Review on Design and Analysis of SS-PP Honeycomb Master leaf of Mahindra Bolero Pickup

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Abstract— In order to economize energy and conserve naturalresources, weight reduction has been the main focus of automobile manufacturers in the present scenario. The increasing competition and innovations in automobile sector tends to modify the existing products or replacing old products by new and advanced materials. Composite sandwich construction has been recognized as a promising concept for structural design of light weight transportation systems such as aircraft, high-speed trains and fast ships. A sandwich development gives great basic effectiveness, i.e. with high proportion of quality to weight. Regardless of the fact that the idea of sandwich development is not new, it has been fundamentally embraced for non-quality piece of structures in the most recent decade. The aim of the present study is to investigate the strength characteristics of honeycomb sandwich panels with core of polypropylene theoretically and experimentally. FEA of the both existing and honeycomb master leaf will be carry out. A series of strength tests will carry out on composite honeycomb-cored sandwich panel specimen in three point bending test. Simplified theories are applied to analyse bending deformation, buckling or ultimate strength. The structural failure characteristics of composite sandwich panels are discussed.

Key words: Honeycomb, Core, Face Sheets, Polypropylene,Stainless-Steel

I. INTRODUCTION

As the day by day gone new innovations are in automobile sector, the replacement of existing materials is concerned for various parts of the vehicle. The suspension system is one of them. A suspension system of vehicle is also an area where these innovations are carried out regularly. More efforts are taken in order to increase the comfort of user. Appropriate balance of comfort riding qualities and economy in manufacturing of leaf spring becomes an obvious necessity. To improve the suspension system, many modifications have taken place over the time. The suspension leaf spring is one of the potential items for weight reduction in automobiles as it accounts for 10% - 20% of the unsprung weight. This achieves the vehicle with more fuel efficiency and improved riding qualities. Inventions of parabolic leaf spring, use of composite materials for these springs are some of these latest modifications in suspension systems. This seminar mainly focuses on the implementation of composite materials by replacing steel in conventional leaf springs of suspension system. Weight transfer during cornering, acceleration orbraking is usually calculated per individual wheel and compared with the static weights for the same wheels.

II. LITERATURE REVIEW

1) C. W. Schwingshackl, P. R. Cunningham, and G. S. Aglietti, “Honeycomb elastic material properties: A review of existing theories and a new dynamic approach”, in the present paper the effective shear modulus of composite plates with honeycomb core is determined. This elastic coefficient represents one very important property especially in constructions subjected to torsion and combined bending-torsion
2) IonisBarboutis, “The strength characteristics of aluminium honeycomb sandwich panels”, in this paper the study of demand for lightweight structures made of sandwich panels is ever increasing in many Industrial sectors. Numerous research efforts have been taken by various researchers in this area in terms of weight and cost reduction. Sandwich panel is a composite structure and it is an excellent alternative material in place of weight reduction without sacrificing its strength and stiffness characteristics.
3) Ramesh S Sharma, “Vibration response analysis of honeycomb sandwich panel with varying Core Height”.
   In this paper it is shown that the, effect of core height on fundamental natural frequency of honeycomb sandwich panel is studied. It is found that effect of core height has large influence on fundamental natural frequency of honeycomb sandwich panel. As core height increases frequency also increases.
4) R.P.Ambare and Hredey Mishra “Design and performance of master leaf used for Mahindra pick-up” in this paper researcher showed that reduction in un-sprung weight is possible due to use of composite material for fabrication of leaf spring. Almost 50% weight reduction is done. Composite master leaf does not get rusted, so the performance will not get reduced after continuous use. The ultimate tensile strength of the composite leaf more than that of conventional master leaf ensuring good mechanical properties Stresses generated in the composite are much lower than that of conventional one. Stiffness of the composite leaf spring is nearly same as that of conventional steel master leaf. So we can replace conventional one by composite.
5) Kuldeep P.Toradmal , Pratik M.Waghmare, Shrishail

B.Sollapur "Three point bending test on honeycomb panel" in this paper work it is clear idea about, "Recent trends in modern railway industry shows more and more use of composites specially sandwich structures to build the coaches so as to achieve higher speeds, reduced power consumption and increase in pay load carrying capacity. Honeycomb sandwich structures have wide applications as structural and non-structural materials of the coaches in the railway industry. A sandwich construction consists of two thin facing layers separated by a thick core. Static three-point bending tests were carried out in order to investigate the failure loads.

6) Mohansing R. Pardeshi , Dr. (Prof.) P. K. Sharma, Prof.

Amit Singh, "Vibration analysis of e-glass fibre resin mono leaf spring used in lmv", in this paper vibration analysis done on, a leaf spring is a simple form of spring, commonly used for the suspension in vehicles. A leaf spring which is an automotive component is used to absorb vibrations induced during the motion of vehicle. Leaf Springs are long and narrow plates attached to the frame of a trailer that rest above or below the trailer's axle. There are single leaf springs and multi leaf spring used based on the application required. It also acts as a structure to support vertical loading due to the weight of the vehicle and payload. Under operating conditions, the behaviour of the leaf spring is complicated due to its clamping effects and interleafs contact, hence its analysis is essential to predict the displacement and mode frequency.

III. PROBLEM STATEMENT

As comparing the reference paper it is found that it not possible practically to replace composite material like epoxy resin, glass fibre, carbon fibre, E glass fibre, polypropylene etc. For goods carrier vehicles like Mahindra Bolero Pickup's leaf spring even their weight reduction properties .So it is necessary to find out ultimate material for conventional leaf spring, by which we can make leaf spring practically.

IV. MATERIAL SELECTION

With reference to above mentioned problem, the material like stainless steel honeycomb material may be best replacement for leaf spring. Because it has better structural, mechanical properties with weight reduction. Because it is clear that weight is directly proportional to the performance of vehicle.

V. METHODOLOGY

1) With proper dimensions design a master leaf of a vehicle by using proper software.
2) Calculations are made to find out percentage reduction in weight of leaf spring.
- Purchase sheet of stainless steel and polypropylene honeycomb material to make bending and vibration test.
3) Following machines are used to perform above mention test:
- FFT analyzer.
- Bending testing machine.

VI. DESIGN

Calculation for weight reduction: Mass of specimen of dimension 300*100 mm=density*volume

1) Plain carbon steel as material =density *volume $=7.85*10^{-3}*300*100*7 =1648.5$gm

2) Stainless steel honeycomb material = $m_f + m_c$
$=480+14.80=494.80$gm

Percentage reduction in weight of leaf spring
$= 100-(494.80/1648.5)*100$

$=69.89\%$

Fig. 1: Master Leaf of Bolero Pick up by using Cati v 5

VII. CONCLUSION

Hence by above calculations and FEA analysis results we can conclude that by using stainless steel-polypropylene honeycomb composite it is possible to reduce the weight of master leaf approximately by 69%.

VIII. FUTURE SCOPE

The following are the recommendations made for the future scope in this project:

1) Improvements can be made in the design of the sandwich leaf spring, by varying the core thickness and the orientation of the layers used in the laminate.
2) A multi-cored sandwich leaf spring can be designed with two or more cores of different materials, bonded together by an adhesive material.
3) In this project, the honeycomb sandwich leaf spring used whose face sheets and the cores are joined together rigidly. But still better results can be obtained if the material properties of the adhesive material are also defined in detail while modelling the sandwich leaf spring, so as to improve the performance of the leaf spring to a larger extent.
4) Improvements can be made in the design of the sandwich, by varying the core thickness and the orientation of the layers used in the laminate.

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