# DESING AND ANALYSIS OF DISC BRAKE SYSTEM FOR ALL TERRAIN VEHICLE

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***ABSTRACT***

*In All Terrain Vehicle (ATV), each single system has been studied and developed in order to meet safety requirement. Instead of having air bag, good suspension systems, good handling and safe cornering, there is one most critical system in the ATV vehicle which is brake systems. Without brake system in the vehicle will put a passenger in unsafe position. In this project, the optimized design of brakes and use of outboard brake system in front side, inboard brake system in rear side has been evolved. The disc diameter and caliper specification has find out by theoretical calculations such as brake force, stopping time, weight distribution, and brake torque. And standard disc brake has modeled using solid works and the thermal analysis and structural analysis has made on disc plate using ANSYS software. And also calculate the maximum temperature and Heat flux of disc plate model. The thermal-structural analysis is then used with coupling to determine the deformation and the Von Mises stress established in the disc, the contact pressure distribution in pads. The investigations are performed by using both experimental and computational means and the results are compared and discussed.*

***Keywords:*** *Inboard Braking, Unsprung weight, Drive shaft. Validation will be with analytical as well as experimentation with required torque and forces to rotate the cage.*

## INTRODUCTION

All-terrain vehicles (ATV's) have become very popular for both recreational and utility purposes. ATV's are off-road vehicles characterized by having four wheels (two front and two rear) with low pressure tires, handlebars connected to the front wheels for steering, a straddle-type seat designed for a single rider, laterally extending footrests on opposite sides of the vehicle, and an engine and transmission located generally beneath the straddle-type seat and substantially between the footrests. Typically ATV's are not wider than about 50 inches-most commonly about 44-48 inches in overall width. In many applications, it is desirable to have all four wheels driven by the engine. Four wheel drive ATV's typically have one drive train connecting the transmission to the rear wheels and a separate drive train connecting the transmission to the front wheels.

ATV's desirably include a braking system capable of braking all four wheels. Typically the braking system includes a separate disc brake on each front wheel and a disc brake on the generally rigid axle carrying the rear wheels. A master cylinder, typically operated by a handlebar-mounted lever, is hydraulically connected to each of the disc brake calipers so that actuation of the lever simultaneously actuates all of the brake calipers, providing even braking of all of the ATV's wheels.

## PROBLEM IDENTIFICATION

Vehicle handling is the most important way that, vehicle performs transverse to their direction of motion, significantly during cornering and swerving. It also includes their directional stability when moving in steady state condition. While driving a vehicle, its handling comfort and braking performance are the most important aspects of a vehicle's "active" safety. The utmost lateral acceleration is sometimes discussed on individual basis as "road holding". (This discussion is directed at road vehicles with at least three wheels, however a number of it is going to apply to alternative ground vehicles.) Cars driven on public roads whose engineering requirements are handling over comfort as well as passengers space which has to be present in a sports car.

### Twisting Force on Suspension Arm:

In normal brake system, the brake torque is generated on calliper and it is applied directly to

the knuckle. Further it has been transferred to the suspension arm. So suspension arm must resist the twisting force applied by the brake.

**More Unsprung Mass:**

More unsprung mass

All weight which is supported by the suspension, including portions of the weight of the suspension members are regarded as sprung weight. Un-sprung weight includes the suspension upright and all components attached to it; the brake caliper, brake disc, wheel, tire and a portion of suspension arms.

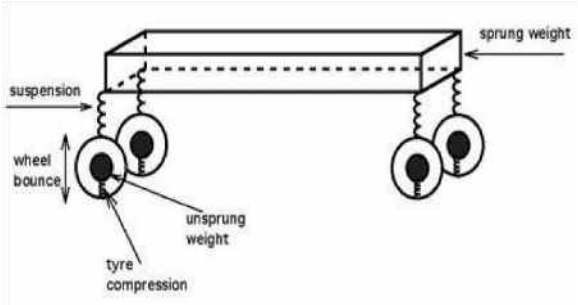
Sprung weight is protected from the shocks and vibrations that the wheels experience as they travel over every bump and pothole. This makes for a more comfortable ride and protects the sprung components from destructive and life shortening shocks and vibrations. Conversely, unsprung weight must be designed to be tough enough to survive the constant shocks and vibrations, which can be difficult for complex parts such as wireless pressure sensors. In general, it's best to have a high ratio of sprung to un-sprung weight. A higher proportion of sprung weight can then push down on the wheels and tires with more force, keeping them in contact with the pavement or whatever surface they are traveling across. Maintaining contact with the roadway improves handling and traction, and this becomes more of an issue for off-roading and traveling over rough roads. So as a rule, designers try to minimize un-sprung weight to improve handling and steering.

**Complex Hub and Knuckle Design:**

In rear side, the hub and knuckle design is more complex due to arrangement of disc and calliper inside the wheel setup and also there is an drive shaft arrangement in rear side. So, it has more complex to designing the outboard brake system within wheel setup.

**Brake Bleeding Effort:**

Bleeding problem takes place when the brake lining has hole or the hole is made during the manufacturing process that leads to bleeding of the fluid from the lining that leads to break




failure.

**LITERATURE REVIEW**

"V.M.M.Thilak, R.Krishnaraj, Dr.M.Sakthivel, K.Kanthavel, Deepan Marudachalam M.G, R.Palani" In this work, an attempt has been made to investigate the suitable hybrid composite material which is lighter than cast iron and has good Young's modulus, Yield strength and density properties. Aluminium base metal matrix composite and High Strength Glass Fiber composites have a promising friction and wear behaviour as a Disk brake rotor. The transient thermo elastic analysis of Disc brakes in repeated brake applications has been performed and the results were compared. The suitable material for the braking operation is S2 glass fibre and all the values obtained from the analysis are less than their allowable values.

and they are also included in the current investigation. Transient analysis of disc brake vibration using a large FE model that includes thermal effects is carried out.

"Q Cao1, M I Friswell, H Ouyang, J E Mottershead and S James" This paper presents a numerical method for the calculation of the unstable frequencies of a car disc brake and the analysis procedure. The stationary components of the disc brake are modelled using finite elements and the disc as a thin plate. This approach facilitates the modelling of the disc brake squeal as a moving load problem. Some uncertain system parameters of the stationary components and the disc are tuned to fit experimental results. A linear,

complex-valued, asymmetric eigenvalue formulation is derived for disc brake squeal. Predicted unstable frequencies are compared with experimentally established squeal frequencies of a realistic car disc brake.

"Rajendra Pohane, R. G. Choudhari" FEM model is preparerd for contact analysis. A three dimensional finite element model of the brake pad and the disc is developed to calculate static structural analysis, and transient state analysis. The comparison is made between the solid and ventilated disc keeping the same material properties and constraints and using general purpose finite element analysis. This paper discusses how general purpose finite element analysis software can be used to analyze the equivalent (von-mises) stresses& the thermal stresses at disc to pad interface

"Abd Rahim Abu-Bakar, Huajiang Ouyang" This paper studies the contact pressure distribution of a solid disc brake as a result of structural modifications. Before modifications are simulated, four different models of different degrees of complexity for contact analysis are investigated. It is shown that the contact pressure distributions obtained from these four models are quite different. This suggests that one should be careful in modeling disc brakes in order to obtain correct contact pressure distributions. This work could help design engineers to obtain a more uniform pressure distribution and subsequently satisfy customers' needs by making pad life longer.

"Piotr GRZEŚ" The aim of this paper was to investigate the temperature fields of the solid disc brake during short, emergency braking. In this paper transient thermal analysis of disc brakes in single brake application was performed. To obtain the numerical simulation parabolic heat conduction equation for two dimensional model was used. The results show that both evolution of rotating speed of disc and contact pressure with specific material properties intensely effect disc brake temperature fields in the domain of time.

"H.Mazidi, S.Jalalifar, J. Chakhoo" In this study, the heat conduction problems of the disc brake components (Pad and Rotor) are modelled mathematically and is solved numerically using finite element analysis.

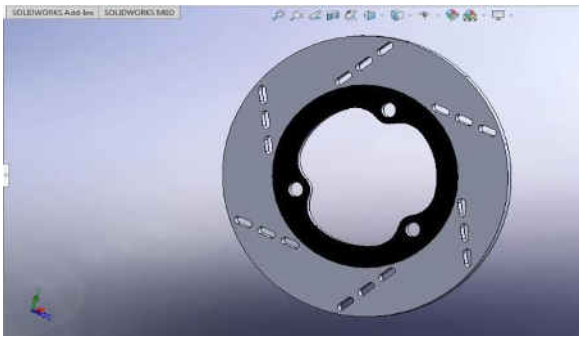
## METHODOLOGY

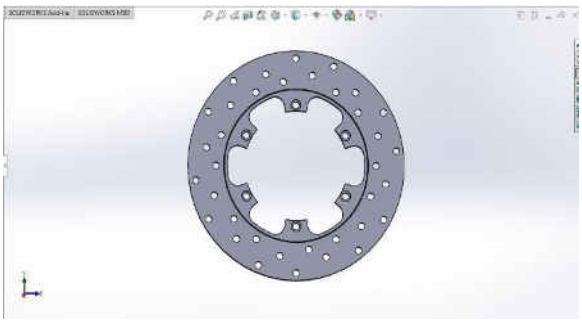
1. Problem Identification through research papers and discussion forums.
Data collection phase involves the collection of reference material for project
Concept.
2. Literature Review.
3. Mechanical Design of Conventional & Inboard Braking System.
4. Theoretical Results.
5. Production Drawing and Preparation
Production drawings of the parts are prepared using Auto Cad, with appropriate
dimensional and geometric tolerances. Raw material sizes for parts are also Determined.
6. Modeling of the same.
7. Analysis of Disc.
8. Experimental Results.

## EXPERIMENTATION

### Modeling of disc brake by solidworks

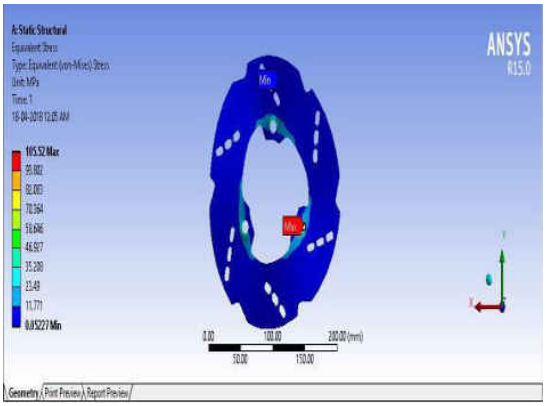
Model view of front disc rotor



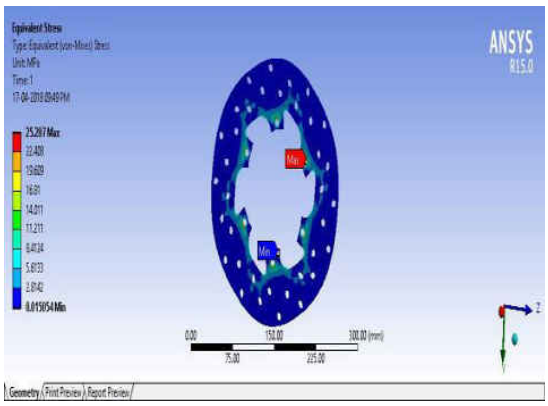


Model view of rear disc rotor

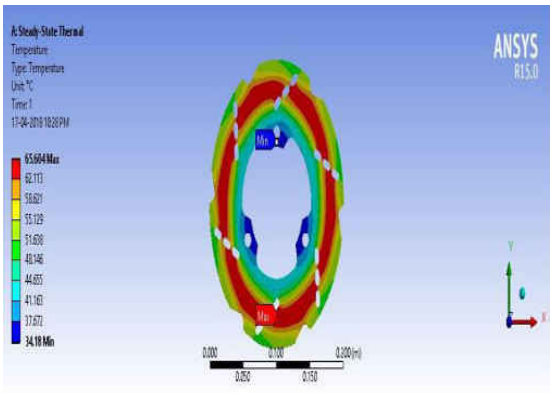
**Disc brake analysis using ANSYS**



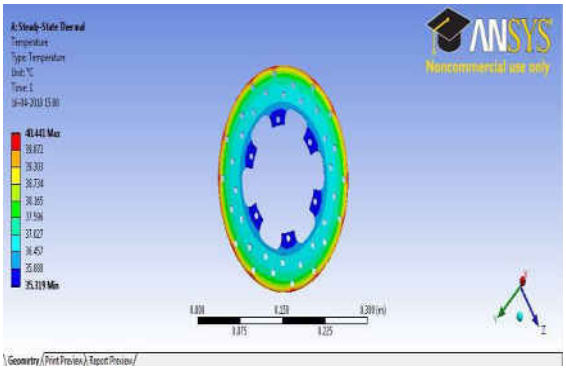

Equivalent Stress View Of Rear Disc Rotor




Equivalent Stress View Of Front Disc Rotor




Temperature Distribution Of Front Disc Rotor




Temperature Distribution of Rear Disc Rotor

**CONCLUSION**

In this project, all design parameters of brake system has determined by theoretical calculation and also disc temperature and heat flux has determined by using numerical method. The disc rotor and caliper standard has selected by using design parameters and standard disc brake has modeled using solid works and also this project presents thermal analysis and structural analysis of a standard disc brake model based on ATV vehicle specification. Regarding the calculation results, we can say that they are satisfactorily in agreement with those commonly found in the literature investigations. It is also concluded that inboard brake system is the best for the All Terrain Vehicle to obtain good performance. All the values obtained from the analysis are less than their allowable values. Hence the brake disc design is safe based on the strength and rigidity criteria.

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