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Design And Simulation Of Doubly Curve Sandwich Panel For An Automobile Application

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ABSTRACT

Sandwich panel is any structure made of three layers, A low density core and Thin skin layer bonded to each other. It is a sandwich structured composite. The strength and lightness of this technology makes it popular and widely used. Core and skin materials can vary widely and core may be of honeycombed structure or solid filled structure. Enclosed panels are termed as Cassettes.

The project aimed at design and simulation of doubly curve sandwich panel in Modeling software and Thermal analysis will be carried out in Ansys. In this project car body panel is selected as a target weight reduction component. This can be achieved either using high strength low weight material or by using low weight composite sandwich panel. In this we are going to use Al-Mg alloy as panel and polyethylene sheet, pet foam and balsa wood as a core. By using Al sheet alloy for panel we can improve stiffness by reducing thickness and weight moreover this panel prevents the heat flux infiltration and hence improves air conditioners efficiency In this we are using aluminum alloy as panel and three different insulating materials as gasoline is volatile it under goes quick evaporation according to CPCB (central pollution control board) more than 30% of emissions from cars coming from fuel evaporation .Thermal analysis of the panel will be carried out using Finite element solution(FEA) by using ANSYS.

INTRODUCTION

A sandwich panel is one structure which is made of three layers, it is a low density core material which is having a thin skin layer attached on either of the sides. These panels are generally used in the application where there is a high requirement of strength even called as rigidity and the weight of the application should be less.

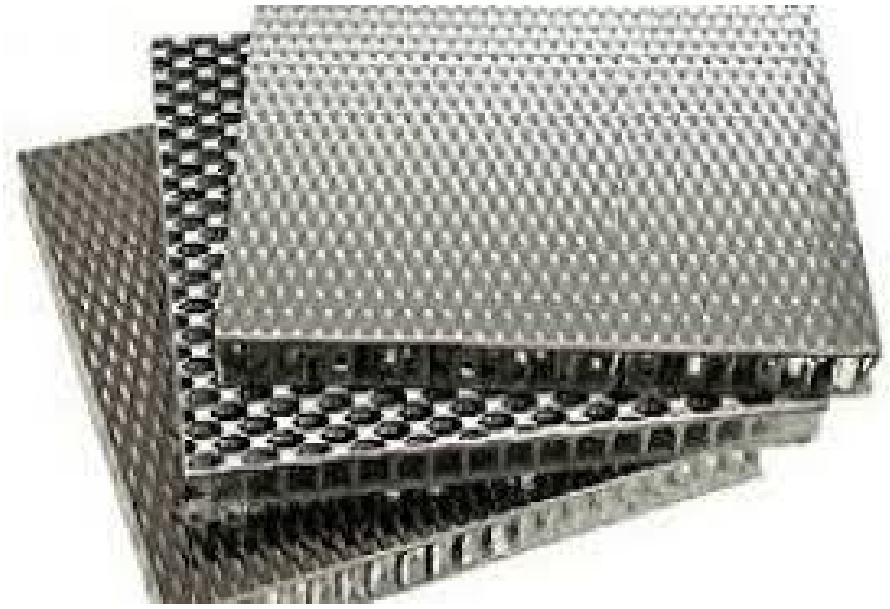
It is well known for its flexibility for its applications, the core and the upper material can vary in many different types, but the inner material can be widely vary as a solid or even a honey comb structured design. Enclosed panels are termed cassettes.

APPLICATIONS

These are very largely seen in aircraft applications such as the mechanical requires much performance and the low weight is more essential.

There is a much scope in the transportation such as automotive applications. A research is even going in the building and the construction, which are used as prefabricated products. These type of products are generally seen in the industrial and the office buildings and even in private buildings. These come with a high quality product with best flexibility in terms of design. They are having the better sustainability with high energy efficient.

These are generally used even too in packaging applications too, which includes the polypropylene honey comb structure design, polypropylene boards etc.



LITERATURE SURVEY

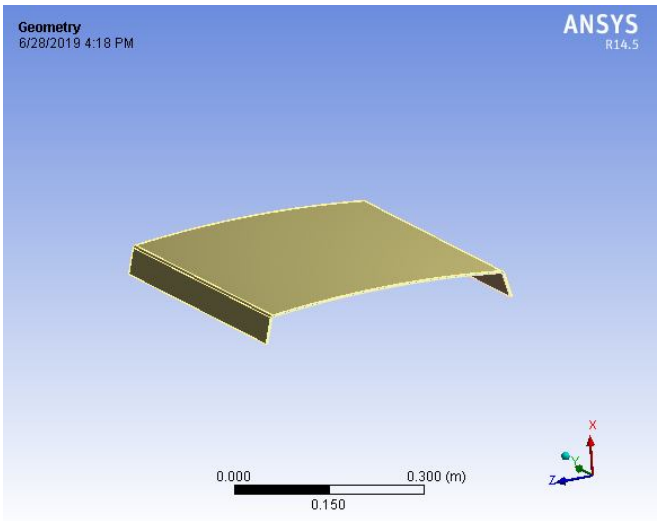
Over the past several decades, the importance of crashworthiness has been growing in virtually every transportation sector. Newer designs are proposed every day to improve the crashworthiness of a structure. There are constant efforts, in the field of crashworthiness, to reduce the injuries sustained by vehicle occupants. It is preferable to design a vehicle to collapse in a controlled manner, thereby ensuring the safe dissipation of kinetic energy, and limiting the seriousness of injuries incurred by the occupants.

The use of composites, as discussed earlier, has increased dramatically over the last few decades. Fiber-reinforced composite sandwich structures are characterized by specific stiffness and strength, exceeding that of similar metal structures. With emphasis on light-weight vehicles, the use of composite materials in aerospace and automotive structures has created a need to further understand the energy-absorption characteristics of compositematerials.

ANALYSIS OF THE ORIGINAL MATERIALS FOR THE MODEL

Materials used - Aluminum + polyethylene + aluminum

Geometry file



The above fig. shows the imported file i.e. even called as geometry which is designed in solid works and imported as a stp format file. We can clearly see the model with the three different layers. The outer layer is aluminium while the inner material is an insulation material in which polyethylene is used

Temperature

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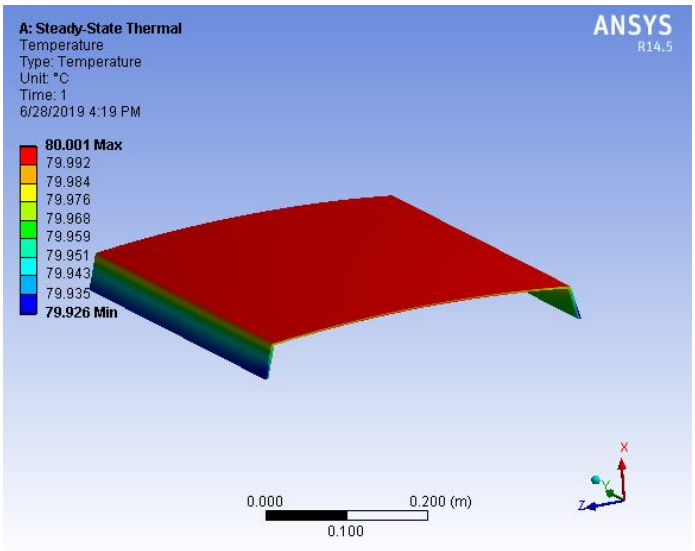
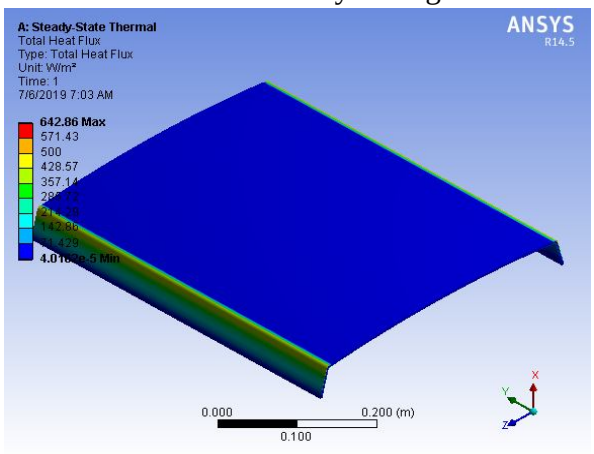


In the above fig we can spot the maximum heat is generated at top of the bonnet and it is noted as 80°C. As because of the insulation paper the temperature is not passing to the bottom of the bonnet.

Total heat flux

Heat flux is denoted $\vec{\phi}_q$, the subscript q stipulatingheat flux, as opposite to mass or momentum flux. Fourier's law is ansignificant application for these concepts.

In the below fig we can observe the max heat flux is noted as 643.62W/m^2. As it is on the sides of the bonnet as if we verify the figure



Directional heat flux

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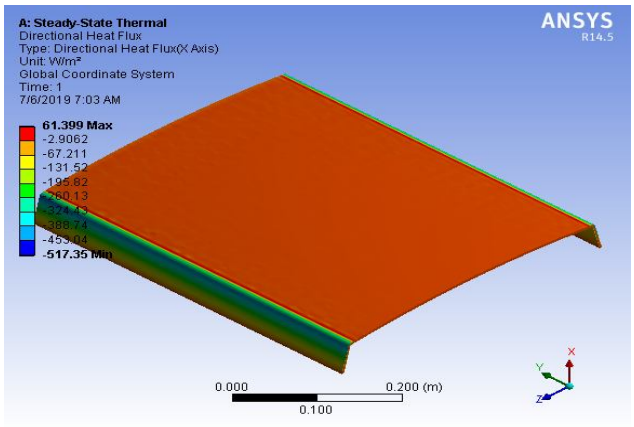
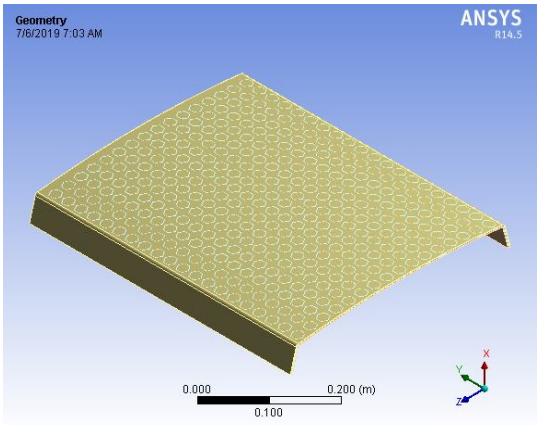


ANALYSIS OF THE ORIGINAL MATERIALS FOR THE MODIFIED MODEL (HONEY COMB STRUCTURE)

Materials used-Aluminum + polyethylene + aluminum

Geometry file



The above fig. shows the imported file i.e. even called as geometry which has been designed in solid works and imported as a stp format file. We can clearly see the model with the three different layers. The outer layer is aluminium while the inner material is an insulation material in which polyethylene is used. The above figure is the modified model from the original model as here in this model we have changed the insulation part i.e. the middle layer. Here the middle layer used is a honey comb shape structure.

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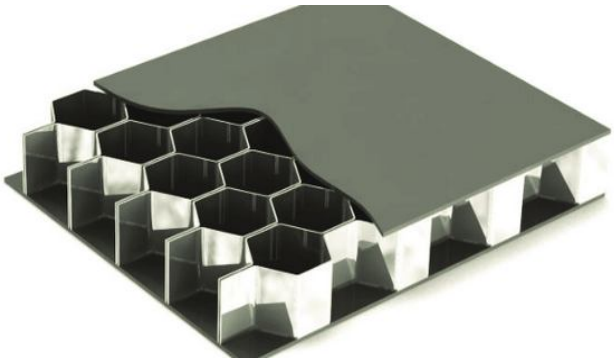
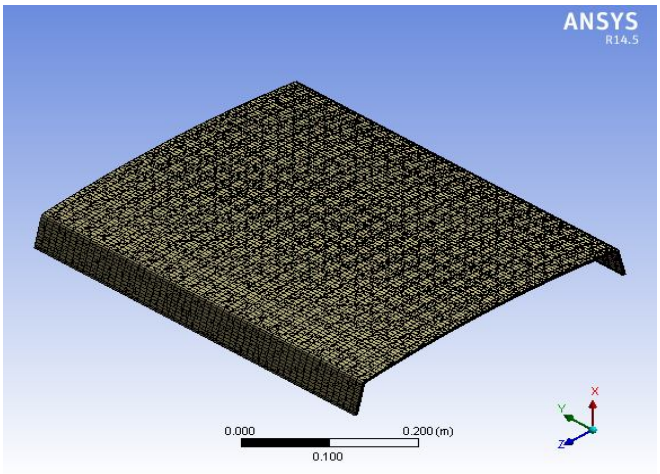


Honeycomb structures are natural or man-made structures that have the geometry of a honeycomb to allow the minimization of the amount of used material to reach minimal weight and minimal material cost.

The hexagonal comb of the honey bee has been admired and wondered about from ancient times. The first man-made honeycomb, according to Greek mythology, is said to have been manufactured by Daedalus from gold by lost wax casting more than 3000 years ago. Marcus Varro reports that the Greek geometers Euclid and Zenodorus found that the hexagon shape makes most efficient use of space and building materials. The interior ribbing and hidden chambers in the dome of the Pantheon in Rome is an early example of a honeycomb structure.

Galileo Galilei discusses in 1638 the resistance of hollow solids: "Art and nature even more, makes use of these in thousands of operations in which robustness is increased without adding weight, as is seen in the bones of birds and in many stalks that are light and very resistant to bending and breaking". Robert Hooke discovers in 1665 that the natural cellular structure of cork is similar to the hexagonal honeybee comb and Charles Darwin states in 1859 that "the comb of the hive-bee, as far as we can see, is absolutely perfect in economizing labour and wax"

Meshed file



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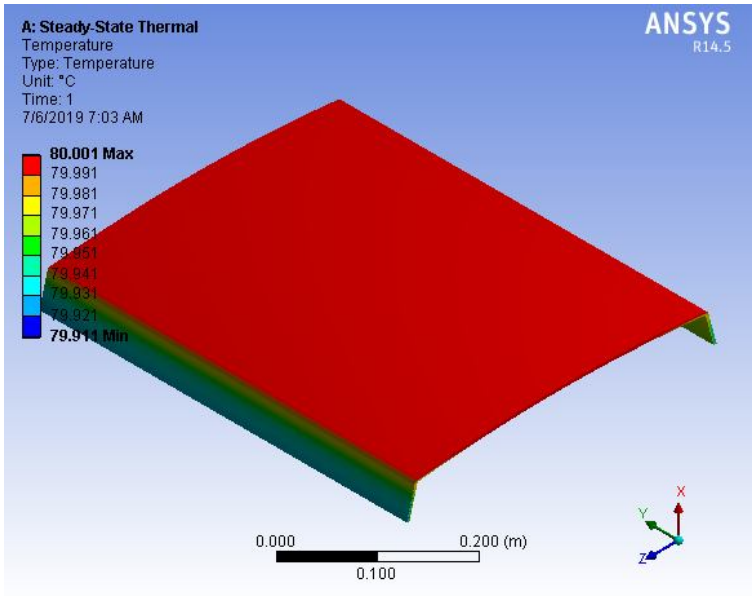
Meshing is the term automatically integrated with each solver in the ansys. Here there are many times of meshing models. Here in our project we have used a fine based meshing with the triangular profile. The above figures show the meshing of the imported model.

Temperature



In the above fig we can spot the maximum heat is generated at top of the bonnet and it is noted as 80^{o}C. As because of the insulation paper the temperature is not passing to the bottom of the bonnet.

Total heat flux

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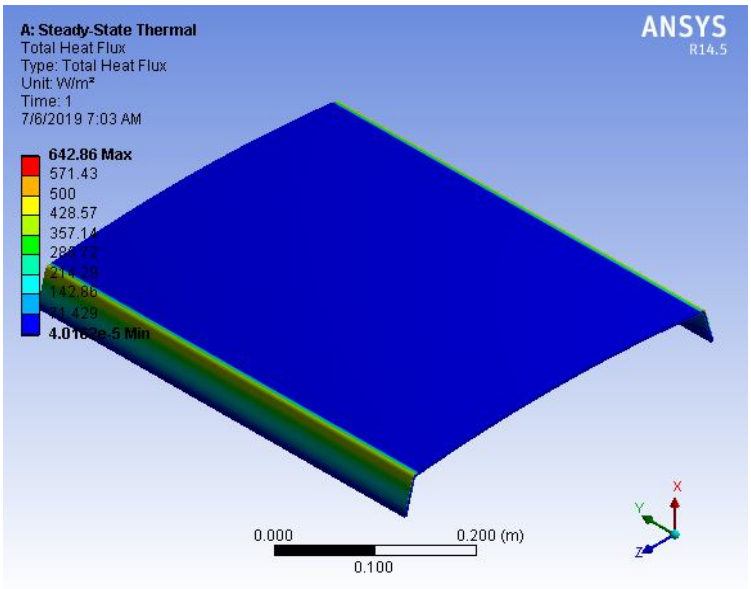


In the below fig we can observe the max heat flux is noted as 642.86W/m^2. As it is on the sides of the bonnet as if we verify the figure

Tables

MODIFIED MODEL (HONEY COMB STRUCTURE):

MATERIALS	TEMPERATURE	TOTAL HEAT FLUX	DIRECTIONAL HEAT FLUX
POLYETHYLENE	80.001	643.62	33.957
PET FOAM	80.002	619.58	31.365
BALSA WOOD	80.004	807.46	43.79

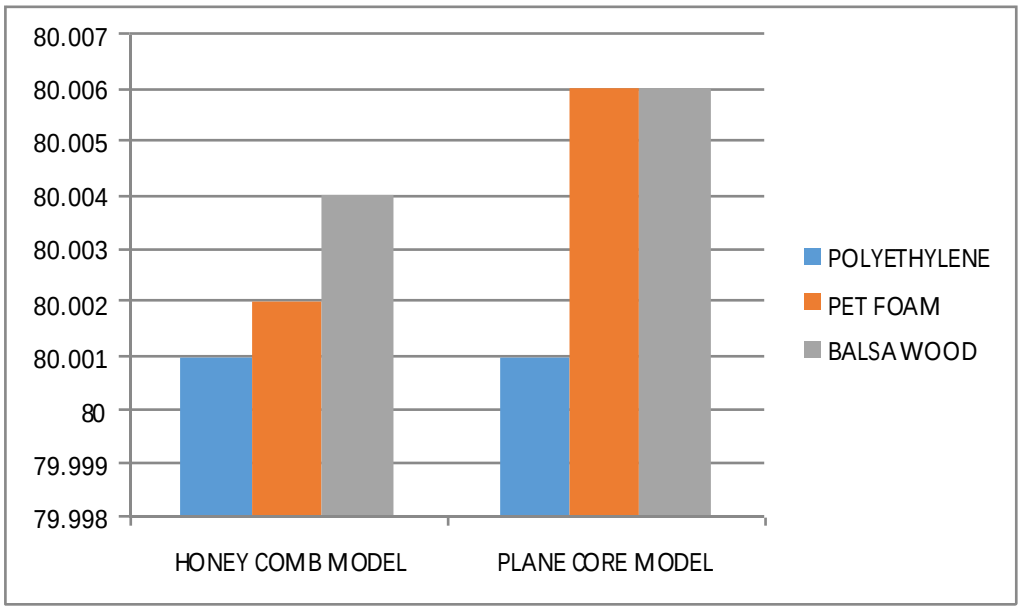
PLANE CORE MODEL:

MATERIALS	TEMPERATURE	TOTAL HEAT FLUX	DIRECTIONAL HEAT FLUX
POLYETHYLENE	80.001	642.86	61.399
PET FOAM	80.006	567.59	60.951

BALSA WOOD	80.006	616.83	60.958

GRAPHS

TEMPERATURE



TOTAL HEAT FLUX

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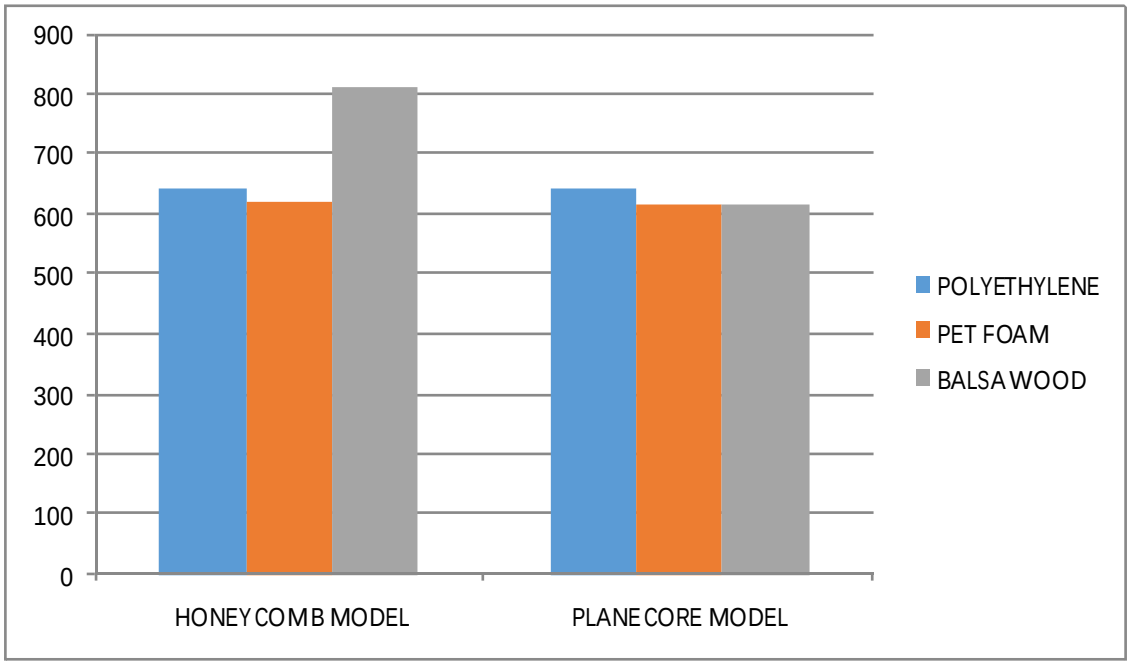

CONCLUSIONS

The objective of this thesis work is to observe the effect of performance on the insulation done on the bonnet of a vehicle. Here we have considered a real-time bonnet from an automobile vehicle and the 3 different insulation materials are chosen i.e., polyethylene, pet foam and balsa wood. Now the insulation design is also modified to honey comb structure in the place of a complete sheet model. And the three insulation materials are verified using ansys for the best insulating which supports and does not affect the body getting best insulating material so because of that we can improve the total air condensing efficiency and decrease the evaporation of fuel due to heavy temperature so that we can improve the cooling effect in the passenger cabin in car and increase the fuel economy of vehicle as consider in this thesis car body bonnet is consider as the bonnet is playing a vital role as we see in present day new cars a thermal insulting sheet is placing between the bonnet and engine in order to avoid over heating of bonnet which is danger because of that new technology is concentrating on proper and latest cooling systems and avoiding heating bonnet.

As in the graphical representation we can clearly observe that the pet foam has got the best results when compared with the other material in the plane core model and as well as in the honey comb model. So by this we can conclude the plane core model has the better output which acts a best insulating material which avoid over heating of car body so that the passenger cabin can be cool even in hot summer and avoids evaporation of fuel as we now fuel used in vehicles are volatile in nature because of that evaporation of fuel takes place so by this sandwich panel we can get also improve the fuel efficiency. Although the weight of the composite sandwich panel is less than the normal aluminum panel as it is an double advantage because of weight reduction and also insulating material which keeps passenger comfort.

REFERNCES

1. 1st International Conference on Advances in Mechanical and Mechatronics Engineering ICAMMEN 2018 8-9 Nov 2018, ANKARA
2. ScienceDirect,*Transportation Research Procedia 14 (2016) 1013 – 1020,*Deniz Hara, Gökhan O. Özgen, Investigation of weight reduction of automotive body structures with the use of sandwich materials
3. Akshay Bhusnure1, Krishna Bhosale, Prof. PrashantPatane, Prof. AshishUtage, Prof. SudeshPowar; Study on weight reduction of automotive body structures for energy saving and emission reduction. International Journal for Research in Engineering Application & Management (IJREAM); Vol.04, Special Issue AMET-2018
4. Mohamed Alymohamed, Mohamed Aly Mohamed, A materials selection procedure for sandwiched beams via parametric optimization with applications in automotive industry; https://www.researchgate.net/publication/259122150_A_materials_selection_procedure_for_sandwiched_beams_via_parametric_optimization_with_applications_in_automotive_industry
5. GangZhou, BolunZhang, AimeePasricha, A study of indentation behaviour of sandwich panels supported rigidly;https://www.emerald.com/insight/content/doi/10.1108/IJSI-01-2016-0004/full/html
6. Hai Fang,1 Huiyuan Shi,2 Yue Wang,1 Yujun Qi,1 and Weiqing Liu3, Experimental and Theoretical Study of Sandwich Panels with Steel Facesheets and GFRP Core ; https://www.hindawi.com/journals/amse/2016/7159205/abs/
7. Labans Edgars' Zudrags Kaspars'Kalnins Kaspars, Structural Performance of Wood Based Sandwich Panels in Four Point Bending; https://doi.org/10.1016/j.proeng.2017.02.073
8. Ji-Hyung Lee, Sung-Hoon Kang, Yu-Jin Ha, and Sung-Gul Hong, Structural Behavior of Durable Composite Sandwich Panels with High Performance Expanded Polystyrene Concrete; International Journal of Concrete Structures and Materials