

Design & Development of Car Door Hinge and Disassemble System

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Abstract - The working system of any door is completely based on its hinges. The opening and closing of the door takes place with the rotation of hinges. In Day-to-day life, we come across many Automobile incidents such as Car Drowning, Car catching Fire etc. During these incidents, the door gets stuck up and there is difficulty in opening of the door. And the conventional hinges cannot be disassembled once they are fixed to the doors. Hence it becomes difficult to open the doors in such situations. As a result of which there is a huge loss of lives of people inside the car. In order to save the lives of people, a dedicated Door disassemble system has been designed and realized. The system was designed to replicate the conventional Car door system in the same way as it is present on the real life test track. The objective of this research was to design a hinge to evaluate its performance at different circumstances and to design a suitable mechanism to Disassemble the door. After analyzing different loads on the hinge, a FEA of the hinge body was done. Also, the strains and stresses within a hinge point during design were analyzed. The Hinge design is shown to be accurate and efficient, with potential for future application.

Key Words- Car Drowning, Door Hinges, FEA (Finite Element Analysis), Hinge Design, Door disassemble System.

INTRODUCTION

Hinges are used to operate the doors in many systems like doors of houses, automobile doors etc. It facilitates the opening and closing of any type rotating doors. Generally, door hinges are either welded or fixed with Nut- bolt system to the doors and to the body of the system. They get permanently attached to the door and cannot be removed easily whenever desired.

In case of automobiles, there are situations like Car drowning in Water, Car catching fire etc., where the doors get locked up due to failure of Centre Lock System. In such incidents, the only way to escape is by breaking the glasses which is very difficult in such situation. As a result of which there is a huge loss of lives of the persons in the car.

Hence there is a need to replace the conventional system with a new design which could serve for the better purpose in such situations.

The objective is to develop a new system which can solve this problem. The purpose of our new design is to detach the door from car body so that the person can easily escape from the car. The scope of this research is to save the lives on people in future circumstances like Car drowning in Water, catching fire etc., where the doors get locked up due to failure of Centre Lock System.

Review

Conventional Car door hinges:-

Door hinges are door retention system components which plays very important role in automobile as it holds the door of automobile in case of side impacts or rollover accidents. Hinges is the assembly of components connected to the door and body of the vehicle, linked to each other and capable of rotating around the same axis. Conventional system consists of two hinges for each door, an upper hinge and a lower hinge. Inside the hinge there is a circular pin that allows the hinge to swivel around pin axis.

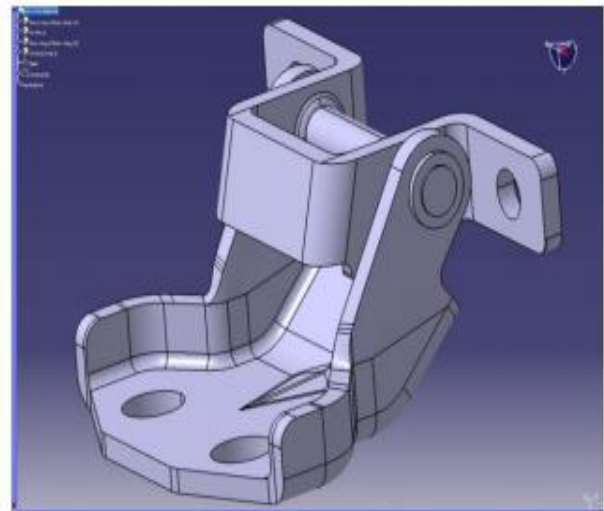


Figure 1 Conventional Hinge



Figure 2 Conventional Hinge

Such hinges cannot be opened instantly in any difficult situations and hence there is a need to design a new car door hinge which could facilitate the detachment of the door from car body in any situation.

After studying the problem statement, we have proposed a new hinge which will satisfy the purpose of need. This hinge will work under normal conditions while opening and closing of door and, it will disassemble during emergency situation. In this research work, we have replaced the conventional hinges with new designed hinge and simultaneously we have made a mechanism to open this newly designed hinge of the door.

Proposed Design of Hinge:-

New hinge consists of two coaxial cylinders. One of the cylinders is outer part which is hollow and cut two equal halves while the other cylinder is inner part which is in 'I' section. Both the cylinders are kept intact through two pins. Simultaneously, a mechanism is provided a latch of the car door.

Since the co-axial cylinders are easily rotated with respect to one another, the new hinge design is done in cylindrical shape.

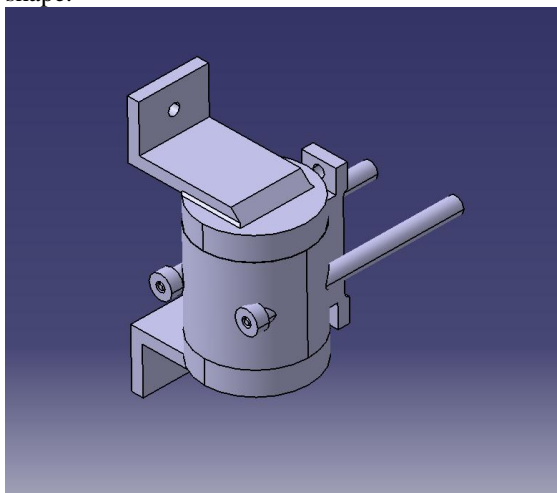


Figure 3 Proposed Hinge

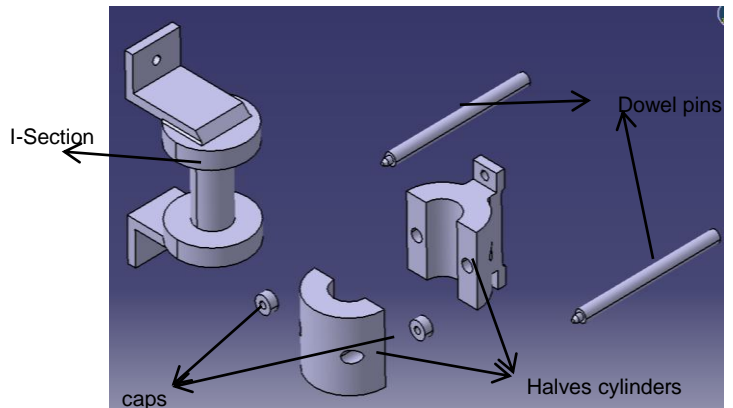


Figure 4 Exploded View

- Halves Cylinder: -
 The halves hollow cylinder is to hold the I-section and provide the rotation without any misalignment. One half cylinder is welded to the car body.
- I Section: -
 The I-Section is attached to the door which rotates inside the hollow cylinder. The load of a door is being taken by this section. The I-section completely transfers the load to the car body.
- Dowel Pin & Cap:-
 The pins help to keep the two outer cylinder intact with 'I' section in the middle. Some of the load is carried by this pins. Caps is used to hold both the cylinders.



Figure 5 Manufactured Hinge Part

The actual manufactured hinge component made of Aluminum Alloy.

FEA of New design of Hinge:-

Forces are taken from the Indian Standard IS 14225:1995 Automotive vehicles-locking systems and door retention components - general requirements, Bureau of Indian standards. Each door hinge system shall support the door and shall not separate when a longitudinal load of 11130 N

is applied. In transverse load condition, each door hinge system shall support the door and shall not separate when a transverse load of 8930 N is applied.

The Material used is Aluminum Alloy.

Material	Tensile Yield Strength	Ultimate Strength
Al	2.8E+08	3.1E+08

The Results obtained from the forces applied in both the direction are as follows:

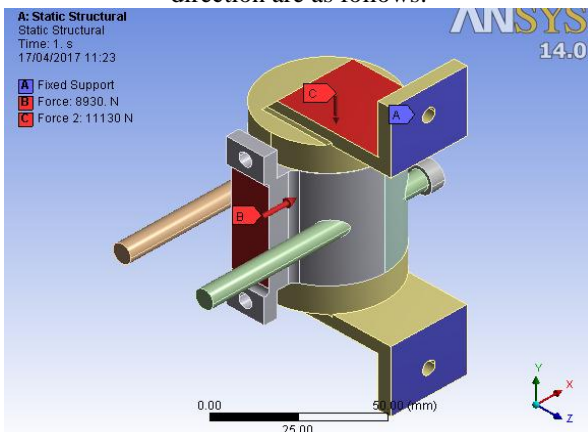


Figure 6 Forces on Hinge

Here arrow C is along the Longitudinal direction and arrow B is along the Transverse direction.

For Transverse Direction:-

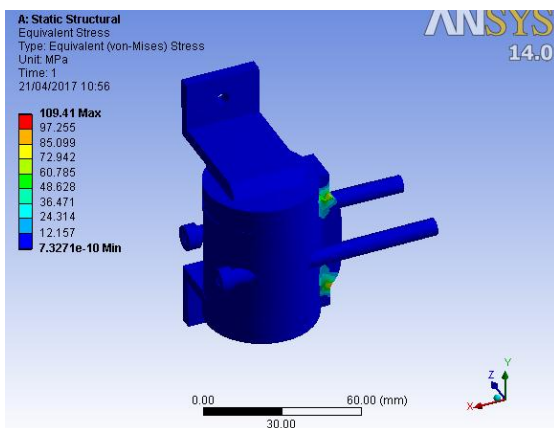


Figure 7 Stress in Transverse Direction

By static analysis of Hinge under extreme conditions Maximum Deformation: 0.011726mm.

Max. Stress produced: 109.41MPa

As stresses are well within the limit of yield stress (242MPa) and deformation is much less, so design is safe.

For Longitudinal Direction:-

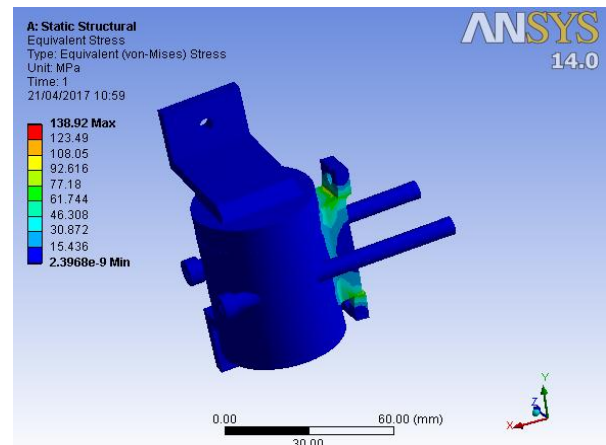


Figure 8 Stresses in Longitudinal Direction

By static analysis of Hinge under extreme conditions Maximum Deformation: 0.045mm

Max. Stress produced: 138.92MPa.

Mechanism to disassemble the door:-

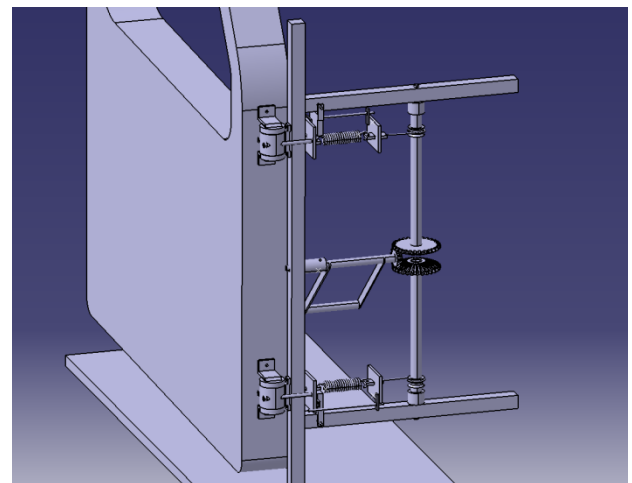


Figure 9 Disassemble System

Working:-

The complete mechanism is working as follows: -

The rotating handle is rotated by hand to actuate the mechanism. The rotating handle acts like a trigger for the mechanism. It is rotated through 90-120 degrees. The rotating handles which in turn rotates the Bevel gear pinion. The Bevel gear pinion drives two gears and transmits the motion from handle to pulley. Basically the Bevel gear is used as, the motion is in perpendicular direction and at the same time torque also gets increased. Now the pulley transfers the motion in perpendicular direction through rope. The one end of the rope is connected to tension spring. The helical tension spring is directly connected to dowel pins of the hinge. The spring makes the rapid motion so that the doors get immediately detached from the car body.

This rapid motion of spring is done by plates & rod as shown in the fig.

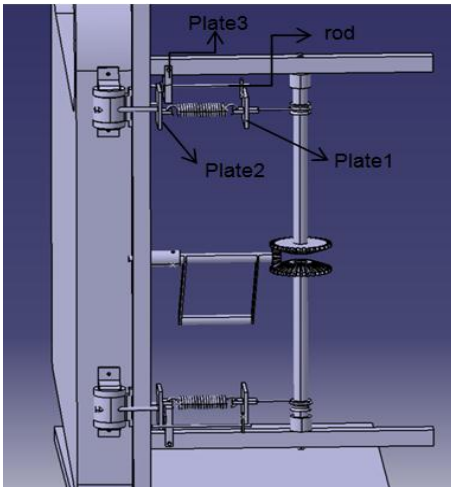


Figure 10 Mechanism to Disassemble

The spring is connected at the two end of plates1 & 2 .The rod is attached to plate 1 and it penetrates inside plate 3 which doesn't allow the plate 3 to rotate along its perpendicular axis. The plate 3 holds the plate 2 in static position.

When the spring gets stretched, plate 1 moves in forward direction and simultaneously rod come out from plate3 which rotates it and makes the plate 2 free. Due to energy stored in the spring it pulls the dowel pin out of the hinge

This separates the two halves of the outer cylinder and the I Section along with the doors gets disassembled. The similar mechanism works for the lower hinge. . This mechanism will work only when it is manually actuated while under normal conditions there is simple opening & closing of the door. This mechanism will be situated under the dashboard where the person can easily rotate the handle and will be able to escape easily in the emergency situation.

CONCLUSION

After going through the research report, it is to be concluded that, new design for hinge of the car door has been proposed which ultimately serves the purpose of supporting (holding it to chassis) as well as rapidly disassemble in case of emergency. Whole design has conceptualized to be mechanical which means it has been purposely avoided any kind of electronic system or sensors so that system won't fail in different emergency situations. This new hinge design has wide future scope and it can also play an important role in general door safety systems.

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