International **J**ournal of **M**anagement, **M**odern **S**ciences and **T**echnologies
ISSN: 2305-199X || WWW.IJMMST.ORG
Open-Access || pp-26-29

Static and Modal Analysis of AC mounting bracket used in Cars for Weight Optimization

Mrs. Atole Minakshi B., Mr. Shrivastav Vishal M.
[1](Mechanical Engineering, Dattakala Group of Institution Swami Chincholi Bhigwan ,india)

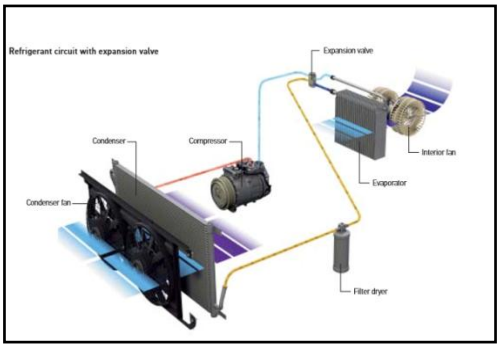
Abstract : *The air conditioners used in cars are mounted on a bracket in the bonnet. This project intends to analyze the bracket and optimize the weight by replacing the material of the bracket by composite material. Weight reduction will increase the efficiency, though very minute. To design a composite bracket for AC mounting in a car. To analyze the designed AC mounting bracket of car. To reduce the weight of the bracket by replacing the conventional material by conventional material.*

Keyword**:** *compressor, condenser, Evaporator, AC bracket.*

INTRODUCTION

Consider air conditioning and cooling as unit. Although the air conditioning system and the engine cooling system are two separate systems, they influence one another. Air conditioning system operation places additional load onto the engine cooling system and the coolant temperature rises.The additives contained in the coolant do not only protect against frost, but also against engine overheating. The proper coolant composition increases the boiling point of the medium to above 120 °C. An enormous performance reserve is particularly important in the summer, when air conditioning system and cooling system are heavily burdened by ambient temperatures and long trips. The best approach is to check the coolant during air conditioning service as well.

Fig. AC System in car



Types of brackets:

A. Engine Mounting Bracket of Car
B. Aeroplane engine's continental engine mounting Bracket
C. AC compressor mounting bracket

Composite Materials:

A composite material is defined as a material composed of two or more constituents combined on a macroscopic scale by mechanical and chemical bonds.

Glass Fiber:

Glass fiber (or glass fibre) is a material consisting of numerous extremely fine fibers of glass.

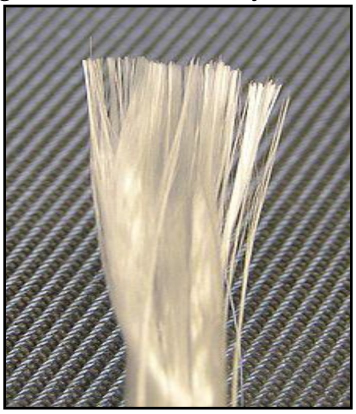


Fig. Glass Fiber

Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. Although not as strong or as rigid as carbon fiber, it is much cheaper and significantly less brittle when used in composites. Glass fibers are therefore used as a reinforcing agent for many polymer products; to form a very strong and relatively lightweight fiber-reinforced polymer (FRP) composite material called glass-reinforced plastic (GRP), also popularly known as "fiberglass". This structural material product contains little or no air or gas, is denser, and is a much poorer thermal insulator than is glass wool.

ISSN: 2305-199X || WWW.IJMMST.ORG

THEORETICAL DESIGN

Calculation of thickness for Steel Bracket:

Compressor will be installed on the bracket with the help of bolts, which allows us to change the width of the bracket which can be less or more than the width of the compressor. Bolts and base of the compressor may have shape which will help us bolting the compressor to the plate.

This leads to shape of side closed L bracket, Dimension of the bracket will be 450 mm in length and W mm in width which is variable in the design table. All the formulae below are submitted in the design table and best suited width of 100 mm is selected from that design table. Stress calculations for the 100 mm width SS 403 steel plate bracket design is given below.

F(N)	L(mm)	W(mm)	Mt(N-mm)	FOS	Yield Strength	E	Density (kg/m^3)	Allowable Stress	t	Volume	Weight (kg)
512.08	450.00	100.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	4.74	521562.99	4.17
512.08	450.00	125.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	4.24	609630.84	4.88
512.08	450.00	150.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	3.87	696852.65	5.57
512.08	500.00	200.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	3.35	938765.48	7.51
512.08	450.00	225.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	3.16	960150.05	7.68
512.08	450.00	250.00	38406.15	2.00	205.00	193000	8.00E-06	102.50	3.00	1049571.72	8.40

Following stress needs to be checked Shear Stress.

Direct and Bending Stress

Let us consider 17.4kg weight on the bracket.
Material for manufacturing of bracket is selected as steel.
Forces acting on the component installed on automobile are as follows
3g loading in all three directions independently acting on the component when applied on the compressor.
Area of the plate under compressor is 450mm by 100mm
So area of plate under the compressor:-

$$A = 450 \times 100 = 45000mm^2$$
$$Load\ acting = 17.4kg \times 3 \times gravetational\ acce$$
$$Load\ acting = 17.4 \times 3 \times 9.81$$
$$Load\ acting\ L = 512.08\ N$$
$$Direct\ Stress = \frac{512.08}{45000}$$
$$\sigma_{direct} = 0.0114\ Mpa$$

So direct stress is negligible.
Design thickness of plate according to shear limit.
Small area under shear is width wise

Which is

$$A_{shear} = W \times t$$
$$A_{shear} = 100 \times t$$

Force = 512.08 N

$$\tau = \frac{F}{A_{shear}}$$
$$\tau = \frac{512.08}{100 \times t}$$
$$\tau_{all} = \frac{5.1208}{t}$$
$$\tau_{all} = \frac{0.5 \times S_{yt}}{FOS}$$

Factor of safety selected as 2

$$\tau_{all} = \frac{0.5 \times 205}{2}$$
$$\tau_{all} = 51.25\ Mpa$$

Hence

$$t = \frac{5.1208}{51.25} = 0.099\ mm$$

38 gauge sheet should be selected which is approx 0.152 mm thick.

ISSN: 2305-199X || WWW.IJMMST.ORG

Also we must check thickness according to bending stress.
Bending forces acting on base plate are on the centre of compressor or acting downwards.
512 N downward causes couple with distance of 50 mm frame support at cross-section B just near the support bending stress will be caused by 512 N as follows

$$M = F \times \frac{W}{2}$$
$$M = 512 \times \frac{100}{2}$$
$$M = 25600\ N.mm$$

According to bending we know that

$$\frac{M}{I} = \frac{\sigma}{Y} = \frac{F}{R}$$

$\sigma$is maximum when Y = max
Where
Y = distance of stress from neutral axis

$$Y = \frac{t}{2}$$
$$I = \frac{bd^3}{12}$$
$$I = \frac{100 \times t^3}{12}$$
$$\sigma_{all} = \frac{M.Y}{I} = \frac{25600 \times 6}{100 \times t^2}$$
$$\sigma_{all} \times t^2 = 1536$$
$$\sigma_{all} = \frac{205}{2} = 102.5\ Mpa$$
$$t^2 = 14.985$$
$$t = 3.87 \text{ mm}$$

Nearest gauge for the mounting is 8
Thickness of the sheet will be 4.176 mm
Weight of the Bracket can be given by the following formulae
Total area of the developed sheet metal will be 2 width and length rectangular areas and 2 end covers with square areas

$$At = 2 \times Al + 2 \times Ab$$
$$At = 2 \times b \times l + 2 \times b \times b$$
$$At = 2 \times 100 \times 450 + 2 \times 100 \times 100$$

$At = 110000\ mm^2$

$$volume = At \times t$$
$$V = 110000 \times 4.176$$
$$V = 459360 mm^3$$
$$weight = V \times \rho$$

Where ρ – Density of SS 403 material which is 8E-06 kg/mm^3

$$weight = 459360 \times 8E - 06$$
$$Weight = 3.675\ kg$$

Linear static analysis:

The finite element analysis (FEA) is a computational technique used to obtain approximate solution of boundary value problems in engineering. Simply stated, a boundary value problem is mathematical problem in which one or more dependent variables must satisfy a differential equation everywhere within a known domain of independent variables and satisfy specific conditions on the boundary of the domain. The static structural analysis of steel AC compressor mounting bracket is done by finite element analysis using ANSYS 16.2 software. The properties of the material used are given in the table below. The analysis is done on a 3d model.

Material Property	Notation	SS 403	Unit
Modulus of Elasticity	E	2.06×10^5	MPa
Poisson Ratio	V	0.3	-
Density	ρ	7850	Kg/m^3
Tensile Strength	Syt	205	MPa

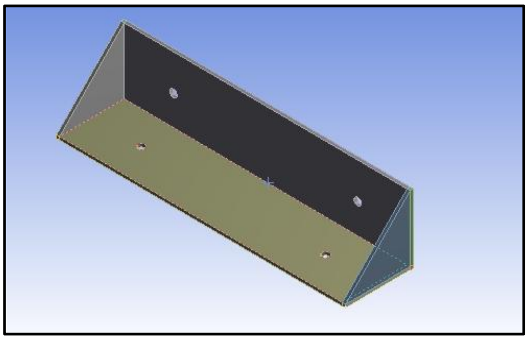


Fig1. Steel AC mounting bracket

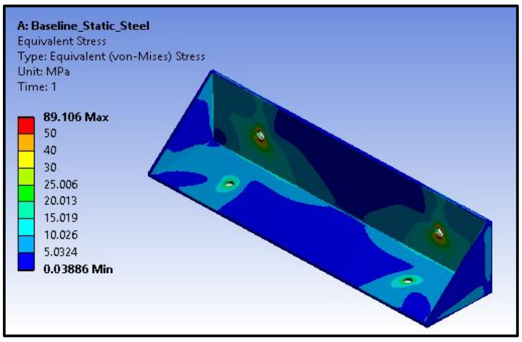


Fig.2 Von Mises Stress plot for Steel AC

CONCLUSION

The composite AC mounting bracket will be modelled and analyzed for weight reduction and the modified bracket will be manufactured and tested. And also reduce the weight of the bracket by replacing the conventional material by conventional material.

REFERENCES

- *R. P. Kumar, Dr. K Rambabu, "Study of Design and Analysis of Air Conditioner Compressor Mounting Bracket". International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438.*
- *HarshalBankar, P. Baskar, "Dynamic Analysis of Air Conditioner Compressor Mounting Bracket". International Engineering Research Journal (IERJ) Special Issue 2 Page 4825-4829, 2015, ISSN 2395-1621.*
- *M. Singh • D. Singh • J. S. Saini, "Dynamic Analysis of Condenser Assembly of Automobile Air Conditioning System Using CAE Tools". J. Inst. Eng. India Ser. C (April–June 2013) 94(2):135–145 DOI 10.1007/s40032-013-0067-z.*
- *Pushpendra Mahajan, Prof. Abhijit L. Dandavate, "Analysis and Optimization of Compressor Mounting Plate of Refrigerator using FEA". Website: www.ijetae.com (ISSN 2250*-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 5, May 2015).

