Brakes Analysis of BAJA ATV

Aditya Pratap Singh, Harshit Soni, Keshav Padia, Achintya Sharma

Department of Mechanical and Automation Engineering, Amity University, Noida, Uttar Pradesh

Abstract— *In the modern day and age where automobiles are an essential part of our day to day life, the requirements of each are different. Some demand for a high-performance machine whereas others require a comfortable ride. The modern engineering helps in achieving all the aspects of a safe, reliable and fast vehicle. With the change in time, the need for an all-terrain vehicle has gradually increased. The research paper includes the optimisation of braking system for minimum stopping distance and locking all four tyres simultaneously. The SolidWorks struct-static analysis and simulation are done to obtain a better braking system which can provide the best in class arrangements for the customer. The research focused on disc, master cylinder position. The designs provide the sturdiness and durability which is the primary requirement for an all-terrain vehicle. The study comprises of braking for BAJA-ATV. The all-terrain conditions require active braking and all wheels locking at the instant time. The research paper includes the parameters for the efficient disc, callipers, master cylinder position for effective braking.*

Keywords— BAJA, brake, all-terrain.

I. INTRODUCTION

In today's world of globalisation and modernization, the need for racing vehicles is increasing day by day. The all-terrain vehicle requires efficient braking which demands the quality disc, prominent callipers and master cylinder mountings according to space availability inside the vehicle. The most important parameter for any all-terrain racing vehicle is the braking system. They are obliged to stop the vehicle inside the minimum conceivable separation and it is carried out by changing over fresh vitality of the vehicle into hotness vitality by grinding which scattered into the air. The primary prerequisites of brakes are: The brakes must be sufficiently stable to stop the vehicle inside the base conceivable separation in a crisis. In any case, this ought to likewise be steady with wellbeing. The driver must have an appropriate control over the vehicle amid crisis braking and the vehicle should not slip. The brakes must have excellent anti-fade qualities and their viability ought not to diminish with consistent delayed application. A circle brake get together comprises of Plate rotor that pivots with the wheel; Calliper gathering appended to the controlling knuckle, Erosion materials (plate cushions) that mounted to the calliper Assembly.

II. DESIGN

The need for the braking system is to increase the safety and manoeuvrability of the vehicle by statically and dynamically locking all four tires on both paved and unpaved surfaces.

Tandem Master Cylinder mounted on the front of brake pedal providing the driver with enough space. The master cylinder bore, size, calliper piston radius and pedal ratio determined by doing the brake calculations.

Rotors and Callipers: The energy of vehicle motion converted into heat, the rotors are required to dissipate a honcho amount of heat quickly and efficiency. This heat transfer is achieved through 4 mm thick disc of the diameter 200 mm. The disc is resistant to warping and provides adequate heat transfer properties. The rotors provide better pad bite and conditioning as well as to reduce weight as much as possible.

The callipers used are of dual pistons with the diameter of 27mm each. It consists of 3/4 inch bore OEM manufactured tandem master cylinder.

The pedal used has a pedal ratio of 4:1 and adequate brake line pressure is developed to bring the vehicle to stop early.

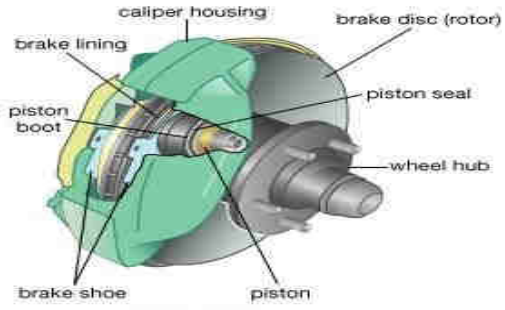
Steel braided brake lines run through the length of the car and flexible rubber lines at the A-arms. They chose due to their flexibility, strength and ability to maintain high line pressure values.

The reliability of our braking system improved by using the diagonal split (X split) system to ensure the safety of the driver.

Circuit Type	X type
Force Applied by the driver	250 N
Pedal Ratio	4:1
Pressure Developed(Circuit)	3.508 MPa
Clamping force of one calliper	8035.21 N
Friction(Brake Pad)	0.4
Frictional Force applied on the disc by the calliper (each	3214.08 N

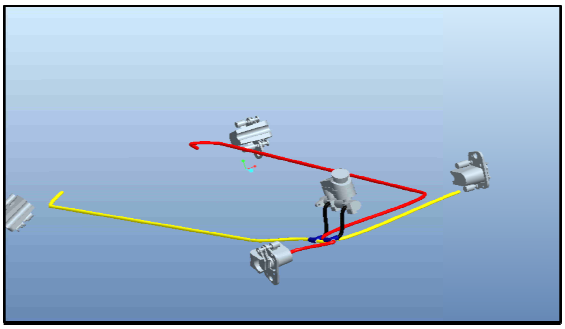
wheel)	
Torque produced in each Rotor	276.41 N-m
Static Front Axle Load	970.71 N
Static Rear Axle Load	1775.80
Weight Transfer	1226.4 N
Dynamic Front Axle Load	2197.11 N
Dynamic Rear Axle Load	549.41 N
Total Area of Rubbing Face	0.008011 m^2
Heat Flux	1409806 w/ m^2
Heat Flux on each Front Wheel	563922 w/ m^2

Braking Calculations



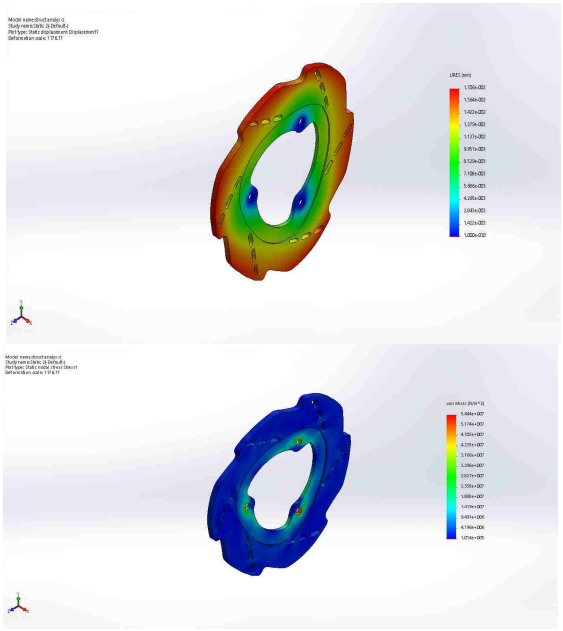
Name	**Type**	**Min**	**Max**
Displacement	**URES: Resultant Displacement**	**0 mm Node:1656**	**0.0170584 mm Node:56**

Disc Brake



X- type layout of brake circuit

Name	Type	Min	Max
Stress 1	VON: von Mises Stress	101442 N/ m^2 Node:25352	5.64383e+007 N/ m^2



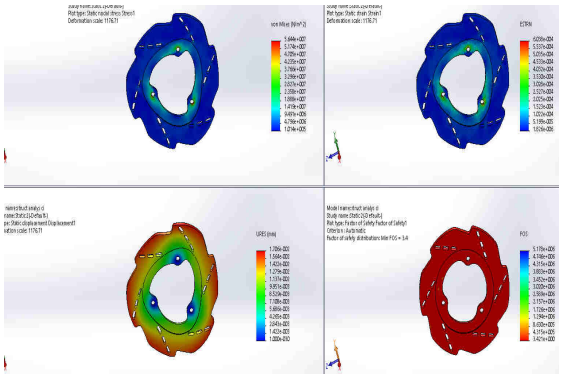
Structural Analysis of Disc

Static Structural Analysis of disc using Solidworks 2015

A static structural analysis of the disc to study the stress distribution on the disc. There were 23916 elements and 41899 nodes created. Max stress developed is 5.64383e+007 n/m^2 near the region connected to the hub.

Deformation of disc

Maximum displacement of disc occurs at node 76 with value =0.0170584 mm



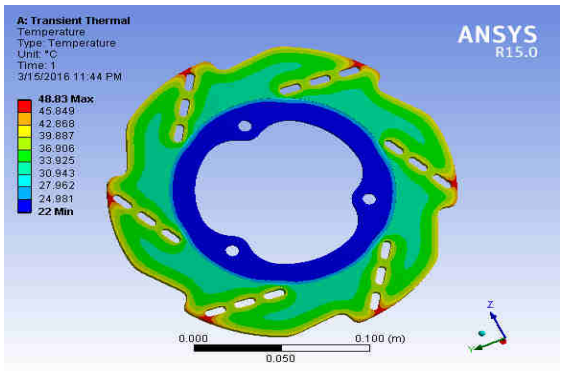
Stress-Strain-Displacement-Factor of Safety

Transient Thermal Analysis

The principle of braking is to convert kinetic energy with which the vehicle is propelling to heat energy when the brakes are applied. So, the disc should possess high heat transfer rate to dissipate the heat produced when brakes are applied. Heat generated when brakes are applied dissipated into surroundings through convection between pad-rotor and the air present around it. Finally, heat generated on the disc is cooled to ambient temperature.

Kinetic Energy of the Vehicle	½*m*v^2	½*296*$(11.11)^2$ =22588.08 J
Total Heat	½*m*v^2 /t	22588.08/2=11294.04 W
Heat(80% of mass in front)	(½*m*v^2 /2)*0.80	(11294.04*0.8)/2=4517.6W

Thermal Calculations

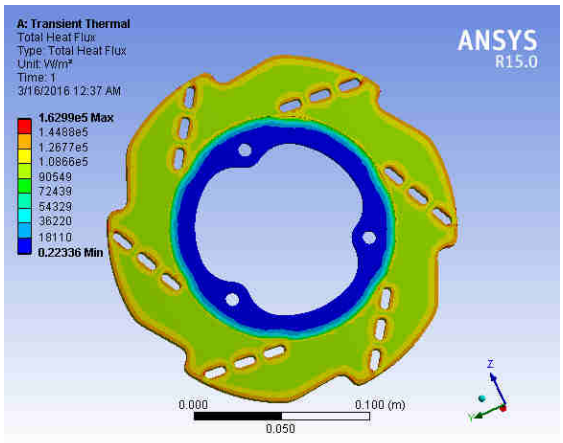


Single Stop Temperature Rise in the Disc

There were 18762 elements and 33610 nodes generated. The temperature distribution over the disc for only braking shown in the figure.

Maximum Temperature: 48.83^{O}C

MinimumTemperature: 22 ^{O}C



Heat Flux obtained from transient thermal analysis

III. CONCLUSION

The research paper concludes the efficient braking parameters for BAJA ATV. The braking system is the backbone of an ATV, determining the best parameters several analyses is done by using solidworks and Ansys. The structural analysis is done to determine the strength and sturdiness of the disc, along with it deformation, stress, strain, displacement and factor of safety is analysed to provide the best suitable dix quality for better performance. Heat flux of disc is done to determine the dissipation. The single stop temperature analysis provides to understand the instant temperature occurred in disc. TheBraking parameters are suitable for efficient performance of 300kg. of BAJA ATV. The disc is enough sturdy and safe for high-duty performance and the master cylinder, rotor positions provides all 4 wheels locking simultaneously, with in minimum stopping distance.

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