

## ANALYSIS OF DISC BRAKE

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### ABSTRACT

Brakes are used to stop or slowing down the vehicle by friction. For better performance structural, stress and thermal analysis is preferring to choose a low stress material. Thermal and Structural Analysis of Roto (disc) of Disk Brake is aimed to evaluating the performance of disc brake rotor disc of a vehicle under several braking condition. ANSYS workbench is used for obtain the temperature distribution, variation of the stresses and deformation of entire disc brake rotor disc profile. In this present work, the material of the rotor disc of disc brake is being change instead of cast iron s 2 glass fiber i. e. high strength glass fiber is used to dissipate more heat. 2 glass fiber has good density properties. We found it suitable material for the braking operation fiber and all the values obtained from the analysis are less than their allowable value, and we found it more feasible than cast iron.

**KEYWORDS:** ANSYS, Disc Brake , FEA (Finite Element Analysis), Solid works, Thermal Analysis.

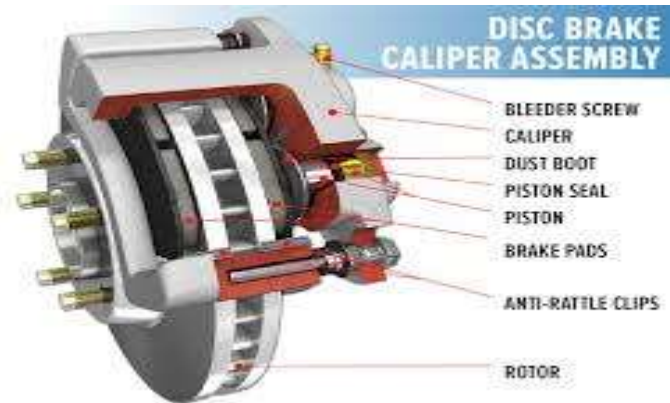
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### I. INTRODUCTION

In today's growing market (in the field of automation) the competition for best performance of vehicles is growing vastly. The racing will definitely know the importance of a good brake system not only in the means of safety purposes but also for staying emulative. It is (brake system) the most important part of a vehicle. Brakes are used to stop or slow the vehicle within the possible distance and is done by transform the kinetic energy into heat energy by friction. The heat is then dissipated into the atmosphere, the brake system must call for the followings:

- (a) The brake should be stronger to stop the vehicle within a min. distance.
- (b) The driver should have good control over the vehicle while applying braking and the vehicle must not skid.
- (c) The brake should have good anti- fade characteristics (their effectiveness must not decrease fade with constant prolonged application) .
- (d) The brakes should have good anti wear properties.

The first important part of a vehicle is Brake system. Brakes are used to stop or slow the vehicles within the possible minimum distance and it happens by transforming kinetic energy of vehicle into heat energy by generation of friction which is next dissipated into environment. The brakes must be stronger to stop the vehicle with-in the least distance. An inspection into usage of new materials is inevitable which can improve braking efficiency and give better stability to vehicle. The suitable material for the rotor disc of disc brake system is S-2 glass fiber.



All the values gained from the analysis are less than their allowable values. Here the rotor disc of disc brake is designed by using Solid works and analysis is performed by ANSYS workbench..

## II. ANSYS

Ansys develops and marketizes engineering simulation software used across the product life cycle. Ansys Mechanical FEA (finite element analysis) software is used to simulate computer-generated models of structures, electronics, or machine components for analyzing strengths, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. Ansys is used to find how a product will function in different specifications, without manufacturing test products or conducting crash tests. For example, Ansys software simulates how a bridge holds up after many years of traffic, how to better process to reduce waste, or how to construct a slide that uses less material without losing safety. Most of the analysis simulations are done by using the Ansys Workbench. It is one of the company's main products. An Ansys user can start the analysis on Ansys Workbench by giving the dimensions of the object, and after that adding weight, pressure, temperature, and other physical properties. Finally, the Ansys software simulates and analyzes movement, fatigue, fractures, fluid flow, temperature distributions, electromagnetic efficiencies, and other effects over time.

Ansys also provides software in terms of data management and backup, research, and teaching. It is (Ansys software) sold on an annual subscription basis.

## III. FEM

The FEM (finite element method) is the broadly used way to solve problems of engineering and mathematical models. Difficult problem areas of interest include the stereotypical fields of structural analysis, heat transfer, fluid flow, mass transportation, and electro-magnetic potential. The FEM (finite element method) is a particular numerical method for solving partial differential equations in two or three space variables (say boundary value problems). To solve a problem, the FEM sub-divides a large system into pieces which become easier to solve; these no. of pieces of large elements are called finite elements. This is achieved by a specific space discretization in the space dimension, which is then applied on the construction of a mesh of the object in the numerical region for the solution, which has a finite number of points. The FEM (finite element method) formulation of a boundary value problem results in a system of algebraic equations. This method approximates the unknown function over the domain. The equations that model these finite elements are then assembled into a larger system of equations that models the whole problem. The finite element method uses variation techniques from the calculus of variations to approximate a solution by minimizing an associated error function.

## IV. S2 GLASS FIBER

Glass-makers throughout history had experimented with glass fibers, but mass production of glass fibers was only made possible by the invention of fine machining tools. Fabrics of woven glass fibers have been used as thermal insulators because of their high ratio of surface area to weight. However, the increased surface area makes

then much recognizable to chemical attack. High-strength glass is generally known as 'S type glass' in the USA, 'R Glass' in Europe and 'T Glass' in Japan. The categories of higher strength fibers are called the S2 glass categories. Glass fiber in general is known to be the 'heavier' fibers within the reinforcement market. It was originally developed for military applications in the 1960s later it is started being use in commercial market. High strength glass fibers are used in applications require greater strength and light in weight. the composition of s 2 glass fiber contains  $Al_2O_3$  - 24.8% ,  $B_2O_3$ - 0.010% ,  $BaO$  - 0.20% ,  $CaO$  - 0.010% ,  $FeO$  - 0.21% ,  $MgO$  - 10.27% ,  $NaO_2$  - 0.27% ,  $SiO_2$  - 64.2% And other 0.030%.

## V. ROTOR DISC OF DISC BRAKE

The rotor of disc brakes are commonly made by grey cast iron. Brake absorbs the kinetic energy of the rotating parts <Wheels> and the energy is then dissipated in the form of heat (heat energy) into the atmosphere. For better performance, structural stress and the thermal analysis low stress materials are preferred. Thermal and Structural Analysis of Rotor disk of Disk Brake is preferred at evaluating the performance of rotor disc of disc brake of vehicle under several braking. The SAE maintain and specify for the manufacturing of grey cast iron for various applications. In this work, an experiment has been made by choosing the suitable hybrid composite materials which is lighter than cast iron and has good Young's modulus, Yield strength and density properties as a rotor disc material of disc brake. The analysis of Disc brakes has been performed and the results were compared. The suitable material for the disc brake rotor is S2 glass fiber and all the values gained from the ansys results are less than their allowable values. The rotor Disc of disc brake design is safe on the basis of strength and rigidity criteria. The analysis of Disc brakes has been performed. ANSYS workbench is applied to the disc brake rotor with frictional heat generation. The present study can provide a useful material of rotor disc of disc brake and improve the brake performance of Disc brake.

### 5.1 Rotor disc modeling

On the basis of specifications the element type chosen is PLANE 77. The element has provided one degree of freedom and temperature on each node. Free meshing is being considered since the 2D figure is not a regular shape. The elements have compatible temperature shapes and are well suited to model curved boundaries.

### 5.2 Meshing

Meshing is nothing but the turning of the object into various number of parts also known as discretization. Meshing of the disc brake rotor has been done on ANSYS, using the tetra-hedral shaped element.

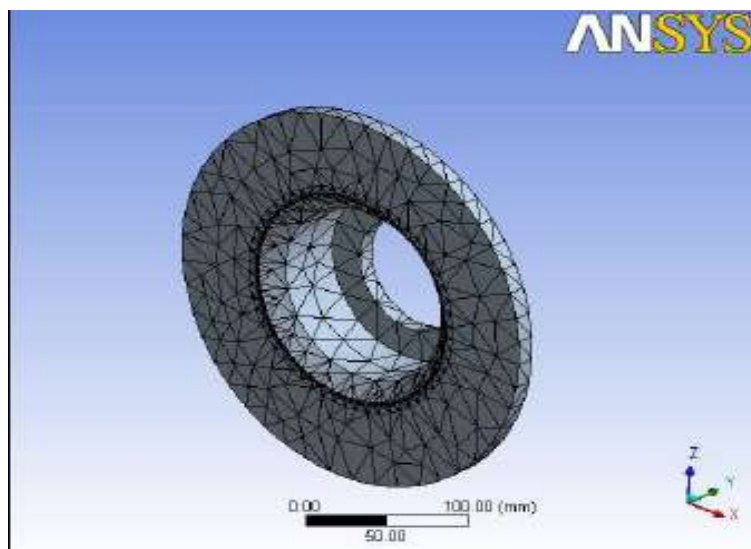
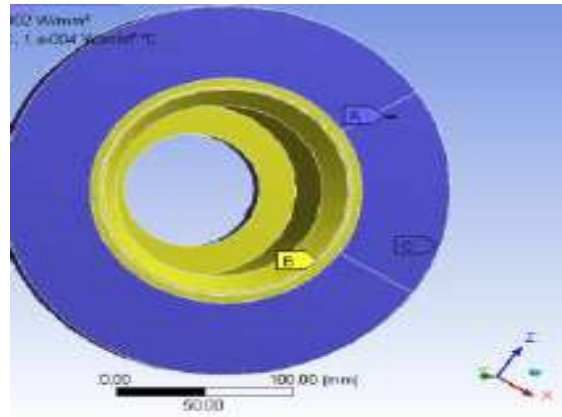


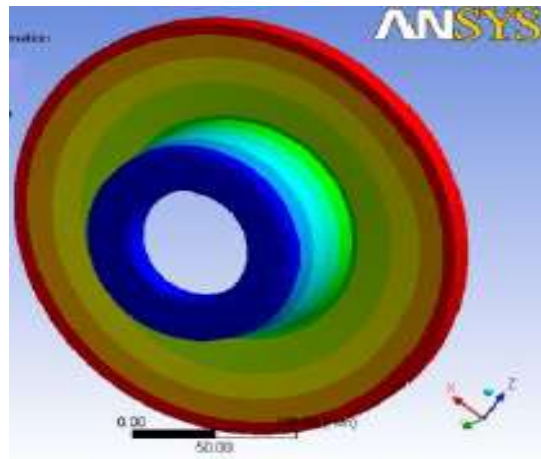
Fig-1: meshing of rotor disc

## VI. RESULT

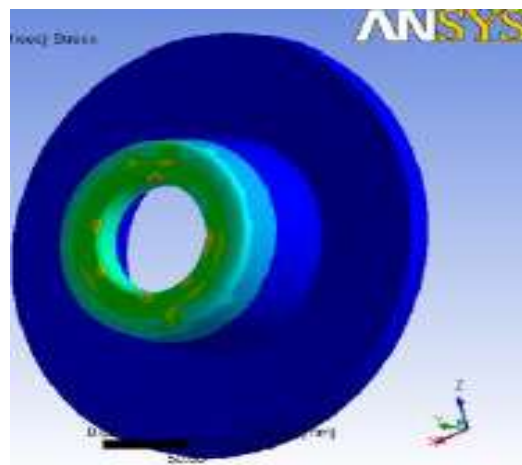
The investigation into using of s 2 glass fiber made disc rotor of disc brake is completed which increases the braking efficiency and providing long durability time of the disc brake and avoid all problems of loading . The most suitable material is s 2 glass fiber (high strength fiber).



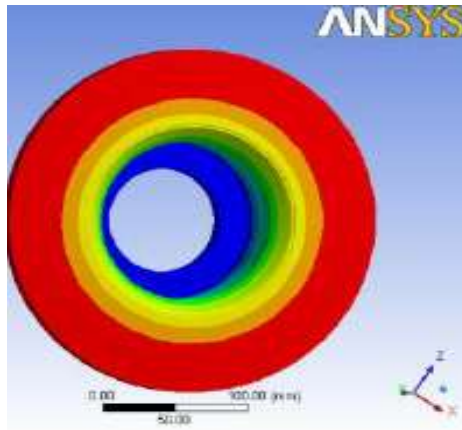
**Fig-2:** Thermal loading variations



**Fig-3:** Total deformation status



**Fig-4:** Equivalent stress status



**Fig-5:** Temperature distribution

Material	Deformation	Von-misses (equivalent) stresses (Mpa)		Temperature (c°)	
		Maximum	Minimum	Maximum	Minimum
Grey cast iron	0.35191	50.330	0.92339	480.74	289.44
S2 glass	0.16097	50.100	0.07900	66.120	11.092

### VII. CONCLUSION

The analysis of Disc brake has been performed after changing the rotor disc material of disc brake in this project s 2 glass fiber has been used. Disc brake rotor disc is madce of it. Ansys workbench is performed on the disc brake rotor and result has been obtained. The effects on the material properties of s 2 glass fiber based on contact ratio of friction surface are examined.

### FUTURE SCOPE

Disc brake provides better brake performance than the other brakes because of uniform and equal pressure distribution by the disc brake calipers during squeezing the rotor disc of disc brake. The present study can provide a useful information about rotor disc material that improve the brake performance of Disc brake.

The thermal analysis is carried out to find the temperature variations stress generation and heat dissipation across the rotor disc of disc brake using Ansys software.

In future the quality of material can be enhanced by adding additional material or by using ventilated disc brakes made by s 2 glass fibers.

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