Design and Weight Optimization of Engine Mounting Bracket

K. Diwakar[1], Dr. B.E Kumar[2]

[1]P.G Student, Department of Mechanical, Madanapalle Institute of Technology & Science, Madanapalle, Andhra Pradesh, India.
[2] Professor, Department of Mechanical, Madanapalle Institute of Technology & Science, Madanapalle, Andhra Pradesh, India.

Abstract— *In the present scenario, the safety of the passengers have become a major concern in the development of the automotive products. In this scenario, engineers have more challenging tasks to innovate various mechanisms that aims for the safety of passengers without compromising the performance of automobile systems.*

The engine mounting system of four wheeler of "BEAT CHEVROLET" is taken for this study. The objective of the present study is to reduce the weight of the BEAT CHEVROLET Engine Mounting Bracket by using optimization technique(Material Optimization). The details of the geometry is taken from the existing component and it is developed by the commercial tool CATIA. The meshing is done in Hyper mesh and the structural analysis is conducted by FEA commercial tool, HYPER WORKS.

In this study, material optimization is done by considering three different materials which are gray cast iron, aluminum silicon carbide and aluminum alloy 5052 to the geometry. The detailed structural analysis have been made on the engine mounting bracket is by using commercial tool, HYPER WORKS.

Keywords— *Engine Mounting Bracket, Hyper Works, hyper mesh,*.

I. INTRODUCTION

During design of vehicle structures, it is always challenging to achieve higher stiffness and strength and simultaneously reduce weight, that is to say, to optimize the structures. There have been various types of the optimization methods that were developed and have successfully been used in the vehicle structure design.

Recently, in the course of designing large commercial vehicles, various optimization methods were attempted for optimal structure design, specially the mounting brackets of chassis components such as an air-compressor, a leaf spring, a radius rod, etc. It is very important that these mounting brackets should have proper stiffness and strength to provide sound durability and NVH characteristics to a vehicle, while maintaining light weight.

Therefore, these brackets undergo many design changes throughout the vehicle development process. In addition, the brackets are usually made of cast iron with solid complicated shapes and large densities, but have simple load cases. All these conditions make the brackets preferable candidates for the optimization application, even though in principle the optimization methods can apply to any structural parts.

The main purpose of this paper is to present an analytical optimization tool developed to assist design engineer in arriving at an engine mounting system with the most potential to decouple the stress, displacements and without violating the constraints imposed by packaging and manufacturing.

Fig1: Location of engine mounting bracket of a car

This program has the following functions:

Strength Analysis is carried out for three different materials which commonly used for engine mounting bracket in the market.

Materials are Aluminum silicon carbide, Aluminum alloy 5052 and Gray cast iron.

Units systems used are length is in mm, density in ton/mm3, stress units is Mpa and young's modulus is in Mpa.

Designing is done in CATIA V5R19 software using US patent.

Meshing is done in Altair Hyper mesh, Materials input, and boundary condition applied in hyper mesh.

Radios as a solver we are solving linear static analysis by using OEM's loads and fixing locations.

Force is 150 new tons three bolted holes are fixed and solve the problem

1.1FUNCTION OF VEHICLE MOUNTS

The main function of an engine mounting bracket is to reduce the engine vibrations occurred in engine.

It absorbs the road-shocks and engine vibrations so that the driver does not feel any engine movement.

II. DESIGN AND MODELLING OF ENGINE MOUNTING BRACKET(BEAT CHEVROLET)

The design parameters and dimensions directly taken from the existing component "Beat Chevrolet" and design should be completed by using CatiaR19 and meshing can be done using hyper mesh and analysis can be done using hyper works the results should be compared between base model and optimized model.

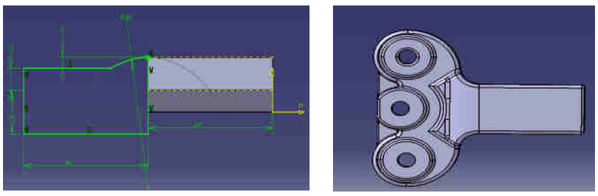
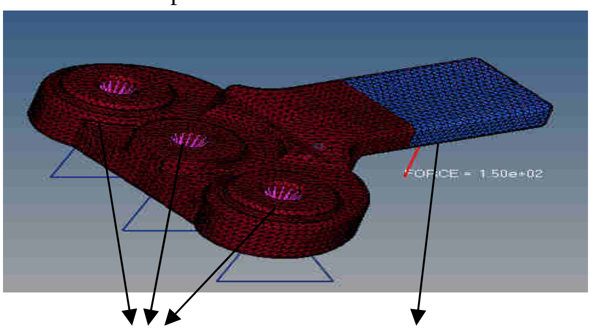


Fig 2 :Catia Model of EMB(BEAT CHERVOLET)

2.1Meshed Model and its Procedure:

Meshing of an engine mounting bracket is done by using the software hyper mesh. In hyper mesh we use 3D mesh for solid components and element type should be solid and element shape should be tetrahedral.



Fixed condition load location

Fig 3 Tetrahedral Meshed Model with Load conditions

2.2Material Selection & Its Properties:

Material selection is one of the major concern in this presentation. The Engine Mounts are generally made of Gray Cast iron because of its high strength and high specific heat capacity. The density of an GCI is 7200 kg/m^3.Due to its high density the weight of the component should be more, so to reduce the weight of the component we have to choose low density and high strength materials which are aluminum silicon carbide composite material and aluminum alloy 5052.Now a days these materials are used in many applications like Automobiles, Aircraft, etc…., The static analysis should be done for all these three materials and compare their respective weights and stresses.

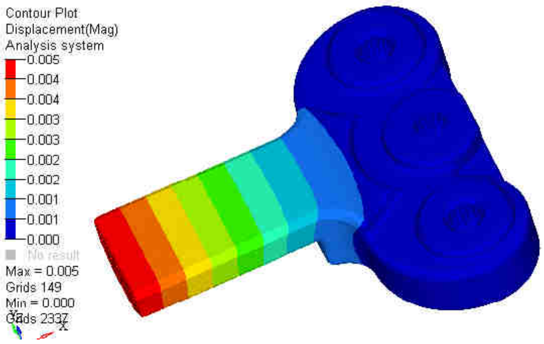
Table1:Mechanical Properties of three materials

S.NO	YOUNGS MODULUS (Mpa)	Density (g/mm^3)	Poisson's ratio
1.Gray cast Iron	125000	7.28	0.25
2.Aluminum Silicon Carbide	115000	2.88	0.33
3.Aluminum Alloy 5052	70300	2.68	0.33

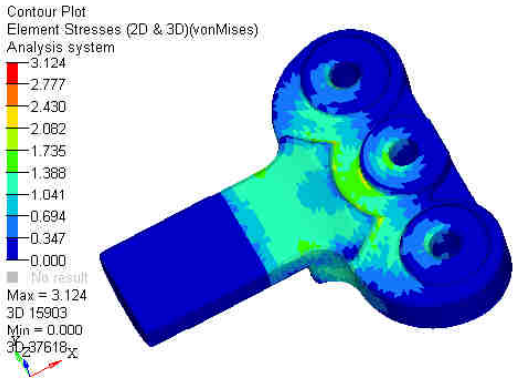
III. RESULTS AND DISCUSSION

The Engine mounting bracket is developed according to the dimensions taken from the existing component(Beat Chevrolet) and the model is kept under the load of 150 new tons on one end and the three holes are fixed on the other end .The experiment is done in the isotropic state.

3.1Gray Cast Iron Results:

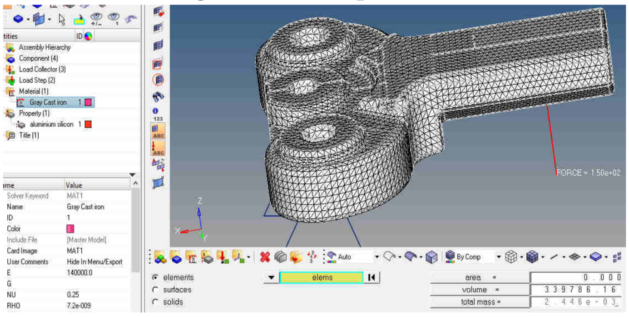


Maximum Displacement: 0.005 mm



Max Induced Stress 3.124 Mpa

3.1.1 Initial Weight of the component:

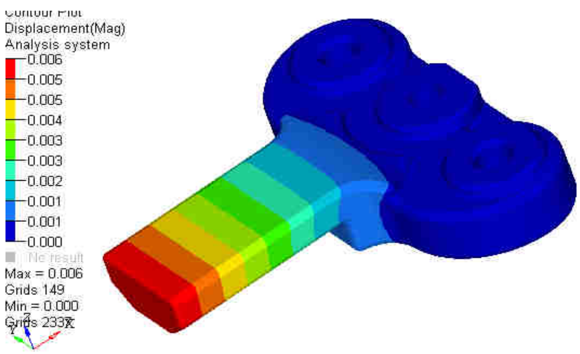


Weight of the model with an GCI material is 2.44 kg

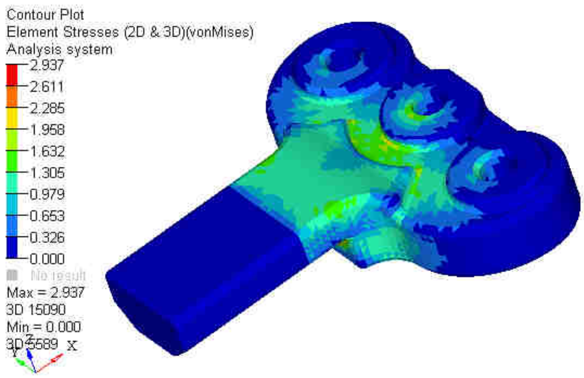
3.2 Aluminum Silicon Carbide Results:

S.NO	Stress (Mpa)	Displacement In mm	Weight of the model in Kgs
1.Gray cast Iron	3.124	0.005	2.446
2.Aluminum Silicon Carbide	2.937	0.006	0.978
3.Aluminum Alloy 5052	2.937	0.010	0.910

The first alternate material is used to replace the gray cast iron is Aluminum Silicon carbide which has less density (2880kg/m^3) compared to gray cast iron.

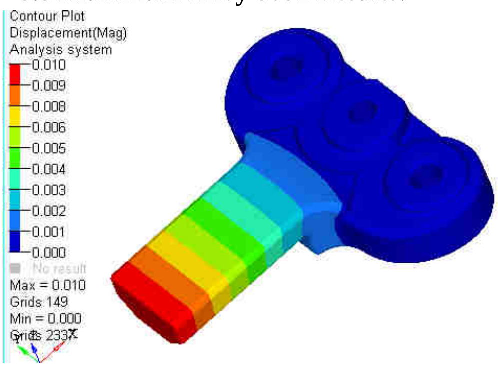


Maximum Displacement: 0.006 mm

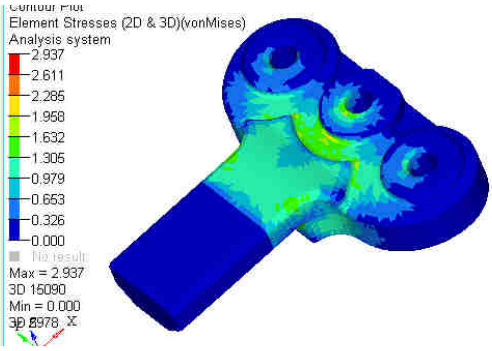


Max Induced Stress 2.937 Mpa

3.3 Aluminum Alloy 5052 Results:



Maximum Displacement: 0.005 mm



Max Induced Stress 2.937 Mpa

3.4 Weight reduction by percentage:

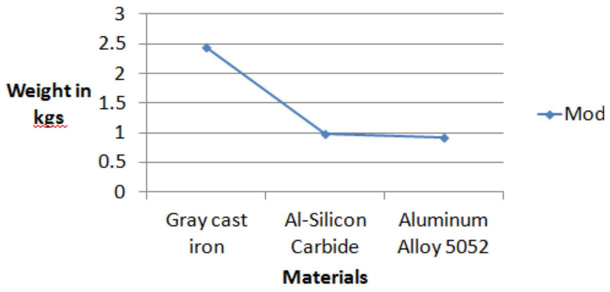
Initial weight of the component = 2.446 kgs

Final weight of the component = 0.910 kgs

$$\text{Total weight reduction} = \frac{2.446-0.910}{2.446}$$

Weight reduction by percentage = 62.79%

IV. WEIGHT COMPARISON GRAPH FOR THREE MATERIALS



V. CONCLUSION

The Engine Mounting Bracket is used to reduce the vibrations created by the engine .The engine mounting bracket is generally made up of Gray cast iron .In this paper the weight reduction of engine mounting bracket is taken under the consideration with out varying the performance of the component .The results obtained states that the weight of the component is reduced to 62% by using Aluminum alloy 5052 material made component .The future scope of this work is to reduce the cost of the component with out changing the performance of the component.

REFERENCES

[1] Pan X., 'Structural Optimization for Engine Mount Bracket', SAE Technical Paper Series 2007-01-2419.
[2] Igami H., Thompson M., Osodo K., 'Automotive Powertrain Mounting System Design Optimization', SAE Technical Paper Series 2003-01-1667.
[3] Chang H., 'A Study on the Analysis Method for Optimizing Mounting Brackets', SAE technical paper series 2006-01-1480.
[4] C. Blawert, N. Hort and K.U. Kainer, 'Automotive applications of Magnesium and its alloys', Transaction Indian Inst. Met. Vol.57, No. 4, August 2004, pp. 397-408.
[5] www.matweb.com