

Literature Review 'Experimental and Finite Element Analysis of the Drum Brake'

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Abstract - It is important to evaluate the braking systems that have been designed to predict the behavior of the braking system than followed with improvements. In automobile vehicles the braking system is most important safety system. Mechanical fatigue failures occur due to cyclic loading during the operation. The fatigue study can be done by considering a loading, time, surface condition and material. So the finite element analysis (FEA) method is used to evaluate the performance under fatigue loading. Also, the experimental test of the fatigue gives the validation of the design.

Key Words: Braking system, Fatigue, Finite element analysis (FEA), cyclic loading, validation of design.

1. INTRODUCTION

The brake system is vital in the automobile. The brakes are used to stop or slow down the speed of the vehicle. If the braking system miscarries, there may be a crash. The drum brake's strength, stiffness and dynamic characteristics directly affect the working characteristics and service life of the braking system, and vehicle safety, comfort, handling stability, noise [01].

Fatigue is a phenomenon related with cyclic stressing or straining of a material. Endurance or fatigue limit can be defined as the magnitude of stress amplitude value at or below which no fatigue failure will occur, no matter how large the number of stress reversals are, in other words leading to an infinite life to the component or part being stressed. The fatigue stresses distribution on the component depends on the various factors such as application of loading, the material of the component, loading time, surface roughness. The fatigue failure analysis of the component is significant in order to improve the component's life [02]. The Finite Element Analysis (FEA) is the simulation of any physical phenomenon by using the numerical method called Finite Element Method (FEM). Engineers use it to reduce the number of physical prototypes and experiments and optimize components in their design phase to develop better products, faster. FEA is a virtual environment, for the

purpose of finding and solving structural or performance issues [03] [04] [05].

To improve the brake performance and also the stability of the vehicle braking system, it is of vital important to carry out finite element analysis of the brake drum. Previous literatures studied the design, optimization and finite element analysis of the braking system related functional components [05]. The FEA and experimental test of the brake drum were rarely studied. However, the FEA of the brake drum plays an important role. Through FEA and experimental test, the design validation of the brake drum can be obtained. Therefore, in this paper, the FEA and experimental test of a certain type of brake drum is carried out, and its results provide reference for design and manufacture [06] [07] [08].

2. LITERATURE REVIEW

Shenshen Shi [01] discussed that the basic principle and composition, structure of automobile brake system. The vehicle brake system is the most chief system in vehicles. If the brake be unsuccessful, there may be a crash. In addition, vehicle brake system is a crucial constituent to measure the performance of a vehicle. [24 May 2016]

Prof. K. Gopinath *et al.* [02] discussed on design aspects related to fatigue failure, an important mode of failure in engineering components. Fatigue failure causes mainly due to cyclic variations in the applied loading or induced stresses. Detailed about how component leads to fatigue failure, what factors influence them, how to account them and finally how to design parts or components to resist failure by fatigue.

D. R. Marigoudar *et. Al* [03] research study of the part of fatigue life in design of mechanical components, and the methods to compute the fatigue life of the different components. Its role in on new designs in enhancing the design based on the life of the components.

Klaus-Jurgen Bathe [04] described that the Finite Element Procedures. FEA is now an important part of engineering analysis and design. Finite element analysis is practically for the analysis of structures, solids and fluids. Designers use it to minimize the number of physical prototypes and tests and optimize components in their design phase to improve products, in minimum time period.

Dan Yang *et. al* [05] studied that the dynamic characteristics of the brake drum are theoretically calculated and studied by the finite element method in ANSYS software. Through the analysis and calculation of the model, the natural frequencies and vibration shapes are computed, which provides a reference for analysis and design of the brake drum.

Meenakshi *et. al*. [06] optimized the design of Hero Honda Passion brake drum. Optimization is done by changing the material of the brake drum, under different braking time and operational conditions with different stresses, deformation values. Optimized results concludes that the CE alloys can be a better material for brake drum applications of light commercial vehicles and it also increases the braking performance. [Aug. 2015]

Panithi Dasu *et. al*. [07] carried out a detailed static and fatigue analysis of aluminum alloy wheel under a radial load have been done using FEA package. Fatigue performance is a main consideration in the design and performance assessment. It is tough to measure fatigue life by analytical methods. So, finite element analysis has been used to evaluate the performance of wheels over their life and results show that design is safe. [April 2017]

Uday Pratap Singh *et. al*. [08] carried out to design the drum brake by using the finite element analysis. The brake drum is analyzing under given boundary conditions for cast iron, aluminum metal matrix composite and stainless steel. A static structural and thermal analysis of different materials is done. The FEA results of all these material; aluminum metal matrix shows less value of deformation as well as maximum von-mises stress under static structural analysis. [June 2018]

V. Dharani kumar *et. al*. [09] analyzed aluminum alloy A356 wheel subject to different loads under running conditions for fatigue loading. Fatigue life of Al-alloy wheel A356 has been studied for the radial loading and test situations. The result of static and fatigue analysis of alloy wheel is found out. Also the life of the wheel, factor of safety by using S-N curve found out. [2014]

P. Venkataramana *et. al*. [10] studied that the factors in FEM for more accuracy. Designing the brake drum under altered load and speed situations. The obtained stresses in the brake drum are lower the allowable stresses of the brake drum material so the design will be acceptable. [April 2013]

3. CONCLUSIONS

- The braking system is the vital element of the automobiles which reduce the speed or sudden stop of the automobile. The drum brake's strength characteristics are directly affecting the working and service life of the braking system, and vehicle safety, comfort, handling stability, noise [01].
- The braking system subjected to the variable loading such as fatigue loading. Fatigue is a phenomenon related with alternative loading or to cyclic stressing or straining of a material. The fatigue stresses distribution on the component depends on the various factors such as application of loading, the material of the component, loading time, surface roughness. The fatigue failure analysis in Finite Element Analysis is significant in order to improve the component's life [02]. Engineers use it to reduce the number of physical prototypes and experiments and optimize components in their design phase to develop better products. [03].
- Studying the above literatures, it is concluding that to enhance the brake performance of the automobile braking system, the significant given to carry out finite element analysis of the brake drum. Studied literatures shows that the design, optimization and finite element analysis of the braking system related functional components [06]. So the FEA and experimental test of the brake drum were rarely studied. By FEA and experimental test, the design validation of the brake drum can be obtained. To know the drum brake material's mechanical properties, the reverse engineering is carried out [07]. Therefore, in this paper, the FEA and experimental test of a certain type of brake drum is carried out, and its results provide reference for design and manufacture [08][09][10].

REFERENCES

- [1] Shenshen Shi, "Final Thesis Automobile Brake System", Savonia University of Applied Sciences, 24 May 2016.

- [2] Prof. K. Gopinath & Prof. M. M. Mayuram, "Fatigue Consideration in Design", Indian Institute of Technology Madras, NPTEL, 31-Dec. 2009. Mechanical Engineering and Robotics Research, Vol. 2, No. 2, April 2013.
- [3] D. R. Marigoudar, S.R.Patil, "Role of Fatigue Life in industrial Designs", IOSR Journal of Mechanical and Civil Engineering.
- [4] Klaus-Jurgen Bathe, "Finite Element Procedures", Prentice Hall, Pearson Education, Inc., Second edition, 2014.
- [5] Dan Yang, Zhen Yu, Leilei Zhang, and Wentao Cheng, "Modal Analysis of Automobile Brake Drum Based on ANSYS Workbench", International Conference on Mechatronics, Computer and Education Informationization, 2017.
- [6] Nagendra Akula, Dr K Rajagopal, "Experimental Investigation of Design and Fatigue Analysis of Two Wheeler Lighter Weight Compound Wheel", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), PP 60-66.
- [7] Meenakshi Kushal, Suman Sharma, "Optimization of Design of Brake Drum of Two Wheeler through Approach of Reverse Engineering by Using ANSYS Software", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 4 Ver. IV, PP 70-75 Jul. - Aug. 2015
- [8] Panithi Dasu, L. Abhilash, "Fatigue Analysis of Aluminum Alloy Wheel", International Journal of Research in Mechanical Engineering & Technology, Vol. 7, Issue 1, April 2017.
- [9] Uday Pratap Singh, A. K. Jain, "Finite Element Analysis of Drum Brake by using ANSYS", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 6 Issue VI, June 2018.
- [10] Subramanyam, L. Sravani, "Design and Analysis of Drum Brakes", International Journal of Research in advanced engineering technologies, Volume 6, Issue 1 May 2017.
- [11] P. Venkataramana, "Design of a Brake Drum using Finite Element Method", International Journal of