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Optimization Of Disc Brake Rotor With modified shapes

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Abstract-: ***This work is bestowed with studies concerning on disc brake rotor by modelling & analysis of various shapes of slots of different vehicle's disc brake rotor with same outer diameter & inner mounting position of holes on wheel hub as like Bajaj neutron star one hundred fifty. Static structural and steady state thermal analysis of disc brake rotor of Bajaj neutron star 150 DTSi and conjointly on different shapes of disc brake rotor analysis done victimisation software. i.e ANSYS 14. Therefore, it provides optimize stress, deformation & weight of the modified disc brake rotor & conjointly smart heat dissipation. On the idea of weight parameter implementation of latest hydraulic brake rotor is done. Hopefully this project will facilitate everybody to know verification of disc brake rotor and the way enforced disc brake works a lot of efficiently, which might help to scale back the accident which will happen in daily.***

Keywords: Expansion joints, thermal expansion, fatigue calculation, Modified design, Re-Analysis, heat dissipation.

I. INTRODUCTION

In building plan we make the frame works, structures, and strategy just to fulfill our essential prerequisites. These are a portion of the decisions to make forms, at which the essentials of designing and a portion of the customary law and determined basics can be utilized or connected to accomplish the required true objective. These building configuration devices comprises of breaking down the items, setting up the designing illustrations, figuring distinctive computations both hypothetically and scientifically and combination, testing and more to get fine parts. The information gained from this project is to be ready to perceive the steps required in structural &thermal analysis of hydraulic brake rotor by victimization FEA method. The ways employed in this project will later be used in future as reference for similar analysis and development .The disc brake rotor may be studied on the assorted areas like material improvement on the disc brake rotor, vibration on the disc brake, noise and squeal of the disc brake and thermal stress analysis on the disc brake rotor. Hopefully this project can facilitate everybody to understand structural and thermal analysis of hydraulic brake rotor of changed shapes and the way disc brake works additional efficiently, which may facilitate to scale back the accident which will happen in day to day life. The final optimization will be done based on the results which has been declared by the FE model which has been tested seriously under all suitable conditions and the most approximate form of the model will be selected for the further process.

II. PROBLEM SATEMENT AND SCOPE OF THE WORK

PROBLEM SATEMENT: High temperature during braking will caused to Brake fade, premature wear, Brake fluid vaporization, Bearing failure, Thermal cracks, Thermally-excited vibration. Therefore, it is important to study and predict the temperature rise of a given brake component and assess its thermal performance in the early design stage. Finite element analysis (FEA) has been preferred and chosen method to investigate some of the above concerns such as disc brake rotor temperature rise and thermal cracks

Scope of Project:

- To improve braking efficiency
- To improve heat dissipation across the disc brake rotor.
- To understand modeling & finite element analysis (FEA) of different shape disc brake rotor

- Optimization

III. MODELING

Modeling of Bajaj pluser star one hundred fifty DTSi & four totally different shapes disk brake rotor are planning in CATIA VS R20 with keeping same outer diameter and inner mounting position of hole on wheel hub as like original. totally different shapes of discs are for correct heat dissipation. Static structural and steady state thermal analysis of real model of disc brake rotor of Bajaj neutron star 150 DTSi and conjointly on different shapes of disc brake rotor for analysis plotting results of von mises stresses, Total deformation & Steady state Temperature in analysis software. i.e ANSYS fourteen

2D drawing of original of disc brake rotor of outer diameter is 240 mm &mounting position holes of disc brake rotor on wheel hub is 1251mmPCD is shown in

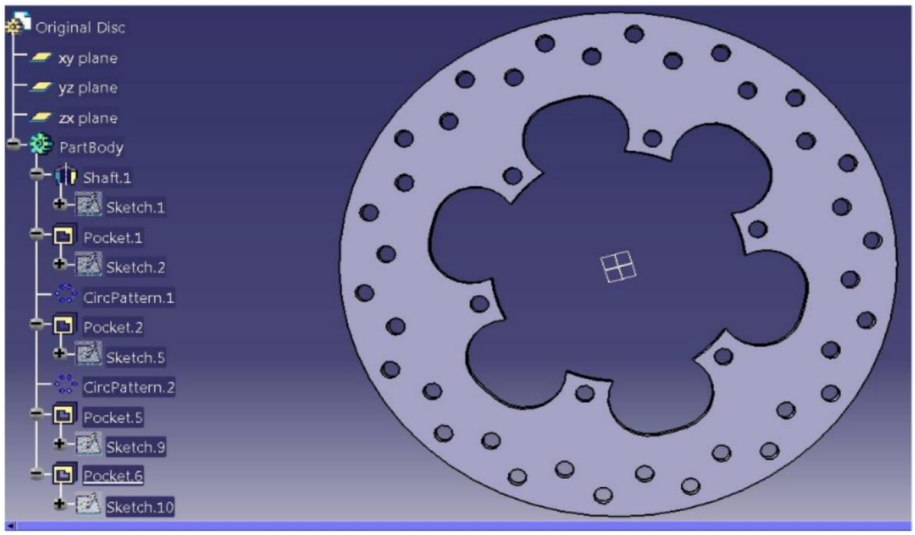


Fig. 1. This is standard dimensions of Bajaj pulsar 150 cc bike

While designing the geometry of disc brake rotor care has been taken for the maintain standard dimensions. Geometry has been modified by adding curved surfaces for better heat transfer & improves stiffness properties.

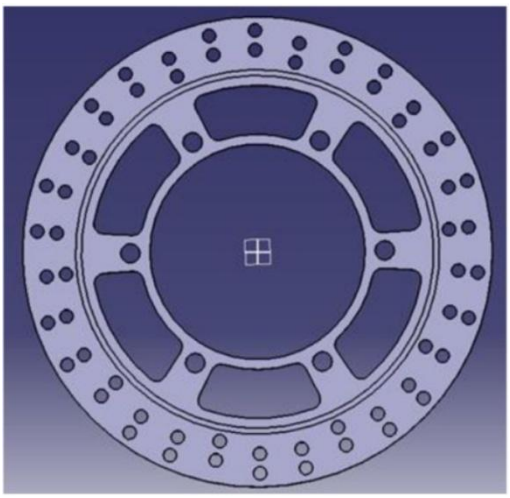


Fig. 2. 3D Modeling of shape 4 of disc brake rotor

- **FINITE ELEMENT ANALYSIS:**

Finite Element Method is a numerical procedure for solving continuum mechanics of problem with accuracy acceptable to engineers. Finite Element Method is a mathematical modeling tool involving discretization of a continuous domain using building-block entities called finite elements connected to each other by nodes for once and moment transfer. This process includes Finite Element Modeling and Finite Element Analysis.

In displacement based FEM, stiffness of the entire structure (Part or assembly) is assembled from stiffness of individual elements. Loads and bounda1y conditions are applied at the nodes and the resulting sets of the simultaneous s equations are solved using matrix methods and numerical techniques. In short, FEM is a numerical method to solve ordinary differential equations of equilibrium.

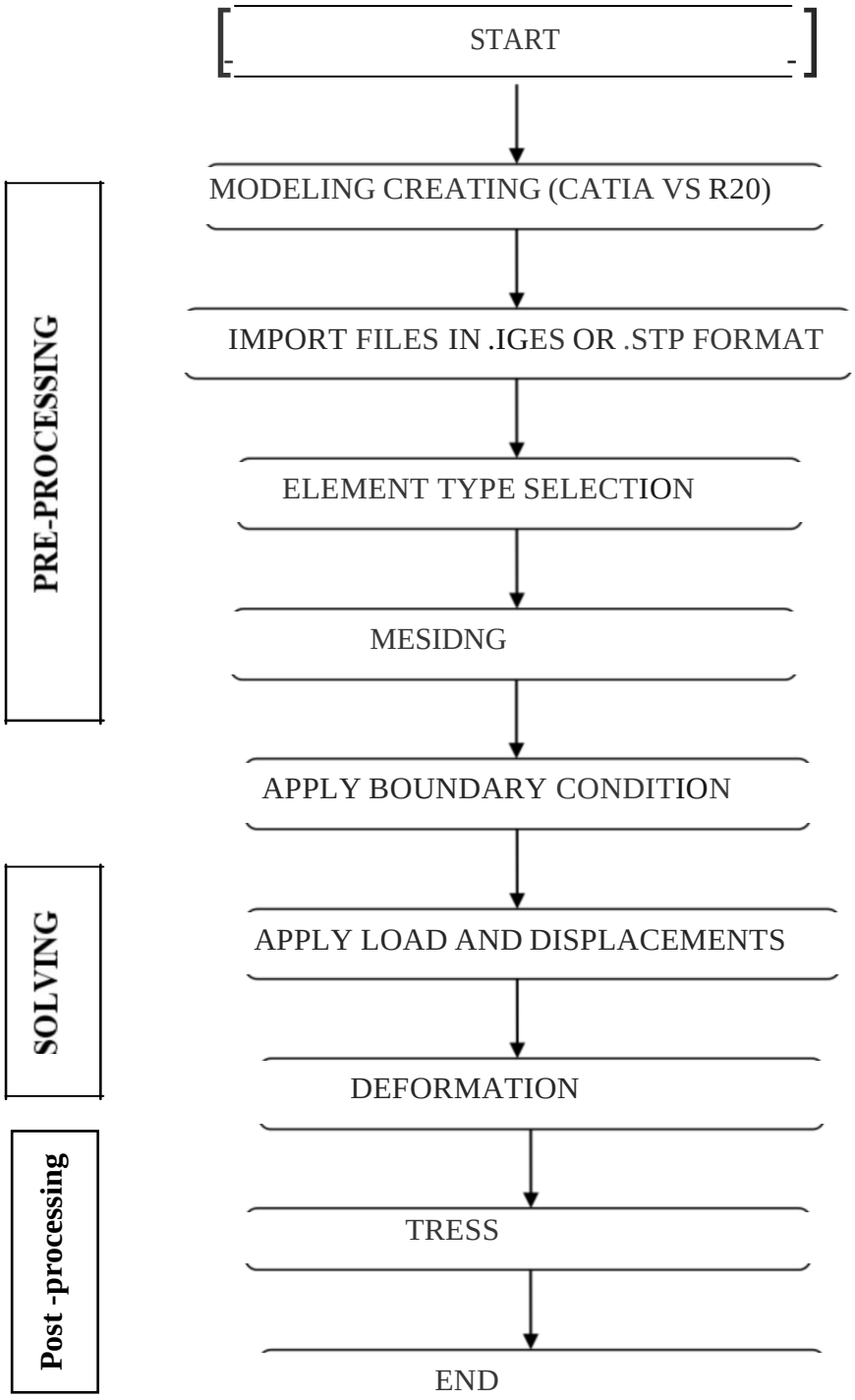


Fig 3: Flow Chart of Finite Element Method (Structural Analysis)

IV.RESULT AND DISCUSSION

SOFTWARE RESULTS:

The highest stresses & deformations are reached at the contact surface disc pads. The rise in stresses & deformation is due to change in shape of disc brake rotor. For the four types of discs with original disc brake rotor, one notice that changes occurs in stresses, deformation & weight.

Table N o . 1 Results of Von-mises, Deformation,Weight

Sr. No.	Disc Brake Rotor	Von-Mises Stresses (MPa)		Deformation(m)		Weight (Kg)
		Max.	Min.	Max.	Min	
1	Original disc brake rotor	19.083	0.00971	3.695*10-^{3}	0	1.052
2	Modified shape 1 disc brake rotor	19.67	0.00890	3.829*1-0^{3}	0	1.15
3	Modified shape 2 disc brake rotor	15.291	0.022301	3.730*1-0^{3}	0	1.207
4	Modified shape 3 disc brake rotor	27.456	0.009036	5.3427*10 -^{3}	0	1.026
5	Modified shape 4 disc brake rotor	20.707	0.008189	5.6881*10-^{3}	0	0.954

For cast iron components, ultimate tensile strength is considered to be the failure criteria. Failure occurs when the maximum stress in the component due to external force exceed the ultimate tensile strength even once. Cast iron components have a homogeneous structure. To account for these factors, a large factor of safety, usually 3 to 5, based on ultimate tensile strength is used.

The effects of the friction material properties on the contact ratio of friction surfaces are examined and the larger influential properties are found to be the thermal expansion coefficient and the elastic modulus. We can say that modified shape 4 disc brake rotor is the suitable shape for the braking operation and all the values of weight obtained from the analysis are less than original disc brake rotor & also has allowable strength. Hence the brake disc design is safe based on the strength and rigidity criteria. Therefore maximum heat dissipation modified shape 4 disc brake rotor the best possible disc brake rotor for the present braking application.

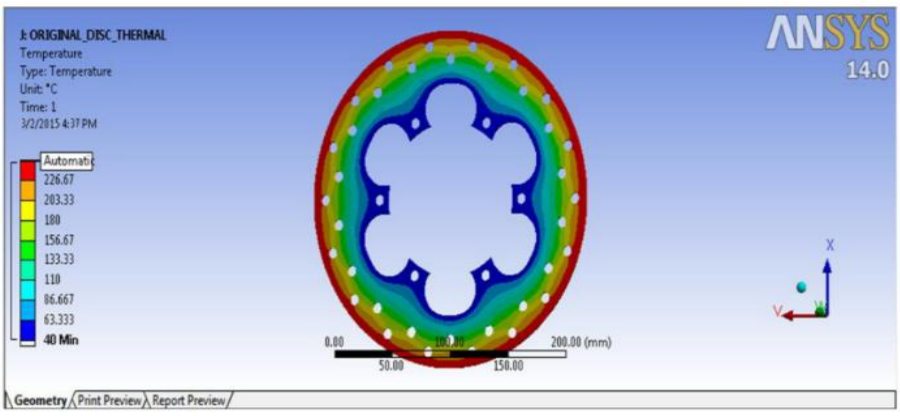


Fig.4. Steady state Temperature of original disc brake rotor

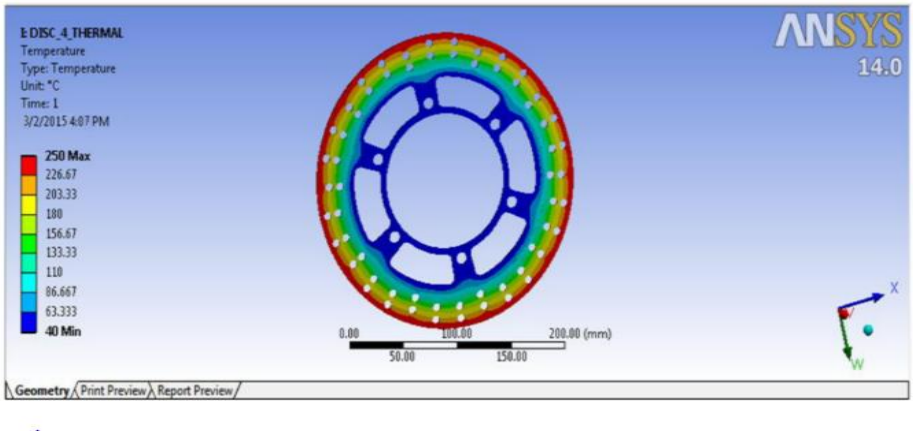


Fig.5. Steady state Temperature of modified shape 4 disc brake rotor

Fig. 4 & Fig. 5 indicates the temperature distribution across the disc brake rotor with various region-wise diameter which decreases from outer diameter to mounting position holes of disc brake rotor on wheel hub i.e. maximum temperature occurs at outer side due to friction between friction pad and disc brake rotor

- SOFTWARE RESULTS OF THERMAL HEAT DISSIPATION:

From the software results on the criteria of strength & weight modified shape 4 disc brake rotor gives optimum results in term of stress & deformation so modified shape 4 disc brake rotor is selected.

During an emergency braking, all the heat produced with the interface is equal to the heat absorbed by the disc and the brake lining. At the time of braking process, a part of the consequently, the determination of the heat transfer coefficients is essential. Their exact calculation is however rather difficult, because these coefficients depend on the location and the construction of the braking system, the speed of the vehicle travel and consequently of the air circulation. Since the process of heat transfer by radiation is not too important.

Table N o . 2 Result of original disc brake rotor

Sr. No.	Region-wise diameter (mm)		Software Result (Average Temp. in °C)
	Region	Diameter	
1	I	240-220	238.33
2	II	220-200	191.67
3	ill	200-180	145
4	IV	180-170	98.33
5	V	170-110	51.67

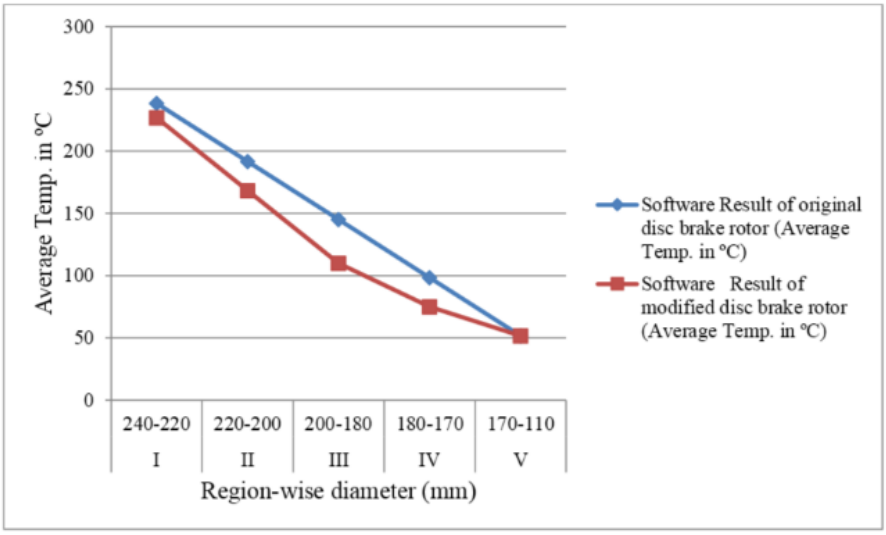
Table No. 2 shows the variation in temperature distribution by region -wisediameter according to software

Table N o . 3 Result of modified shape 4 disc brake rotor

Sr. No.	Region-wise diameter (mm)		Software Result (Average Temp. in °C)
	Region	Diameter	
1	I	240-220	226.66
2	II	220-200	168.33
3	III	200-180	110
4	IV	180-170	75
5	V	170-110	51.66

Table No. 3 shows the variation in temperature distribution by region-wise diameter according to software.

Graph shows Software result of original & modified shape 4 disc brake rotor



From above graph on the basis of software results it is clearly understand that average temperature occurs in modified shape 4 disc brake rotor is minimum as compared to original disc brake rotor

CONCLUSION

Structural improvement considerably reduces the fabric needed within the disc brake rotor. These design improvements in element are often employed in varied ways. Firstly, the burden of the half is reduced therefore the value of production. If this significantly exceeds the look criteria, the part would be massively improved. The Shape optimization has been successfully optimized which gives high quality brake disc at a lower cost. Modified shape 4 disc brake rotor minimize the undesirable effects in the operation of the rotor such as thermal elastic instability, premature wear, cracking, brake fluid vaporization and thermally excited vibrations & temperature fade.

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