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# Computational Analysis & Design Study of Pulsar 150 Front Disc Brake

***Atharv Mishra*[a] *, Pulkit Solanki*[b]****

*PG scholar, Department of Mechanical Engineering, SAGE UNIVERSITY, Indore,*[a]
*Assistant Professor, Department of Mechanical Engineering, SAGE UNIVERSITY, Indore*[b]

A B S T R A C T

The disc brake is a device for slowing or stopping the rotation of wheel of vehicles. To stop the wheel, friction material in the form of brake pads is forced mechanically, hydraulically, pneumatic, or electromagnetically against both sides of the disc and cause the wheel to slow or stop. When brakes were used rapidly, the discs and brake pads will become stress. The brake cannot brake with better because disc brake become crack. Now, there are different types of disc brake design which is normal disc brake, drilled disc brake, grooved disc brake and combination drilled and grooved brake disc. Normally every different type of design disc brake produces different brake performance and stress. This happens because during the brake process the formation of gas between brake pads and rotors. The design of the disc is important to determine the rate of stress and uniform wear of disc and brake pad and thus affecting braking efficiency. In this present work on the pulsar 150 front disc, the design prepared by Creo 4.0 and analysis Ansys perform on Ansys Software with the help of two different materials like structural steel and stainless steel, in this work following Criteria analysed like Stress valve observed during the analysis stainless steel offered higher stress valve as compared to structural steel as 638.24 N/mm2 & 485.66 N/mm2 Respectively. Heat dissipation higher offered by stainless steel and having good corrosion resistive property too so stainless steel should be first priority for manufacturing point of view.A

**Keywords**: Creo 4.0, Structural Steel, Stainless Steel & Ansys

## 1. Introduction

Brake is essential part of automobile which try to reduce the speed of the vehicle and change the kinetic energy into another form of energy, according to the new traffic & road safety law new modification occurred into braking technology now day.it is impossible to convert all energy into useful work in case on braking system some amount of energy converted into the form of heat energy and few part of energy converted into vibration. In article [1] having deep description of several type of braking system used in automobile, basically most of the time disc brake and frictional brake are used in all type of roadway transportation system but as observed drum brake heat dissipation rate higher than the disc brake, one of the main reason behind that is having large area to air flow as well self-cleaning ability as centrifugal force [2]

Following are the type of braking System:

a. Foot brake and Handbrake
b. Internal expanding brake System
c. External contracting brake System
d. Externally Expanding Brakes System
e. External contracting braking System
f. Mechanical braking system

* *Corresponding author.*
E-mail address: shailendrasingh217@gmail.com

**Heat transfer in Disc brake**:

According to the second law of dynamics, whenever the temperature of a system becomes different from the atmosphere temperature, the system tries to achieve the atmosphere temperature, it is called the second law of thermodynamics. Heat is always transmitted from high temperature to low temperature body, there are two main processes called convection and conduction. Change of energy from one form to another

**Conduction**:

The instantaneous molecular transfer of heat that takes place in gases, liquids, and solids. Direct molecular transmission, which is the active engagement of particles inside a medium or between media, is different from conduction in that none of the material mediums move during it. The continuity equation for conduction, known as Fourier's law of heat conduction, says that thermal gradient per unit area is equivalent to the average temperature gradient, with thermal conductivity serving as the proportionality constant

## 2. Modelling

Stainless steel and structural steel were the two different metals used in this study to make disc brakes. The disc brake was created with SolidWorks, and ANSYS was used for the thermal analysis. FEA, or finite element analysis, is the practical use of finite element modelling, and it is best understood when applied to actual problems. FEA has been used extensively in the automotive industry. It's a tool that design engineers use frequently when using the product expansion technique. While still in the process of building an adaptable computer-aided design (CREO) model, design engineers may use FEA to assess their designs. This enables design engineers to switch back and forth while improving the model and integrating the results of the FEA study into the overall design process. Understanding the foundations of FEA, modelling techniques, inherent flaws, and their effects on the calibre of the results are prerequisites for using FEA as a design tool. FEA is a computer technique used to conduct engineering issue studies.

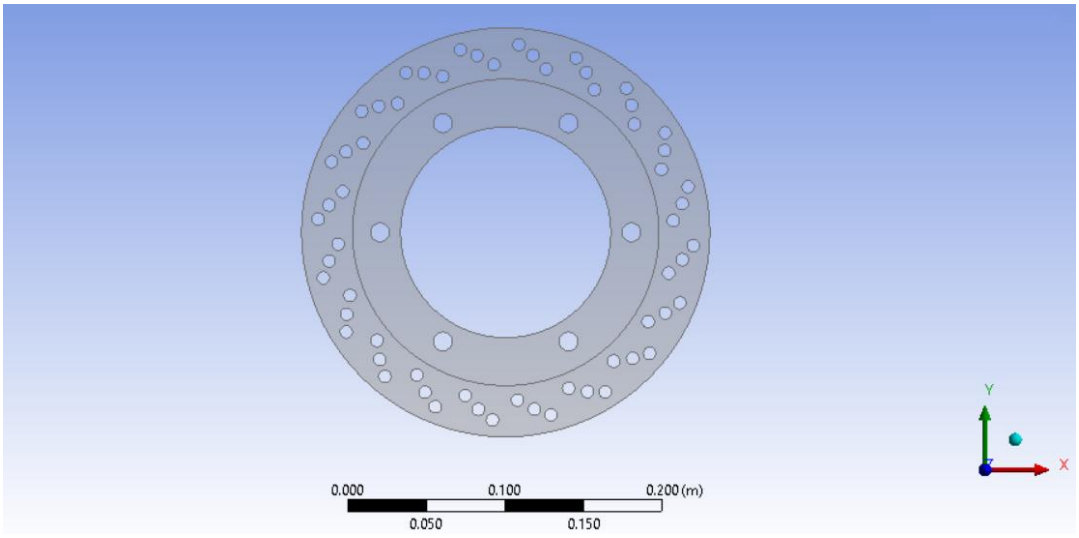


Figure 1 Modelling of Disc Brake

### 2.1 Applying boundary conditions

Figure shows the boundary conditions applied to the disc brake when the convection was applied to the top of the disc brake to maximize disc breakage. The figure illustrates the circumstances of the disc brake border applied.

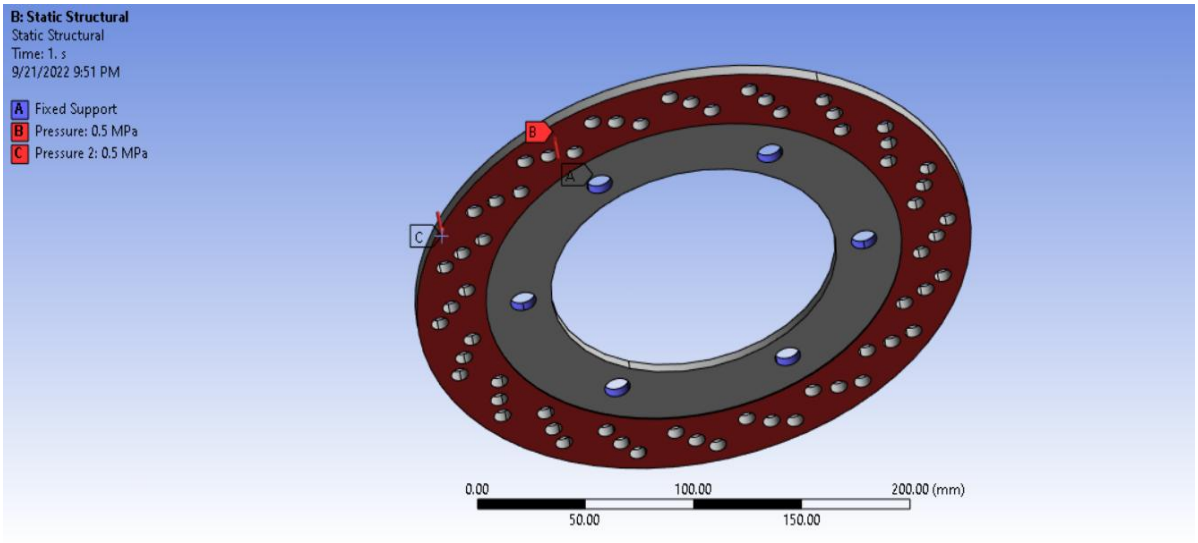


Figure 2 Geometry of disc brake & Boundary condition

The following Procedure follow for Analysis the disc brake

- Design of Disc Brake on Creo 4.0:- the diameter of the disc reduce according to the application of the used the outermost diameter are 260 mm,195mm, 180mm & the inner and last diameter of the disc 120 mm
- Assign material Cast iron & Stainless Steel:- Selected material from the ansys library 14.0
- Applying Meshing Process :- Applying Fine Meshing
- Selecting the area where force applied :- Distance between the diameter of 190mm to 180mm
- Applying Boundary condition:- fixed place where plate attached rigidly with tire
- Calculate the Temperature & Thermal Flux into the disc

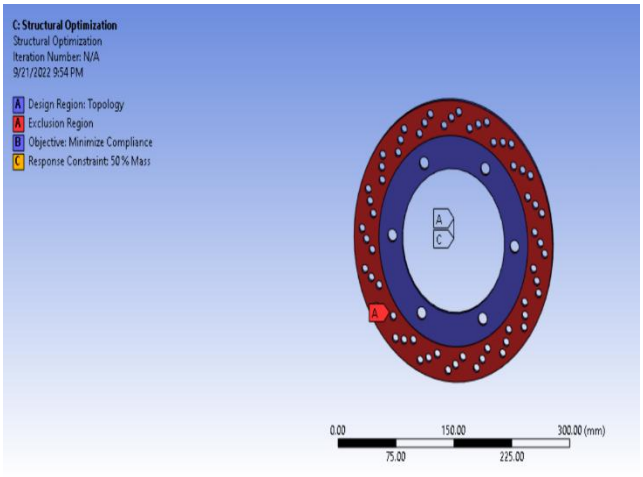


Figure 3 Structural Optimization for both material of disc

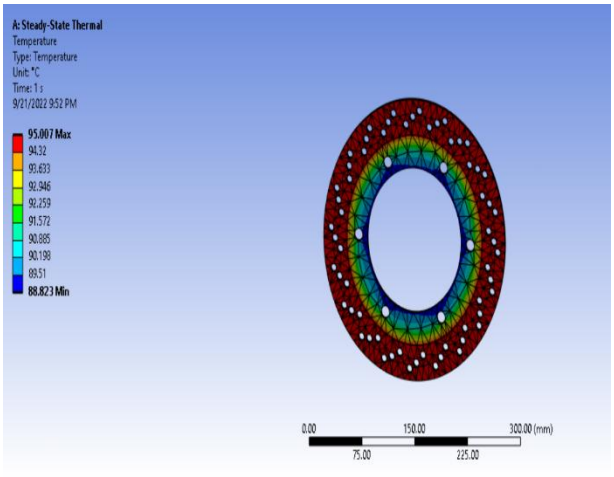


Figure 4Temperature distribution of Stainless-steel disc brake

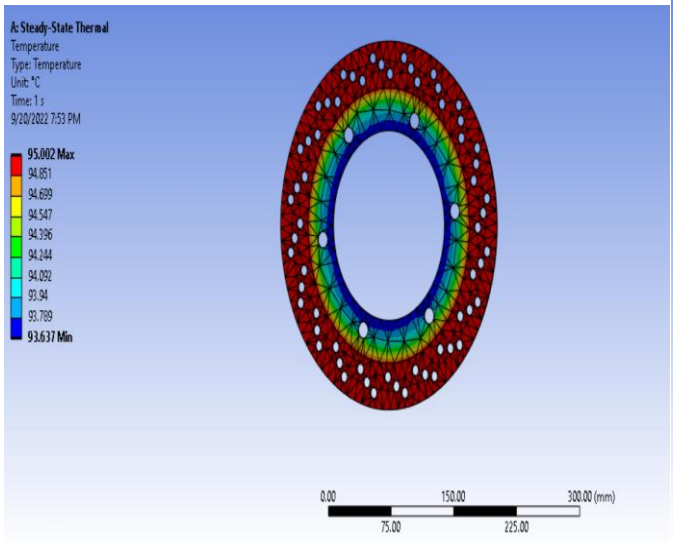


Figure 5Temperature distribution of Structural steel disc brake

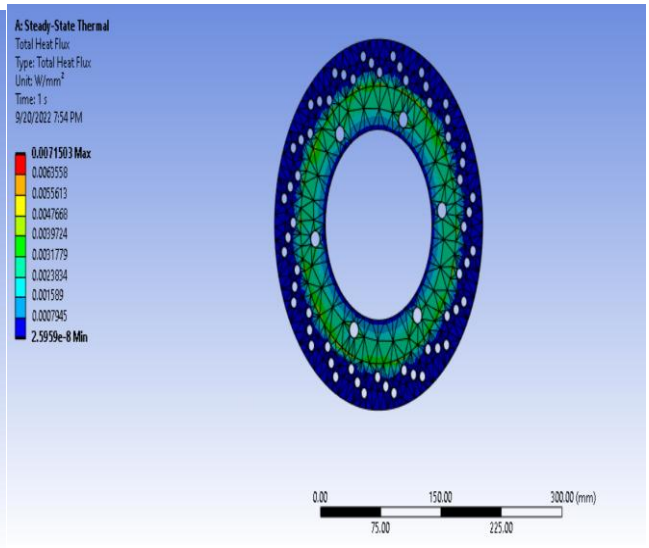


Figure 6Heat flux of structural steel disc brake

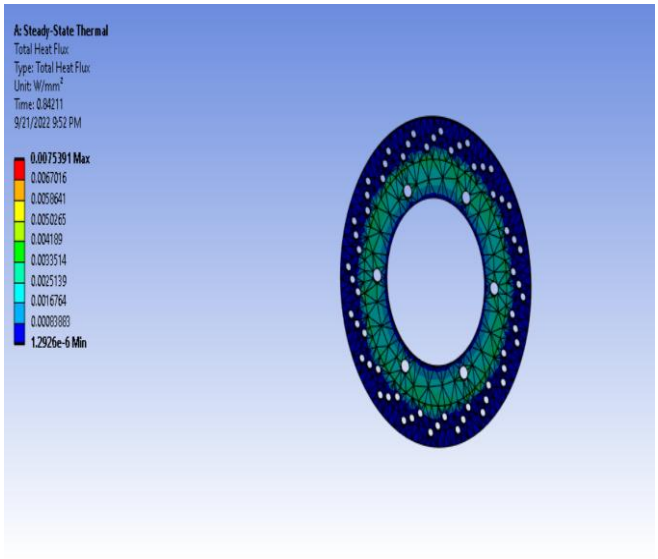


Figure 7Heat flux of Stainless- steel disc brake

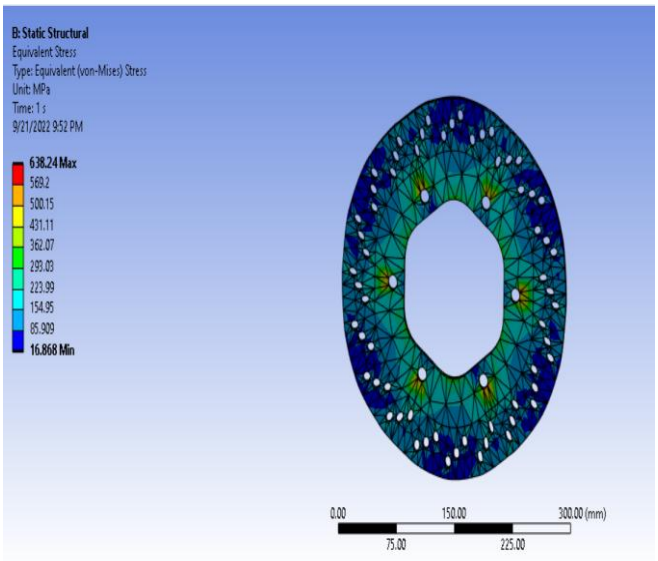


Figure 8Stress Distribution of Stainless- steel disc brake

## 3. Results

As shown in figure thermal analysis was conducted on the Structural steel brake disc and maximum temperature observed is $95.002^{0C}$ and minimum temperature observed is $93.637^{0}$ C& the thermal analysis was conducted on the stainless-steel brake disc and maximum temperature observed is $95.823^{0C}$ and minimum temperature observed is $88.823^{0\,C}$

Table .1 temperature observation in Structural and stainless steel

| Materials | Temperature Distribution (°C) | |
|---|---|---|
| | Min | Max |
| Stainless Steel | 88.823 | 95.823 |
| Structural steel | 93.637 | 95.002 |

Table .2 Maximum and Minimum heat Flux in disc

| Materials | Total Heat Flux in disc (W/mm²) | |
|---|---|---|
| | Min | Max |
| Stainless Steel | 1.2926e-6 | 0.007589 |
| Structural steel | 2.5959e-8 | 0.007150 |

## 4. Conclusion

Immediately following the analysis of the braking effectiveness of disc brake systems. Because structural steel disc brakes corrode when exposed to moisture and cannot be used on two-wheelers, we choose stainless steel, even though thermal analysis revealed that the maximum temperature rise of structural steel discs is significantly lower than that of stainless steel. The results of this study could be used to develop an effective design tool and boost the braking efficiency of disc brake systems. Lower results than those that were allowed were obtained from the study. The brake Disc analysis is therefore safe if the strength and stiffness requirements are met. The research project mentioned above yielded the following conclusions:

- Stainless steel profiles offer a higher heat dissipation rate, As a result, it is suitable for manufacturing.
- the maximum temperature on a Structural steel disc brake is 95.002 degrees Celsius, with a temperature decrease of 93.637 degrees Celsius.
- the maximum temperature on a stainless steel disc brake is 95.007 degrees Celsius, with a temperature decrease of 88.823 degrees Celsius.
- the maximum temperature decrease on a stainless steel disc was discovered, indicating that this material is appropriate for design.
- during the analysis observed maximum deformation found in structural steel than the stainless steel that is one of the reason to selection of stainless steel for manufacturing of disc brake.

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