# Study of Car Disc Break Rotor

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*Abstract*— With the demands for increased safety in the operation of automotive vehicles, many are now equipped with disc brakes. The major advantage of the disc brake is a great reduction in brake fade and the consequent marked reduction in the distance required to stop the vehicle. Braking is a process which converts kinetic energy of vehicle into mechanical energy which must be dissipated in form of heat. This paper reviews numerical methods and analysis procedures used in the study of automotive disc brake. It covers Finite element Method approaches in the automotive vehicle. It is found that the complex Contact analysis is still the approach favored by the automotive industry. Analysis of brake rotor includes Structural analysis and Steady state Thermal analysis for each design. This paper reviews work of previous investigators on Structure and transient analysis on the disk rotor and the design of rotor to evaluate and compare their analysis.

***Keywords:*** Break System, Disc Brake, Structure Analysis, FEA

## I. INTRODUCTION

Braking with disc brakes is accomplished by forcing friction pads against both sides of a rotating metal disc, or rotor. The rotor turns with the wheel of the vehicle and is straddled by the caliper assembly. When the brake pedal is depressed, hydraulic fluid forces the pistons and friction linings (pads) against the machined surfaces of the rotor. The pinching action of the pads quickly creates friction and heat to slow down or stop the vehicle. A brake disc usually made of cast iron or ceramic composites includes carbon, Kevlar and silica, is connected to the wheel and the axle, to stop the wheel. A friction material in the form of brake pads is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc. These brakes offer better stopping performance than comparable drum brakes, including resistance to "brake fade" caused by the overheating of brake components, and are able to recover quickly from immersion This friction causes the disc and attached wheel to slow or stop. A friction brake generates frictional forces as two or more surfaces rub against each other, to reduce movement. Friction brakes act by generating frictional forces as two or more surfaces rub against each other. The finite element method has become a powerful tool for the numerical solutions of a wide range of engineering problems. It has been developed simultaneously with the increasing use of the high- speed electronic digital computers and with the growing emphasis on numerical methods for engineering analysis.

Fig. 1: Disc Brake Rotor

## II. LITERATURE REVIEW

Pravin Mohan and Patel Sudheendra S [ 2017] Disc brakes offer higher performance braking, simpler design, lighter weight, and better resistance to water interference than drum brakes. The aim of this conceptual design was to increase the strength of the caliper, without increasing the weight of the caliper by a large amount and reducing the thermal deformation at high operating temperatures. Since titanium is difficult to machine. titanium has higher mass density care was taken while designing the new brake system to keep the weight increase to minimum. The existing brake caliper was analyzed for given load conditions with new material suggested. The results were studied for displacements and stresses along with thermal effects. the major difference in the passenger car brake system and this system is that the caliper has multiple pistons on both sides of rotor. These four pistons are for applying uniform pressure to the rotor from the brake pads to increases the braking efficiency at high speeds. [1] K. Gowthami, K. Balaji [2016] The

Maximum temperature obtained for Aluminum alloy brake drum is $32.83^0$c which is less compared to the maximum temperature prevailing in cast iron break drum and stainless steel 304 Brake drum. Aluminum alloy is proved better than the other materials considered in this investigation.[2]

The rotor model heat flux is calculated for the car moving with a velocity 27.77 m/s (100kmph) and the following is the calculation procedure

Data:

1) Mass of the vehicle (m) = 2200 kg
2) Initial velocity (u) = 20.83 m/s (75 kmph)
3) Vehicle speed at the end of the braking application (v) = 0 m/s
4) Acceleration due to gravity (g) = 9.81m/s2
5) Coefficient of friction for dry pavement (μ ) = 0.7

 

6) Percentage of kinetic energy that disc absorbs (90%) (k) = 0.9
7) Brake rotor diameter = 0.202 m
8) Axle weight distribution 30% on each side
($\gamma$) = 0.3

Kinetic energy is defined by the equation

(a) Energy generated during braking

$$K.E=k\,\frac{1}{2}\,\gamma\,\frac{m(u-v)2}{2}=64432.5\ J$$

(b) To calculate deceleration time

$$v = u+at$$

Deceleration time = Braking time = 4s

(c) braking power: Braking power during continued braking is obtained by differentiating energy with respect to time

$$P_b = K.E/\ t = 16108.125\ W$$

(d) To calculate stopping distance

$$d = \frac{u2}{2\mu g} = 31.59\ m$$

Yugesh Anil Kharche and Prof. Dheeraj Verma [2014] The circle brake is a gadget for decelerating or halting the revolution of a wheel. Braking is a procedure which changes over the motor vitality of the vehicle into mechanical vitality which must be scattered as heat. This paper introduces the investigation of the contact weight disseminations at the plate interfaces utilizing a point by point 3-dimensional limited component model of a genuine car circle brake.[3] K. M. Muniswamy et al. [2013] Heat exchange upgrade on ventilated brake circle with edge tendency point variety. The goal of the present examination is to research the potential heat move upgrades in ventilated brake plate by differing the geometrical parameters of the cutting edges inside the stream entry. The thickness stays consistent and just the length can be changed to fit the inward and external span. The computational model built in GAMBIT. The models are fathomed utilizing ANSYS-FLUENT exclusive software bundle. The outcomes demonstrate a huge increment in the heat exchange rate with sharp edge tendency point arrangements when contrasted with customary straight edge. The Nusselt number is observed to be in a power-law association with the Reynolds number. Particular connection among laminar and violent condition is anticipated. [4]

## III. Conclusion

Braking with disc brakes is accomplished by forcing friction pads against both sides of a rotating metal disc, or rotor. Disc brake design plays as an important role in heat transfer as other variable like plate & vane thickness, fin material and flow pattern. There is scope of research in improvement of heat transfer of rotor by increasing the contact time between vanes and air flow by design modification of vanes in such a way that fulfills the requirement. There is a scope of improvement in heat transfer in ventilated disc brake if vane is angled and of alternate length other than straight radial vane.

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