EFFECTIVE REDUCTION OF WEIGHT AND VIBRATION BY OPTIMIZING ENGINE MOUNTING SYSTEM

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Abstract: The highly competitive automotive business industry requires manufacturers to pay more attention to passenger comfort and riding quality. This has forced designers to direct their attention to the development of high quality engine mounting devices, with traditional physical prototyping and testing being gradually replaced by virtual prototyping and numerical simulations. In this paper, we are doing to reduce the weight and vibration by changing the size of the engine Mounting bracket for FSAE Car using CATIA and ANSYS software. Vehicle engine mounting system consisting of engine and three or four mounts are connected to vehicle structure.

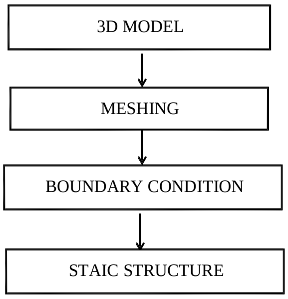
I. INTRODUCTION

The mounting system is the primary interface between the power train and the frame; therefore, it's vital to the determination of the vibration isolation characteristics. Different types of engine mount are presented in this chapter, but the only engine mount that will be used in the work herein are the elastomeric mounts. The elastomeric mounts are made of rubber which withstands large amount of deformation under loads with the ability to almost retain its original shape when the load is removed. This is due to the inherent material property of rubber. Rubber is a viscoelastic material which enables it to be used as an isolator and as a damper.In an automotive vehicle, the engine rests on brackets which are connected to the main-frame or the skeleton of the car.

II. LITRATURE REVIEW

Iwahara and Sakai (1999) discussed various possibilities to isolate the engine. The engine mount layout consists of four mounts supporting the engine. The three and five mount layouts among other layouts are also investigated. Eigen value analysis, frequency response and transient response are used to determine the best way to isolate the engine.Akanda and Adulla (2005) studied a six cylinder four wheel drive vehicle. In such a vehicle, the powertrain includes engine, transmission and transfer case. The torque roll axis approach is used to decouple the modes and come up with the mounting system locations. The author suggests locating the mounts at the nodal points of the fundamental bending modes of the powertrain may reduce the transmitted forces to the body.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.In this paper the literature survey of the comparison of the materials in the weight and vibration of engine mounting bracket.

III. MATHEMATICAL MODES OF VEHICLE:



IV.MATERIALS USED:

PROPERTIES OF ALLUMINIUM ALLOY 6061:

Young’s modulus,	E = 68.9 GPa
Poisson’s ratio,	U = 0.33
Density,	D = 2.70g/cm^3
Tensile Strees ,	= 290 Mpa
Elongation	= 12-25%

PROPERTIES OF MAGNESIUM ALLOY:

Young’s modulus,	E =42 GPa
Poisson’s ratio,	U = 0.3
Density,	D = 1.8 g/cm^3
Tensile Strees ,	= 285 Mpa
Elongation	= 2-10%

PROPERTIES OF CAST IRON:

Elongation	E = 124Gpa
Poison ratio	U = 0.27
Density	D =7.5g/cm^3

V.CATIA MODELLING

This stage involves making the basic model based on the engine positioning on the chassis. The entire modelling is done using CATIA Parametric. Since the geometry suggested a long bracket, material selection became an important consideration due to its weight. To minimize the weight it was decided to make up the mount bracket of two components bolted to each other. One part would be welded on the chassis and the other would be bolted to the engine.

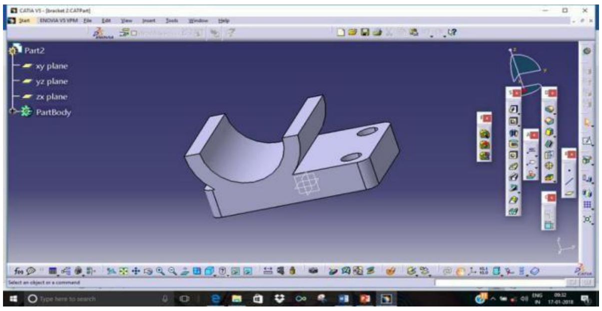


Fig:1 Bracket

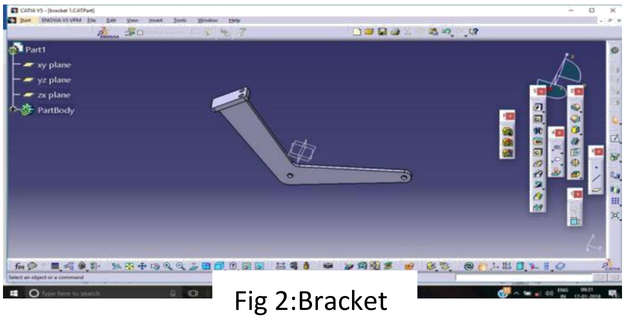
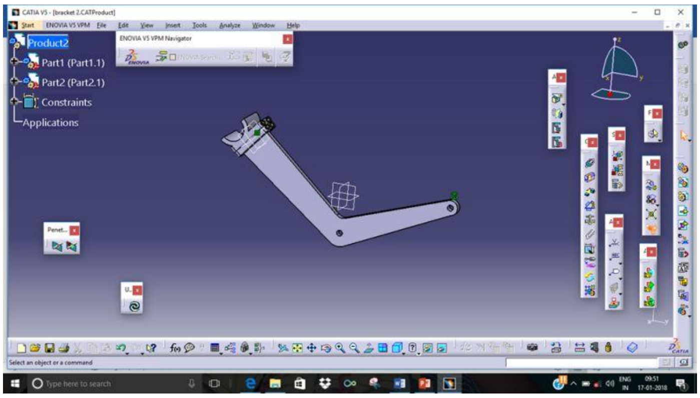


Fig 2:Bracket

ASSEMBLED COMPONENT



VI.OPTIMIZATION OF MOUNTING BRACKET:

From the above results of the preliminary design the following modifications were made .Addition of fillets at sharp edges due to stress concentration. Also, the max displacement of 1.5mm being high, an additional rib was added on the bracket. Since, addition of an additional rib meant addition of weight, mass optimization of the bracket was also done. The results were as follows:

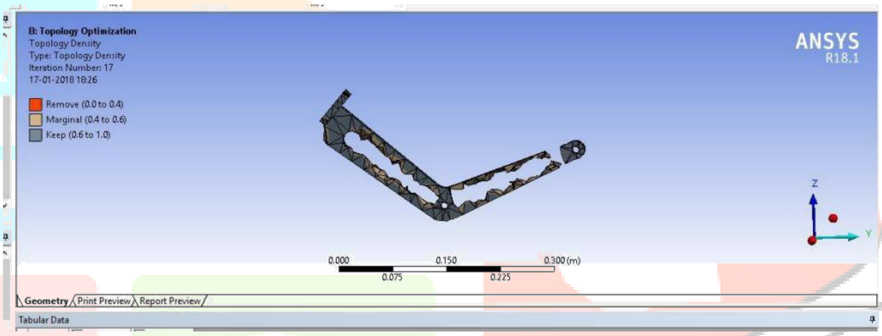


Fig:4. Topological Optimization

The optimization of the bracket is the solved by the material in the removed the topological operation.

MODIFIED ASSEMBLY DESIGN:

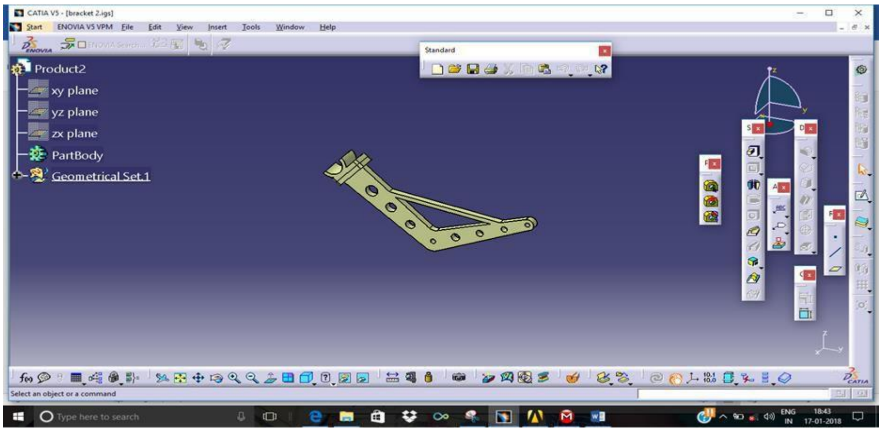


Fig:5. Modify Assembly Design

MODEL ANALYSIS OF MODIFIED DESIGN OF ALUMINIUM ALLOY:

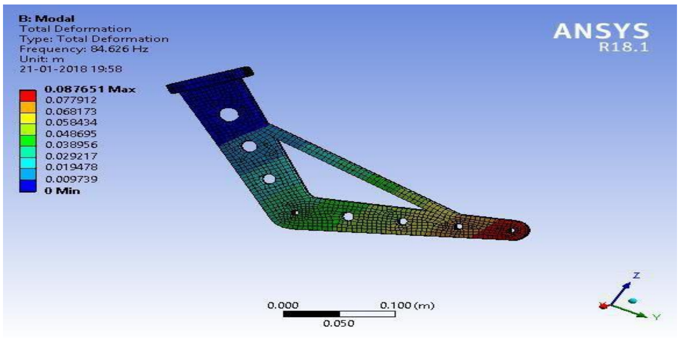


Fig:6. Minimum Analysis

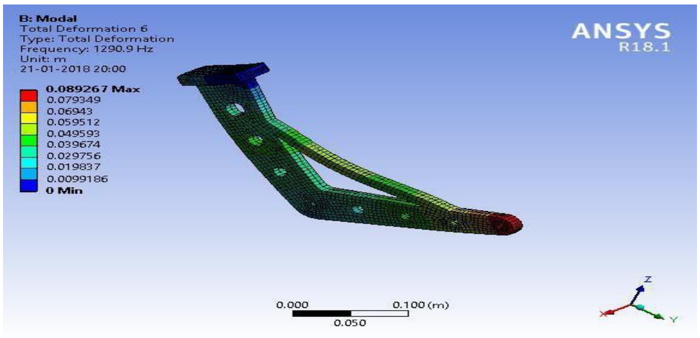


Fig:7. Maximum Analysis

RESULT -FREQUENCY OF ALUMINIUM ALLOY:

MODE	FREQUENCY(Hz)
1	84.595
2	1293.6

Max-Min Frequency of Aluminum Alloy

MODAL ANALYSIS OF MAGNESIUM ALLOY:

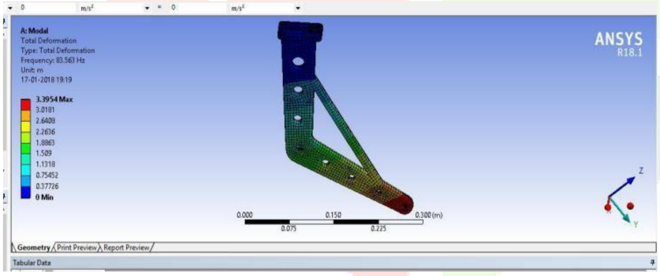


Fig:8.Minimum Analysis of Mg Alloy

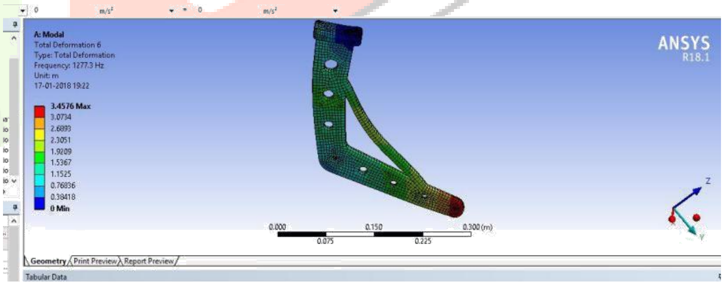


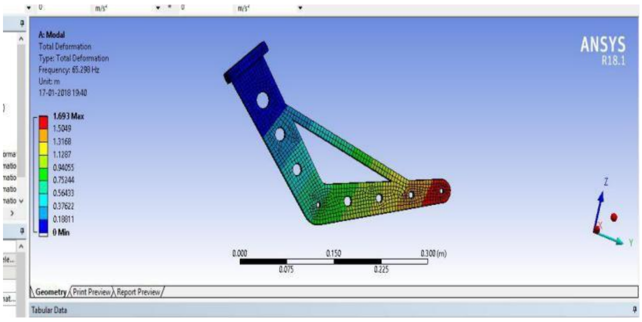
Fig:9.Maximum Analysis of Mg Alloy

RESULT -FREQUENCY OF MAGNESIUM ALLOY:

MODE	FREQUENCY(Hz)
1	83.563
2	1277.73

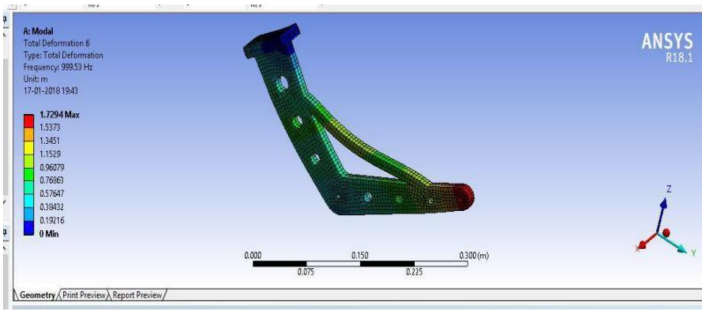
Max-Min Frequency of Mg Alloy

MODAL ANALYSIS OF GREY CAST IRON:



A: Modal
Total Deformation
Type: Total Deformation
Frequency: 65.298 Hz
Unit: m
17-01-2018 19:40

Fig 10:Min Analysis of Grey Cast Iron



A: Modal
Total Deformation 6
Type: Total Deformation
Frequency: 999.53 Hz
Unit: m
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Fig11:Max Analysis of Grey Cast Iron

RESULT -FREQUENCY OF GREY CAST IRON:

MODE	FREQUENCY(Hz)
1	65.298
2	999.53

Max-Min Frequency of Grey Cast Iron

VII.RESULT:

WEIGHT COMPARSION

Existing bracket	Weight G	Type	Material	Weight g	% Reduction
Aluminium alloy 6063	403	EXISTING	Aluminium alloy 6061	410	- 1.73%
			Magnesium alloy	385	4.4%
			G-Cast iron	1420	- 252%
		OPTIMIZED	Aluminium alloy 6061	378	6.2%
			Magnesium alloy	352	12.6%
			G-Cast iron	1245	-208.93%

NATURAL FREQUENCY ANALYSIS:

Existing Bracket	Natural Frequency Hz	Type	Material	Natural Frequency Hz	Difference in Frequency Hz
Aluminium alloy 6063	92.61	EXISTING	Aluminium alloy 6061	92.21	0.40
			Magnesium alloy	84.626	7.984
			G-Cast iron	71.33	21.28
		OPTIMIZED	Aluminium alloy 6061	84.595	8.0165
			Magnesium alloy	83.563	9.047
			G-Cast iron	65.298	27.312

The table shows higher natural frequency for optimized magnesium alloy and Grey cast iron. In practical terms, Mg alloy exhibits better damping characteristics than cast iron. So, Mg alloy will be preferred

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VIII.CONCLUSION:

The design has been successfully optimized and modified from its preliminary stage. The addition of the rib helped in reducing the maximum deformation. The von-mises stress increased from 66.8Mpa to 69Mpa. The weight of the final design was 352 grams compared to the previous 403 grams. The weight is reduced by the 12.6% is higher than aluminium alloy. The bracket successfully damps then engine vibrations in the vibration analysis method.so, the magnesium alloy is better than other materials.

IX.REFERENCES:

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