DESIGN AND FABRICATION OF BRAKING SYSTEM FOR ATV

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Abstract - *A brake is a mechanical device which slowing or stopping a moving object or preventing its motion. Ventilated brake disk is the state of the art technology in automobile braking system. It is well known that the braking capability of brake disk is affected by the rate at which heat is dissipated through forced convection. The rapid increase and decrease of the brake disk temperature could lead to catastrophic failure of the brake disk due to high thermal stress. Aluminium Alloy is expected to have sufficient friction force and coefficient of friction to support the braking system. The standard disc brake two wheelers model using in Ansys and done the Thermal analysis and also calculate the Heat flux, Temperature of disc brake model. This is to understand the pressure force and friction force on the disc brake material, which can help to reduce the accident that may happen in each day. The investigations are performed by using both experimental and computational means and the results are compared and discussed. Analysis shows that significant increase in braking performance can be achieved with relatively simple alteration of the ventilated blade angle and material.*

Keywords: Rotor, caliper, brake circuit and master cylinder.

1.INTRODUCTION

To increase the productivity it is necessary to reduced production time, but the total time for production contains setup time and production time. So the setup time is nothing but elapsed time in between last piece of the old series to the first good piece of new series. Setup time is non-value activity. NVA are those activities which does not convert input into the output for example transportation, setup time, defects etc. and for these type of activities customer does not will to pay. So it is very straight that if we minimize this non-value adding activities it will beneficial. For increase in production time in Single Minute Exchange of Dies we use the different quality tools. Also we can use the modern technologies. Though we invest money in the Single Minute Exchange of Dies the payback period will be very short and bottom line for the company will go up. we have try to reduce the setting time for the machine LA8864 as setting before is 4 to 5 hours, as by this setup it can be reduced to 2 to 3 minutes. As by this, production also will get increased and the turnover of the company also get increased, approximately 3 to 5 engine get out of the production per day after this setup have been installed.

Why braking system for ATV?

1. Reduce accidents.
2. To increase the braking efficiency.
3. Achieving safety for drivers.

Literature Review

[1] Manjunath TV and Dr. Suresh PM did analysis on the thermo mechanical behavior of the dry contact of the brake disc during the braking phase. The coupled thermal structural analysis was 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 the performance of the rotor disc. A comparison between analytical and results obtained from FEM was done and all the values obtained from the analysis was less than their allowable values. Hence the best suitable design, material and the rotor disc was suggested on the performance, strength and rigidity criteria.

[2] Karthick C and Kumaresan G did research on thermal analysis and enhancement of disc brakes.The research is about the fabrication of disc brake and an attempt has been made ti investigate the material selection, manufacturing process and testing. Thus the results provide better understanding on the fabrication and testing behavior of disc brakes and assist the automotive industry in developing optimum and effective disc brake rotor.

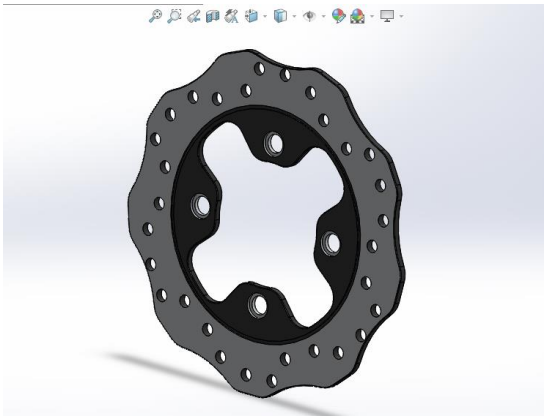
[3] Swapnil R. Abhang, and D.P Bhaskar did research on deswign and analysis of disc brake rotor. The research is about the thermal analysis of disc brake of a vehicle. Heat generation and dissipation of disc brake are analysed.This is to understand the pressure force and friction force on the disc brake material, which can help to reduce the accident that may happen in each day. In this research ,work design of a disc brake is proposed with copper liner on its brake disc, the heat transfer of existing and hybrid disc will be calculated for finding the effectiveness of heat transfer.

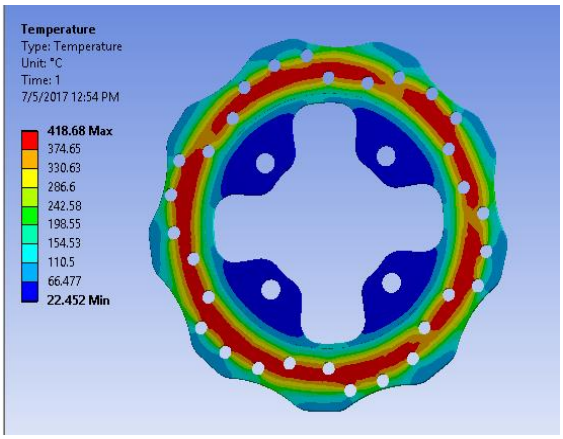
Related concept:

When you push the brake pedal it depresses a piston in the master cylinder, forcing fluid along the pipe. The fluid travels to slave cylinders at each wheel and fills them, forcing pistons out to apply the brakes. Fluid pressure distributes itself evenly around the system. The combined surface 'pushing' area of all the slave pistons is much greater than that of the piston in

the master cylinder. Consequently, the master piston has to travel several inches to move the slave pistons the fraction of an inch it takes to apply the brakes.

This arrangement allows great force to be exerted by the brakes, in the same way that a long-handled lever can easily lift a heavy object a short distance. Most modern cars are fitted with twin hydraulic circuits, with two master cylinders in tandem, in case one should fail. Sometimes one circuit works the front brakes and one the rear brakes; or each circuit works both front brakes and one of the rear brakes; or one circuit works all four brakes and the other the front ones only. Under heavy braking, so much weight may come off the rear wheels that they lock, possibly causing a dangerous skid. For this reason, the rear brakes are deliberately made less powerful than the front. Most cars now also have a load-sensitive pressure-limiting valve. It closes when heavy braking raises hydraulic pressure to a level that might cause the rear brakes to lock, and prevents any further movement of fluid to them. Advanced cars may even have complex anti-lock systems that sense in various ways how the car is decelerating and whether any wheels are locking. Such systems apply and release the brakes in rapid succession to stop them locking.





METHODOLGY

BENCHMARKING

In the bench marking all the OEM (original equipment manufacturer) products are compared with respect to one another. This comparison is made in different criteria that include Technical specifications, cost and availability.

Table 1 For Rotor

DER:-Disc Effective Radius

S.NO	Rotor Diameter(mm)	DER(mm)	Type	Cost(Rs)
1	150	60	Drilled	460/-
2	180	75	Drilled	750/-
3	190	80	Drilled	850/-
4	200	85	Drilled	1000/-

Table 2 For Brake Fluids

S.NO	Brake fluid	Dry Bp (°C)	Wet Bp (°C)
1	DOT-3	205	140
2	DOT-4	230	155
3	DOT-5	1200	180
4	DOT-5	200	180

1. We have decided to use **DOT 3** brake fluid.
2. It is inexpensive, and available at most gas stations, department stores, and any auto parts store.
3. It is completely compatible with DOT 3 and DOT 5.1.

Table 3 For Master Cylinder

S.NO	MASTER CYLINDER DIAMETER(cm)	TYPE	COST
1	2	SP	550/-
2	2.5	DP	850-1050/-
3	3-4.5	DP	1800-5000/-

SP:-Single Piston Maser Cylinder DP:-Double Piston (Tandem Master Cylinder).

CALCULATIONS:

1. Force output of the Brake pedal assembly

$$F_{bp} = F_d \times \{L_1 \div L_2\}$$

=294.3(7/1)

=2060.1 N

Hydraulic pressure generated by Master cylinder

$$P_{mc} = \frac{F_{bp}}{A_{mc}}$$

=2060.1/3.1415*10^-4

=6.557*10^6 N/m2

2. Hydraulic pressure transmitted to the caliper

$$P_{cal} = P_{mc}$$

=6.557*10^6 N/m2

3. Force generated by the caliper

$$F_{cal} = P_{cal} \times A_{cal}$$

=6.557*10^6*1.25663*10^-3

=8239.76 N

4. Clamp force generated by the caliper

$$F_{clamp} = F_{cal} \times 2$$

=8239.76*2

=16,479.53 N

5. Frictional force generated by the brake pads

$$F_{friction} = F_{clamp} \times \mu_{bp}$$

=16,479.53*0.4

=6591.8 N

6. Torque generated by the rotor

$$T_r = F_{friction} \times R_{eff}$$

=6591.8*0.110

=725.09 Nm

The torque will be constant throughout the entire rotating assembly as follows:

$$T_t = T_w = T_r$$=725.09 Nm

7. The Force reacted between the tire and the ground

$$F_{tire} = \frac{T_t}{R_t}$$

=725.09/0.292 =2482.33 N

The total braking force generated is defined as the sum of the frictional forces at the four tires which is given as follows:

$$F_{total} = \sum F_{tire\ LF,RF,LR,RR}$$

=9929.33 N

8. The deceleration of the vehicle

$$a_v = \frac{F_{total}}{m_v}$$

=9929.33/260

=38.189 m/s2

9. Stopping distance of the vehicle

$$SD_v = \frac{v_v^2}{a_v \times 2}$$

= (16.66)^2/(38.189*2)

=3.63 m

10. Determining parameters related to vehicle static weight distribution:

Here • V_f = the front axle vertical force (weight)

= 40% of weight =104kg

• V_r = the rear axle vertical force (weight)

= 60% of weight =156kg

• V_t = the total vehicle vertical force (weight)

= 260kg

Distance from the front axle to the CG

$$CG_{f,x} = \frac{V_r}{V_t} \times WB$$

= (156/260)*1.3716

= 0.822 m

$$CG_{r,x} = \frac{V_f}{V_t} \times WB$$

= (104/260)*1.3716

= 0.548 m

From these relationships, it naturally follows that:

$$CG_{f,x} + CG_{r,x} = WB$$

(0.822+0.548) m=1.3716 m

1.3716=1.3716

11. Absolute weight transferred from the rear axle to the front axle

$$WT = \left(\frac{a_v}{g}\right) \times \left(\frac{h_{CG}}{WB}\right) \times V_t$$

= (3.89/9.81)*(0.5969/1.3716)*260

= 44.86 Kg

3. CONCLUSIONS

By using the Above calculations and knowing the advantages of 7000 Series Aluminium Alloy disc brakes compared to drum brakes, pneumatically actuated disc brakes of below specification have been used for both front & rear of an All-Terrain Vehicle.

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BIOGRAPHIES

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