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Analytical Approach toward Design Optimization and Development of an Engine Mount for a Go-Kart Vehicle

Anurag Upadhyay[1], Pulkit Sagar[2] and Brajesh Tripathi[3]

[1,2,3]Gautam Buddha University
E-mail: [1]anuragme013@gmail.com, [2]pulkit.sagar96@gmail.com, [3]brajesh28@gmail.com

Abstract—*The work focuses on the designing of mount system for 109.2cc engine powered go-kart and optimizing it through variable dimensional changing and optimization of design in the compact form after performing through static structural finite element analysis. The results ofvon-misses stress and deformation are obtained through FEA which leads to development to the component of higher strength and comparable lesser weight. The rectangular tubes are implemented to fabricate the mount bracket and chassis of is developed with circular pipes of MS 1020 DOM.*

Keywords*: CAD, Engine Mount, Go-kart, FEA, Otimization.*

1. INTRODUCTION

The automobile components are subjected to be having lesser weights and higher strength. Engine mount system is implemented to support the engine and power train components and to prevent it from the undesired, non-directional motion as well as to segregate the chassis from the noise, vibration and enhancing the ride comfort[1]. The engine mount is attached to the frame through either welding or fasteners. A good engine mount is not only mechanically stronger but it also should physically simpler thus making less material utilization and less machine operations are required to develop the mount which in turn corresponds to be economical feasible.

Fig. 1: Final Go-kart Model.

The go-kart is developed for the National Go-Kart Competition-2014 organized by Indian Society of New Era Engineers (ISNEE). In this competition the student from different college's forms team of then participate to design and fabricate their go-kart. The competition limits the teams to use engine of maximum capacity of 125cc. The team developed the go-kart getting power from 109.2 cc Honda active 4 stroke, single cylinder, air cooled engine. The vehicle overall length and breadth are 1803.4mm and 1163.4mm respectively. The vehicle takes turn in the radius of 2.1m. The Engine is capable of providing the best speed of 64.5Km/hr[2].

2. DESIGN

The Design for the mount system is taken to be readily simpler and the position of mount system is chosen where assembly and disassembly of engine can be taken simply. "Fig. 1. Sample Design of Engine Mount System and Design of Chassis of Vehicle" shows the approach of design of mount system this design is analyzed under FEA by changing the thickness of both the mounts. The center to center distance between the base frame members/Engine Mounts are 233.1mm. Height of each mount system taken from the base frame is 180mm. The length of the wall that contained hole and length of wall that does not contain hole for each mount system are 27.5mm and 42mm respectively. Thickness 1 corresponds to the thickness of holed wall whereas thickness 2 corresponds to the thickness of the non-holed wall.

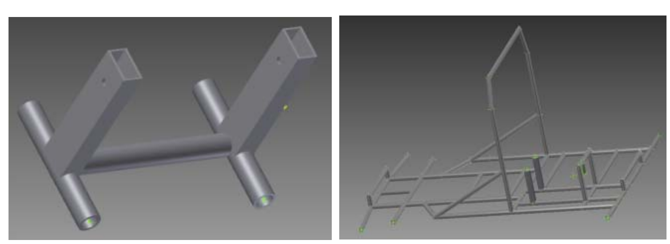

Fig. 2: Sample design of engine mount system and design of chassis of vehicle.

Thickness 1 and thickness 2 are made to change so to obtain best and efficient mount system. The CAD models for mount system and frame are prepared in Autodesk Inventor Professional 2014.

Fig. 3: Final frame model with engine mount

3. MATERIAL

The main elemental phase of designing any part is selecting the best material. The material selection is not limited to those material having greater strength, the material must also be having lesser weight, having good weld ability, welding properties with other materials, cannot corrode easily, can sustain impact forces, can sustain under changing of cyclic as well as non-cyclic loads, the non-mechanical properties are also taken in consideration like material cost and ease of availability[3]. So considering these parameters there are allot of investigations takes place. After the investigations through market survey and internet the material MS 1020 DOM is chosen. The properties of MS 1020 DOM are shown in "Table 2. Material Properties MS 1020 DOM".

Table 1: Material properties of MS 1020 DOM

Parameters	Values
Density	7.87g/cc
Tensile Strength, Ultimate	551.58 Mpa
Tensile Strength, Yield	482.63 Mpa
Rockwell Hardness	B80
Poisons Ratio	0.29
Carbon Percentage	0.2073%
Iron Percentage	98.83%

4. FINITE ELEMENT ANALYSIS

The static structural finite element analysis is performed in Ansys release workbench 14.5. The FEA is performed for each mount system. This test provides us the results to choose the best optimized mount system. During test the force is applied on the holed part of mount where engine assembles. This point is assumed under maximum loading condition.The force applied is 1000 N for a time period of 1sec. The Lower part of the mount attached to frame is made to be as fixed support.

4.1 Results

Stimulation 1: First specimen analysis.

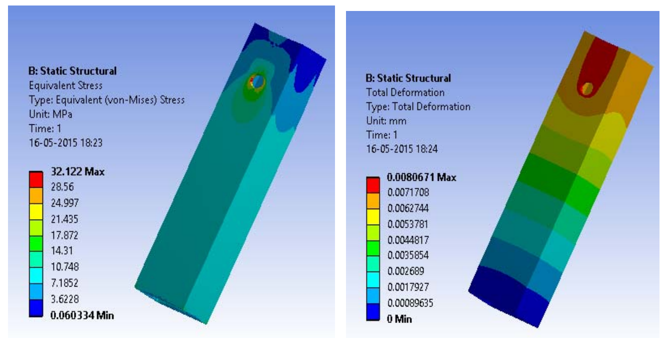

Fig. 4: Von-misses stress and deformation results offirstspecimen.

Table 2: Specimen first data values.

Parameter	Value
Thickness 1	2mm
Thickness 2	1mm
Nodes	41026
Elements	20260
Stress	32.122 MPa
Deformation	8.06X10-3
Mass	0.30157 Kg
Total Mass	0.60314 Kg

Stimulation 2: Second specimen analysis.

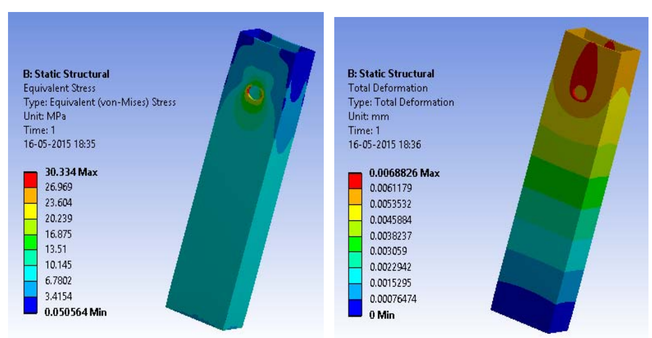

Fig. 5: Von-misses stress and deformation result of second specimen

Table 3: Specimen second data values

Parameter	Value
Thickness 1	2mm
Thickness 2	2mm
Nodes	40938
Elements	20317
Stress	30.334 Mpa

Deformation	6.88X10-3mm
Mass	0.36798Kg
Total Mass	0.73596 Kg

Stimulation 3: Third specimen analysis.

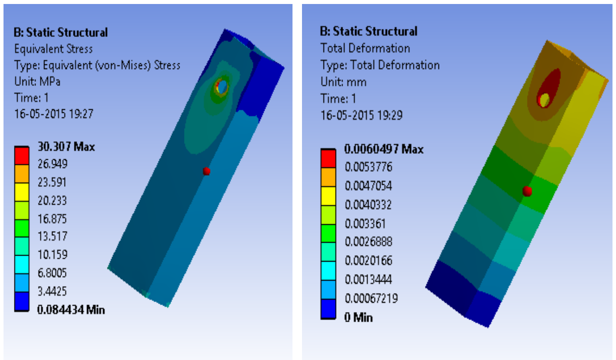

Fig. 6: Von-misses stress and deformation results of third specimen.

Table 4: Specimen third data values.

Parameter	Value
Thickness 1	2mm
Thickness 2	3mm
Nodes	41811
Elements	21193
Stress	30.307 MPa
Deformation	6.049X10-3 mm
Mass	0.43439Kg
Total Mass	0.86878 Kg

Stimulation 4: Fourth specimen analysis.

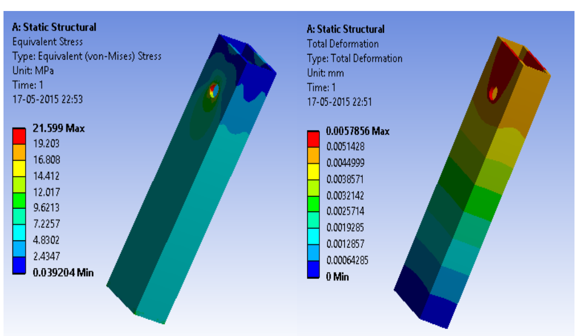

Fig. 7: Von-misses stress and deformation results of fourth specimen

Table 5: Specimen fourth data values

Parameter	Value
Thickness 1	3mm
Thickness 2	1mm
Nodes	45925
Elements	23803
Stress	21.599 MPa
Deformation	5.785X10-3mm
Mass	0.4135Kg
Total Mass	0.8270 Kg

Stimulation 5: Fifth specimen analysis.

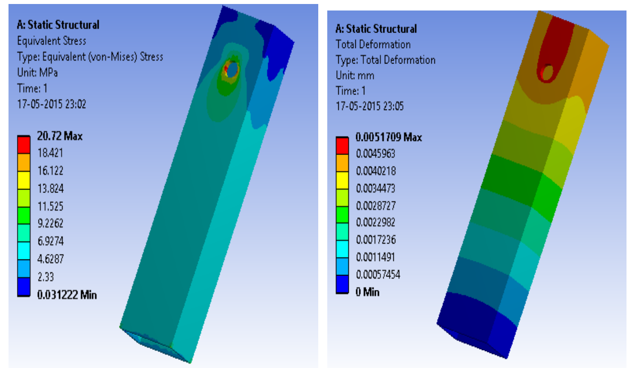

Fig. 8: Von-missesstress and deformation results of fifth Specimen.

Table 6: Specimen fifth data values

Parameter	Value
Thickness 1	3mm
Thickness 2	2mm
Nodes	45193
Elements	23467
Stress	20.72 MPa
Deformation	5.1709X10-3 mm
Mass	0.47426Kg
Total Mass	0.94052 Kg

Stimulation 6: Sixth specimen analysis.

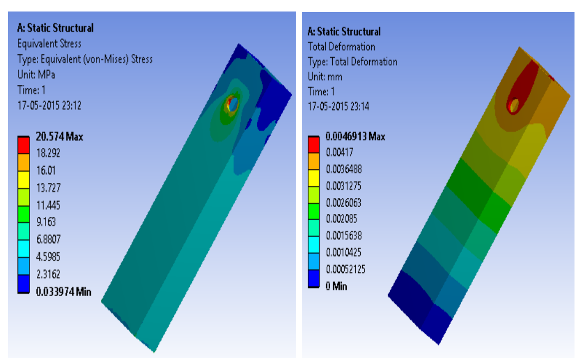

Fig. 9: Von-misses stress and deformation results of sixth specimen

Table 7 Specimen sixth data values

Parameter	Value
Thickness 1	3mm
Thickness 2	3mm
Nodes	46870

Elements	25020
Stress	20.574MPa
Deformation	4.691X10-3 mm
Mass	0.53501Kg
Total Mass	1.07002 Kg

Stimulation 7: Seventh Specimen analysis.

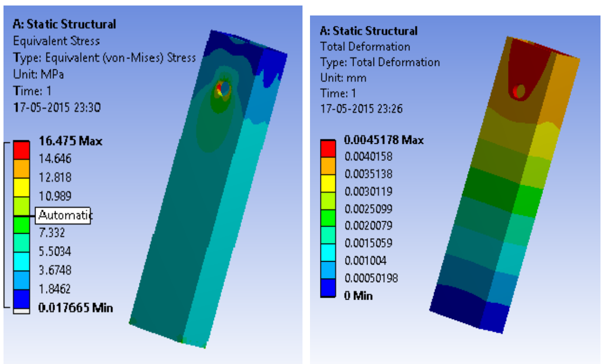

Fig. 10: Von-misses and deformation results of seventh specimen.

Table 8: Specimen seventhdata values

Parameter	Value
Thickness 1	4mm
Thickness 2	1mm
Nodes	52689
Elements	29057
Stress	16.475 MPa
Deformation	4.517X10-3 mm
Weight	0.52542 Kg
Total Weight	1.05084 Kg

Stimulation 8: Eight specimen analysis.

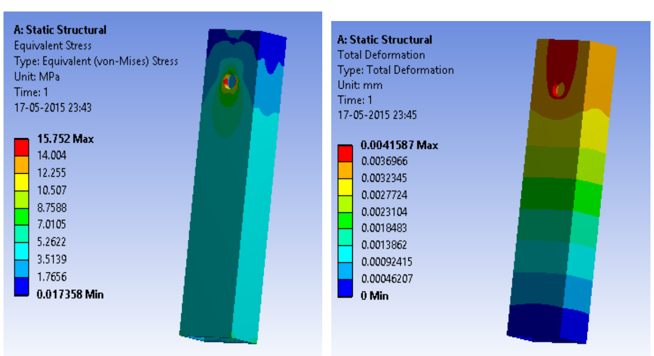

Fig. 11: Von-missesstress and deformation results of eight specimen.

Table 9: Specimen eightdata values.

Parameter	Value
Thickness 1	4mm
Thickness 2	2mm
Nodes	51590

Elements	28444
Stress	15.752 MPa
Deformation	4.157 X10-3 mm
Mass	0.58053Kg
Total Mass	1.16106 Kg

Stimulation 9: Ninth Specimen analysis.

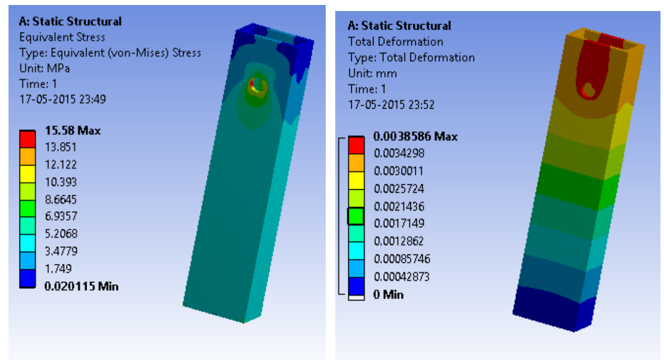

Fig. 12: Von-misses stress and deformation results ofninthspecimen.

Table 10: Specimen Ninthdata values.

Parameter	Value
Thickness 1	4mm
Thickness 2	3mm
Nodes	53944
Elements	30316
Stress	15.58 MPa
Deformation	3.8586 X 10-3 mm
Weight	0.63564Kg
Total Weight	1.27128 Kg

Stimulation 10: Tenth specimen analysis.

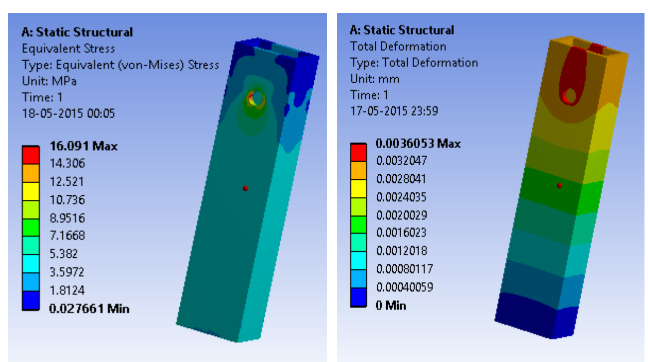

Fig. 13: Von-misses and deformation results of tenth specimen.

Table 11: Specimen tenthdata values

Parameter	Value
Thickness 1	4mm
Thickness 2	4mm

Nodes	57356
Elements	32961
Stress	16.091 MPa
Deformation	3.605X10-3 mm
Mass	0.69074Kg
Total Mass	1.38148 Kg

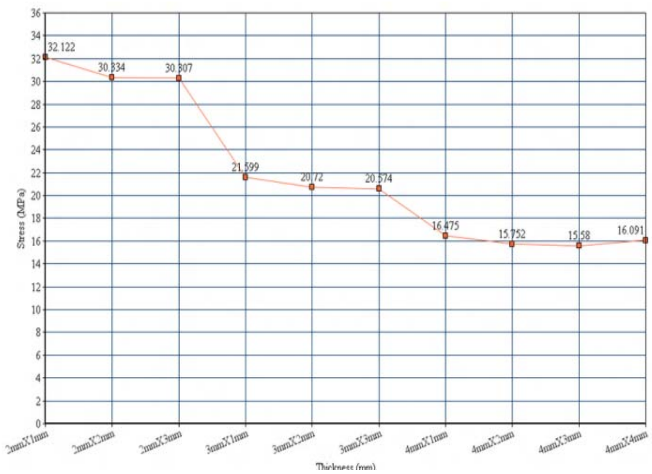

Fig. 14: Stress v/s thicknessgraph for each specimen.

5. CONCLUSION

The Finite Element analysis performed in the software provides us the different values of stress and deformation generated. So by keeping in consideration the value of Factor of safety, minimized stress and minimum deformation the final design is selected. From the "Fig. 12 Stress v/s thicknessgraph for each specimen." it can be easily seen that the stress value slightly decreases with increase in the thickness 2 i.e. thickness of the non-holed wall but it decreases tremendously on increasing the thickness 1 which is the thickness of holed wall. The value decrease is linearly for each specimen and the lowest value is obtained from the specimen ninth so final opted design is specimen ninth.

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