© September 2020| IJIRT | Volume 7 Issue 4 | ISSN: 2349-6002

Finite Element Analysis of Magnesium Metal Matrix Composites Disc Brake

Satish J[1], K G Satish[2]
[1]*Assistant Professor, SJM Institute of Technology, Chitradurga*
[2]*Assistant Professor, UBDT College of Engineering, Davanagere*

***Abstract* - There is a impressive shift in technology from transmission system to braking system in today's changing automotive market. From the point of view of performance as well as safety the braking system is regarded as one of the most critical systems. Disc brake is the latest development in automotive vehicles that dissipates the heat more quickly than traditional drum brakes. The key advantage of the disc brake is that the friction material i.e. the caliper is in contact with just a small portion of the surface. Therefore, the disc has a large surface area that can dissipate the heat into the atmosphere. In this paper static stress analysis of disc brake made up of magnesium metal matrix composites, is conducted using finite element analysis. The disc model was developed in solid works software and imported to Ansys workbench for analysis. Structural analysis is used to determine the deformation and von misses stress established in the disc.**

***Index Terms* - Disc brake, structural analysis, Ansys, FEA analysis.**

I.INTRODUCTION

Disc brake is one of the forms of brake that uses callipers to force stationary pads to maintain a pressure on the spinning disc. The vehicle retardation is achieved by applying the pressure on the disc & calliper assembly that is connected to the wheel or axle. The vehicle's kinetic energy is converted to the heat energy that is then dissipated into the surrounding area [1]. In an immediate situation, the brakes have to be powerful enough to stop the vehicle within a minimum distance. the driver must have sufficient control over the vehicle during extreme situation braking and the vehicle should not skid [2]. Hydraulically actuated pistons bring the friction pads into contact with the spinning disk as brakes are applied, causing equal and opposite forces on the disk. Because of the friction between the disk and the pad the kinetic energy of the rotating wheel is converted into heat which stops the vehicle after a certain distance. The rubber-sealing brakes act as a return spring while releasing the brakes and pull the pistons and friction pads away from the disc [3]. Figure 1 shows the parts of disc brake.

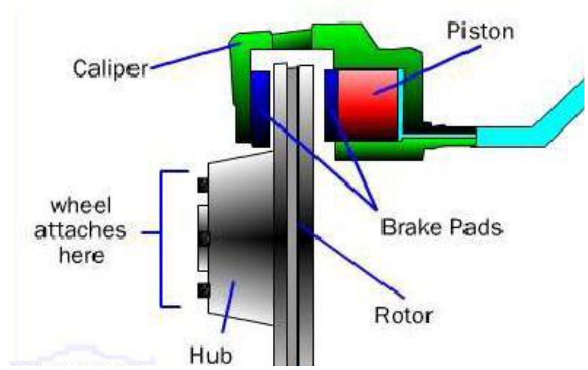

Figure 1: Parts of a Disc Brake [4]

II. METHODOLOGY

The design, size and measurements of the disk are based on the actual measurements used in two-wheeler Honda Shine vehicle. The disc model was developed in solid works software and imported to Ansys workbench for analysis. ANSYS is a finite element analysis software. To solve problems, ANSYS requires three phases of pre-processing, solution & postprocessing. Pre-processing step includes the preparation of FE model, real constant, property of materials & discretization. The analysis is carried out in ANSYS using the following procedure.

- First, the measurements of the disc were taken from two-wheeler Honda Shine vehicle.
- Design the disc model through the Solid works software.
- After starting the ansys workbench 19.0, import the disc model and the analytical mode is taken as steady structural state.

- The properties of the materials are described for the model profile.
- The model is then meshed where the pertinence or meshing is defined i.e. fine meshing.
- The limit (boundary) conditions are introduced to the brake disc after meshing.
- From the solution bar select the parameters whose solution is needed.
- The results have been obtained in the form of contour image.

III. MATERIAL PROPERTIES AND MODEL OF DISC BRAKE

Hybrid composites i.e., magnesium metal matrix reinforced with silicon carbide and aluminium oxide was selected as a material for disc brake due its specific properties. Table 1 shows the properties of magnesium metal matrix composites. The disc model was developed in solid works software and measurements of the disc was taken from two-wheeler Honda Shine vehicle. Geometry of the model was shown in the figure 2.

Table 1: Properties of material

Properties	Density (g/cm^3)	Young's Modulus (Gpa)	Poisons ratio
Magnesium metal matrix composites	1.67	47	0.34

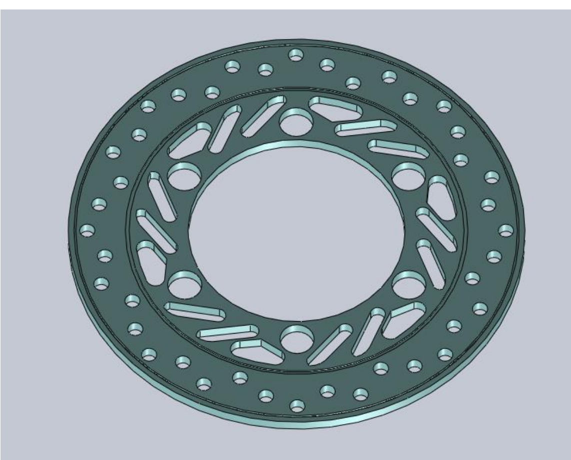

Figure 2: Geometry of the model

IV. RESULTS AND DISCUSSIONS

It is important to investigate the use of new materials to improve the braking efficiency and facilitate greater vehicle reliability. Acceptable hybrid fusion material that is lighter than structural steel and has good elasticity modulus, characteristics of yield strength and density. Structural analysis is used to determine the deformation and von misses stress established in the disc. A static analysis measures the effects on a system of steady loading conditions, while ignoring inertia and damping effects like those induced by time-varying loads. However, a static study can involve steady inertia loads (such as gravity and rotational speed), and time-varying loads which can be approximated as static equivalent loads. Figure 3 - 8 indicates the total deformation, deformation in x, y, z axis, normal stress and strain developed in the disc.

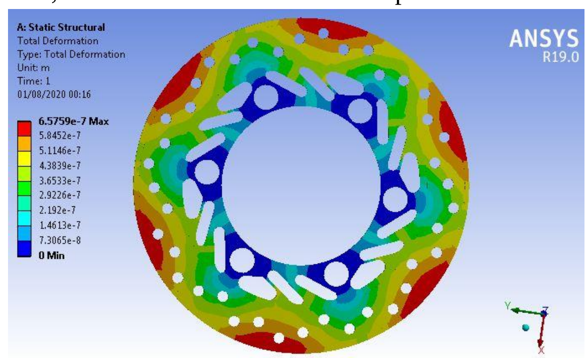

Figure 3: Total Deformation

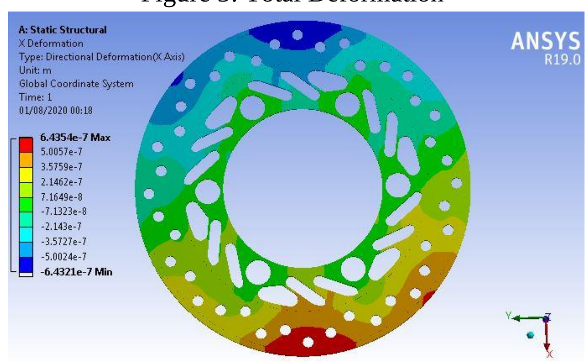

Figure 4: Deformation in X axis

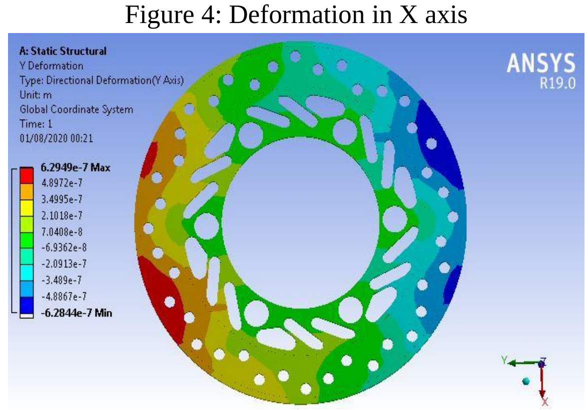

Figure 5: Deformation in Y axis

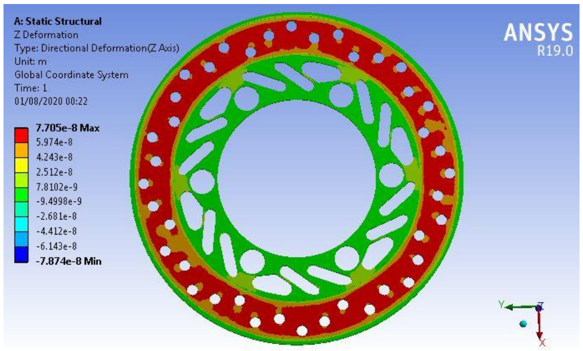

Figure 6: Deformation in Z axis

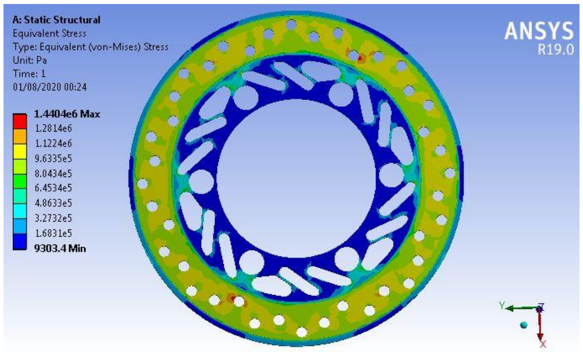

Figure 7: Normal Stress

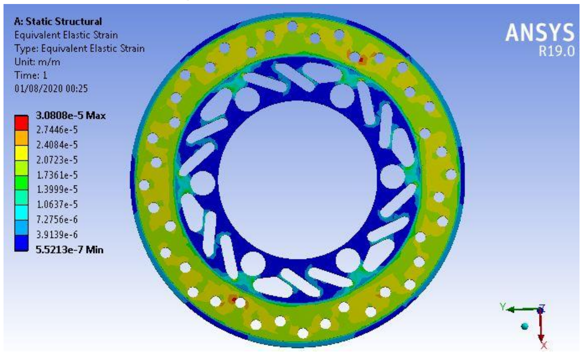

Figure 8: Normal Strain

V. CONCLUSION

Measurements of the disc was taken effectively from two-wheeler Honda Shine vehicle. Disc brake was successfully designed through solidworks software. Total deformation, normal stress and normal strain were successfully determined by conducting the static structural analysis through ansys workbench 19.0. All the values derived from the analysis are lower than their permissible values. Brake disk design is secure, based on the standards of strength and rigidity. By observing the results of structural analysis, it may conclude that, magnesium metal matrix composites may consider as an appropriate material for the disc brake.

REFERENCES

[1] Swapnil.D.Kulkarni, J.J.Salunke, "Thermal Analysis of Brake Disc", International Journal of Research in Engineering and Technology, Volume: 06 Issue: 02, Feb-2017.

[2] Shailendra Pratap Gautam, Sateesh Chandra Yadav, Salim Akhtar, Vimlash Sahani, Sandeep Tiwari, Deepak Kumar Yadav , Shyam Bihari Lal, "Finite Element Analysis Of Disc Brake using ANSYS WORKBENCH Software ", International Journal of Scientific & Engineering Research, Volume 6, Issue 4, April-2015.

[3] Meesala Vanajakshi, Pothuraju. V. V. Satyanarayana, E. Lakshmi Devi, "Static Structural Analysis of Vented and Non-Vented Disc Brake", International Journal of Trend in Scientific Research and Development, Volume 3 Issue 5, August 2019.

[4] Prashant P. Suryawanshia,Amol R. Tanpurea,Sachin R. Dhatraka,Bhavesh C. Lokhandea,Rohan D. Hucche, "Thermal and Structural Analysis of two wheeler Disc Brake", International Journal of Innovative and Emerging Research in Engineering, Volume 4, Issue 4, 2017.

[5] Rajkamal Dhavamani, "Structural Analysis of Disc Brake", International Journal of Mechanical Engineering and Technology (IJMET), Volume 9, Issue 3, March 2018, pp. 846–856.

[6] V. Saritha, Vinayak G. Kachare, "Finite Element Analysis of Disc Brake Rotor Using Different Materials", International Journal of Mechanical Engineering and Technology (IJMET), Volume 7, Issue 6, November–December 2016, pp.410–416.

[7] Bansal D Simaria, Himanshu P Ravaliya, Jigar H Chaudhary, Sagar P Parmar, Pravin R Parate, "Structural Analysis of Rotor Disc of Disc Brake", International Journal of Advance Research in science and engineering, volume 06, special issue No.(04), December 2017.

[8] Swapnil R. Abhang, D.P.Bhaskar, "Design and Analysis of Disc Brake", International Journal of Engineering Trends and Technology (IJETT) – Volume 8 Number 4- Feb 2014.

[9] Daniel Das.A, Christo Reegan Raj.V, Preethy.S, Ramya Bharani.G, " Structural and Thermal Analysis of Disc Brake in Automobiles ", International Journal of Latest Trends in

Engineering and Technology (IJLTET), Vol. 2 Issue 3 May 2013.

[10] M.D. Rajkamal, "Structural Analysis of Disc Brake", International Journal of Mechanical Engineering and Technology (IJMET), Volume 9, Issue 3, March 2018, pp. 846–856.

[11] Sagar B. Porlekar, S.G. Bhatwadekar, G.R Kulkarni, "Design, analysis and optimization of brake disc made of composite material for a motor cycle", International Journal of Research Publications in Engineering and Technology [IJRPET], Volume 3, Issue 3, March-2017.

[12] N. Balasubramanyam, smt. G. Prasanthi, "Design and Analysis of Disc Brake Rotor for a Two-Wheeler", International Journal of Mechanical and Industrial Technology (IJMIT)-Vol. 1, Issue 1, pp: (7-12), Month: October 2013-March 2014.