Design and Analysis of Mounting Bracket for Aero Space VEHIVLES

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ABSTRACT : *In Aerospace industries, while designing the components the most critical aspect that is to be considered is the compactness and the weight of the components. According to the Newton's second law, the energy required for the vehicle depends on the mass of flight.. Since it is very much needed to reduce the weight and therefore it is designed and optimized for minimum weight without sacrificing the function. The most common material is Aluminum alloy- 6061 as it has high strength to weight ratio. Aluminum alloy-6061 has high strength and light compared to Graphite Epoxy Composite. The most important factors that are concentrated are stress distribution and deflections*.

Keywords: *Design parameters, Different types of Brackets, FEM*

INTRODUCTION

Brackets are meant for carrying loads, support structures, bearing that supports the shafts. Mounting Brackets are used in various fields such as Aerospace Industries, applications, etc.

In the present work we deal with the Mounting brackets used in Aerospace industries, which are used to carry loads of Batteries, Electronic Goods ,etc. As Minimum weight is the critical factor in Aerospace Industries we have optimized the weight of the Bracket by reducing the volume of the Bracket by giving number of cutouts and by changing materials of the Bracket such as Al Alloy and Graphite Epoxy Composite.

These Mounting Brackets are found in large number in Aerospace vehicles, as we are able to reduce the weight of a single Mounting Bracket, hence we can reduce the weight to a large extent in the Vehicle, which is the key factor in Aerospace Vehicles.

The Present work has been undertaken to Design and analysis of the Mounting Bracket to reduce the weight to a large extent by maintaining High Factor of Safety.

1. Different Types of Brackets

1.1 Wall Brackets

Wall brackets are of those fixed to wall for the purpose of supporting bearing, which may either be cast with the brackets.

1.2 Pillar Brackets:

It is used to support a horizontal shaft from a pillar where there is no wall in the way of wheels or pulleys on the shaft.

1.3 Mounting Brackets:

A bracket used to the back of cabinet if the slides can't be mounted to the slide of cabinet .when you have frame cabinets instead of frameless. These are mainly used in aerospace and automobile industries. For supporting the structures such as electronic

goods like batteries sensors in automobile for fixing the body to the chassis and for fixing the auxiliaries

The shapes of the mounting brackets according to the application; they may be hanging type or supporting type. In dimensionality, these mounting brackets are differed according to the weight. Most of the brackets are made up of cast iron in automobile industry as the load carrying capacity is more and good in compression and absorbs the disturbances in travelling

1.4Drive bay Mounting Bracket:

These are mainly used in aerospace and automobile industries. For supporting the structures such as electronic goods like batteries sensors in automobile for fixing the body to the chassis and for fixing the axiliaries

The shapes of the mounting brackets are different and are particularly varied according to the application; they may be hanging type or supporting type. In dimensionality, these mounting brackets are differed according to the weight i.e. to be carried or of the size object to be carried.

The material selections for the bracket are also depending on the application point of view. Most of the brackets are made up of cast iron in automobile industry as the load carrying capacity is more and good in compression and absorbs the disturbances in travelling. In aerospace industry these are made up of aluminum as the weight is considered as critical factor and at the same time the strength to weight ratio is needed to be more.

The criterion for design of the mounting bracket it depends on the loading also. If any eccentric loading acts on the brackets the design criteria based on the shear and flexural moment. If the loads act transverse, the design is based on shear and bending stress. These mounting brackets are fixed to the structure bolts are pins.

Fig : Automobile Mounting Bracket

IDENTIFICAION OF PROBLEM

In any design problem, output of the design depends on the input given i.e., the design parameters, which affects the design adversely and some of the definitions are to be mentioned clearly. Some of the general inputs are mentioned

- What is the importance of the part?
- What are the design parameters?
- What are the loads that are acting on the designed component?

The unambiguous definition of the problem makes the designers work easy. Probably the most critical step in the design process is the definition of the problem. The true problem is not always what is seems to be at first glance because this first step requires such a small part of the total time to create the final design, its important is often overlooked. This project deals with the optimize of the mounting brackets, which are mostly used in many areas like aerospace, automotive etc.

The mounting bracket, which is optimized and analyzed, is being used in aerospace launching vehicles, for mounting batteries of different weights and size. The problem is to optimize the minimum weight, as the aerospace vehicle is needed to design for minimum weight. In the launching vehicles mounting brackets are mostly used for supporting parts and structures.

Some of the inputs of mounting brackets are

The dimensions of battery i.e. to be mounted on the brackets are:

Length of battery = 350mm

Width of battery = 280mm

Height of the battery = 100mm

Weight of the battery = 20kg

The initial dimensions of the mounting bracket at first step are:

Length of bracket = 400mm

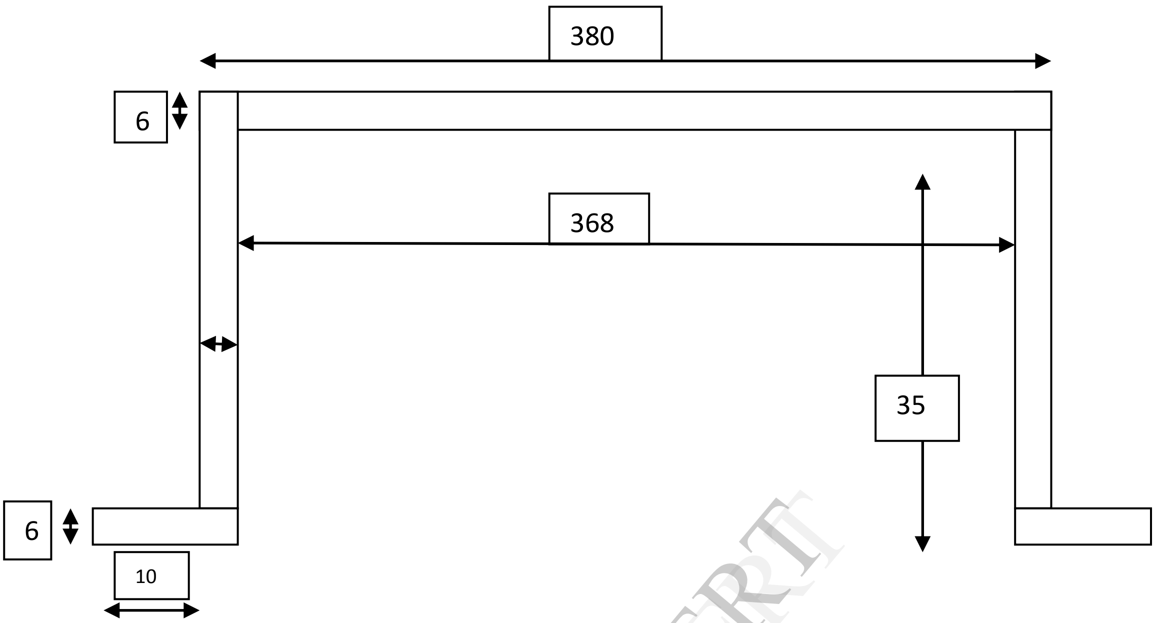
Width of the bracket = 300mm

Initial thickness = 6mm (based on shear and bending stress)

Loading conditions:

The static load of the battery = 20kg

Accelerated load = $20 * 9.81\ \text{mm}/_{sec^2}$



All dimensions in mm.

Fig: Model of Mounting Bracket

Taking the above bracket is consider 5 sections.that is having 20 cylinder volumes subtracted.

That's in 1^{st} volume = 5^{th} volume; 2^{nd} volume = 4^{th} volume; &3^{rd} volume.

Density = mass/volume ⇨ Mass=density*volume

Weight of bracket without cut:

Volume of bracket without cuts= [1^{st} &2^{nd} & 3^{rd} &4^{th} &5^{th} volumes]-[20 cylinder volumes]

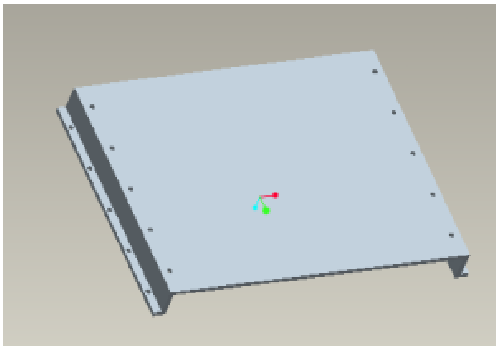
Cube volume =l*b*h; cylinder volume= π *r2 *h;

Volume of Bracket without cuts = [(l1*b1*h1)+(l2*b2*h2)+ (l3*b3*h3)+(l4*b4*h4)+(l5*b5*h5)]-[20* π *r2 *h]

⇨ [(.01*.3*.006)+(.006*.3*.035)+(.38*.3*.006)+(.006*.3*.035)+(.01*.3*.006)]-[20*π*.003*0.003*.006]

⇨ [.000018+.000063+.000684+.000063+.000018]-[.00000339428]

⇨ .00084260582 m3



Mass of bracket for aluminium material= density*volume

=2800*.00084260582

=2.35929 kg

Mass of bracket for graphite epoxy material=density *volume

=1600*.00084260582

=1.34816915 kg

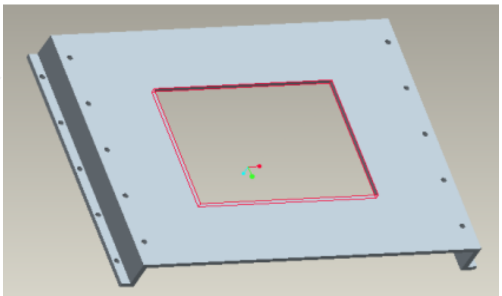
Weight of bracket with single cut:

Volume of bracket with single cut= volume of bracket without cuts –single cut of volume

=.00084260582-(.2*.15*.006)

=00084260582-.00018

= .00066260582 m3



Mass of bracket for aluminum material= density*volume

= 2800*.00066260582

=1.8552960 kg

Mass of bracket for graphite epoxy material=density *volume

=1600*.00066260582

=1.06016915 kg

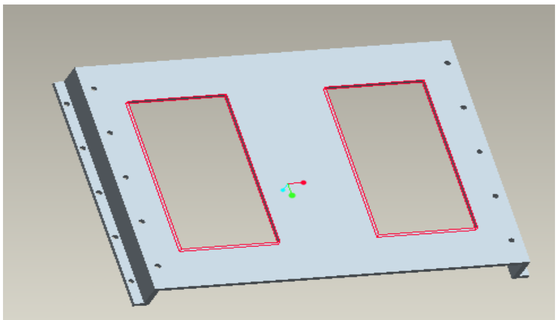
Weight of bracket with double cuts:

Volume of bracket with double cut=volume of bracket without cuts-double cut of volume

=.00084260582-(2*.2*.1*.006)

=.00084260582-.00024

=.00060260582m3



Mass of bracket for aluminum material= density*volume

=2800*.00060260582

=1.6882960 kg

Mass of bracket for graphite epoxy material=density *volume

=1600*.00060260582

=.96416915 kg

Weight of bracket with four cuts:

Volume of bracket with four cuts= volume of bracket without cuts-four cuts of volume

=.00084260582-(4*.11*.085*.006)

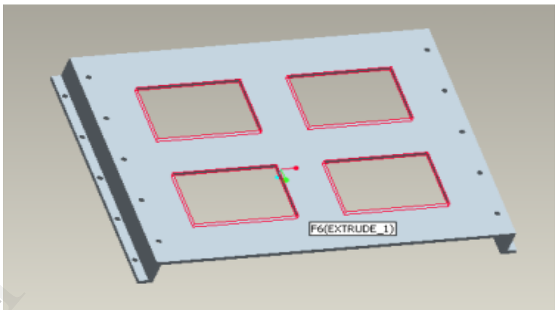
=.00084260582-.000198

=.00064460582 m3

Mass of bracket for aluminium material= density*volume

=2800*.00064460582

=1.8048960 kg



Mass of bracket for graphite epoxy material=density *volume

=1600*.00064460582

=1.03136915 kg

2. Introduction to Finite Element Analysis

Engineers today face increasing difficult challenges to contend in rapidly changing global market-to-market products in better quality at lowest cost possible, so that product have good market in competition. To achieve these goals, one of the powerful tools available for the designer is computer aided finite element analysis.

Finite element analysis is a powerful numerical technique for analysis. FEA is used for stress analysis in that area of solid mechanics. The basic concept of finite element method is that a body/structure may be divided in to smaller elements called finite elements. The properties of the elements are formulated and combined to obtain the solution for the entire body/structure. For a given practical design problem, the engineers has to idealize the physical system into a FE model with proper boundary conditions and loads that are acting on the system. Then the descritiztion of a body or structure into cells of finite elements is performed and the mathematical model is analyzed for every elements and the for complete structure. The various unknown parameters are computed by using known parameters

material	**Cut outs**	**Uy in meters**	**Uz in meters**	**SUM in meters**	**Von Mises Stresses in MPa**
AL	0	0.0000043496	0.0000022832	0.0000066328	3.22048
	1	0.0000001188	0.00000028348	0.00000039128	1.89818
	2	0.000059882	0.00000045253	0.00000603245	2.04412
	4	0.00000081549	0.000042928	0.00000438439	1.85898
GEC	Cut outs	Uy in meters	Uz in meters	SUM in meters	Von Mises Stresses in MPa
	0	.000022980	.0093882	.00941118	2.16238
	1	.0000086066	.00022368	.00023228	1.82040
	2	.0000029161	.00020896	.000210886	2.05842
	4	.000031154	.0029404	.002981554	1.88380

Table:Results summary of various outputs stresses

3.1 DEFORMED SHAPE AND VON MISES STRESSES OF MOUNTING BRACKET BY USING AL ALLOY-6061

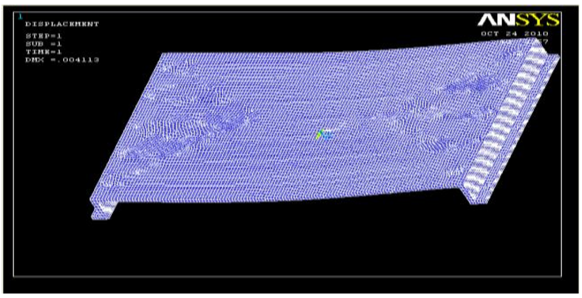


Fig:3.1.a Deformed shape of mounting bracket with out cuts(6mm)

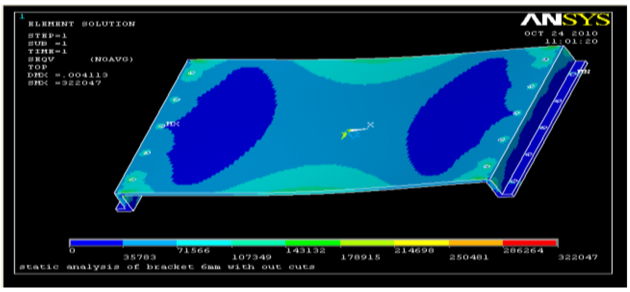


Fig:3.1.b Von mises stresses of mounting bracket with out cuts(6mm)

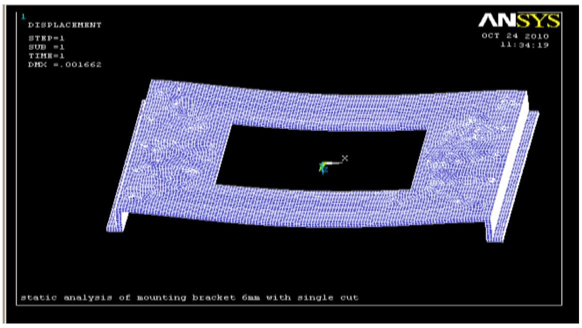


Fig:3.1.c Deformed shape of mounting bracket with single cut(6mm)

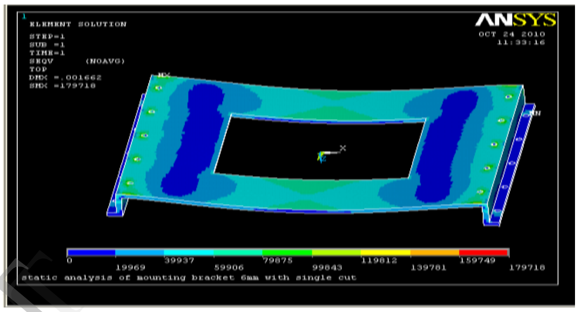


Fig:3.1.d Von mises stresses of mounting bracket with single cut(6mm)

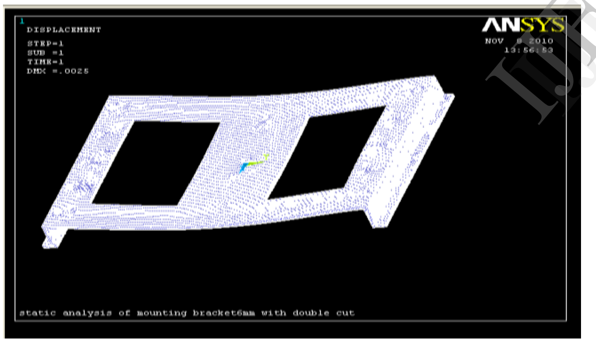


Fig:3.1.e Deformed shape of mounting bracket with double cut (6mm)

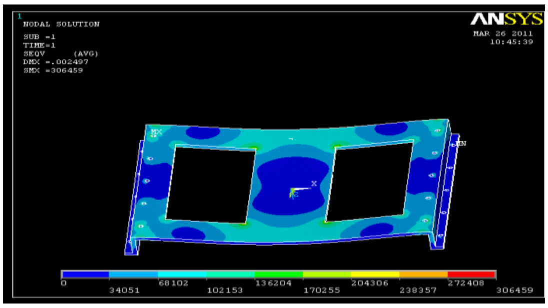


Fig:3.1.f Von mises stresses of m,ounting bracket with double cut (6mm)

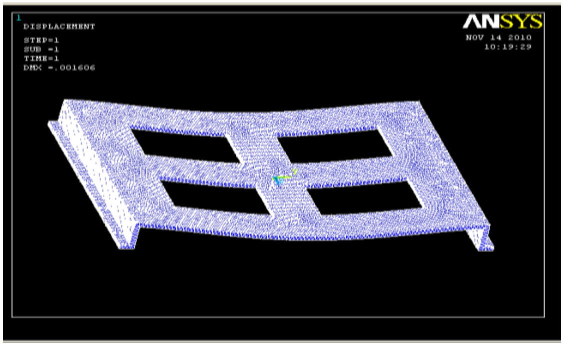


Fig:3.1.g Deformed shape of mounting bracket with four cut (6mm)

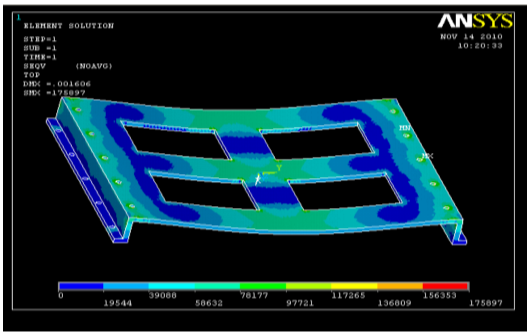


Fig:3.1.h Von mises stresses of mounting bracket with four cut (6mm)

DEFORMED SHAPE AND VON MISES STRESSES OF MOUNTING BRACKET BY USING GRAPHITE EPOXY COMPOSITE

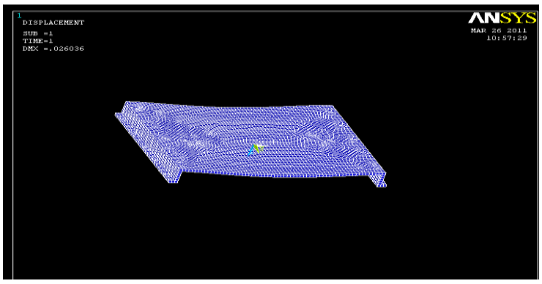


Fig:3.1.i Deformed shape of mounting bracket with out cuts(6mm)

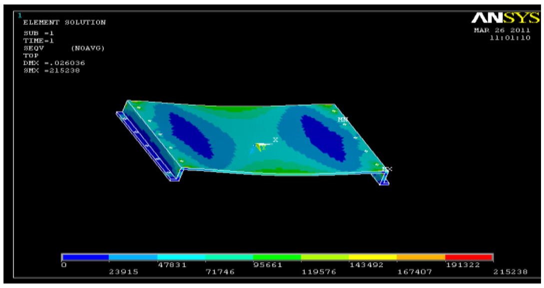


Fig:3.1.j Vonmises stresses of mounting bracket with out cuts(6mm)

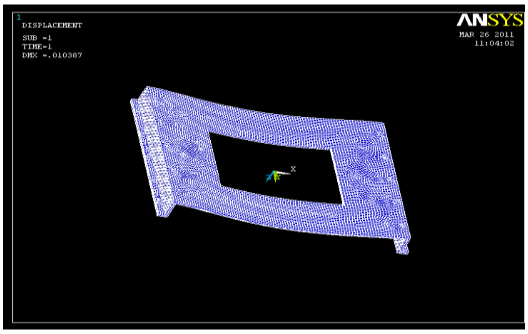


Fig:3.1.k Deformed shape of mounting bracket with single cut(6mm)

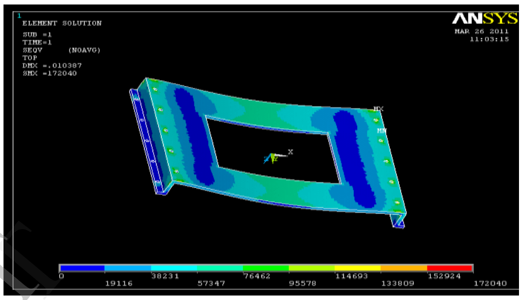


Fig:3.1.l Vonmises stresses of mounting bracket with single cut(6mm)

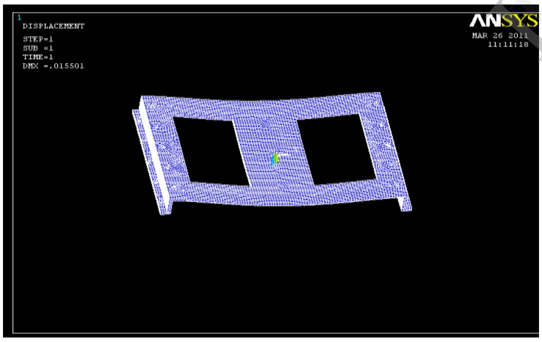


Fig:3.1.m Deformed shape of mounting bracket with double cut (6mm)

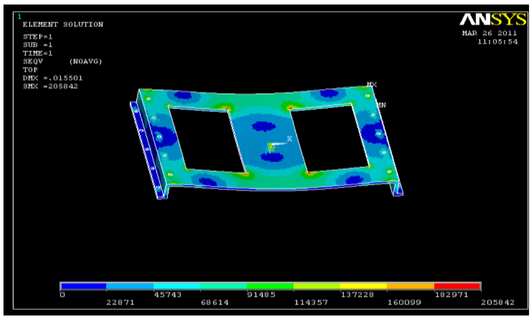


Fig:3.1.n Vonmises stresses of mounting bracket with double cut (6mm)

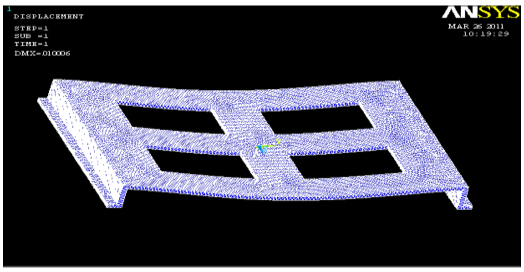


Fig:3.1.o Deformed shape of mounting bracket with four cut (6mm)

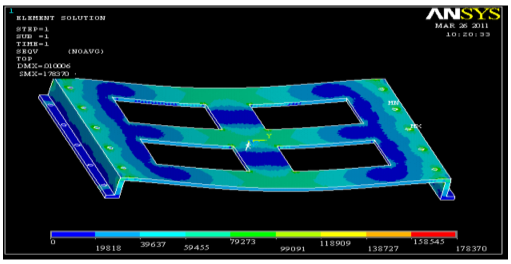
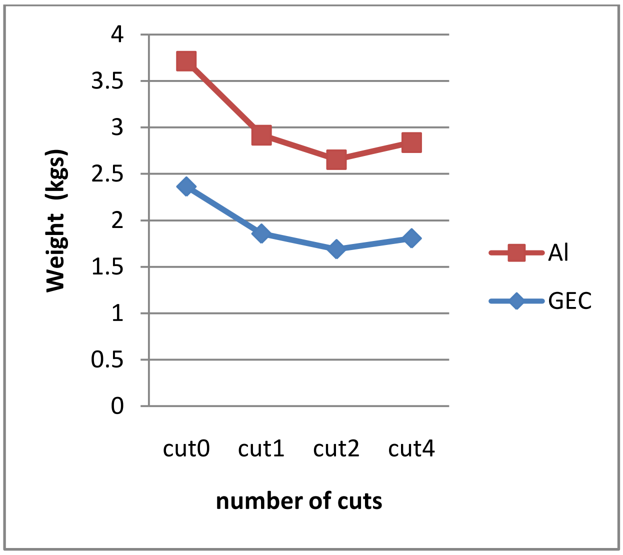
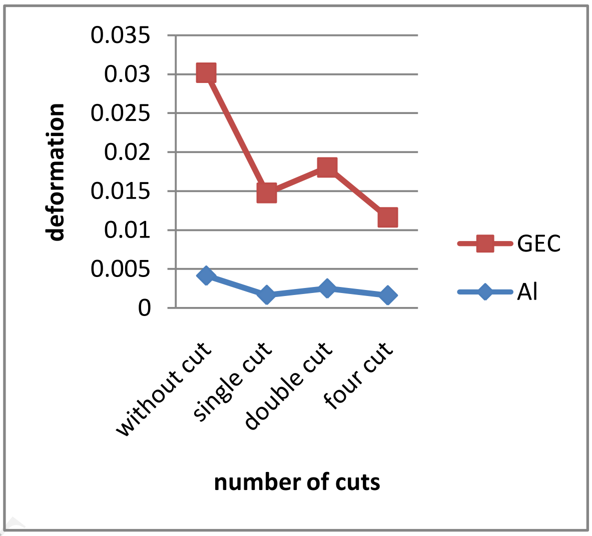


Fig:3.1.p Von mises stresses of mounting bracket with four cut (6mm)

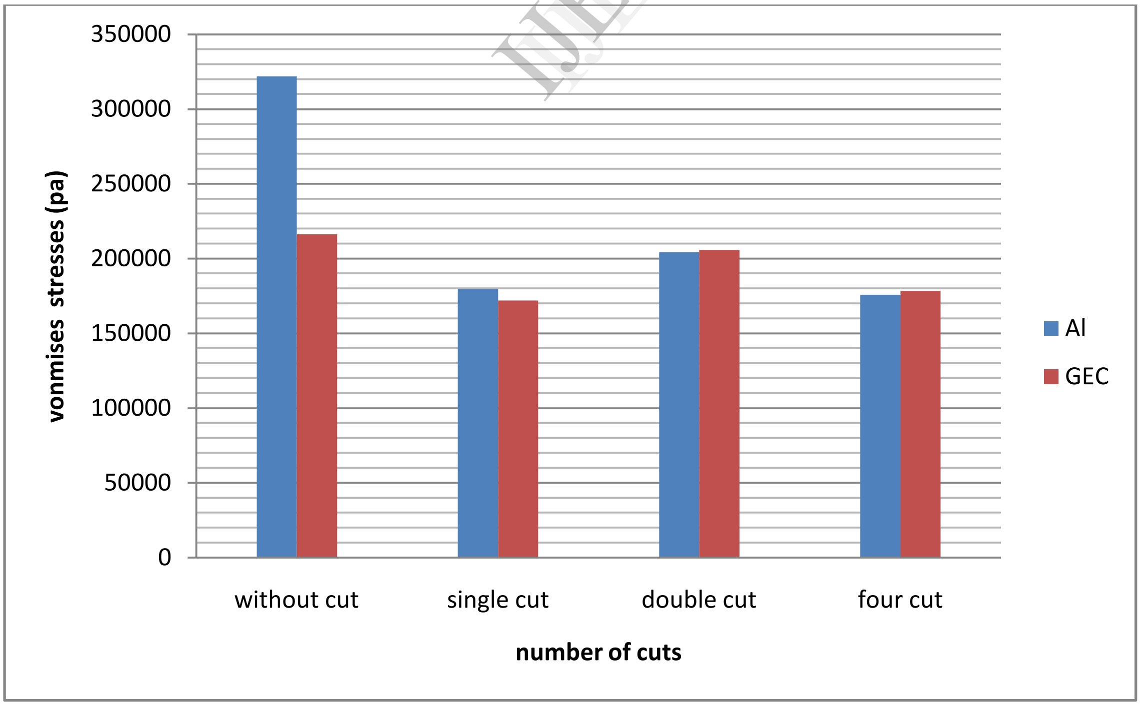
3.2 Graphs Representing Various Outputs





Graph 3.2.a: compare b/w weights of Al alloy-6061& GEC

Graph 3.2.b: compare b/w deformations of Al alloy-6061 & GEC



Graph 3.2.c: compare b/w vonmises stresses of Al alloy-6061& GEC

CONCLUSIONS

The conclusions that are drawn from the present work are

- Comparing the mass of 6mm mounting bracket, 6mm without cuts is weighing 2.362kg By reducing the thickness of bracket to 6mm double cut is weighs to 1.688 kg, the percentage reduction of weight is 28.5% as compared to without cut to double cut bracket.

- For the mounting bracket Deflections are coming far less that 1mm.The stresses induced are coming well below the Allowable stresses maintaining High factor of safety.

- As all the results i.e. Deflections and Stresses are within range. 6mm with double cut Al alloy mounting bracket is considered as Optimum size for minimum weight (1.688kg) consideration.

- Mass of 6mm double cut Composite bracket is weighing about 0.966kg, which is very less compared to 6mm without cut (1.34kg).

Mass of 6mm thick Graphite Epoxy Composite bracket with 6mm 2 cuts is 0.966kg which is about 42.5% less than the 6mm 2 cuts Al alloy bracket

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