DESIGN AND ANALYSIS OF DRUM BRAKE: A REVIEW

[1]Mr. Rupesh Gajanan Rohankar, [2]Dr. Fahim Rahim Sheikh
P.G Research Scholar[1], Assistant Professor[2],
Department of Mechanical Engineering,
Pankaj Laddhad Institute of Technology & Management Studies, Buldana (MH), India
Rupeshrohankar95@gmail.com[1], fahimsheikh786@gmail.com[2]

ABSTRACT

The mechanical braking system transforms the vehicle's kinetic energy into heat energy, allowing the vehicle to come to a halt or slow down. To bring the vehicle to a complete halt, a pair of shoes is pressed on the drum in order to provide enough friction. Brake drums are heated and under a lot of thermal stress when they're working. Therefore, materials for brake drums are selected in a manner that allows them to endure high temperatures and pressures. Working in comfort necessitates the development of drum brakes with reduced noise and vibration.

Keywords: noise, vibration, drum, AL alloys, grey cast iron, heat exposure, corrosion.

INTRODUCTION

To stop or slow down an object in motion, one uses a brake. One of the earliest forms of vehicle braking technology was the drum brake. Most automobiles still employ drum brakes on the back wheels, even though they were originally deployed 100 years ago. the third To slow down or stop moving objects, brakes are utilized. Heat energy is transformed from kinetic energy as a result of friction. Through convection, the heat energy is escaping into the surroundings. The following should be met by the brake to ensure smooth operation and extended life:

- There needs to be an instantaneous means of dissipating the heat that is produced when the brake is applied. Since the drum swells at high temperatures, the effective pedal travelling is increased.
- The material's convection and conduction thermal coefficients are high.
- Materials with a low expansion coefficient when subjected to heat.
- It must to be lightweight while still possessing adequate strength.
- There ought to be enough room for the wheels to fit it.
- The brake ought to be highly resistant to wear.
- The brake needs to be engineered in a way that minimizes vibration and noise.[8]

LITERATURE REVIEW

Putti Srinivas Rao et al. [1], adding a fin to the outside of a drum brake increases the amount of heat that flows out of the drum. Drum brakes that use a highly conductive substance in its yearly fins and have a rectangular cross-section are ideal for efficient heat transfer, although they are heavier. Therefore, a triangular fin is ideal since it allows for greater heat transfer while being lighter.

Professor Vidyadhar R. Bajaj and colleagues [2] Based on the current braking drum, suggested two other designs. The FG260, SS: 4404 unique gray cast iron is used for all of the designs. Design-1 proposes removing material off the outside of the drum in a manner that maximizes the area for heat transfer. This design achieves a weight reduction of 4.74 percent as compared to the current drum. Reducing the wall thickness from 13 mm to 7 mm optimizes the section in proposed design-2. The second design reduces the weight of the drum by 4.06% when compared to the current drum. The results of the CAE analysis show that this strategy successfully reduces drum weight without compromising performance.

Anup Kumar et al. [3], who analyzed the structural and thermal aspects of drum brakes, these devices are essential for stopping or slowing down moving objects, which in turn reduces acceleration and velocity. Over the course of a single cycle, the transient temperature rises noticeably. This proves that the duration allotted for cooling the drum is insufficient. Perhaps the finite element method's most popular application is in structural analysis. Heat is the byproduct of the energy that brakes dissipate. The way this heat is lost in the air causes the vehicle to come to a halt. The comparison of the maximum obtained stress has completed the design check. According to the results, the design is risk-free, and the drum brake works as expected under the tested load.

Bako Sunday et al. [4] found that fins or expanded surfaces significantly improved heat transfer rates. With the addition of fins, the existing drum brake loses one-fourth of its weight. Brake drum analysis uses gray cast iron. With a width of 7 mm and a distance of 20 mm between each fin, the model employs six fins on the exterior of the drum. Brake drum designs in Solid Works 2013 are based on the Kicreyco drum brake catalog. Results show that the suggested fin-equipped drum model experiences less stress and has a higher heat transfer capacity at 150 N brake shoe force and 120 °C internal temperature than the current model.

Amit Phatak et al. [5] investigates drum brake sounds. The Frequency Response Function (FRF) is an essential tool for non-linear vibration (NVH) analysis. It acts as a transfer function for the structure being tested by providing a displacement output to force input relation in the frequency domain. An understanding of structural resonances, damping of materials, and deformation pattern at resonances can be obtained by this function. Each of these pieces of data is critical for NVH analysis and prevention. There is intense rivalry in the passenger car market because of important factors like price, fuel economy, and vehicle comfort. A great deal of an assembly's noise, vibration, and harshness is dependent on those components. Liner and drum interface cannot be controlled under braking conditions. Reduced braking performance is an unintended consequence of lowering the coefficient of friction. Making structural changes to components during design to strengthen them and using the FRF quality assessment process before manufacturing are the best ways to reduce squeal noise. After considering all of the data, it becomes clear that increasing the stiffness is a simple approach to lowering the brake squeal and rearranging the natural frequencies pattern. Better outcomes are observed when the rib structure of the back plate is taken into account.

K.Gowthami and K. Balaji et al. [6], a thermal examination of several materials, including cast iron, aluminum alloy, and stainless steel 304, will be conducted for a brake drum. Brake drums made of aluminum alloy may withstand temperatures as low as 32.83°C, much lower than the highest temperatures recorded for brake drums made of cast iron and stainless steel. Cast iron brake drums have a cross sectional weight of 11.305 kg. Stainless steel 304 material results in a 9.53% increase in weight, while aluminum alloy material results in a 58.52% decrease. The aluminum alloy brake drum has a thermal deformation of 0.006329 millimeters, which is somewhat higher than the stainless steel brake drum's thermal deformation of 0.004328 millimeters but lower than that of cast iron brake drums. The results of this experiment show that aluminum alloy material is superior to the other two materials.

Meenakshi Kushal et al. [7] To improve the design of the drum brake uses a reverse engineering technique and runs an experiment. Analysis shows that compared to aluminum alloy drum brake, CE (Control expansion) alloy brake experiences far less deformation. The surface of CE alloy brake drums heats up less than AL alloy brake drums, which extends the life of the lining material and improves braking performance. Results also show that, when compared to slow braking, the temperature increase in drum brakes is 65% to 66% higher because of quick breaking. It follows that CE alloy is the superior material for drum brake applications in light commercial vehicles since it is lighter, deforms less, and experiences less temperature rise.

PROBLEM IDENTIFICATION

We are aware that there are a number of problems, such as noise, vibration, inefficiency, corrosion, and deformation of the drum. During the operation, we have to control or lower these parameters. Based on our extensive literature review, we have arrived at this proposed problem definition.

OBJECTIVES

Reducing the heating problem, increasing braking efficiency, changing shoe material, adding drum fins, lowering cost, and increasing reliability are the primary goals of our suggested research.

PROPOSED CONCLUSION AND FUTURE WORK

Various sorts of fins will be utilized for the planned experimental inquiry. For example, square, round, or triangular. Various fin cross sections can be accommodated.

EXPERIMENTAL METHODOLOGY

Testing setup

Fig -3.1: temperature rise in drum

At varying revolutions per minute (rpm), we use a temperature gun to gauge the temperature of the bike's outer drum. We found a maximum temperature of 358 K on this bike, whereas another bike registered 385 K. We develop a computer-aided design in Solidworks by measuring the dimensions of a drum brake using a Vernier caliper.

CAD work in Solid works

The current drum brake design is made in Solid Works so that it can be studied further. Additional thermal analysis drum designs include triangular, circular, and rectangular fins.

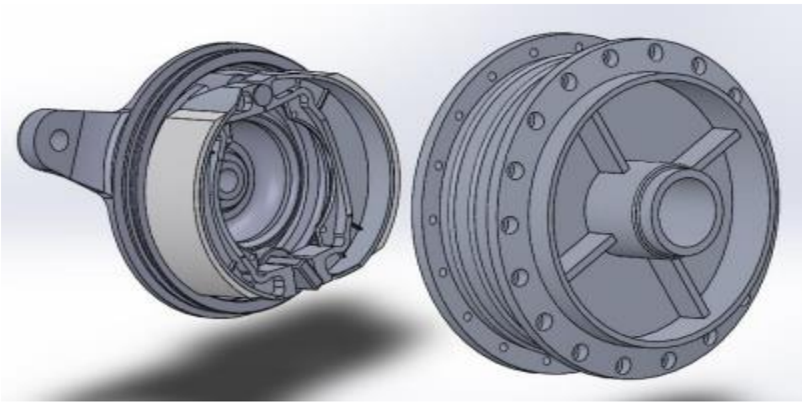

Fig -3.2: Design of drum brake

Thermal Analysis

For better heat dissipation, Al 2024 T6 alloy is used for drum and shoe design, for pad design, the ceramic material is used.

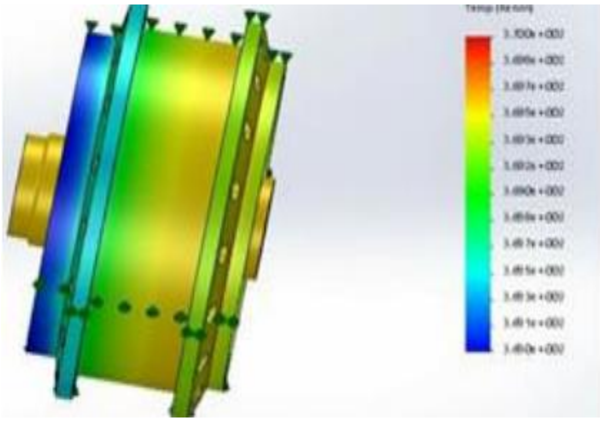

Fig -3.3: Drum without fins

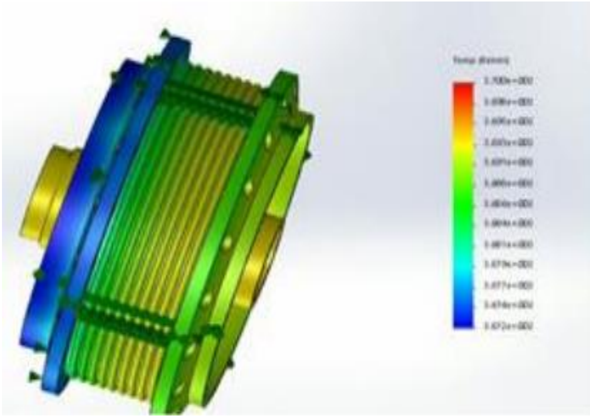

Fig -3.4: Drum with circular fins

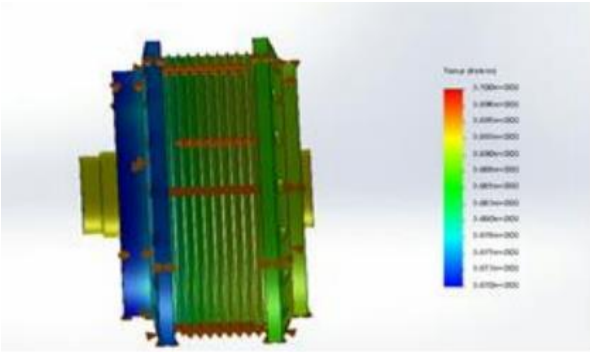

Fig -3.5: Drum with triangular fins

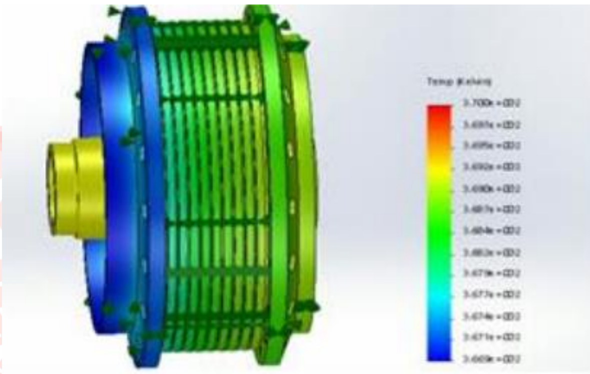

Fig -3.6: Drum with rectangular fins

CONCLUSIONS

According to our hypothesis, the temperature drops, as seen in figures 3.4, 3.5, and 3.6. The simulation analysis of the drum brake in Solid Works reveals an increase in heat dissipation, as shown in figures 3.3 and 3.4. Results from comparing various fin designs show that 1. Dissipation-based heat transfer is more effective in rectangular fins. 2. Rectangular fins dissipate heat more quickly than their round counterparts. 3. As seen at a glance in figures 3.3, 3.4, 3.5, and 3.6, the heat transfer rate of dissipation is intermediate flow of the two fins above in a triangle fin. Optional Acknowledgment In this area, the writers are free to mention anybody they like.

REFERENCES

1. Putti Srinivas Rao, D.V.G.Prasad, D.D.S.P.R. Raju, B.R.Phanindra, B.N.Surya, “Development and Analysis of Finned Brake Drum Model for Effective Heat Transfer”, IJSEAS – Volume-2, Issue-9, September 2016.
2. Arvind P Jinturkar & Prof.Vidyadhar R Bajaj, “Optimization of Hub cum Brake Drum for Weight Reduction”, Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-8, 2016.
3. Anup Kumar and R. Sabarish, “Structural and Thermal Analysis of Brake Drum” Middle-East Journal of Scientific Research 20 (8): 1012-1016, 2014.

4. Bako Sunday, Usman Aminu, Paul O. Yahaya, "Development and Analysis of Finned Brake Drum Model Using Solidworks Simulation", IJIRSET Vol. 4, Issue 5, May 2015.
5. Amit Phatak, Prof. Prasad Kulkarni, "Drum Brake Back plate Analysis and Design Modification to Control Squeal Noise", 2017 IJEDR, Volume 5, Issue 3.
6. K. Gowthami, K. Balaji, "Designing and Analysis of Brake Drum", IJRASET Volume 4 Issue IX, September 2016.
7. Meenakshi Kushal, Suman Sharma, "Optimization of Design of Brake Drum of Two Wheeler through Approach of Reverse Engineering by Using Ansys Software", IOSR-JMCE Volume 12, Issue 4 (Jul. - Aug. 2015)
8. Dvsrbm Subramanyam, l. Sravani, "Design and Analysis of Drum Brakes", International Journal of Research in Advance Engineering Technology, Volume 6, Issue 1 MAY 2017