

# DESIGN AND FABRICATION OF PNEUMATIC SAFETY STEERING SYSTEM.

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## Abstract

The steering wheel is the important cause of fatal injury for drivers in frontal collision. When frontal collision occurs, due to the kinetic energy of driver or occupant body, it moves forward against steering wheel and wind shield. Actually in a frontal collision forces will be first transmitted through driver's feet which act as fulcrum so the body will rotate about it. For the taller driver steering works as fulcrum. Driver head & chest hit the steering or windshield which may cause severe injury or death. Considering the injury potential of steering wheel, we are presenting a new idea pneumatic safety Steering Column. Working of pneumatic safety Steering Column can be explained.

Assume that a vehicle is fitted with this system. Front side of the vehicle is arranged with some mechanical switches. Thus when frontal collision occurs, one or more mechanical switch will get compressed. Thus circuit will get closed and DC current flows to the solenoid valve from battery. Thus the compressed air from Pneumatic cylinder suddenly escapes through the solenoid valve. Thus the steering will get collapsed.

**Keywords :** steering, column, collision forces, safety.

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## 1. INTRODUCTION

In the present scenario transportation has become an important parameter thus it requires the implementation of safety factors in the automobile at low cost which can be afforded even by a common man. Our project deals with the idea of implementing energy absorbing steering column in the car which helps to absorb the impact experienced by the driver during the time of collision at low cost. Energy Absorbing Steering Column (Collapsible steering column) is a kind of Steering Column which minimizes the injury of the driver during a car accident by collapse or breaking particular part of system. Up to now, Steering Column in Crash Analysis had no way to describe these 'Collapse' or 'Slip' by the Axial and Lateral Forces from driver. In this project, I have created a new Steering Column using a Detailed Model which can describe such collapse behavior. In this project, we have been modifying rigid steering column of Maruti-Alto into collapsible steering column for to save human life during frontal impact. The automotive steering column is a device intended primarily for connecting the steering wheel to the steering mechanism or transferring the driver's input torque from the steering wheel. Rigid steering column is a classic design of steering column. The steering wheel has a rigid connection to the steering shaft which is usually a single-piece item. EASC (Energy Absorbing Steering Column) is a kind of Steering Column which minimizes the injury of the driver during a car accident by collapse or breaking particular part of system. In this project, a case study is performed on an existing steering column of Maruti-800 passenger car. This is a rigid column which under crash situation transfers the energy directly to the driver. Thus causing several injury or even fatalities. So, I am modifying this design from a rigid steering to a collapsible steering column.

## 2. Problem definition:

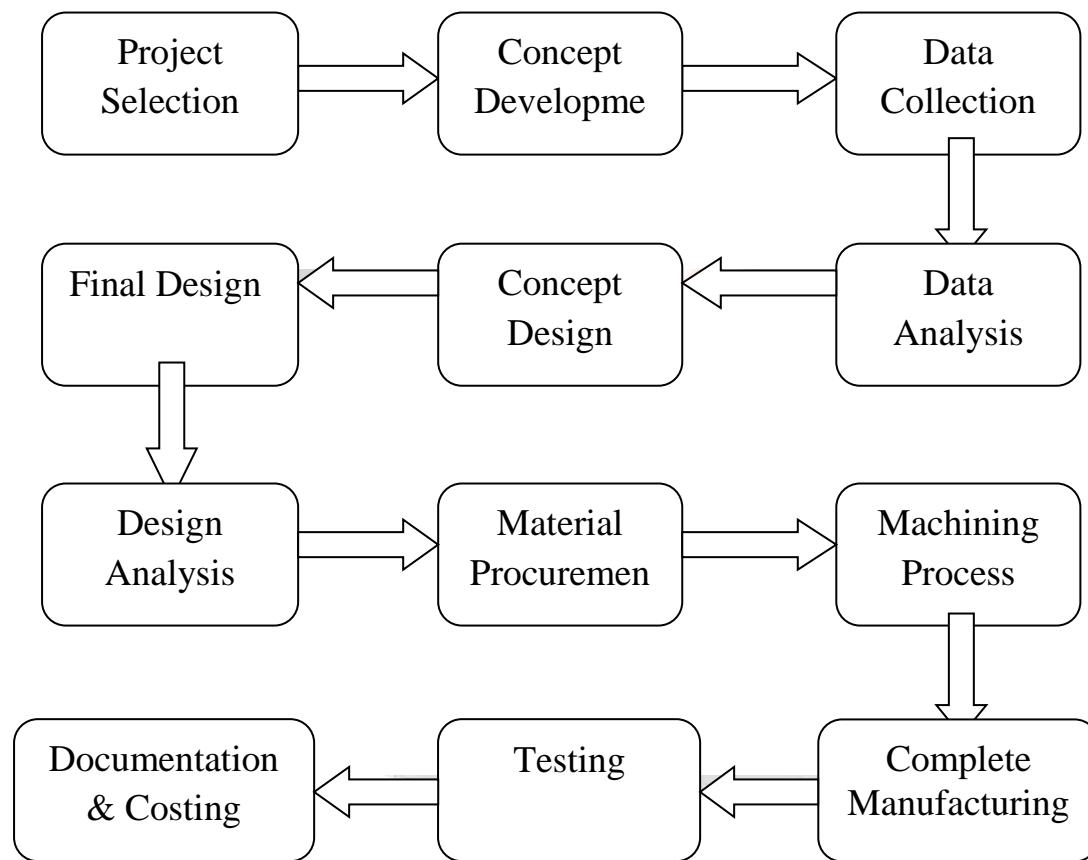
In today's Automobile industry, there are many passenger cars that do not have collapsible steering column. Due to this the casualties in frontal collision accident is high. There are so many example of the car with rigid steering column is Maruti 800, Maruti Suzuki Alto, Tata Nano. In this paper a rigid steering column is redesigned to make it collapsible which in turn can save lives. With the help of company standard test

specification manuals and design parameter authorized workshop peoples and also with the help of research paper it strongly felt that performance of collapsible steering column. So that in this investigation we will create a newly design collapsible steering column by using existing design consideration of rigid steering column and also optimize the modified steering column by setting the control parameters at optimum level without affecting the engine performance.

In conventional vehicles there is no any driver's safety except air bags during emergency condition or accident. During accidental condition there are observe that, if during emergency condition if airbags are not open properly or take time for opening several accidents are happened to overcome this problem we introduce the **pneumatic safety steering system** which increases accuracy of steering handling by using automation in system, so we are trying to do a work on new system in "**pneumatic safety steering system.**"

### 3. Methodology & process flow chart:

The below Methodology shows the sequential operation/steps that will be performed during the project process.



### 4. CONSTRUCTION

It consists of mainly;

**1. Frame:** The frame is of MS material. The frame of our machine is basically used to support the pneumatic components mounted on it. That is steering wheel, double acting cylinder, d.c.v, flow control valve, switches are mounted on frame.

**2. Double acting cylinders:** Cylinders are linear actuators which convert fluid power into mechanical power. They are also known as JACKS or RAMS. Hydraulic cylinders are used at high temperature and produce large forces and precise movement. For this reason they are constructed of strong materials such as steel and designed

to withstand large forces. Because gas is an expensive substance, it is dangerous to use pneumatic cylinders at high pressures so they are limited to about 10 bar pressure. Consequently they are constructed from lighter materials such as aluminum and brass. Because gas is a compressible substance, the motion of a pneumatic cylinder is hard to control precisely. The basic theory for hydraulic and pneumatic cylinder is same.

**3. Pneumatic pipe fittings:** Pneumatic tubing is also available in a number of other materials both with and without reinforcement for use in standard applications. SMC fittings incorporate a positive tube seal while the fitting is under pressure which allows polyurethane tubing to be used.

#### 4. Steering set:



**Fig. Steering set.**

**5. Solenoid type 5/2 dc valve:** A solenoid valve is commonly used, a lever can be manually twist or pinch to actuate the valve, an internal or external hydraulic or pneumatic pilot to move the shaft inside, sometimes with a spring return on the other end so it will go back to its original position when pressure is gone, or a combination of any of the mention above.

**6. Washer:** A washer is a thin plate (typically disk-shaped) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener such as a screw or nut.

**7. Nut and Bolt:** As nuts and bolts are not perfectly rigid, but stretch slightly under load, the distribution of stress on the threads is not uniform.

**8. Battery:** An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work.

**9. Limit Switch:** A switch is an electrical component that can make or break an electrical circuit, interrupting the current or diverting it from one conductor to another. Switches are made to handle a wide range of voltages and currents; very large switches may be used to isolate high-voltage circuits in electrical.

**10. Relay:** A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a low-power signal with complete electrical isolation between control and controlled circuits or where several circuits must be controlled by one signal.

## 5. WORKING

The steering wheel is the important cause of fatal injury for drivers in frontal collision. When frontal collision occurs, due to the kinetic energy of driver or occupant body, it moves forward against steering wheel and wind shield. Actually in a frontal collision forces will be first transmitted through driver's feet which act as fulcrum so the body will rotate about it. For the taller driver steering works as fulcrum. Driver head & chest hit the steering or windshield which may cause severe injury or death. Considering the injury potential of steering wheel we are presenting a new idea pneumatic safety Steering Column. Working of pneumatic safety Steering Column can be explained. Assume that a vehicle is fitted with this system. Front side of the vehicle is arranged with some mechanical switches. Thus when frontal collision occurs, one or more mechanical switch will get compressed. Thus circuit will get closed and DC current flows to the solenoid valve from battery. Thus the compressed air from Pneumatic cylinder suddenly escapes through the solenoid valve. Thus the steering will get collapsed by using pneumatic cylinder.

- **Advantages:-**

- 1) The safety of driver is ensured.
- 2) The cost of steering modification is low.
- 3) The operation of the new system is well controlled.
- 4) Well balanced system.
- 5) It approximately having higher efficiency than of old steering in low cost application brakes.
- 6) It minimizes misalignment & less floor space is required.
- 7) Only simple support structures are required Design & fabrication is easy.
- 8) It increases the safety and working condition.

- **Limitations-**

1. Pneumatic actuators are suitable for only low payload capacity machine.
2. Pneumatic actuators have low power to weight ratio.
3. The operation of actuators is clean but noisy.
4. Monitoring is required to avoid the air leakages.

- **Application:-**

- 1) It is used for safety of commercial vehicles like Car, Buses & Trucks automation system..

## 6. Pictorial Representation





## 7. CONCLUSION

While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose.

Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasize here that we had left no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction.

## 8. Reference

1. Joseph E. Shigley , Mechanical engineering design, sixth edition, Tata Mcgraw hill ,2005.
2. Khurmi R. S.,Gupta J.K., A textbook of machine design, first edition, S. Chand Publication,1979.
3. Thomas Bevan, The Theory of Machines,Third edition, CBS publishers,2005.
4. Ballany P. L.,Theory of machines & mechanisms,Twenty forth edition, Khanna publishers,2005.
5. Bhandari V.B.,Design of machine elements,eighteenth edition, MC graw-hill companies,2003.
6. PSG college of Technology,Coimbatore design data, first edition Kalaikaikathir Achchagam,2003.
7. Anthony Esposito,Fluid Power with Application,sixth edition,Pearson edition,2006.
8. "A Text book on automobile engineering" BY R.K RAJPUT
9. A book on hydraulic and pneumatic control by R.SRINIVASAN JAN 2008 edition.00
10. [www.engineersedge.com](http://www.engineersedge.com)