIA V5R19.

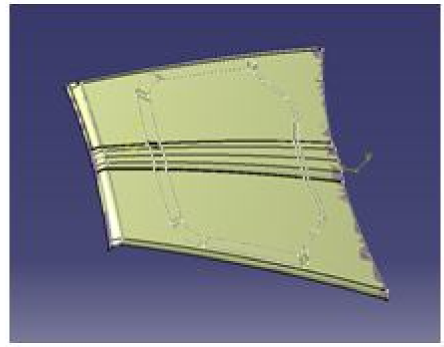


Fig. Existing Bonnet model in CATIA V5R19

Measurements were taken from actual car bonnet through reverse engineering. According to measurements taken3D model was created. This geometry was further taken for meshing in HYPERMESH.

V. FINITE ELEMENT MODELING

In this stage igs file is imported to the meshing software like Hypermesh. The CAD data of the bonnet is imported and the surfaces were created and meshed.

The model consists of infinite number of points hence it should be discretized to some finite number of divisions on which analysis is to be carried out. So we mesh this model to divide it into finite number of divisions called as nodes and elements. We prefer 2d or shell mesh as the third dimension (thickness) of the component is very small as compared to other two dimensions (length and width). Mesh size is selected by convergence criteria. Number of nodes and elements created were 1971 and 1880 respectively. After meshing the model appears as shown in fig.The meshed model is then checked for quality of mesh.

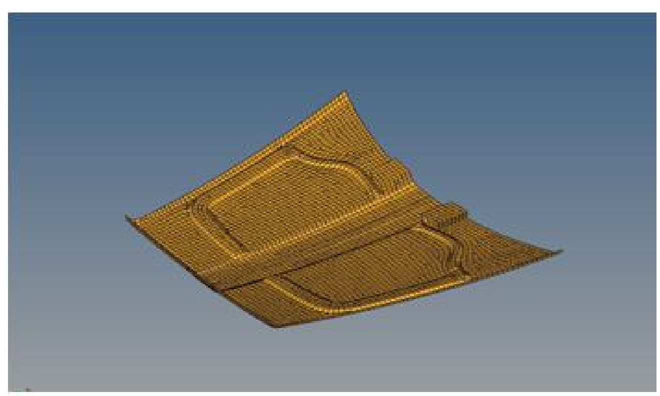
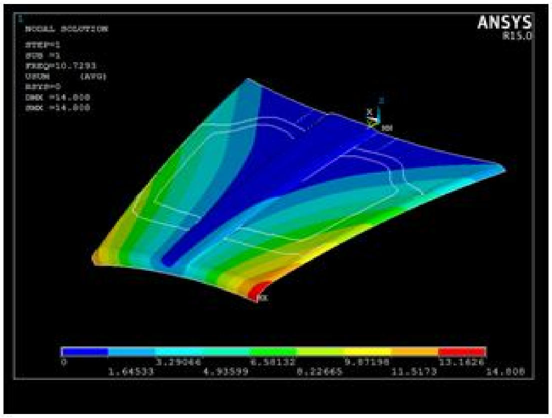


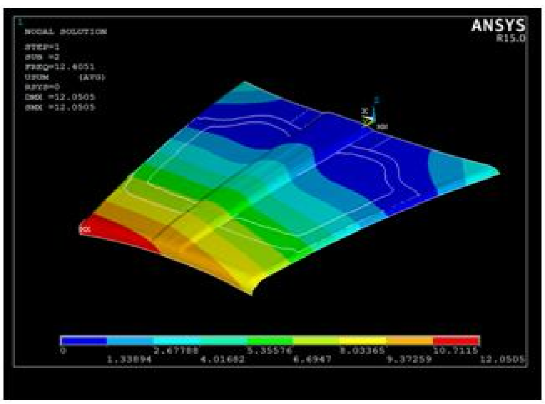
Fig: meshed model of a bonnet with single rib

VII. MODAL ANALYSIS

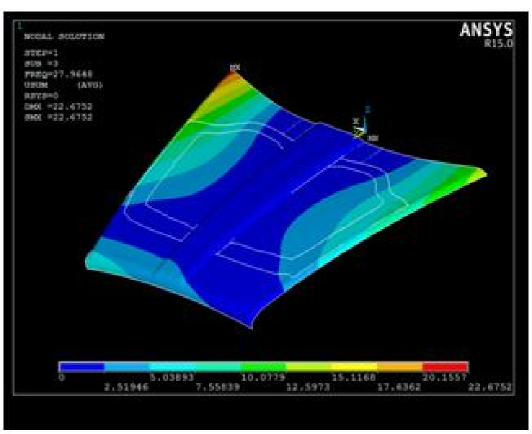
Modal analysis is the study of the dynamic properties of structures under vibrational excitation. Modal analysis uses the overall mass and stiffness of a structure to find the various periods at which it will naturally resonate. These periods of vibration are very important to note in vibration of any machine, as it is imperative that a components or nearby system's natural frequency does not match the frequency of machine. If a structure's natural frequency matches a component's frequency, the structure may continue to resonate and experience structural damage.



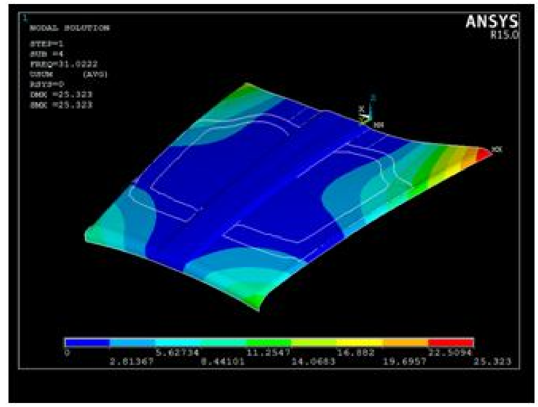
Mode1 at 10.72 Hz



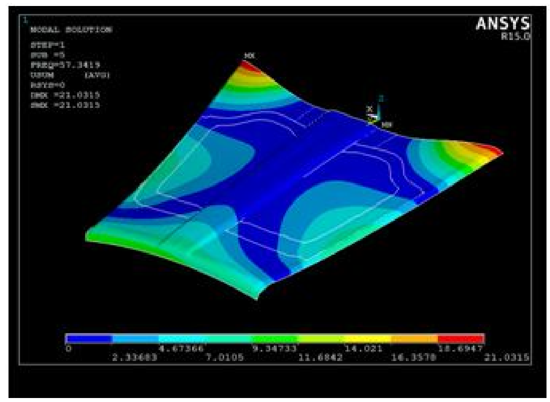
Mode2 at 12.40 Hz



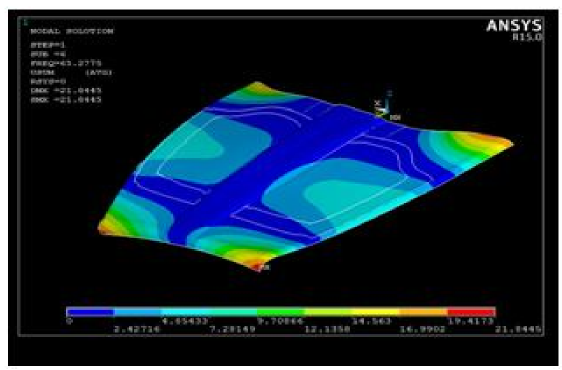
Mode3 at 27.96 Hz



Mode4 at 31.02 Hz



Mode5 at 57.34 Hz



VI. CONCLUSION

From the review of the Research papers it is concluded that in most of the cases, an accident occurs with the pedestrian, and work has been done on the design of front head and rear head panel.

And for the safety of the bonnet, work should be done on the stiffness of the bonnet inner panel. Different inner panel designs can be suggested and checked for its stiffness.

In most of the cases steel and aluminium are used. So, Composite materials can be suggested for better performance of thebonnet.

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