International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 11, November-2018

DESIGN OPTIMIZATION OF FOUR WHEELER AUTOMOTIVE ENGINE MOUNTING BRACKET

GANDLA PAVAN SAI[1], U. MAHABOOB BASHA[2],K TRINATH KUMAR[3]

[1]*PG Scholar, Department of Mechanical engineering, PVKKIT Anantapur,A.P., India.*
[2]*Assistant Professor ,Department of Mechanical engineering, PVKKIT Anantapur.,A.P. ,India.*
[3]*PG Scholar,Department of Mechanical Engineering,GATES INSTITUTE OF TECHNOLOGY,Gooty,A.P, India*

Abstract*— In order to get better designs, the industry was using tools like the FEM Optimization from couple of decades. These types of optimization techniques are useful in validation and optimizing the design to get new size and shape. These techniques surely reduced the design time, when compared to the experimental testing. In this project an engine mounting bracket is selected for analysis; there are four mounting brackets to mount the engine on chassis. This is a very important parameter as the product market life is reducing and there is a need to get more new and better designs with less time to decrease the cost and at the same time increase the stiffness to mass ratio and performance. In this project I have reduced the mass in 0.22kgs per component and as per the cost wise in the year 352000 Rupees saved.

***Keywords*— FEM, Mounting Bracket, Design, performance, Mass**

I.INTRODUCTION

Engine brackets attached in automobiles today are mostly constructed using superior materials and innovative welding techniques. These brackets are metal-based castings that are used for supporting the engine and its various components. The different auto parts that comprise of engine brackets include alternator bracket, smog pump eliminator brackets, power steering brackets, ac-brackets, etc. Automobile aftermarket is flooded with revolutionary and improved engine brackets made from different materials like aluminum, polypropylene, fiberglass, mild steel, and stainless steel.

Typically, engine brackets are of two types single engine and twin engine brackets. Hazelwood, Johannesburg, Ohio, Missouri, Kansas City, Taipei Hsien, Seoul, Zhejiang, Chang Hua, Jiangsu, Michigan, Illinois are the places where manufacturing plants for engine brackets are located.

The design of an engine mounting brackets involves the following considerations: (1) location of engine center of gravity (C.G.) and its orientation, (2) location and orientation of individual mount, (3) selection of stiffness coefficients of each mount.

1.1 Process Methodology

Topology optimization is a method which distributes the density of an initially homogenous volume to achieve a certain objective function while observing the defined constraints. Minimize volume is usually considered as an objective function, while the stress acts as a constraint and with manufacturing constrain such as draw direction. Topology optimization is often used in the early design process to define the optimum part layout.

The optimized models performance in the form of stiffness and strength evaluation is done and parametric study is carried out using Hyper Study according to fulfill the design and testing standard values. Initially it needs to collect the information regarding different loads acting on the bracket and the packaging data for fixing design space. The base bracket results from testing and finite element analysis (FEA) point of view for evaluating final optimized design

II.DESIGN OF ENGINE MOUNTING BRACKET

The 3-D modeling of engine mounting Bracket has been completed in Unigraphics 9.0 (UG NX 9.0). The engine mounting Bracket is provided with three holes for mounting the engine and on the other side, there is one hole provided which is fixed to the body frame and the load is applied on this hole as shown in fig.2.1

The 3-D model of Engine Mounting Bracket is designed in Unigraphics(NX CAD) software and then it is converted to the file formats such as STEP, IGES which are essential for importing in to the other meshing software like Ansys.

The material used to made the Engine Mounting Brackets Mild Steel because of its high strength and high specific heat capacity. The material is applied to each of the models and their corresponding weight is calculated. The density of GCI is taken to be 7.7 g/m^3.

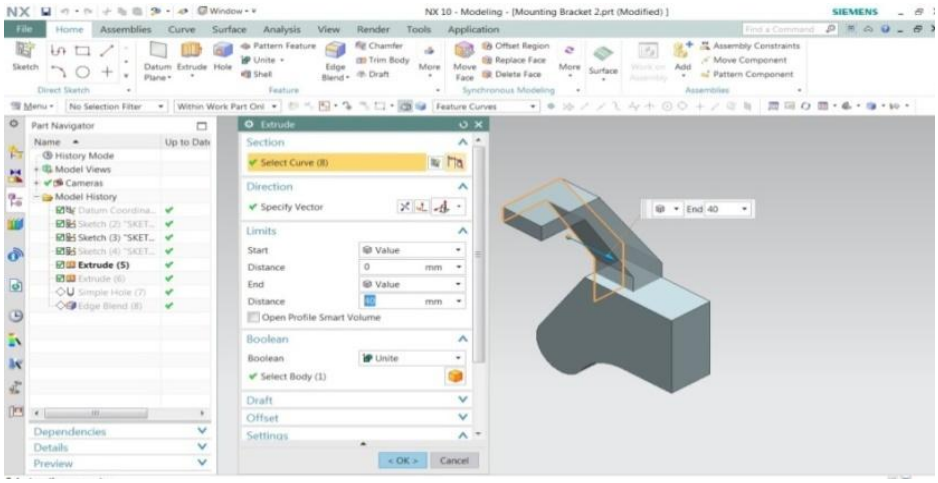

Fig 2.1 Design of engine Mounting Bracket (NX CAD)

III.ANALYSIS AND RESULTS

After preparing the model in Unigraphics it is imported in to theAnsys tool for meshing as tetra mesh and preprocessed for solving the problem by applying the material properties and loading conditions etc. in ANSYS as shown in fig.3.1

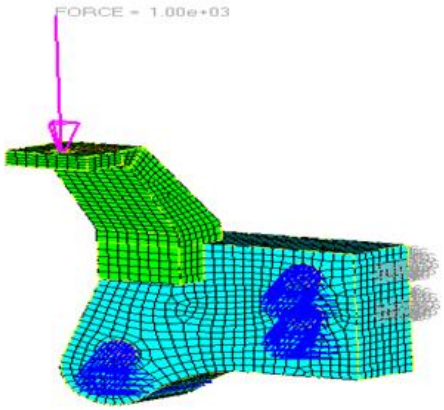

Fig 3.1 Applying Analysis on Engine Mounting Bracket

The analysis on the engine mounting bracket has been done at different loads for different weights. The weight of the engine mounting bracket has been changed by changing the shape of the mounting bracket. And the analsys for different weight is as shown below figures.

3.1 Results Before Optimisation

3.1.1 Displacement

From structural analysis, deformation of the mounting bracket before optimization by applying loads and boundary conditions, the Total Deformation of the bracket is 0.736m this has indicated in red color as shown in below figure 3.2

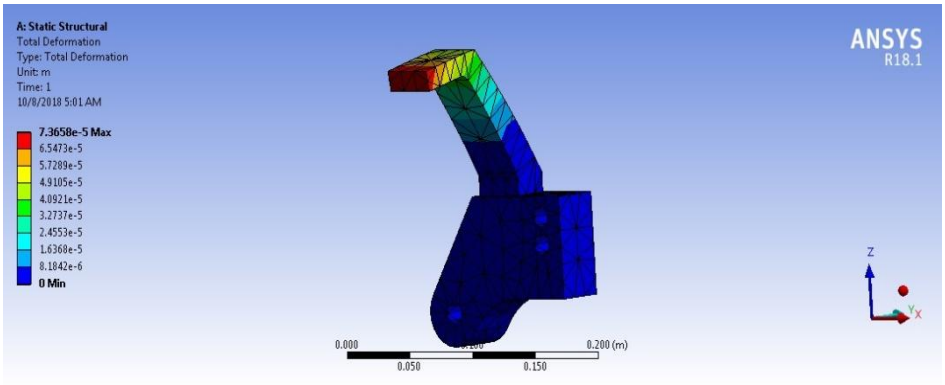

Fig.3.1.1 Deformation in the bracket before optimization

3.1.2 Stresses

Maximum principle stresses in the mounting bracket before optimization by applying loads and boundary conditions, the maximum principle stress of the bracket is 61.05 N/mm^2 this has indicated in red color as shown in below figure 3.3

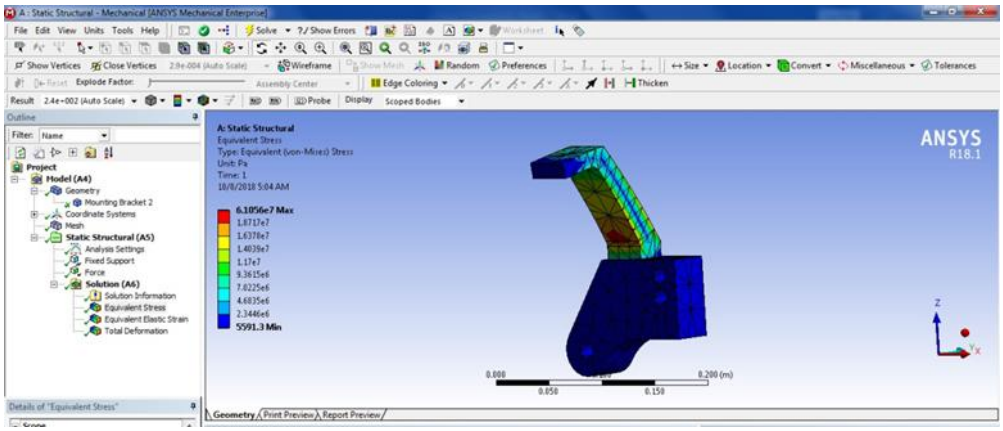

Fig 3.1.2 Maximum principle stresses in the mounting bracket before optimization

3.2 Results After Optimisation

3.2.1 Displacement

Case 1: By removing the weight of the engine mounting bracket of 0.38 kg, The displacement of the bracket is as shown in the below figure 3.2.1. the bracket is tend to failed under the applied load as the material is removed to reduce the weight of the bracket and hence the material has not able to withstand for applied loads as shown below fig 3.2.1

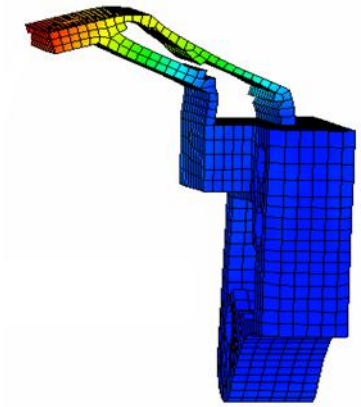

Fig.3.2.1 Displacement of the bracket after reducing the weight of 0.38kgs

Casw 2: By reducing the weight of the mounting bracket by 0.45 kg,ny changing its shape and by removing material from the bracket,the bracket is failed under the applied load conditions because in this case also the material cannot be able to withstand the loads that are applie as shown in fig 3.2.2

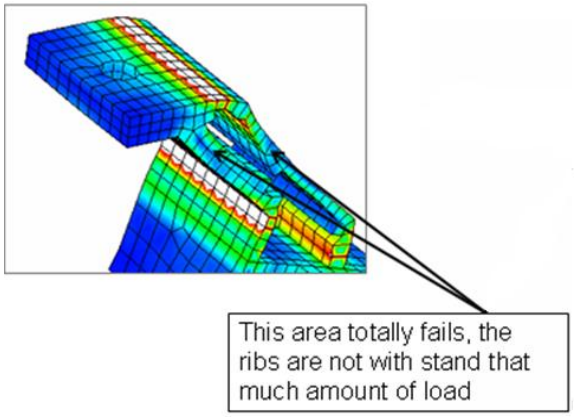

Fig 3.2.2 Displacement of the bracket after reducing the weight by 0.45kg

Case 3: If we are Optimizing the weight of the engine mounting bracket to 0.22kgs , the maximum displacement of the mounting bracket after optimization by applying loads and boundary conditions, is 0.357 mm this has indicated in red color, in this case the material is saving and also the component can be with stand as shown in below figure 3.4.

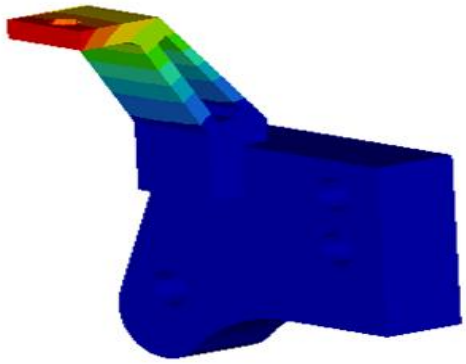

Fig 3.2.3 Displacement of the bracket after optimizing the weight by 0.22kg

3.2.2 Stresses

Case 1: If the weight of the mounting bracket is changed to 0.38 kgs , the stress of the bracket is as shown in the below figure. Obtained stress in the mounting bracket as indicated in red color is 108 N/mm^2. In This bracket has tend to failed under applied load because the material saving is more but the component cannot be with stand as shown in figure 3.2.4.

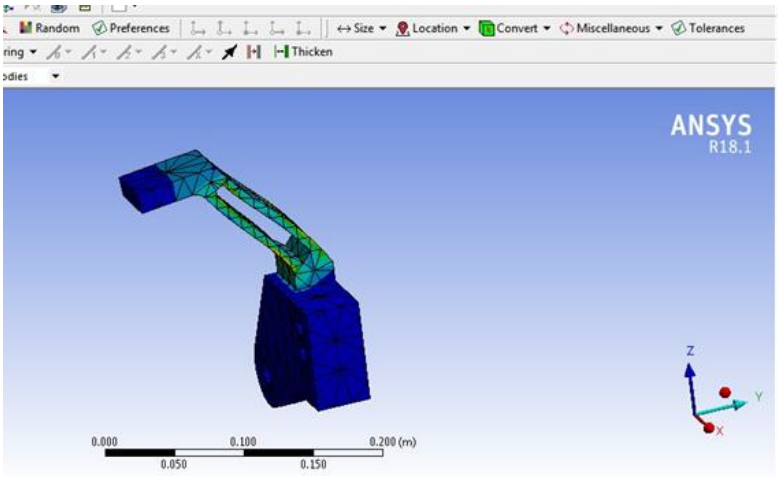

Fig 3.2.4. Stress in the mounting bracket after removing weight of 0.38kgs

Case 2: If the weight of the mounting bracket is reduced by 0.45 kgs, stress in the bracket is as shown in the below figure, obtained stress in the mounting bracket as indicated in red color is 135 N/mm^2. This bracket has also tend to failed under applied load because material is more saving but the component cannot be with stand as shown in figure 3.2.5

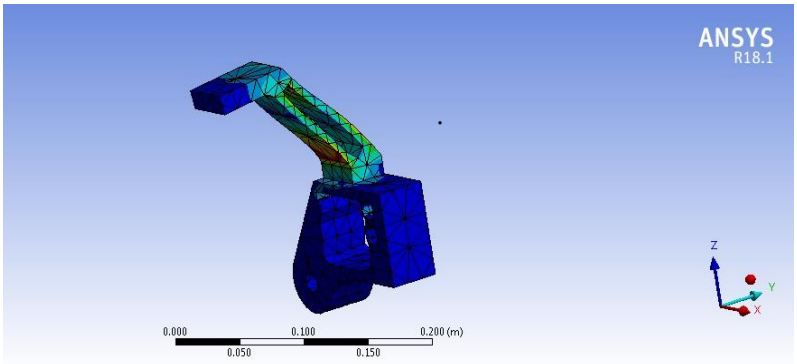

Fig 3.2.5. Stress in the bracket after reducing the weight of 0.45kg

Case 3 : If weight of the mouning bracket is Optimised by 0.22kgs, stress in the mounting bracket after optimization by applying loads and boundary conditions, the maximum stress of the bracket is 66.26 N/mm^2 and it is indicated in red color, in this case the material is saving and also the component can be with stand as shown in below figure 3.2.6.

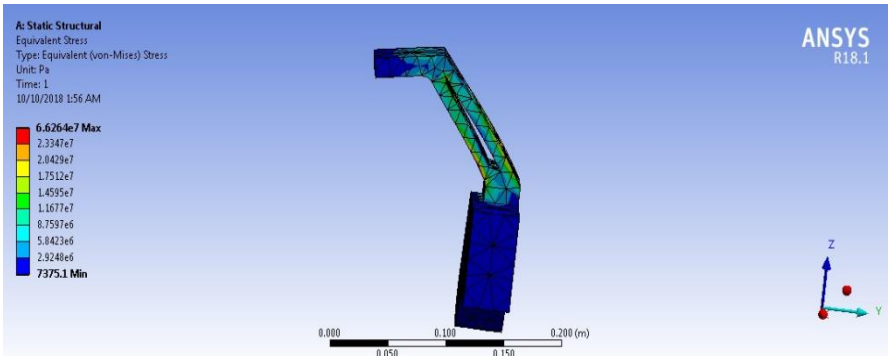

Fig 3.2.6. Stresses in the bracket after reducing weight of 0.22kg

IV.CONCLUSION

From all these three cases, case-3 is more suitable because it is able to with stand under applied loads and boundary conditions, results obtained after topology optimizations are: Stress is 66.26 N/mm^2 and displacement is 0.357 mm, the cost of the bracket also saved By optimizing the weight of the mounting bracket.

From the above results one can says that Optimization of the Engine mounting bracket is dene by changing the weight of the bracket by removing material and also it can reduce the cost of the material by reducing the weight of the bracket.

V.REFERENCES

[1] Altair Engineering. “Altair HyperMesh: Introduction to FEA: Pre-Processing Volume I. ”Hyperworks Training Manual”.
[2] Altair Engineering. “Altair OptiStruct: Concept Design Using Topology and Topography Optimization.” Hyper works Training Manual.
[3] Bendsre, M.P. and Sigmund, O. (1999) ‘Material interpolation schemes in topology optimization’.
[4] Kutylowski, R. (2000) ‘On an effective topology procedure’.
[5] Mlejnek, H.P. and Schirrmacher, R. (1993) ‘An engineer’s approach to optimal material distribution and shape finding.
[6] Olhoff, N., Ronholt, E. and Scheel, J. (1998) ‘Topology optimization of three-dimensional structures using optimum microstructures’.
[7] Suzuki, K. and Kikuchi, N. (1991) ‘A homogenization method for shape and topology optimization’.
[8] Swan, C.C. and Arora, J.S. (1997) ‘Topology design of material layout in structured composites of high stiffness and strength’.
[9] Yang, R.J. and Chahande, A.I. (1995) ‘Automotive applications of topology optimization’, Structural Optimization.
[10] Saurabh M Paropate and Sameer J Deshmukh, "Modelling and Analysis of Motor Cycle Wheel Rim", International Journal of Mechanical Engineering and Robotics Research India, 2013, Vol. 2, No. 3, PP. 2278-0149
[11] Ali Mehrabian, Application of ANSYS Structural™ in Structural Analysis and Design, Journal of Modern engineering, 2007.
[12] BGN Satya Prasad and M Anil Kumar, "Technology Optimization of Alloy Wheel", Altair Technology Conference, 2013.
[13] Saran Thej M, Shankar G, Vamsi Krishna M, "Design Analysis of Two Wheeler Lighter Weight Alloy Wheel", Indian Journal of Engineering, 2013, Vol. 6, No. 15, PP. 2319-7757.
[14] Pan X., ‘Structural Optimization for Engine Mount Bracket’, SAE Technical Paper Series 2007-01- 2419.