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Load Analysis of One and Two Piece Rotor of Disc Brakes Using Fea Package

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Abstract— Disc brake is a metal rotor that spins with the wheel. When the brakes are applied, a caliper squeezes the **disc pads** against the disc will slowing the wheel. Braking is a process which converts the kinetic energy of the vehicle into mechanical energy which must be dissipated in the form of heat. The disc brake is a device for deaccelerating or stopping the rotation of a wheel. A brake disc usually made of cast iron or ceramic composites is connected to the wheel and/or the axle. Friction material in the form of brake pads (mounted on a device called a brake caliper) is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc to stop the wheel. The present research is basically deals with the modeling and analysis of solid and ventilated disc brake using Pro-E and Ansys. In the analysis transient thermal and structural analysis of the rotor disc of disk brake is aimed at evaluating the performance of disc brake rotor of a car under severe braking conditions and there by assist in disc rotor design and analysis. The main purpose of this study is to analysis the thermo mechanical behavior of the dry contact of the brake disc during the braking phase. The coupled thermal-structural analysis is used to determine the deformation and the Von Mises stress established in the disc for the both solid and ventilated disc with two different materials to enhance performance of the rotor disc.

Keywords: Solid disc, Vented disc , Materials, Cre-o, Ansys.

I. INTRODUCTION

1.1 Introduction of brakes

Brakes are most important safety parts in the vehicles. Generally all of the vehicles have their own safety devices to stop their car. Brakes function to slow and stop the rotation of the wheel. To stop the wheel, braking pads are forced mechanically against the rotor disc on both surfaces. They are compulsory for all of the modern vehicles and the safe operation of vehicles. In short, brakes transform the kinetic energy of the car into heat energy, thus slowing its speed. Brakes have been retuned and improved ever since their invention. The increases in travelling speeds as well as the growing weights of cars have made these improvements essential. The faster a car goes and the heavier it is, the harder it is to stop. An effective braking system is needed to accomplish this task with challenging term where material need to be lighter than before and performance of the brakes must be improved. Clearly shows that, together with the steering components and tyres represent the most important accident avoidance systems present on a motor vehicle which must reliably operate under various conditions. However, the effectiveness of braking system depends on the design itself and also the right selection of material. systems than follow with some improvements. In order to understand the behaviors of braking system, there are three functions that must be complied for all the time (Smith, 2002).

- The braking system must be decelerate a vehicle in a controlled and repeatable fashion and when appropriate cause the vehicle to stop.
- The braking should permit the vehicle to maintain a constant speed when traveling downhill.
- The braking system must hold the vehicle stationary when on the flat or on a gradient.

Figure 1: Disc brake

II. MODELING OF DISC BRAKES

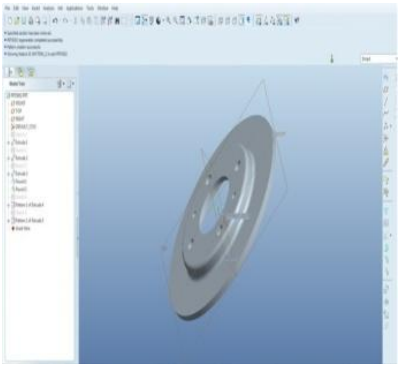
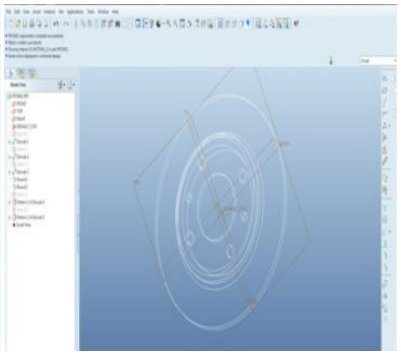



Figure 2: Solid one piece rotor model **Figure 3:** Wire frame model of solid one piece rotor

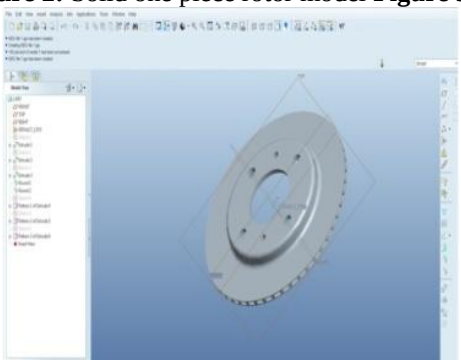
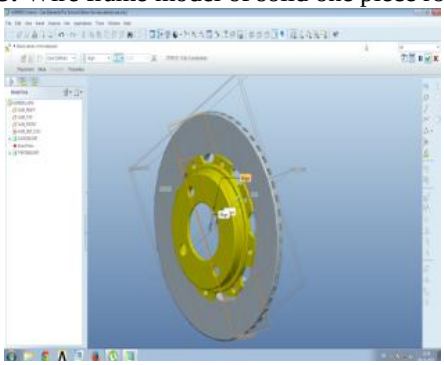



Figure 4: Vented one piece rotor model **Figure 5:** Assembly of two piece rotor model

III. ANALYSIS IN ANSYS

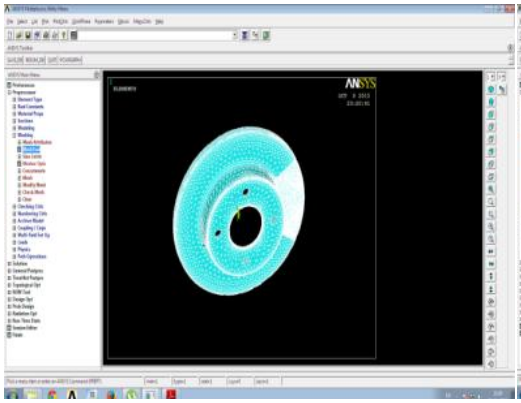
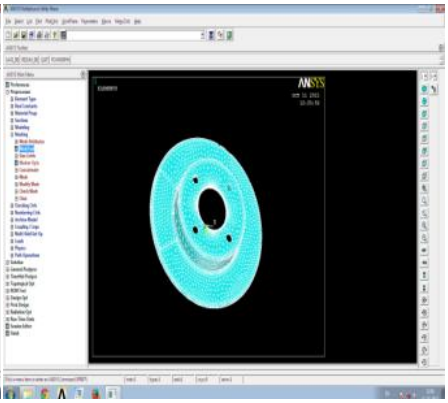



Figure 7: Meshed solid one piece rotor model **Figure 9:** Meshed vented one piece rotor model

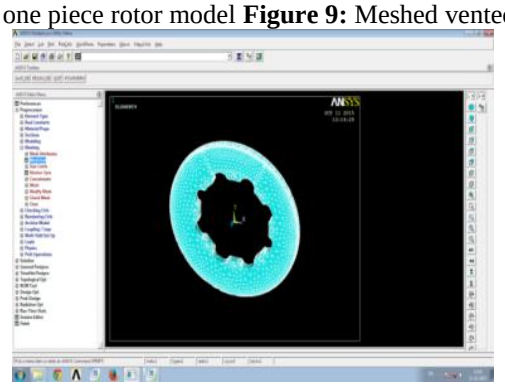


Figure 10: Meshed two piece rotor model

IV. RESULTS AND ANALYSIS

4.1 Solid disc

a. Cast iron

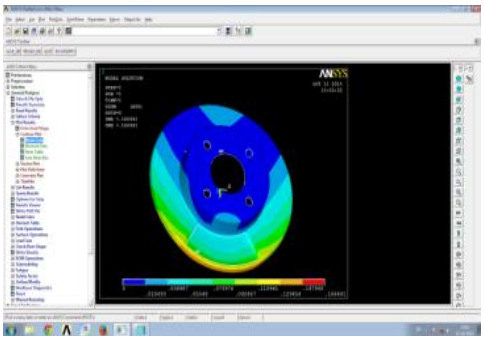
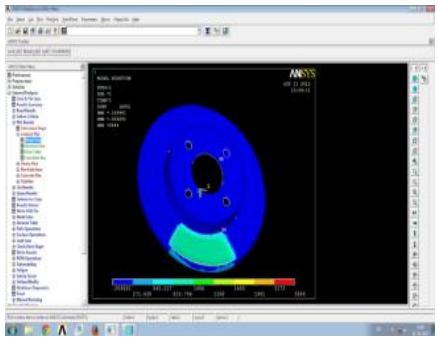



Figure 11: Total deformation **Figure 12:** Stress intensity

b. Alloy steel

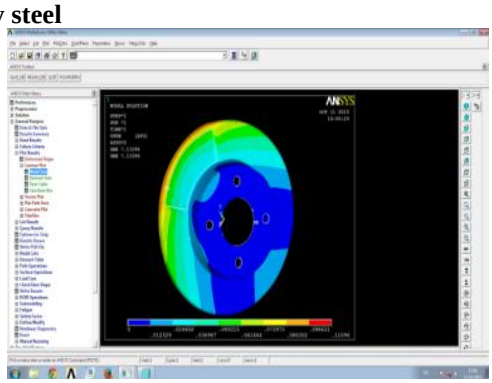
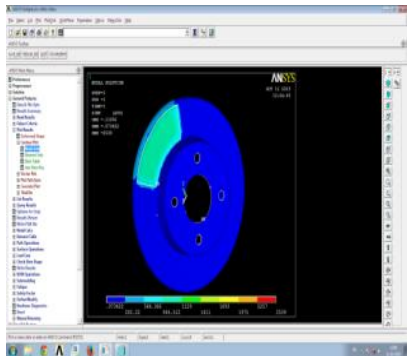



Figure 13: Total deformation **Figure 14:** Stress intensity

c. Carbon composite alloy

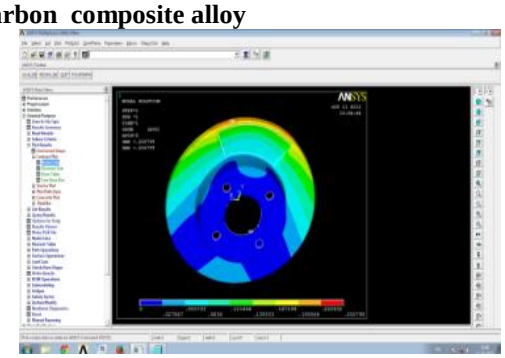
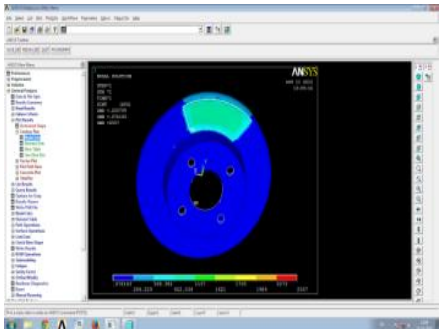



Figure 15: Total deformation **Figure 16:** Stress intensity

4.2 Vented model

a. Cast iron

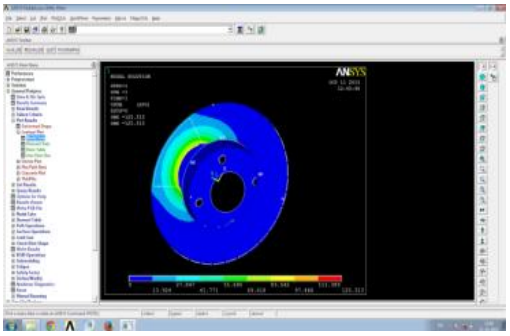
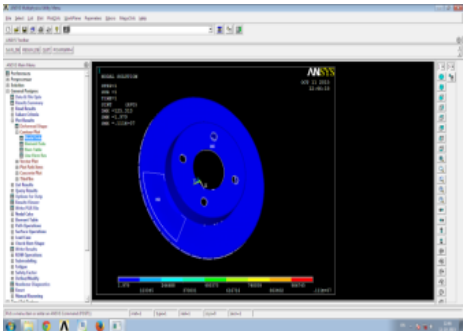
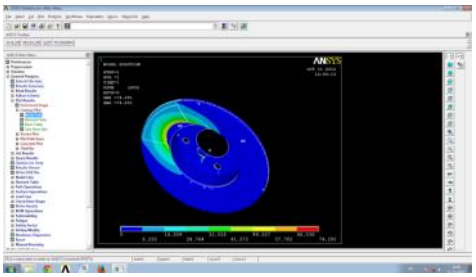



Figure 17: Total deformation **Figure 18:** Stress intensity

b. Alloy steel



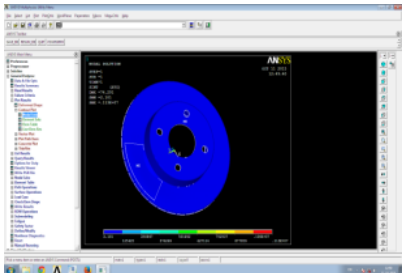
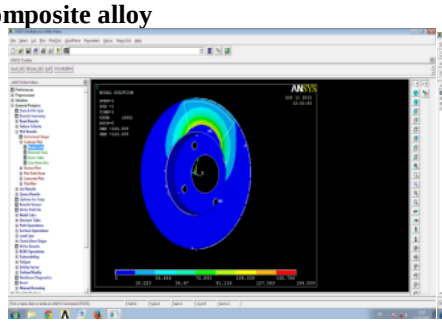


Figure 19: Total deformation **Figure 20:** Stress intensity

c. Carbon composite alloy



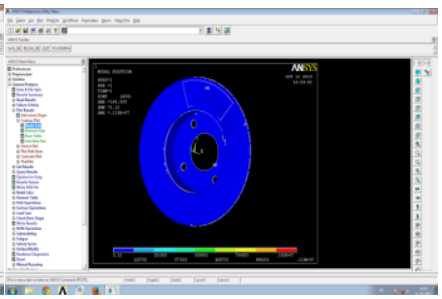
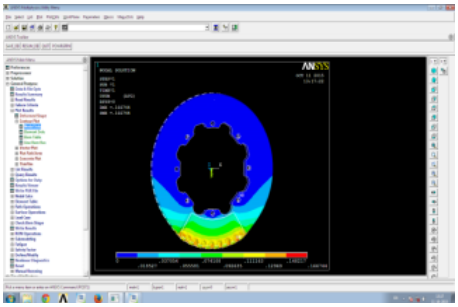


Figure 21: Total deformation **Figure 22:** Stress intensity

4.3 Two piece rotor model

a. Cast iron



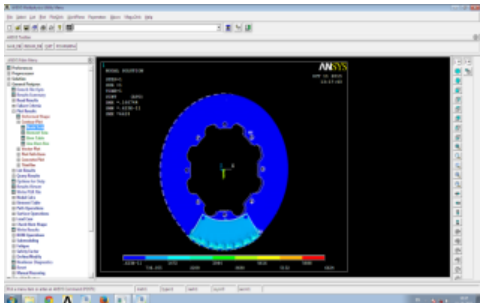
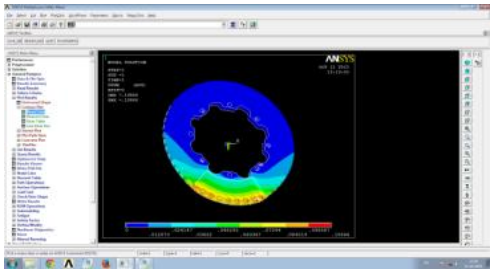


Figure 23: Total deformation **Figure 24:** Stress intensity

b. Alloy steel



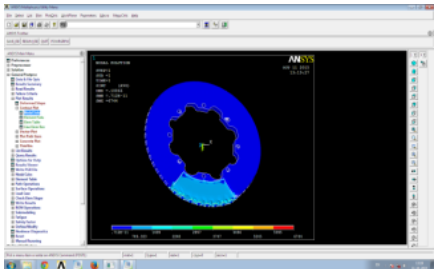
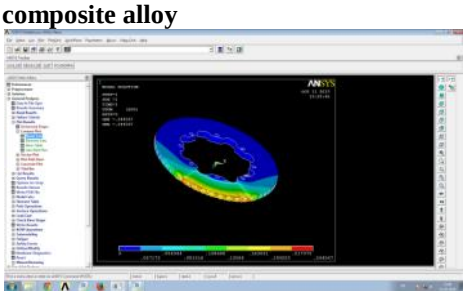


Figure 25: Total deformation **Figure 26:** Stress intensity

c. Carbon composite alloy



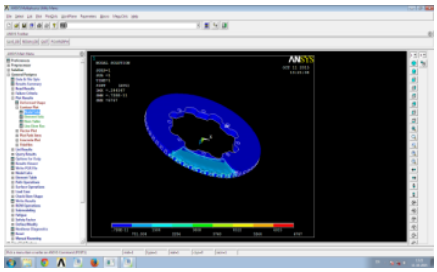


Figure 25: Total deformation **Figure 26:** Stress intensity

4.4 Results comparison

S no	*Type*	*Total deformation*	*Stress intensity*
1	Solid	.166441	2444
2	Vented -1	125.313	.111E+07
3	Vented -2	.166744	6624

Table no 1: Cast iron results

S no	*Type*	*Total deformation*	*Stress intensity*
1	Solid	.11096	2539
2	Vented -1	74.291	.113E+07
3	Vented -2	.10866	6744

Table no 2: Alloy steel

S no	*Type*	*Total deformation*	*Stress intensity*
1	Solid	.250799	2557
2	Vented -1	164.009	.113E+07
3	Vented -2	.244547	6767

Table no 3: Carbon composite alloy

V. CONCLUSION

The modeling and analysis of the rotors done using cre-o and Ansys. The thesis contains the modeling of three rotors which are solid one piece rotor, vented one piece rotor and two piece rotors from the existing dimensions. And analysis is performed on the three rotors by using three different materials under same load condition. After the simulation results were compared by the results we observed that the two piece rotor has the values mast nearly to the solid and vented one piece rotors and also with the comparison of used material we observed that the alloy steel performing good compared to other two materials. By this we conclude that the two piece rotor with alloy steel is the better for the disc brakes manufacturing

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