IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 05, Issue 07 (July. 2015), ||V1|| PP 34-38

Shape Optimization of Master Cylinder of Automotive Active Vacuum Suspended Power Brake

Prof. K. Prahalada rao, KIRAN bolisetty
Prof of mechanical engineering Department and Principal of jntu A college Ananthapur
M.TECH PRODUCT DESIGN Dept of mechanical engineering, Jntu Ananthapur Ananthapur

Abstract**:** - Braking system is a means of converting momentum into heat energy by creating friction in the wheel brakes. The braking system which works with the help of hydraulic principles is known as hydraulic braking systems. The braking system used most frequently operates hydraulically, by pressure applied through a liquid. These are the foot operated brakes that the driver normally uses to slow or stop the car. Hydraulics is the use of a liquid under pressure force or motion, or to increase an applied force. Our special interest in hydraulics is related to the actions in automotive systems that result from pressure applied to a liquid. This is called hydraulic pressure. Since liquid is not compressible, it can transmit motion. A typical braking system includes two basic parts. These are the master cylinder with brake pedal and the wheel brake mechanism. The other parts are the connecting tubing, or brake lines, and the supporting arrangements. Braking action starts at the brake pedal. When the pedal is pushed down, brake fluid is sent from the master cylinder to the wheels. At the wheels, the fluid pushes brake shoes, or pads, against revolving drums or disks. The friction between the stationary shoes or pads and the revolving drums or disks slows and stops them.

Keywords: - *component; formatting; style; styling; insert (key words)*

I. INTRODUCTION

Master cylinder is a component of hydraulic braking system and it is just a simple piston inside a cylinder. Master cylinder is the key element of braking system which initiates and controls the braking action. A reservoir is attached to the master cylinder to store brake fluid. A master cylinder having a reservoir and a cylinder formed from a single piece of molded material. Master cylinder is a component of hydraulic braking system and it is just a simple piston inside a cylinder. Master cylinder is the key element of braking system which initiates and controls the braking action. A reservoir is attached to the master cylinder to store brake fluid. A master cylinder having a reservoir and a cylinder formed from a single piece of molded material. The master cylinder displaces hydraulic pressure to the rest of the brake system. It holds the most important fluid in your car, the brake fluid. It actually controls two separate subsystems which are jointly activated by the brake pedal. This is done so that in case a major leak occurs in one system, the other will still function. The two systems may be supplied by separate fluid reservoirs, or they may be supplied by a common reservoir. Some brake subsystems are divided front/rear and some are diagonally separated. When you press the brake pedal, a push rod connected to the pedal moves the "primary piston" forward inside the master cylinder. The primary piston activates one of the two subsystems. The hydraulic pressure created, and the force of the primary piston spring, moves the secondary piston forward. When the forward movement of the pistons causes their primary cups to cover the bypass holes, hydraulic pressure builds up and is transmitted to the wheel cylinders. When the brake pedal retracts, the pistons allow fluid from the reservoir(s) to refill the chamber if needed. Electronic sensors within the master cylinder are used to monitor the level of the fluid in the reservoirs, and to alert the driver if a pressure imbalance develops between the two systems. If the brake light comes on, the fluid level in the reservoir(s) should be checked. If the level is low, more fluid should be added, and the leak should be found and repaired as soon as possible.

II. WORKING OF MASTER CYLINDER

When the brakes are not applied, the piston cups of the primary and secondary pistons are positioned between the inlet port and the compensating port. This provides a passage between the cylinder and reservoir tank. The secondary piston is pushed to the right by the force of secondary return spring, but prevented from going any further by a stopper bolt. When the brake pedal is depressed, the primary piston moves to the left. The piston cup seals the compensating port blocking the passage between the primary pressure chamber and the reservoir tank. As the piston is pushed further, it builds hydraulic pressure inside the cylinder and is applied or transmitted to the wheel cylinders in that circuit. The same hydraulic pressure is also applied to the secondary piston. Hydraulic pressure in the primary chamber moves the secondary piston to the left also. After the

compensating port of the secondary chamber is closed, fluid pressure builds and is transmitted to the secondary circuit.

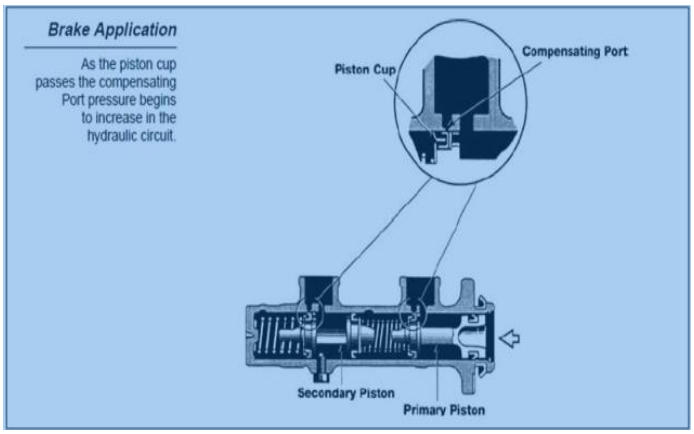


Fig 1. Working of master cylinder-brake application

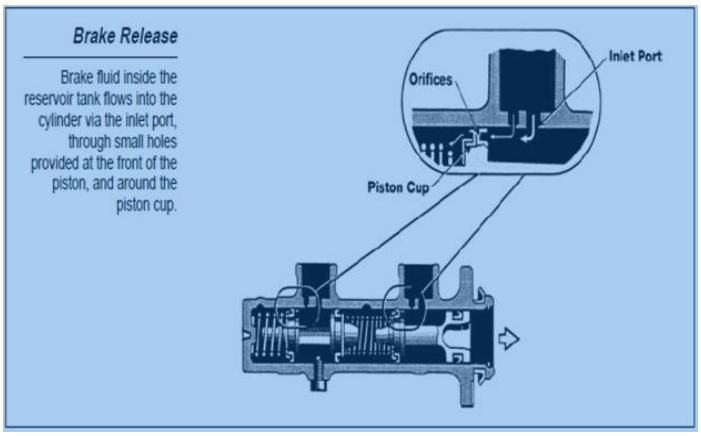


Fig 2. Working of master cylinder-brake release

Design Considerations of Master Cylinder:

The basic information about brake system and its master cylinder, function, purpose, working principle, different shape and size of master cylinder, failure considerations has been taken from automotive brake system. The work done by brake system parts manufacturers tells that cost mold brake master cylinder made of cast iron was used universally in all the old car and light trucks and after that there has been increased research done on improving the mileage of the vehicle by reducing the weight. The research made a way to concentrate on reducing the weight of brake master cylinder by changing the materials. The manufacturers came up with new idea of composite master cylinder having integral body made of aluminum and reservoir made of plastic material and thus reducing the weight when compare to cost mold master cylinder made of cast iron. Those manufacturers are concentrating on reducing weight of master cylinder by changing the material and by changing the type of manufacture. This information gives basic steps for this project in taking reduction of weight further and considering plastic material to design brake master cylinder. The second edition of brake design and safety gives basic design considerations to design safer brakes and its components. The standard of quality of brake technology as changed over the last two decades The new design can only be achieved through proper research, through the use of sound engineering concepts and testing the results of small design changes. The information provided by the author has helped in considering engineering design concepts, safety considerations, material selection, guides, standards and practices for the project.

III. MODELING USING PRO-E

COMPUTER AIDED DESIGN (CAD):

Computer Aided Design (CAD) is the use of wide range of computer based tools that assist engineering, architects and other design professionals in their design activities. It is the main geometry authoring tool within the product life cycle management process and involves both software and sometimes special purpose hardware. Current packages range from 2D vector based drafting systems to 3D parametric surface and solid design modules.

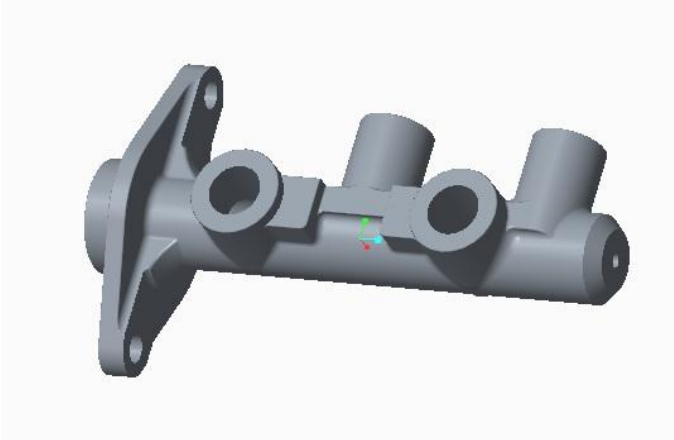


Fig 3. Master cylinder

FEA/M: The finite element method is numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. Because of its diversity and flexibility as an analysis tool, it is receiving much attention in almost every industry. In more and more engineering situations today, we find that it is necessary to obtain approximate solutions to problem rather than exact closed form solution. It is not possible to obtain analytical mathematical solutions for many engineering problems. The finite element method has become a powerful tool for the numerical solutions of a wide range of engineering problems. It has been developed simultaneously with the increasing use of the high- speed electronic digital computers and with the growing emphasis on numerical methods for engineering analysis. This method started as a generalization of the structural idea to some problems of elastic continuum problem, started in terms of different equations

Importing the Model:

In this step the PRO/E model is to be imported into ANSYS workbench as follows:

In utility menu file option and selecting import external geometry and open file and click on generate. To enter into simulation module click on project tab and click on new simulation

Defining Material Properties:

To define material properties for the analysis, following steps are used The main menu is chosen select model and click on corresponding bodies in tree and then create new material enter the values again select simulation tab and select material

Defining Element Type:

To define type of element for the analysis, these steps are to be followed:

Chose the main menu select type of contacts and then click on mesh-right click-insert method

Method - Tetrahedrons

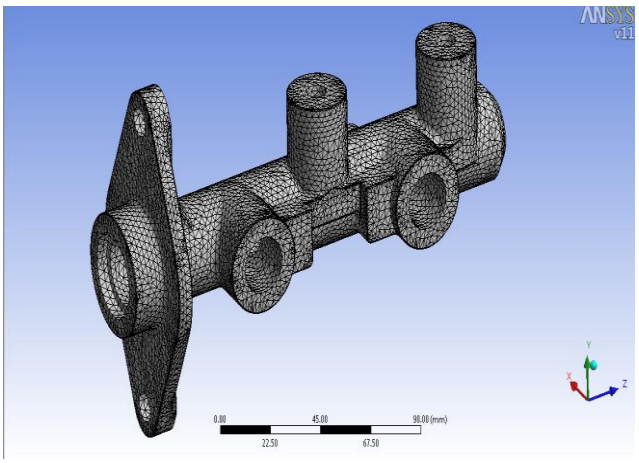
Algorithm - Patch Conforming

Element Mid side Nodes – Kept

Meshing the model

To perform the meshing of the model these steps are to be followed:

Chose the main menu click on mesh- right click- insert sizing and then select geometry enter element size and click on edge behavior curvy proximity refinement and then right click generate mesh.



Statistics	
Nodes	128265
Elements	74481

Fig 4. Mesh generation

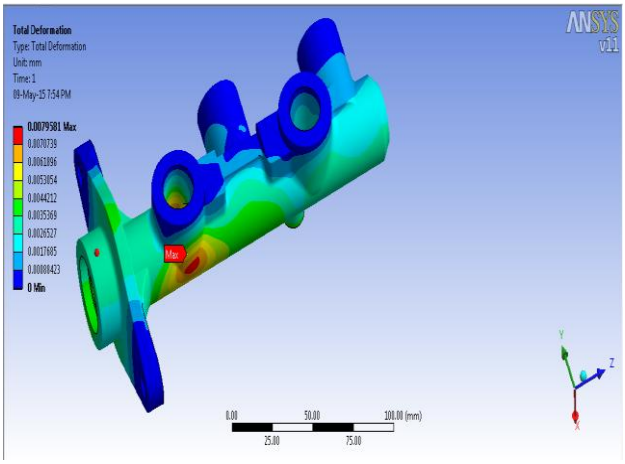


Fig 5. Total deformation

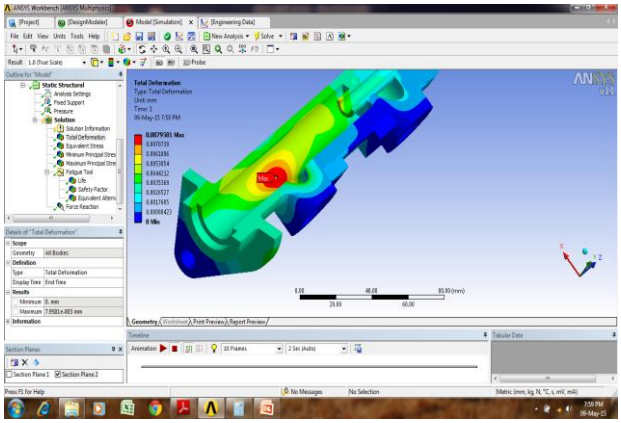


Fig 6. Total Deformation at cut section

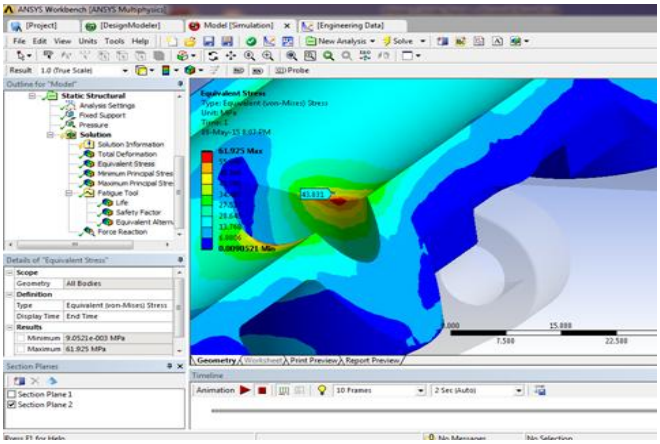


Fig 7. Equivalent stress at cut section

Dia of the cylinder	Total deformation(mm)		Equivalent stress		Pressure
	Minimum	maximum	minimum	maximum	
22.2 mm	0	0.007958 1	0.009052 1	61.925	5.89Mpa
25mm	0	0.066552	0.045067	154.56	4.468Mpa
20mm	0	0.051017	0.025139	185.88	7.26Mpa

IV. RESULTS AND CONCLUSION

Dia of the cylinder	Total deformation(mm)		Equivalent stress		Pressure
	Minimum	maximum	minimum	maximum	
22.2mm	0	0.007958 1	0.009052 1	61.925	5.89Mpa
20mm	0	0.051017	0.025139	185.88	7.26Mpa

For a pressure 7.26 Mpa, applied at 20mm diameter of the cylinder. The maximum stress acting on the surface of Cast Aluminum cylinder is 185.88 N/mm2. Since the maximum stress acting the surface of cylinder is very less compare to the ultimate strength of that material, so the 20mm diameter size of the cylinder can easily withstand the pressure. So We can prefer 20mm dia cylinder instead of 22.2mm dai cylinder.

REFERENCES

[1] Richard F. Waughtal, Automobile weight reduction using High performance plastics.
[2] http://www.akamaiuniversity.us/PJST9_1_155.pdf
[3] George Fontes, H31 Booster rebuild & master cylinder, 1991 BMW 750iL, 2010
[4] Jeri S. Culp, Light weight brake system.
[5] C.J.Buynacek and W.L.Winterbottom, Aluminium master cylinders.
[6] www.beringer.fr
[7] Melior, Inc., Introduction to Brake Systems – Study guide.
[8] LEXUS Technical training, Master cylinder.
[9] Heinz-Heisler "advance vehicle technology", second Edition, 2002, ISBN 07506 51318, Elsevier Butterworth-Heinemann pp. 494-496,
[10] R.K.Rajput(2007), "A textbook of Automobile Engineering", First Edition, Laxmi Publication (P) Ltd., New Delhi – 110002.
[11] Julian happian- smith "An introduction to modern vehicle design", First Edition, 2002, P.C. Brooks and D.C. Barton, ISBN 07506 50443, Elsevier Butterworth- Heinemann pp .157
[12] Tickoo Sham, Maini Deepak, "Pro/ENGINEER Wildfire 4.0 for Designers", 2009, ISBN 1-932709-19-, CADCIM Technologies, USA.
[12] S.Kelley David.,"Pro/ENGINEER Wildfire Instructor", First Edition, 2005, ISBN 0-07-286520-2, McGraw-Hill Higher Education.
[13] "Getting Started with Pro/ENGINEER® WildfireTM", April 2003, Parametric Technology Corporation (PTC).
[14] R.Chandrupatla Tirupathi and Belegundu Ashok D., "Introduction to Finite Element in Engineering", Third Edition, 2002, Prentice-Hall India Ltd.
[15] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (references)
[16] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
[17] I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.