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CAD MODELLING AND THERMAL ANALYSIS OF DISC BRAKE BY USING OXIDE AND NON OXIDE MATERIAL

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Abstract

Vehicle braking system is considered as one of the most fundamental safety-critical systems in modern vehicles as its main purpose is to stop or decelerate the vehicle. The frictional heat generated during braking application can cause numerous negative effects on the brake assembly such as brake fade, premature wear, thermal cracks and Disc Thickness Variation (DTV). In the past, surface roughness and wear at the pad interface have rarely been considered in studies of thermal analysis of a disc brake assembly using finite element method. Motivation of this project is to reduce the weight of disc rotor by replacing conventional materials with composites. The objective of this research is to design and manufacturing aluminum metal matrix composite disc brake by using Stir casting method. AL6061 is used as a base alloy and Al2O3 matrix material. After manufacturing define thermal performance of disc brake models. Thermal performance was a key factor which was studied using the 3D model in Finite Element Analysis simulations. Experimental validation of FEA RESULTS will enable to understand how implemented disc brake works more efficiently, which can help to reduce the accident that may happen in each day

Key Words: *Connecting Rod, Piston, Engine, Stainless Steel, Aluminium Alloy, Pro-E Software, ANSYS Software*

1. INTRODUCTION

Disc brakes are an important component of a vehicle retardation system. They are used to stop or adjust the speed of a vehicle with changing road and traffic conditions. During braking, a set of stationary pads is pressed against a rotating disc to reduce the speed. The heat generated at the disc-pad interface due to friction causes the disc surface temperature to rise in a short period of time. This heat gets transferred to the vehicle and the environment, and the disc cools down. As a result of higher temperatures, in addition to local changes of the contact surfaces, there are deformations occurring in the disc and the pad. Due to different geometries of discs, each disc has different geometrical constraints for the thermal expansion. After some brake cycles, the frictional heat generated during braking application can cause numerous undesirable effects on the brake disc such as brake fade [2,13,10,11], thermal cracks [19,10,11,20], wear [19,10,11], permanent damage [20], breakage in brake disc due to high stress [10], disc thickness variation [8], formation of hot spots Macroscopic cracks [10] might also appear on a disc surface in the radial direction, affecting the performance and life of a brake disc. It has been shown, that during hard braking, high compressive stresses are generated in the circumferential direction on the disc surface which causes plastic yielding. But when the disc cools down, these compressive stresses transform to tensile stresses. When this kind of stress-strain behaviour is repeated due to frequent braking actions, stress cycles with high amplitudes are developed which might generate low cycle fatigue cracks after repeated braking cycle

2. OBJECTIVE OF THE STUDY

The objectives of this project are to:

1. Developed a reduce thermal conductivity model for disc break using CAD software.
2. Investigate the stress analysis of aluminium alloy ANASYS software.
3. Investigate the maximum stress of disc break using ANASYS software.

The computational stress from finite element analysis will be carried out on a CAD connecting rod design. The two different materials are chosen for analysis is structural steel and aluminium alloy. The geometry model for the connecting rod had drawn using CAD software. The analysis was running using ANASYS software. The apply load for the analysis is 900 only

3 .LITERATURE REVIEW

Shaikshavali, G. & Mohan, M. & Goud, E.. (2018). Mechanical Characteristics of Ceramic Particulate Reinforced Al7075 Metal Matrix Composites and Effect of Age Hardening on its Tensile Properties. International Journal of Mechanical and Production Engineering Research and Development. 8. 173-180. 10.24247/ijmperdapr201819

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Calladine, C. (1966). On the Design of Reinforcement for Openings and Nozzles in thin

Spherical Pressure Vessels. Archive: Journal of Mechanical Engineering Science 1959-1982 (vols 1-23). 8. 1-14.10.1243/JMES_JOUR_1966_00_003_02

4 .DISC BREAK WITH OXIDE AND NON OXIDE MATERIAL

The Disc brakes are an important component of a vehicle retardation system. They are used to stop or adjust the speed of a vehicle with changing road and traffic conditions. During braking, a set of stationary pads is pressed against a rotating disc to reduce the speed. The heat generated at the disc-pad interface due to friction causes the disc surface temperature to rise in a short period of time.

A metal matrix composite (MMC) is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound.

When at least three materials are present, it is called a hybrid composite. An MMC is complementary to a cermet.

The thermal analysis, it can be observed that AMC 6061 is a suitable material for a brake disc in terms of mechanical and thermal properties. Hence AMC 6061 is selected as a suitable material for manufacturing of modified brake

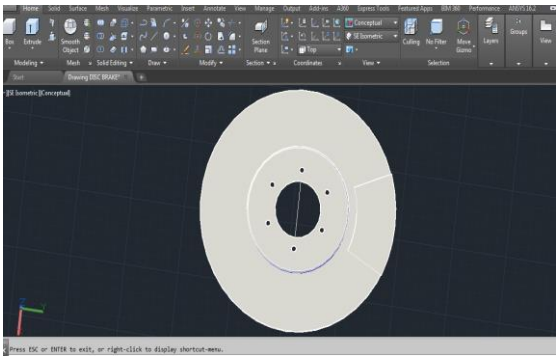
5 .METHODOLOGY

1. Design the disc brake
2. Material selection
3. Structure design
4. Cad modeling
5. Export to iges format
6. Import to ansys
7. Mesh the solid model
8. Select the analysis method
9. Put the input value of material
10. Solve the values by the way of analysis method
11.Take the result from result data sheet.

6 . MATERIAL USED FOR ANALYSIS

MATERIALS AND METHOD: A metal matrix composite (MMC) is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. An MMC is complementary to a cermet. There are many definitions of metal matrix composites which are widely accepted worldwide and in general metal matrix composites are materials which consist of two or more materials phases with primary bulk phase of metal. The bulk metal material in which other materials are added is called matrix phase, whereas materials added to alter the properties are called reinforcements, which are in the form of particles or fibers and are dispersed in the metalmatrix.

7 . CAD MODELING



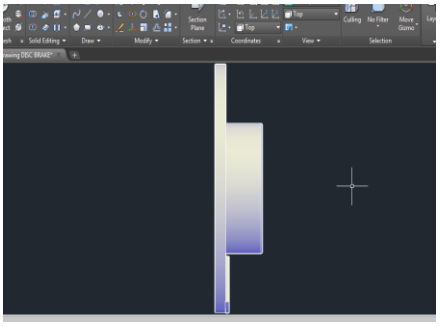
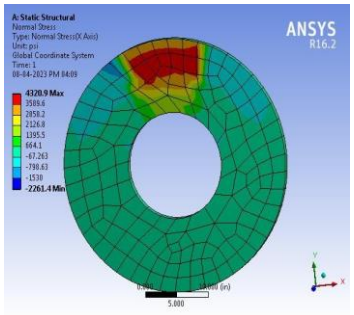
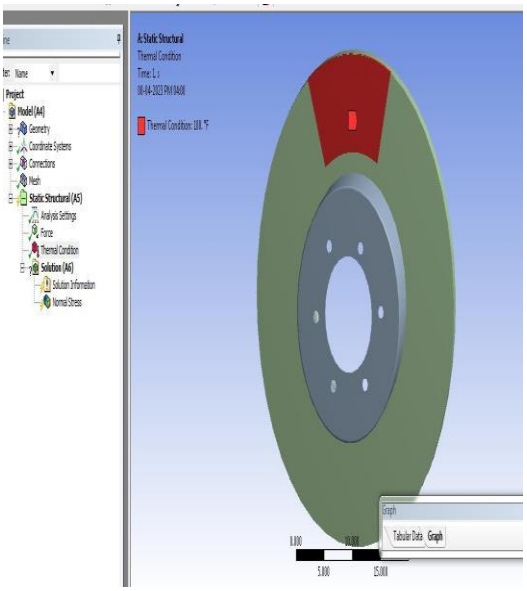


Figure 7.1 cad diagram

8 . ISOMETRIC VIEW:

Figure 8 various view





ANASYS MATERIAL SELECTION

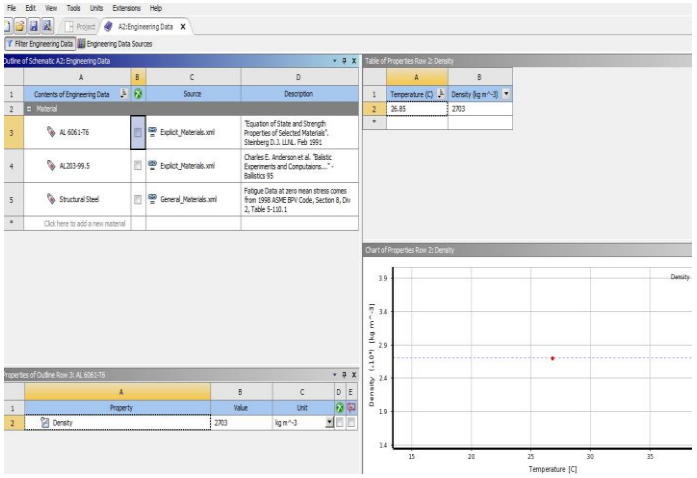
9 . MERITS

1. Reduce a thermal reaction
2. Less heat transfer
3. Heat less for compare other discs.

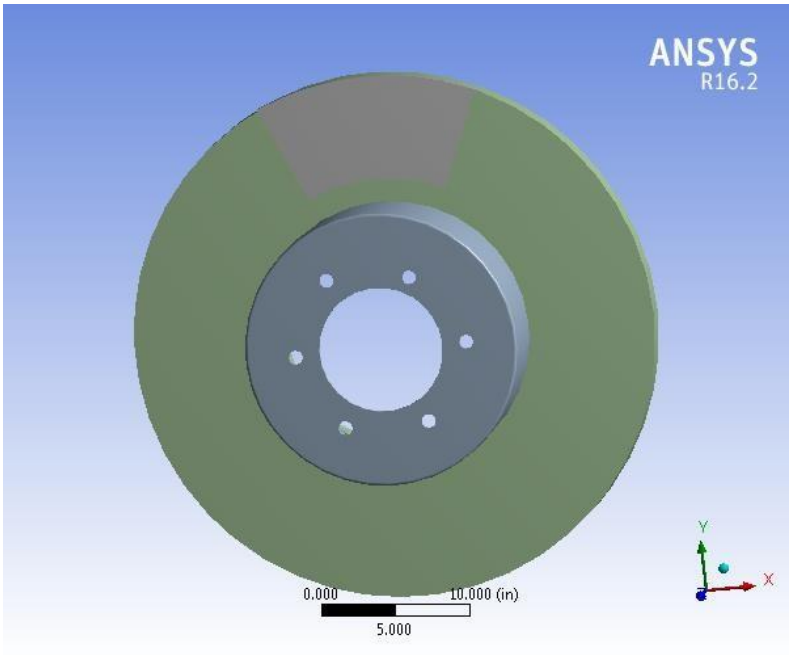
10 . PROCEDURE OF ANALYZING

CAD VERSION: AUTOCAD 2016

INPUT TEMPERATURE:



RESULT:



Normal Stress

11 . CONCLUSION

This experimental study aimed at preparing an Al6061 hybrid metal matrix composite (AHMMC) with the non-metallic ceramic reinforcement materials SiC, Al_2O_3, and fly ash using the stir-casting technique and to explore its mechanical characterization. The density of the proposed composite is decreased and the mechanical properties, including hardness, tensile strength, and yield strength, were slightly lowered compared to that of an Al6061 MMC reinforced with a single ceramic reinforcement material. The AHMMC prepared with equal amounts of SiC, Al_2O_3, and fly ash (each of 5 wt %) possesses a tensile strength of 117 MPa,a yield strength of 79 MPa, and a hardness of 53 BHN. The present study is confined to observing the variation of mechanical properties with the simultaneous increase of weight percentage of SiC and Al_2O_3 in equal amounts in two steps (7.5% each and 10% each) and without any change in fly ash content. The following remarks can be made.

When the SiC and Al_2O_3 content of each increased from 5% to 7.5%, the tensile strength of the composite increased by 8.2%, the yield strength increased by 36.48%, and the hardness increased by 20%.

The increase of SiC and Al_2O_3 content from 5% to 10% leads to an increase of tensile strength and yield strength of the composite by 10.4% and 25%, respectively. However, the hardness of the composite decreased by 16%.

On comparison with the base metal Al6061, the proposed composite exhibits a good improvement in tensile strength, yield strength, and hardness. However, no significant change is observed in impact strength.

12. REFERANCE

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