STRUCTURAL AND THERMAL ANALYSIS OFPROFILES F DISC ROTOR USING FEA

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ABSTRACT

These day technologies go beyond us. For automotive field, the technology of engine develops very fast even the system of the car, luxury etc. which comforts everything that develops by the innovation of engineer. Although the engineer gives priority for comfort or safety measure, but most consumers still have inadequate of knowledge in safety system. During turning movement or sudden braking of any vehicle ,disc rotor subjects to heat dissipation and uneven stresses which causes problem like Scarring, Cracking, Rusting, Poor stopping, noise, Vibration, Pulling, Grabbing, Dragging, Pulsation etc. which increases the chances of accidents due to poor efficiency of disc rotor. Thus safety is the first important thing we must focus. This paper "Structural and Thermal Analysis Of profiles F Disc Rotor Using FEA" studies about different forces acting on disc brake by analysis as well as by designing five different profiles of disc rotors with possible optimization of material and finally selection of desirable performance profile of disc rotor for greater efficiency. Therefore, we can estimate the efficiency of the disc brake. Hopefully this project will help everyone to understand how disc brake works more efficiently, which can help to reduce the accident that may happen in each day.

Keyword: - *Disc rotor, heat flux, stress, design, analysis etc….*

1. INTRODCTION

In braking system one of most important active safety of vehicle. While braking, most of the kinetic energy are converted into thermal energy and increase the disc temperature. This project deals in disc brake rotor design, disc rotor profile selection, disc rotor material selection & thermal stress analysis on Honda CB Unicorn, 150cc brake disc rotor. The heat dissipated along the brake disc surface during the periodic braking via conduction, convection and radiation The findings of this research provide a useful design tool to improve the brake performance of disc brake system. The decisive safety aspects of the disk brake design are shorter braking distances Safety is the first important thing we must focus on any human related things. Here in case of automobiles the brake is one of the major devices which contribute in safety system. So the performance of the same should be as good as possible, and if we are generating the brakes with optimum parameters that is added advantage. Considering this fact on mind this projects deals with,

- Performance improvement of the disc brake
- Material and profile used improvement.

1.1 Existing disc rotor-material-stainless steel

Existing or Original disc rotor having 6 holes with diameter 8 mm arranged equally. There are 36 holes Surrounding disc Diameter 8 mm arranged equally.

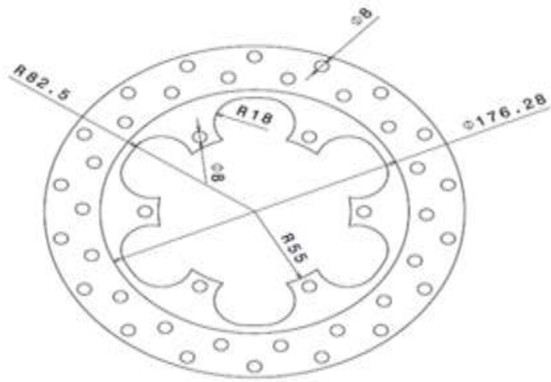

Fig. 1 CAD model of existing disc rotor

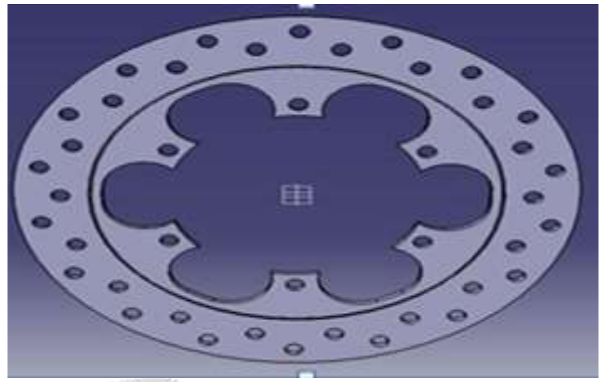

Fig. 2 CATIA model of existing Disc rotor

1.2 Modelling of different profiles of disc rotor using CAD and CATIA

1.2.1 Disc Rotor 1

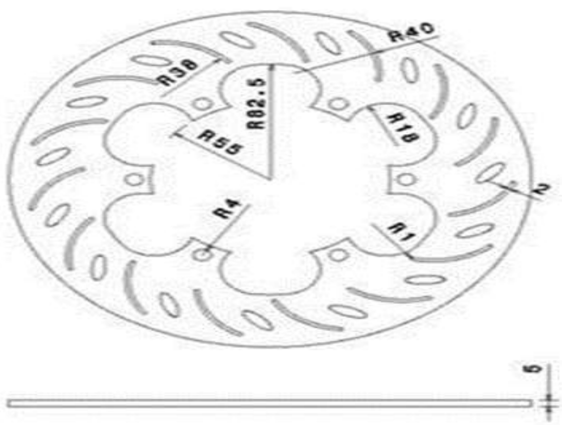

Fig. 3 CAD model of existing disc rotor

Fig. 4 CATIA model of existing Disc rotor

In disc rotor 1 as shown in fig., there are 15 Vanes have been arranged with 15 elliptical shape holes in clockwise direction. Inlet of air flow & outlet of air flow between the vanes is same.

1.2.2 Disc Rotor 2

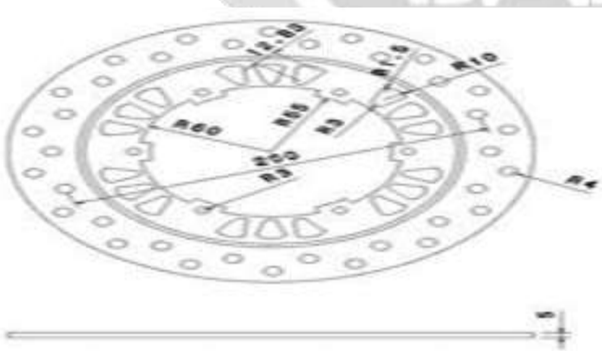

Fig. 4 CAD model of existing disc rotor

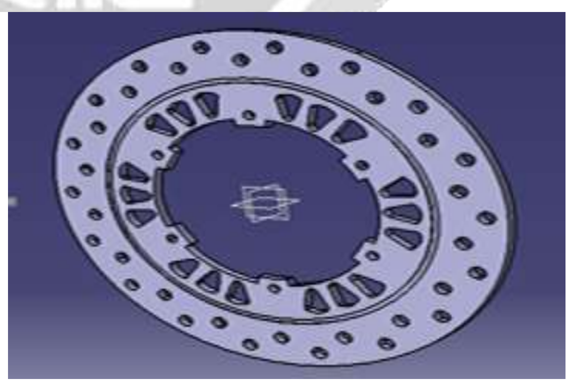

Fig. 5 CATIA model of existing Disc rotor

In disc rotor 2 as shown in fig., Original disc brake has been reduces 6 holes diameter 6 mm. There are 36 holes Surround Diameter 8 mm arranged equally. Original disc brake has been added with 18 cut section& changes central structure.

1.2.3 Disc Rotor 3

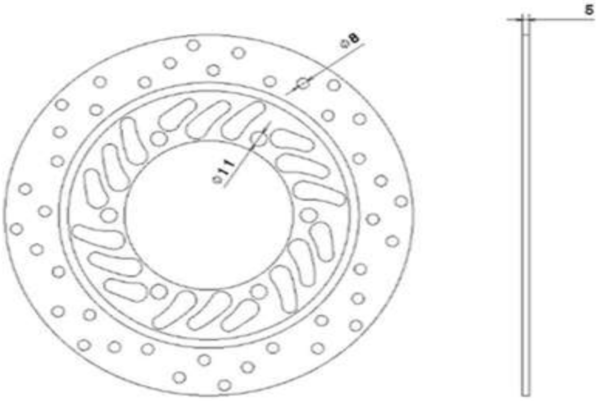

Fig. 6 CAD model of existing disc rotor

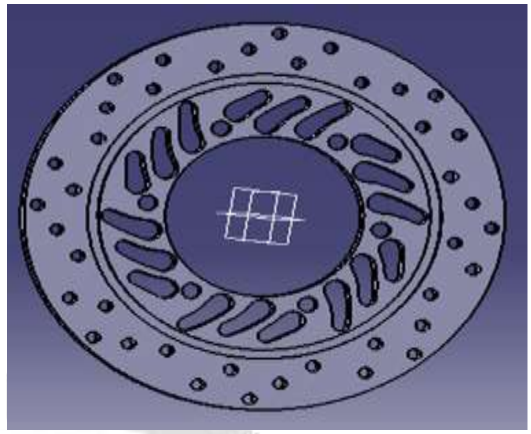

Fig. 7 CATIA model of existing Disc rotor

In disc rotor 3 as shown in fig., disc rotor 3 has been of 6 holes with diameter 10 mm arranged equally same. Original disc brake has been added with rectangular shaped vanes on inner side and surrounding 40 holes of diameter 8mm

2. OPTIMIZATION IN PROFILES OF DISC ROTOR USING STAINLESS STEEL

2.1 Structural and thermal Analysis of Disc Rotor 1

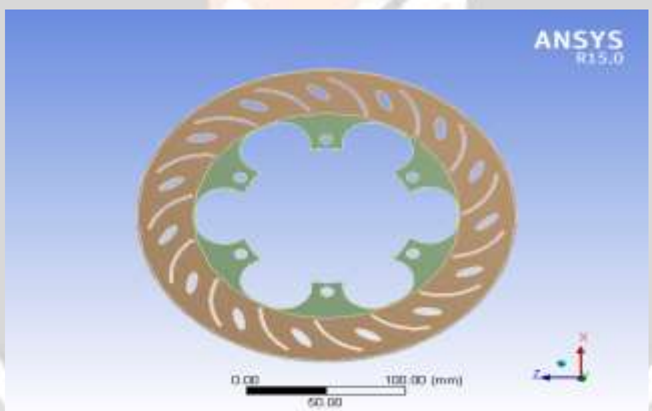

Fig. 8 Imported model of disc rotor 1 in ANSYS

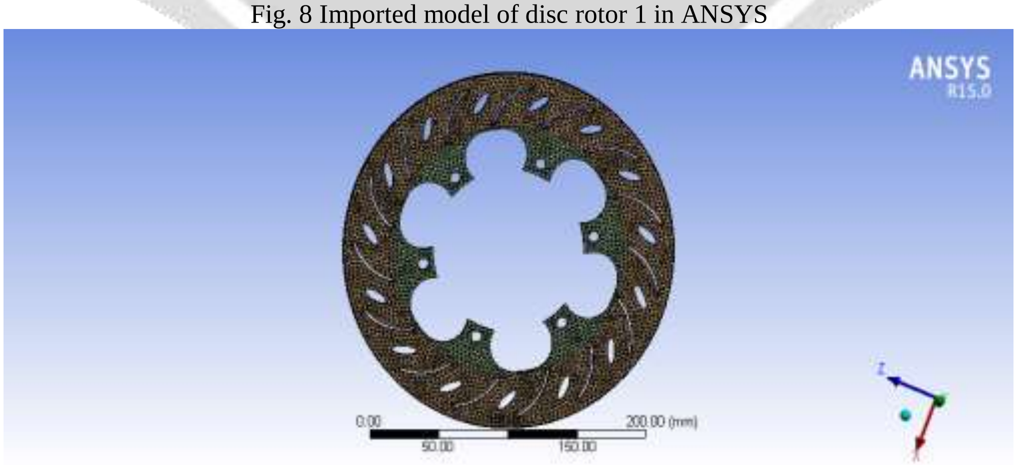

Fig. 9 Meshed model of disc rotor 1 in ANSYS.

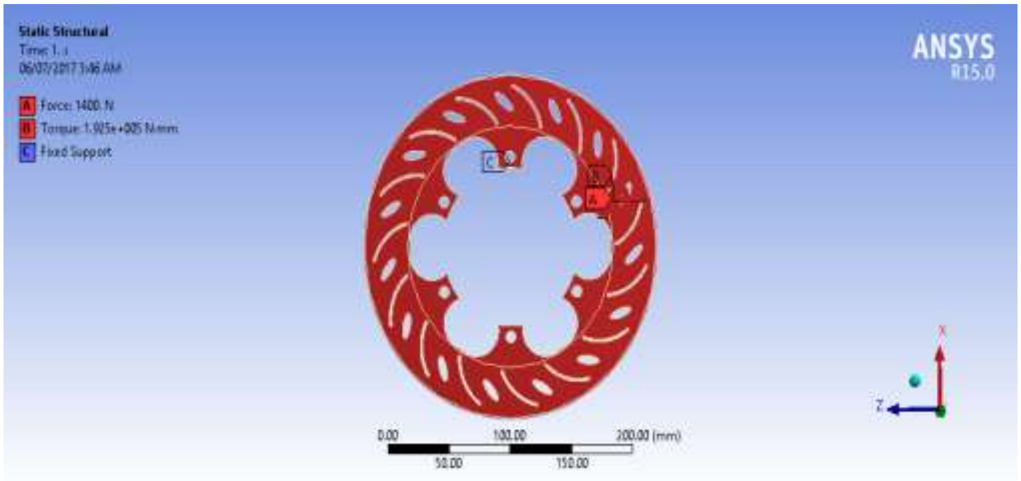

Fig. 10 Boundary conditions (static structural).

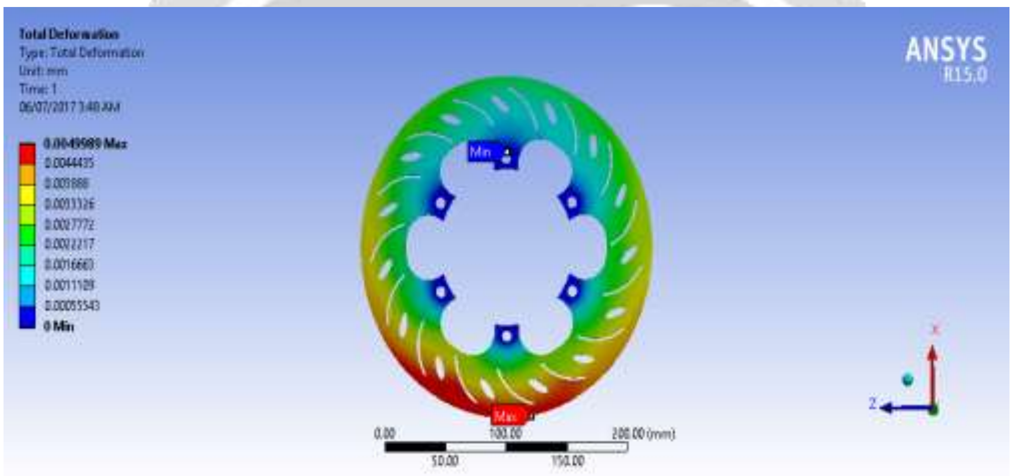

Fig. 11 Deformation result of disc rotor 1.

By changing profile of disc rotor, Maximum deformation and maximum stress is determined which are shown by red portion on disc from structural analysis by applying Force=1400N, Torque=192.5Nm as a boundary condition.

Fig. 12 Stress result of disc rotor 1.

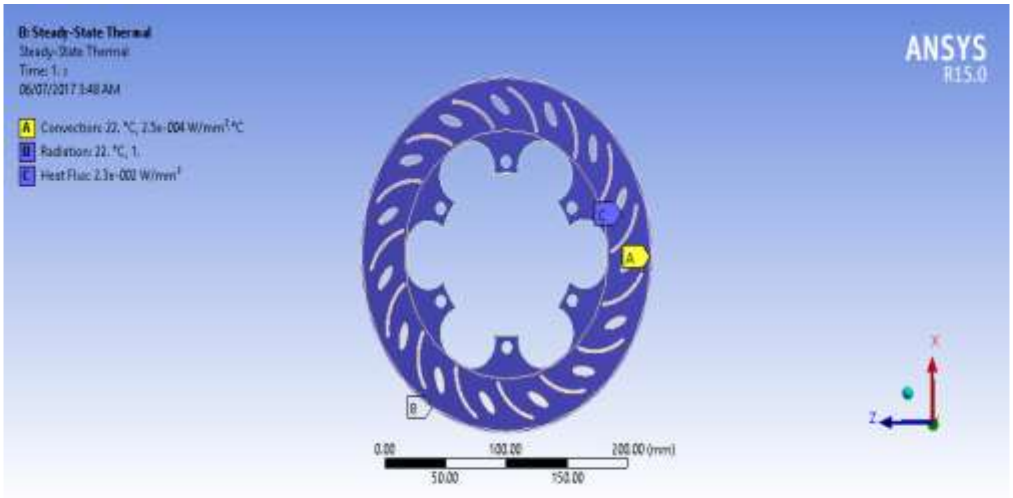

Fig. 13 Boundary conditions (steady-state thermal).

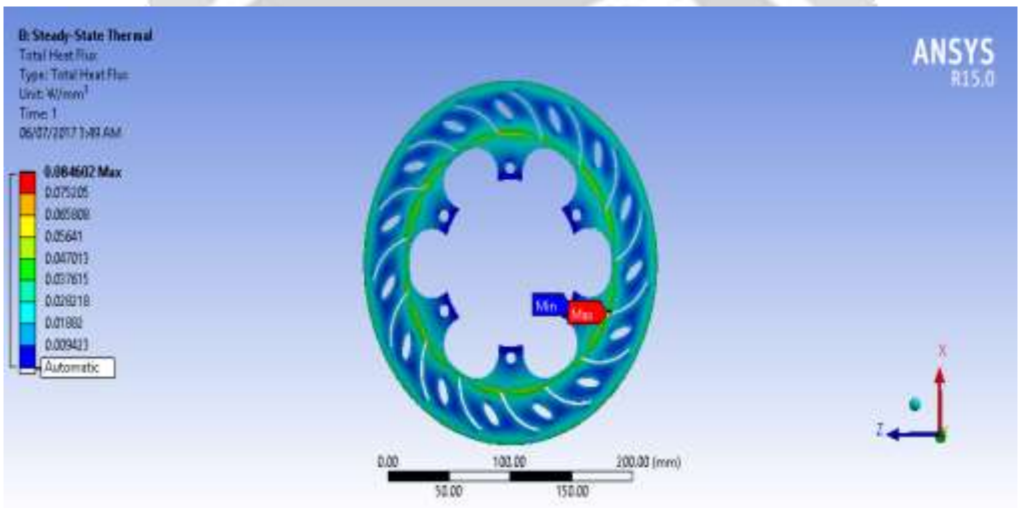

Fig. 14 Result of heat flux of disc rotor 1

Heat flux of disc rotor 1 with Stainless steel as a material is determined reddish area shows maximum heat flux in that area.

2.2 Structural and thermal Analysis of Disc Rotor 2

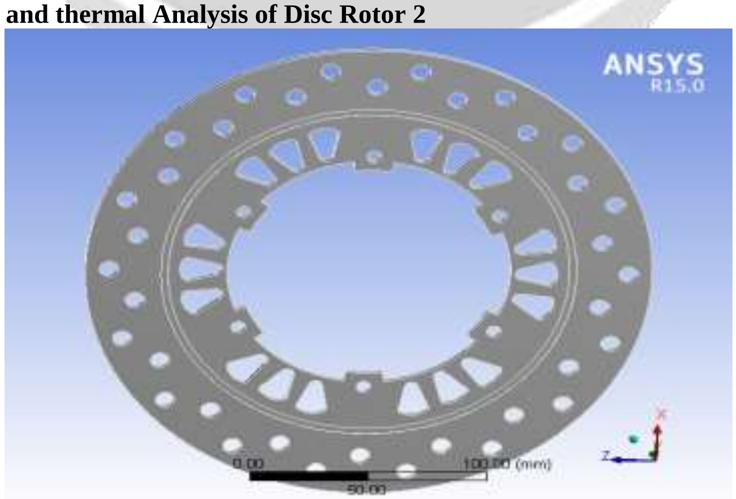

Fig. 15 Imported model of disc rotor 2 in ANSYS

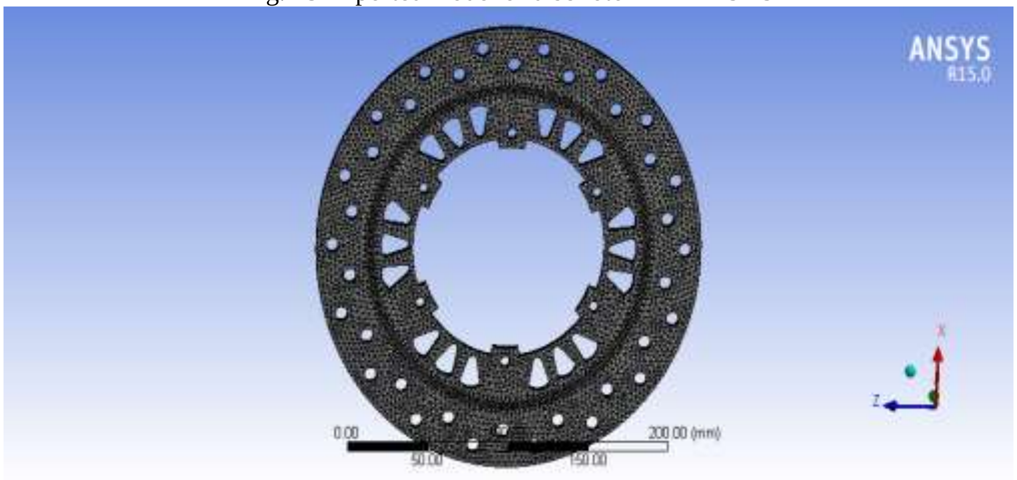

Fig. 16 Meshed model of disc rotor 2 in ANSYS.

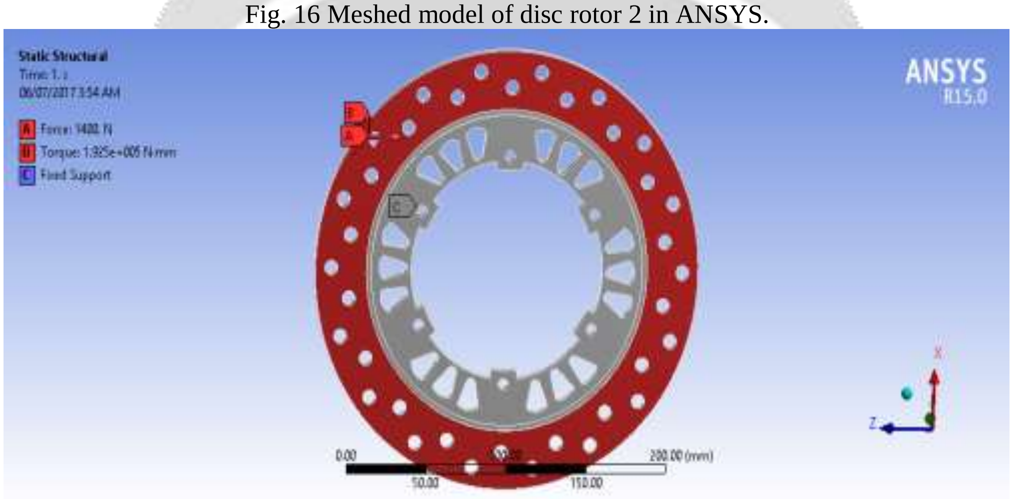

Fig. 17 Boundary conditions (static structural).

Force 1400N and Torque 192.5Nm is applied according to mathematical results and fixed support is given on one side of plate.

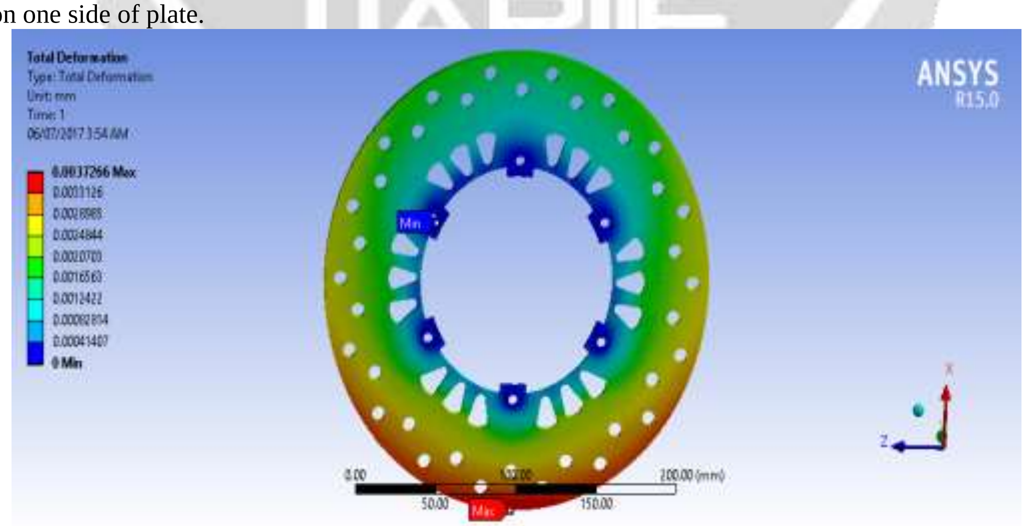

Fig. 18 Deformation result of disc rotor 2.

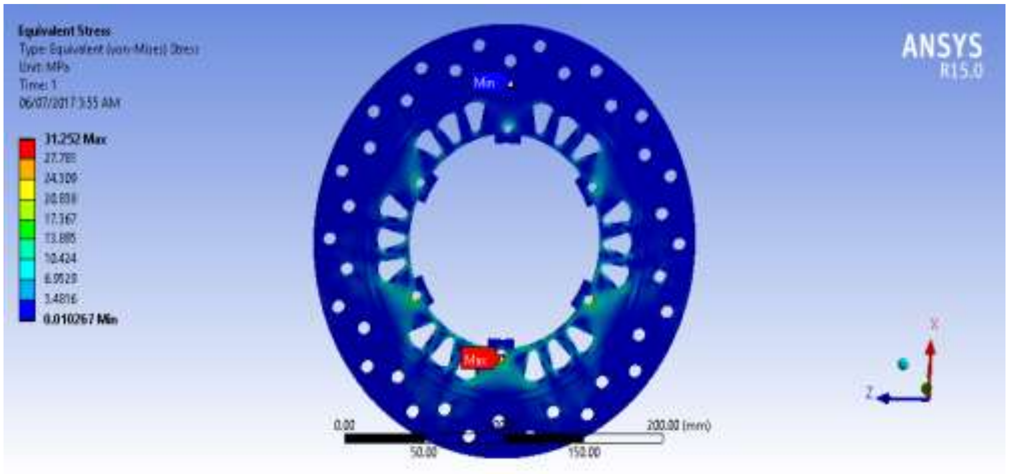

Fig. 19 Stress result of disc rotor 2.

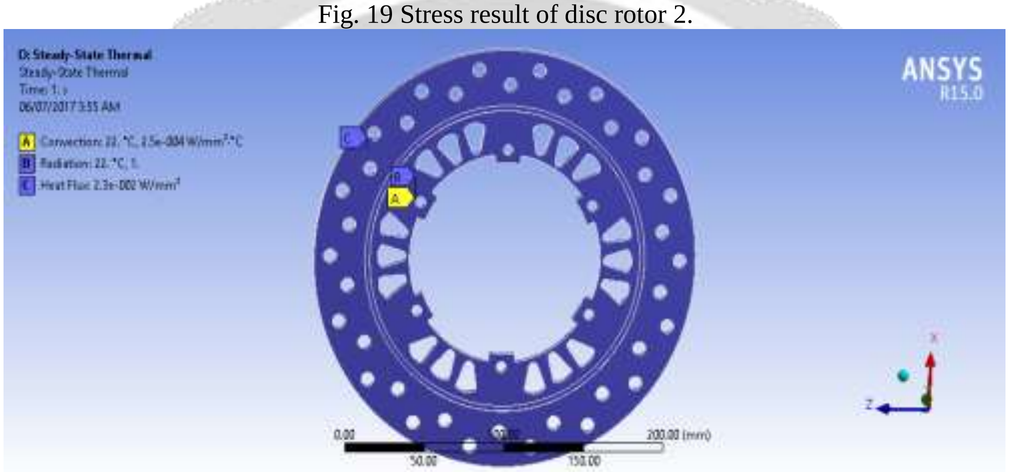

Fig. 20 Boundary conditions (steady-state thermal).

For steady state thermal analysis convective, radiative temperatures are applied as a boundary conditions. Heat flux of disc rotor 3 with Stainless steel as a material is determined reddish area shows maximum heat flux in that area

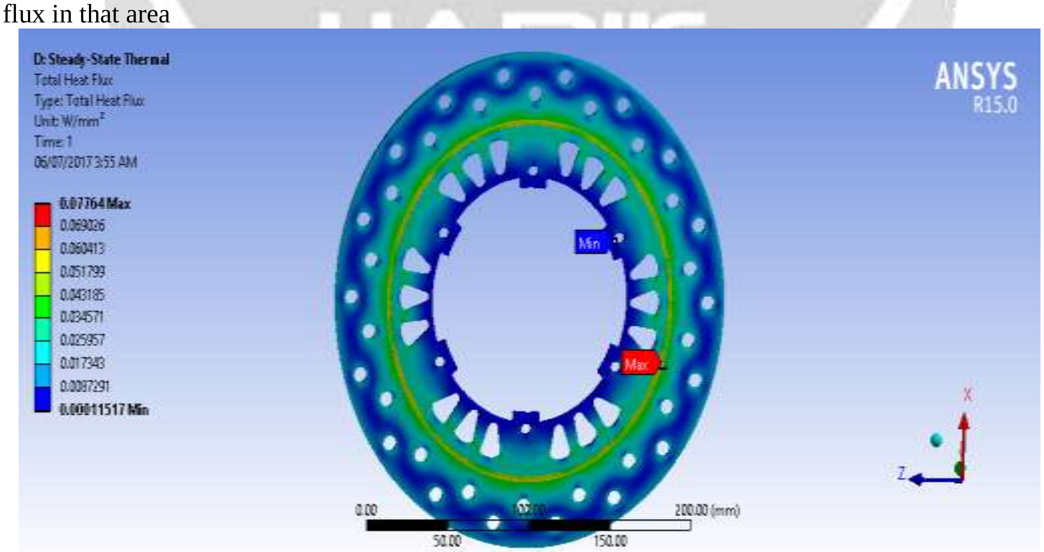

Fig. 21 Result of heat flux of disc rotor 2

2.3 Structural and thermal Analysis of Disc Rotor 3

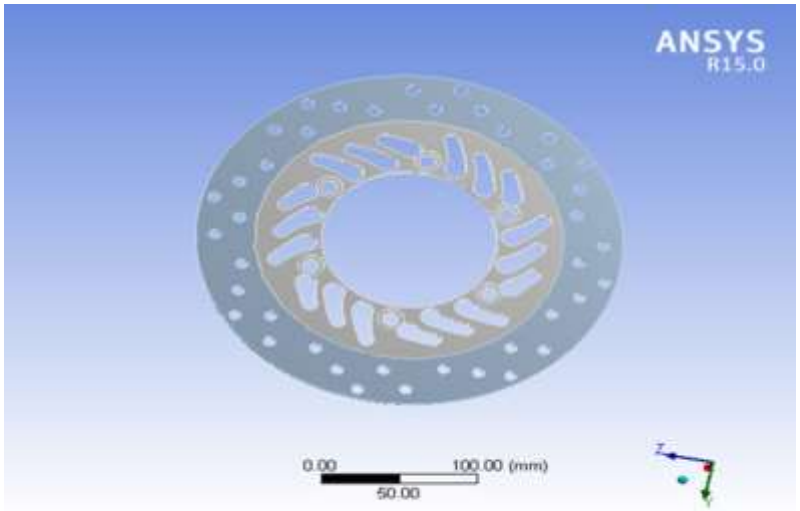

Fig. 22 Imported model of disc rotor 3 in ANSYS

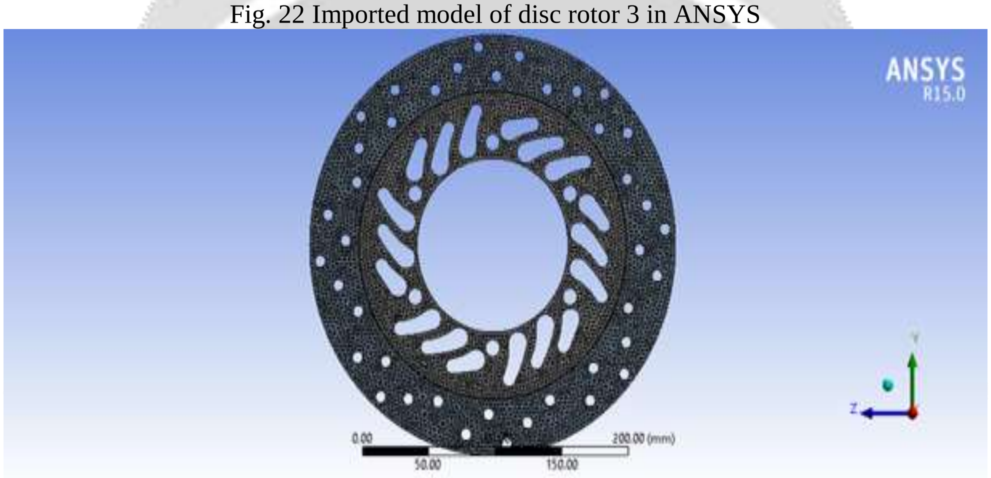

Fig. 23 Meshed model of disc rotor 3 in ANSYS.

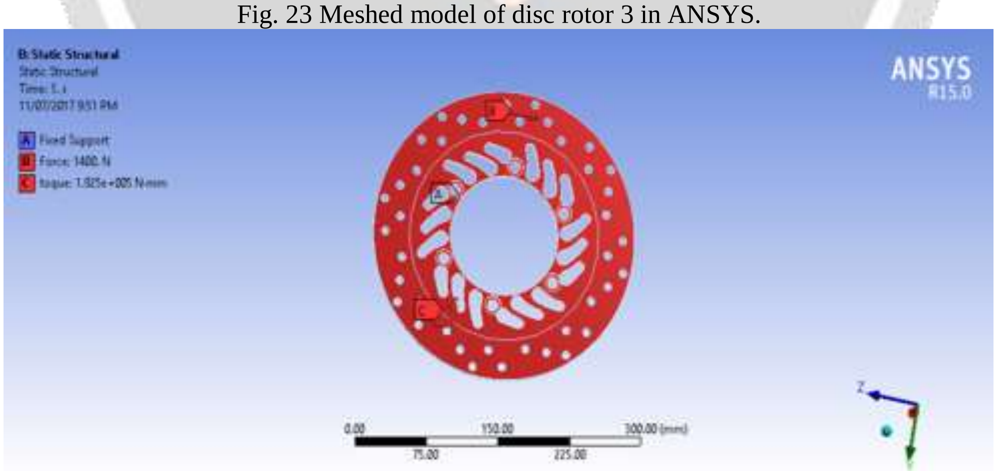

Fig. 24 Boundary conditions (static structural).

Force 1400N and Torque 192.5Nm is applied according to mathematical results. Fixed support is given on one side of plate

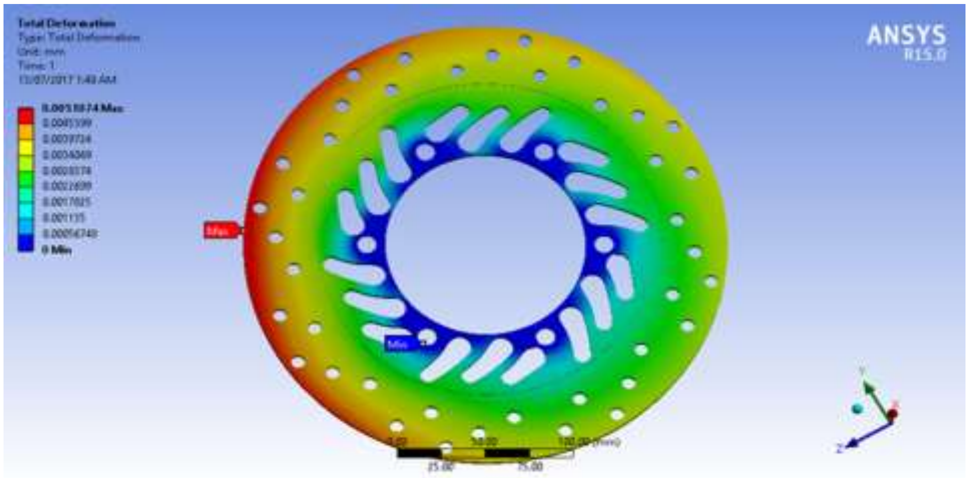

Fig. 25 Deformation result of disc rotor 3.

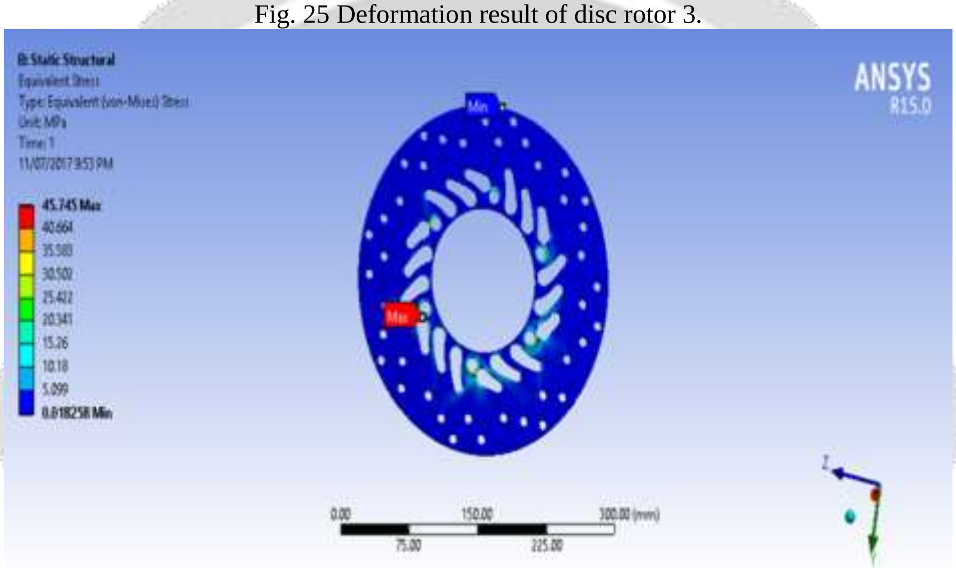

Fig. 26 Stress result of disc rotor 3.

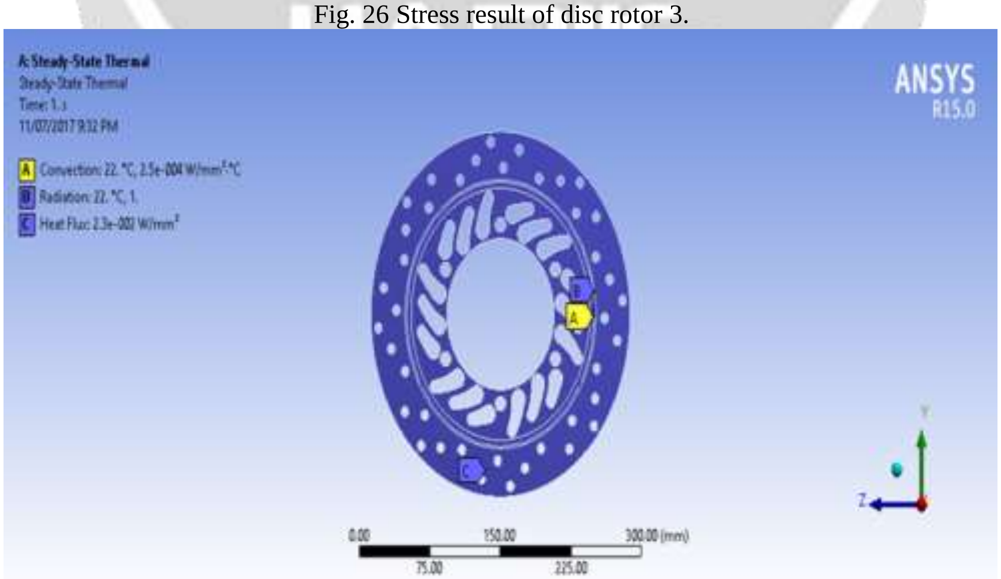

Fig. 27 Boundary conditions (steady-state thermal).

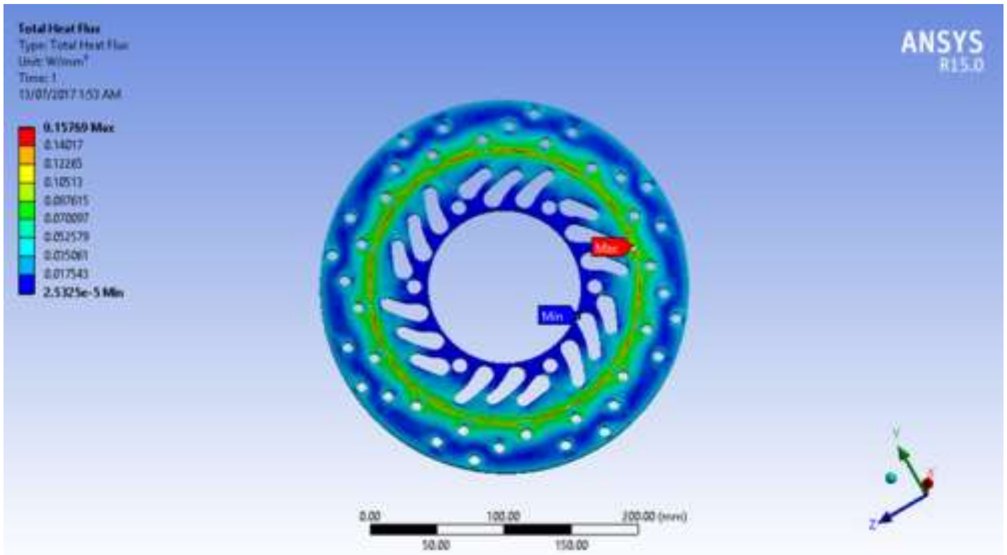

Fig. 28 Result of heat flux of disc rotor 3

Table 3.3 Result of different profile analysis.

Profile of Disc	Deformation, mm	Stress, MPa	Heat Flux. W/mm^2
Disc Rotor 1	0.0049989	40.366	0.084602
Disc Rotor 2	0.0037266	31.252	0.07764
Disc Rotor 3	0.0051074	45.745	0.15769

- From above results it's clear that profile 3 is giving higher heat flux among all profiles and hence its best, its heat flux is 73.99 % more than existing disc profile which is made of stainless steel and 35.10% more than existing disc rotor which is made of grey cast iron.
- Higher Heat flux will give higher heat dissipation rate. Hence disc rotor 3 made up of stainless steel is selected for its best performance.

3. CONCLUSIONS

- From above results it's clear that profile 3 is giving higher heat flux among all profiles and hence its best, its heat flux is 73.99 % more than existing disc profile which is made of stainless steel and 35.10% more than existing disc rotor which is made of grey cast iron.
- Higher Heat flux will give higher heat dissipation rate. Hence disc rotor 3 made up of stainless steel is selected for its best performance.

5. ACKNOWLEDGEMENT

It is of immense pleasure to me in expressing sincere and deep appreciation towards my guide Prof. Hredeya Mishra., for priceless execution of steering this contribution all the way through this work with soft suggestions, embedded supervision and invariable advocacy. Special thanks to the principal and teaching staff of JCOE Kuran, for needful support and encouragement throughout the course authors can acknowledge any person/authorities in this section**.**

6. REFERENCES

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[3] Venkatramanan R., Kumaragurubaran S, Vishnu Kumar C, Sivakumar, Saravanan B., "Design and Analysis of Disc Brake Rotor", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 19 (2015),pp.14558-14562.