Overview of Seismic Response on Building Structures

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Abstract: *The brake device is the most crucial safety device on a car. So when brake is applied, these mechanism aids in slowing the spinning of the vehicles, ensuring a vehicles came to a full stops. In order to do this, various parts of the brake must convert the kinetic energy of the item into heat energy. Friction carries this conversation of force, which lowers the speed and aids in decelerating the automobiles.*
In this research work, with the first step being the creation of a disc brake prototype using ANSYS with some design modifications, followed by the selection of the rotor material based on its properties and use as a disc, the execution of theoretical calculations based on the properties of the front disc brake using the energy-saving procedure, and the comparison of the results with quantitative ones. The comparative analysis of total deformation, total heat flux, equivalent stress and temperature in base model, modified model, proposed model (case 1 and case 2) which we have created in this research work.

Keywords:. *Brakes, disk brakes, drum brakes, Hydraulic Brakes, Pneumatic Braking System ANSYS,*

I. Introduction

A braking device in a motor car is a configuration of different linkages and parts (brake lines or robotic links, brake drum or brake disc, master cylinder or fulcrums, etc.) arranged in such a way that it transforms the kinetic energy of the vehicle into heat vitality, which then stops or decelerates the vehicle [2].
The frictional power produced by the frictional touch among stop footwear and a rotating drums or disk of a stopping device determines how much kinematic power is converted into heat production.
In order to accomplish the braking action on a moving body, the frictional force depends on the surface nature of the metals [8]. Because of this, the bodies must be compressed relatively more closely towards to experience increased friction; also, the faster the respective bodies move in relation to one another, the less friction will be felt among them.
Basic of Design: Two brake shoes were assembled by the manufacturer in such a way that when they meet the braking drum's inner surfaces, internal expanding brake are created.
The disc brake is a device for slowing or stopping the rotation of a wheel while it is in motion. A brake disc is usually made of cast iron, but may in some cases be made of composites such as reinforced carbon-carbon or ceramic -matrix composites. This is connected to the wheel and/or the axle [12]. To stop the wheel, friction material in the form of brake pads (mounted on a device called a brake caliper) is forced hydraulically, pneumatically or electromagnetically against both sides of the disc. Friction causes the disc and attached wheel to slow or stop. Brakes convert motion to heat, and if the brakes get too hot, they become less effective, a phenomenon known as brake fade.

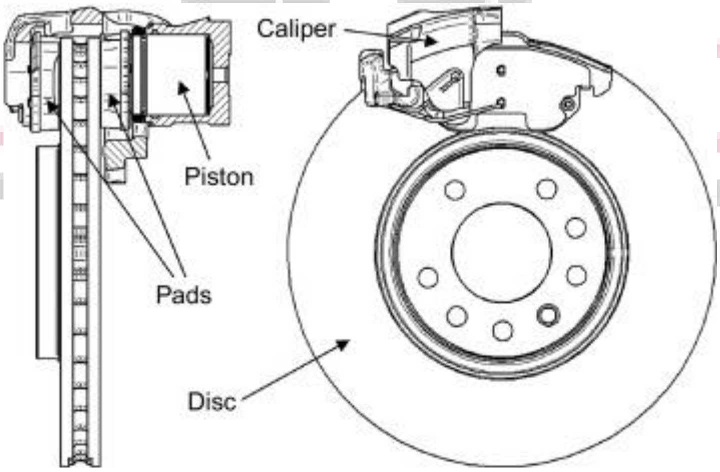

Figure 1 Disk Braking System

The brake rotor (disc) which rotates with the wheel, is clamped by brake pads (friction material) fitted to the caliper from both sides with pressure from the piston(s) (pressure mechanism) and decelerates the disc rotation, thereby slowing down and stopping the vehicle.

When the driver steps on the brake pedal, the power is amplified by the brake booster (servo system) and changed into a hydraulic pressure (oil-pressure) by the master cylinder. The pressure reaches the brakes on the wheels via tubing filled with brake oil (brake fluid). The delivered pressure pushes the pistons on the brakes of the four wheels.
There are two types of disc brakes. One is called the "opposed piston type disc brake" which has pistons on both sides of the disc rotor, and the other is the "floating type disc brake" which has a piston on only one side. The floating type disc brakes are also called the sliding pin type disc brakes.
In this research work we are working on the design of disk brake rotors. We will compare the base model, modified model and our proposed model to evaluate the performance improvement on the basis of structure, heat flux and temperature distribution.

II. LITERATURE REVIEW

Alnaqi [13] studied retractable brake rotors coated with alumina to determine how the coating's characteristics affected how well they resisted heat and friction. A program of brake accelerometer and material characterisation tests was used to study an alumina ceramic coating on AA6082 aluminum alloy (Al-Alloy) and 6061/40SiC aluminium metal matrix composite (Al-MMC) generated by plasma electrolytic oxidation (PEO). The findings demonstrated that, in comparison to the Al-MMC alumina layer, the PEO alumina layer was more homogeneous, robust, and well-adhered to the aluminum alloy substrate.

Ulf Olofsson [14] assess the viability of refinishing brake rotors from a sustainable perspective using an operations on the environment and tribological performance methodology. The ecological effects of making new grey cast iron brake rotors and renovating damaged brake rotors by laser cladding are compared using a simplified life cycle evaluation. It turns out that the laser cladding remanufactured brake rotors use 80% and 90% less energy and have a lower carbon footprint than the original brake rotors. The findings indicate that compared to the original cast iron brake rotor using the same pad material, the refurbished brake rotor produces more friction.

A.Belhocine and W.Z. Wan Omar [15] used CFD analysis to determine the heat transfer coefficient (HTC) on each surface of a vented disc rotor that changes over time in a transient state.

P Shiva Shanker [17] investigated vehicle braking systems, several braking techniques and processes are reviewed in this research. It discusses various braking system types, material characteristics, and various materials used in the production of brakes, particularly disc brakes.

Michael D. Atkins [18] found that increasing the number of vanes for a given rotational speed causes an increase in the mass flow rate of the air pumped by the rotor, a decrease in the inflow angle (), more equally balanced passage velocity profiles, and an increase in Rossby number. These findings were made using bulk flow and tangential velocity mapping measurement techniques.

Wanyang Li [19] examines the state of ceramics research and market trends for automotive disc brakes. Numerous qualities and traits, such as fracture toughness, strength, compactness, corrosion resistance, wear resistance, micro-morphology, and thermal stabilities are examined in relation to ceramic disc brakes. The research directions for ceramics in the area of disc brakes are examined.

Mr. Sumeet Satope [20]assess the two-wheeler disc brake's steady state thermal analysis of the rotor was to assess how well it braked under braking conditions. This work uses mathematics inputs and brake rotor thermal loads to calculate the various parameters needed for thermal analysis under predictions based. Solid Works 15 is used for the design of the brake rotor, and Ansys 14.5 is used for the analysis.

Daanvir Karan Dhir [21] uses the finite element method to examine the temperature that rises of an automotive disc brake during braking and its impact on disc durability. Heat flux was produced when a specific braking torque was applied to the rotor. Numerical analysis of the heat flux produced and the thermal conductivity taken into account was used to determine the stiffness of the rotor and the maximum thermal expansion on the disc rotor.

Shah E Alam [22] provide the findings of a thermal examination of an Indian two-disc wheeler's brake rotor. Understanding the function of the holes in the disk brake is the goal of this essay. Two alternative rotor types are subjected to thermal study. One has a straightforward rotor with no vents or holes, while the other is perforated (consists of holes). The heat loss from a rotor, which is thought to be overheated by disc brake friction when in use, has been studied by researchers.

Most vehicles are equipped with disc brakes these days. The discs in a disc braking system are also called rotors and these parts can warp over time. When you step on the brakes, the brake system's master cylinder pushes brake fluid through to the calipers which, in turn, shove the brake pads up against the rotors. Rotors can warp due to the constant pressure from the pads. They can also overheat, as the friction caused by the pads is unbelievably hot.

Overheating is the most common cause of damage to the rotors. Although cross-drilled rotors help dissipate heat, they do create the potential for stress cracks to develop as a result of intense heat. Thus in this research work we are trying to solve the problem of overheating by modifying the design of disk brake rotors.

III. Proposed Methodology

One of the essential and safety-critical parts of a car is the brake mechanism. Significant improvement during the braking mechanism is provided by a correct rotor design and superior heat dissipation material. This study examines the stress and temperature distribution in a modified ventilated disk brake rotor that has been developed with curved vents, holes, and slots. It is expected that it is stress-free prior to using the brake. The effects of inertia and body force were deemed to be insignificant.

In this study, modified ventilated disk brake rotor has been developed with curved vents, and slots and analyzes the stress and temperature distribution. Finite element models of the rotor are shaped with SolidWorks and simulated using ANSYS. Structural and thermal characteristics are compared with a reference disk brake rotor. In this research work, overall work proceeds in three different Models.

Case 1 –Base Model

Case 2 – Modified Model

A static structural analysis defines the displacements, tension, strain, strength of the framework or part induced by charges that would not inflict stiffness and vibration effects. For each case, the disk brake was subjected to under 962.11 N brake force and 211.66 Nm torque during the braking operation.

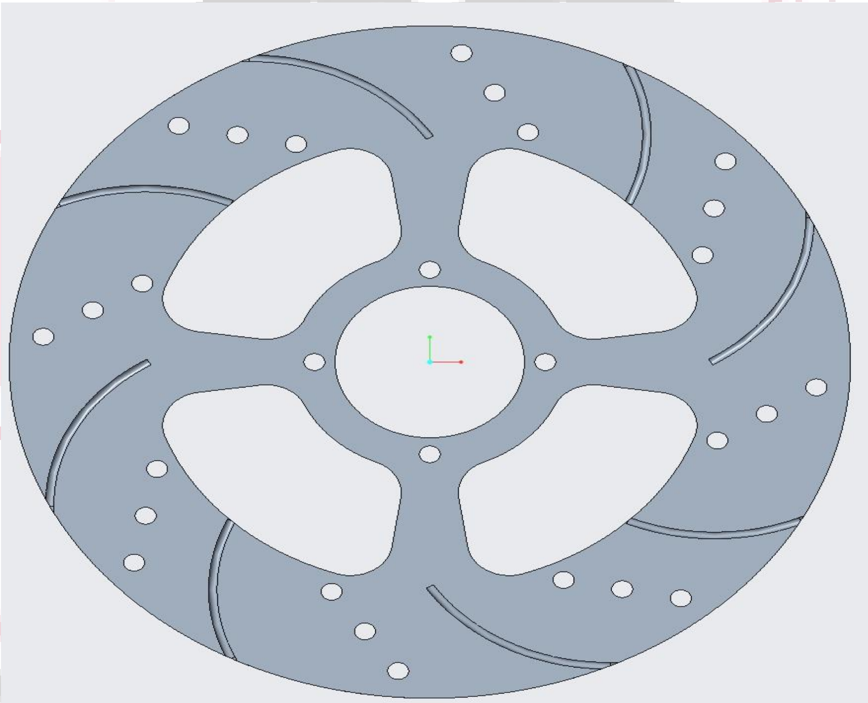

Figure 2 Modelling of Base Model

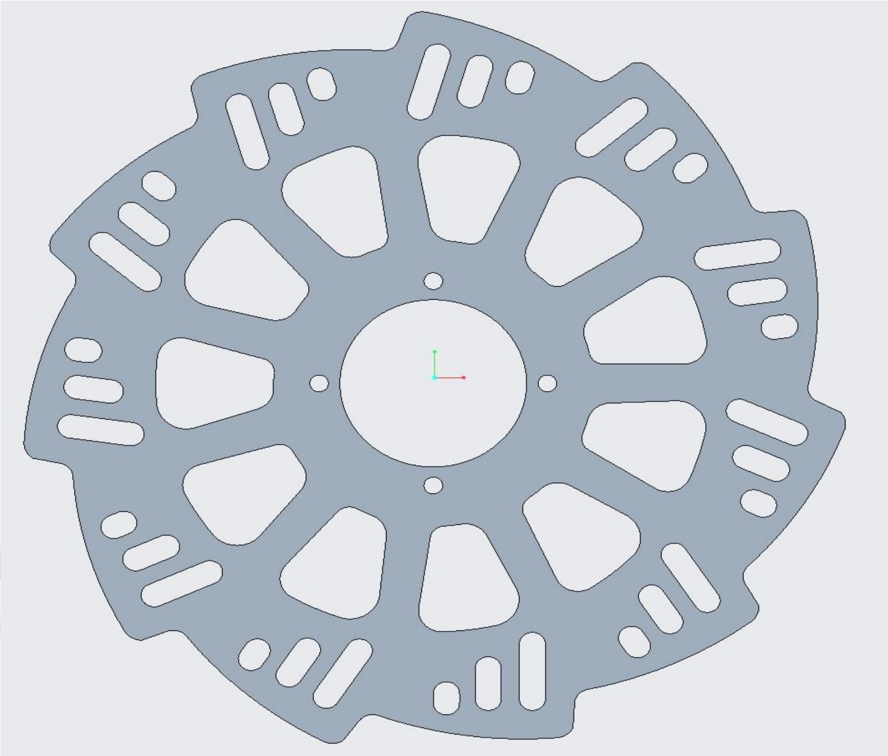

Figure 3 Modelling of Modified Model

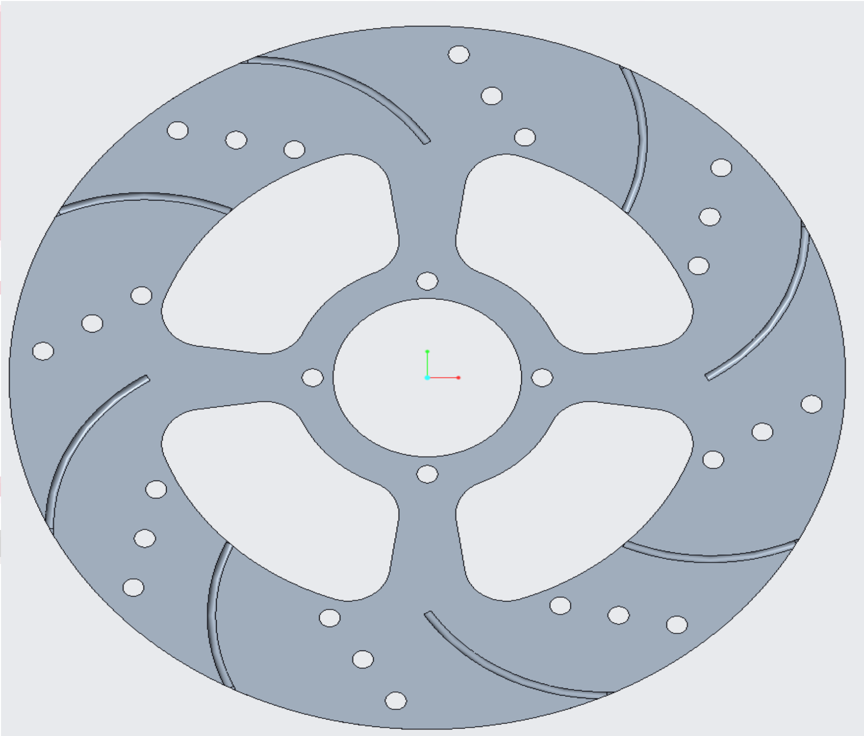

Figure 4 Modelling of Proposed Model Case 1

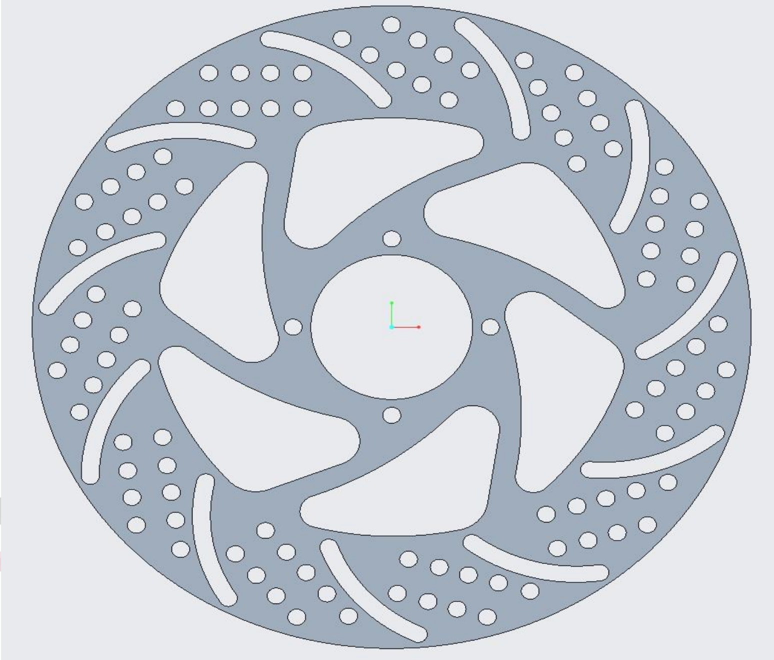

Figure 5 Modelling of proposed model case 2

IV. RESULT AND DISCUSSION

This section shows the comparative analysis of total deformation, total heat flux, equivalent stress and temperature in base model, modified model, proposed model (case 1 and case 2) which we have created in this research work.

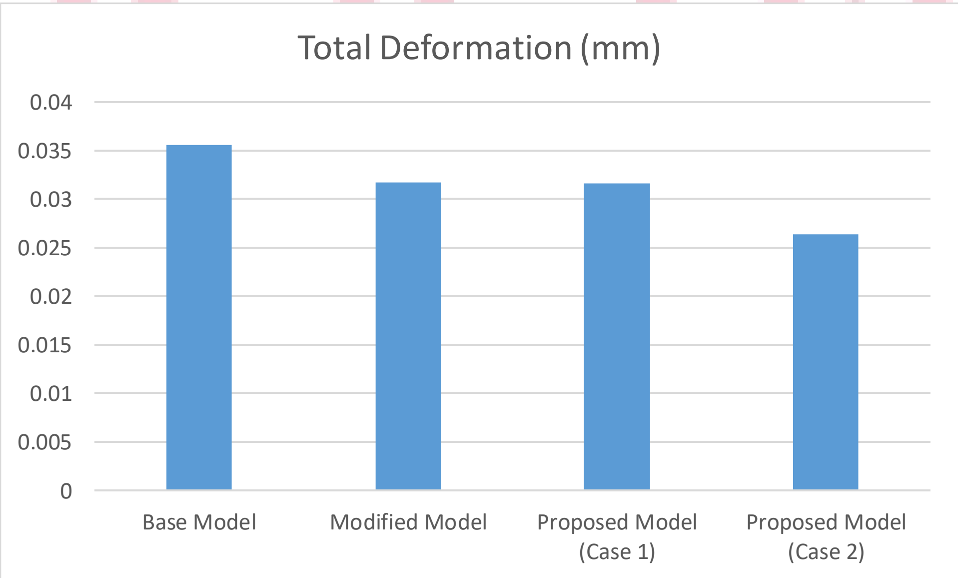

Figure 6 Graphical representation of total deformation in all the mode

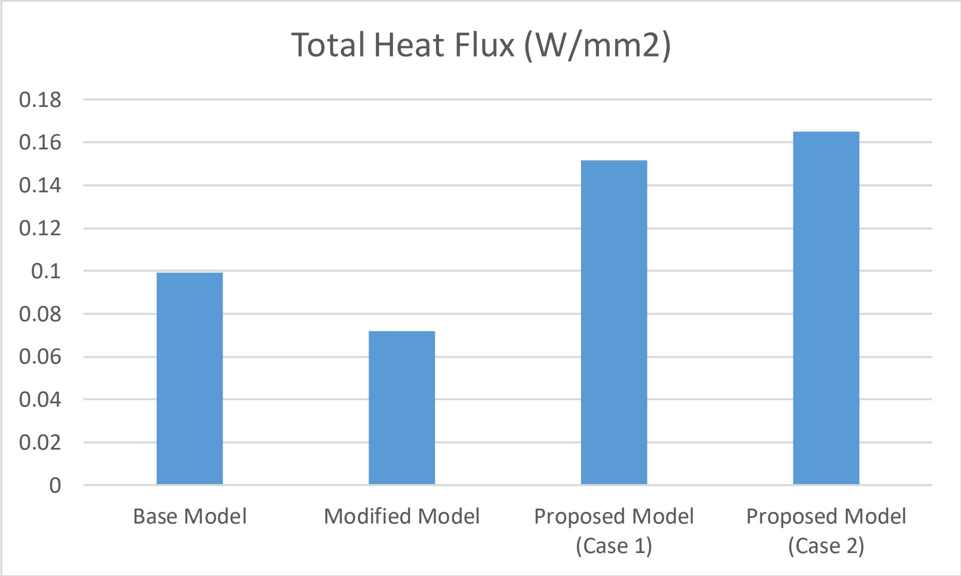

Figure 7 Graphical representation of total heat flux in all the models

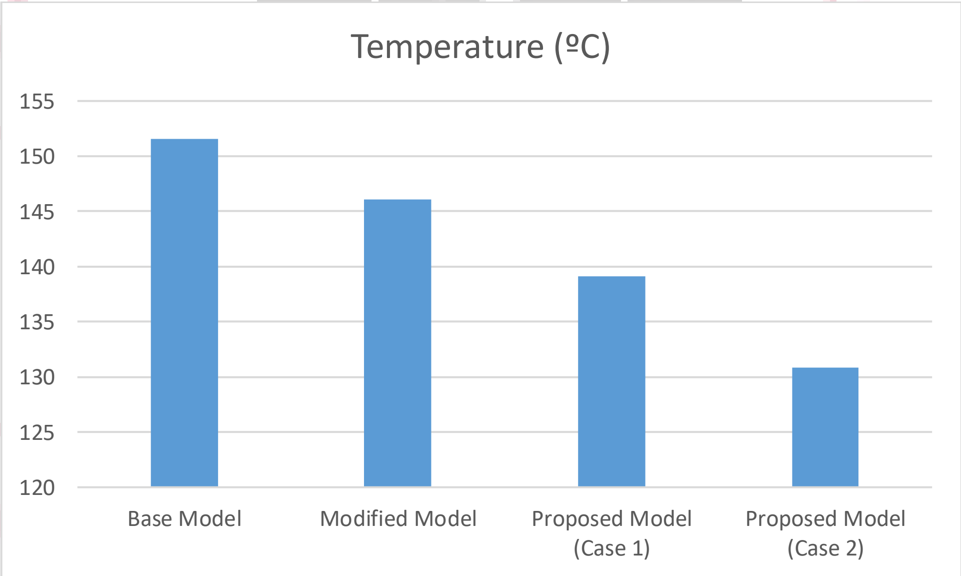

Figure 8 Graphical representation of temperature distribution in all the models

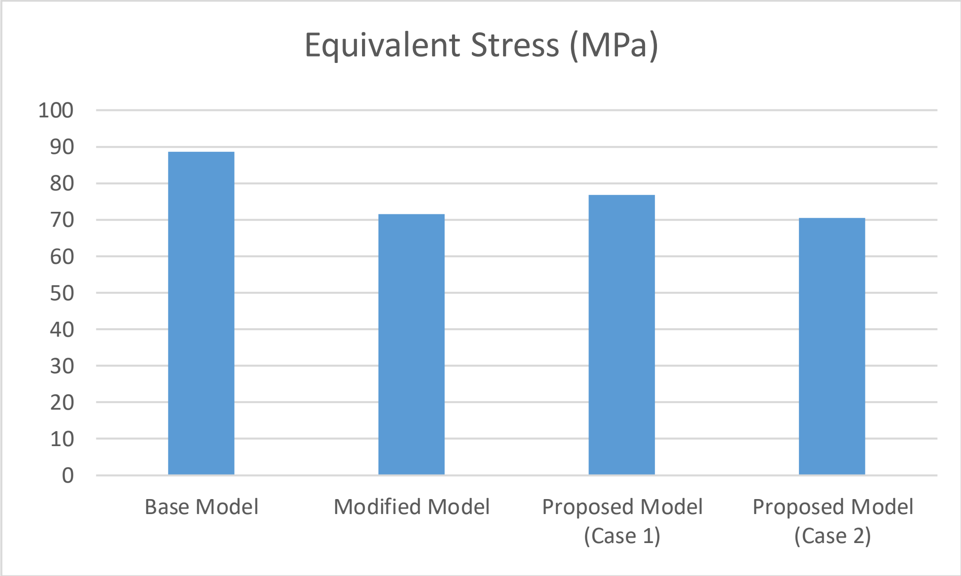

Figure 9 Graphical representation of equivalent stress in all the models

Figure 10 Graphical Comparison of the three models on basis of Stress and Deformation

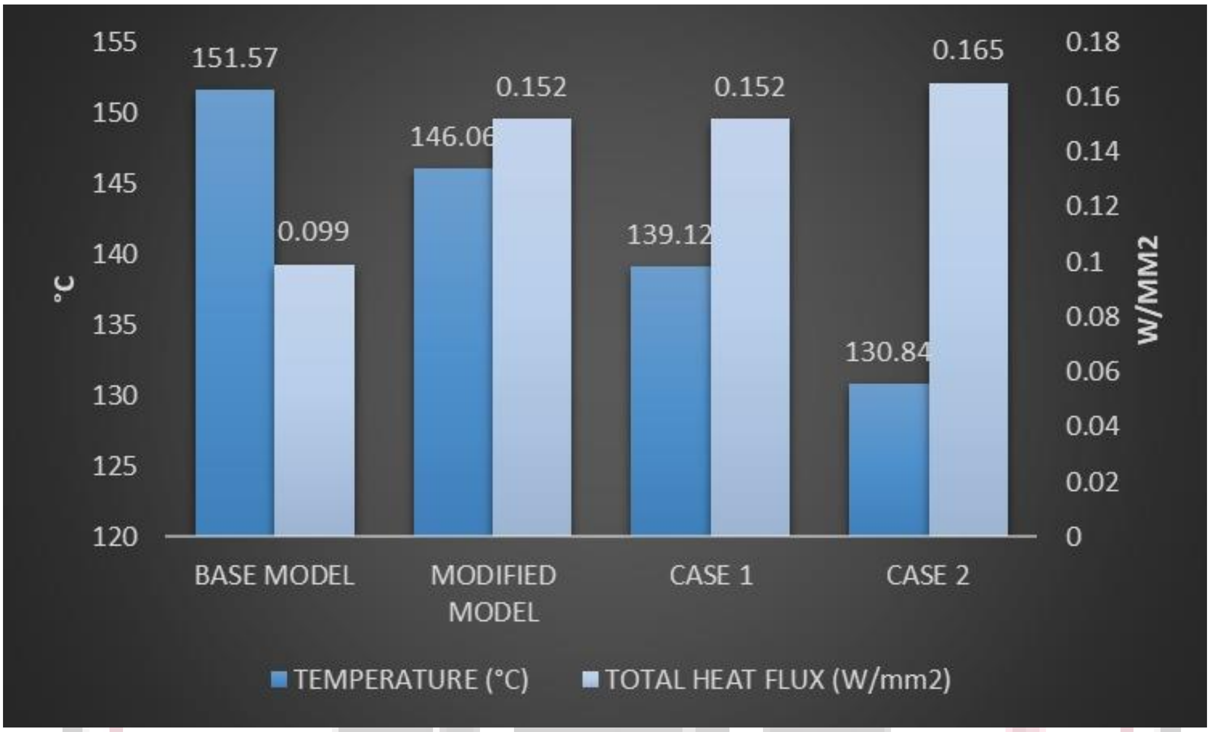

Figure 11 Graphical Comparison of the three models on basis of temperature and total heat flux

V. CONCLUSION

In this study, modified ventilated disk brake rotor has been developed with curved vents, and slots and analyzes the total deformation, total heat flux, equivalent stress and temperature distribution. Finite element models of the rotor are shaped with SolidWorks and simulated using ANSYS. The proposed models have been developed with the combination of straight slots, vanes, and edge cuts. ANSYS platform is used for mesh generation and numerical simulation.

- On comparing the equivalent stress of all the models we can see that, the maximum value of stress is found in base model i.e; 81.61 MPa which is reduced in our proposed model i.e; 70.50 MPa.
- On comparing total deformation of all the models, it is observed that base model has maximum value of deformation i.e; 0.036 mm whereas our proposed model reduces this value to 0.026 mm.
- On comparing the temperature of all the models we can see that, the maximum value of temperature is found in base model i.e; 151.57ºC which is reduced in our proposed model i.e; 130.84ºC.
- On comparing total heat flux of all the models, it is observed that base model has minimum value of total heat flux i.e; 0.099 W/mm2 whereas our proposed model enhances this value to 0.165 W/mm2.

After analyzing all parameters, it can be concluded that the proposed model case 2 shows better performance than the base model of disk brake rotor and can achieve high brake force avoiding cracking and buckling while running condition.

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