

DESIGN AND ANALYSIS OF VECHILE DOOR MECHANISM

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Abstract - The system is mainly concerned with a rail located in the middle of the chassis where the door can move freely through it. Moreover, a guide is fixed with screws at the bottom of the door and it works as an axle in which a piston moves along the guide making possible the opening and the locking of the door. The piston has a translational movement due to a rod in which there are two bearings that provide the rod with a rotating movement. In this manner, the rotating movement of the rod makes possible the translational movement of the piston along the guide. There is another part that completes the mechanism which is the base; this part supports the pin that connects the piston and the rod. The base is also fixed at the bottom of the door with screws, making easier the maintenance and a possible change in the mechanism if the user wants.

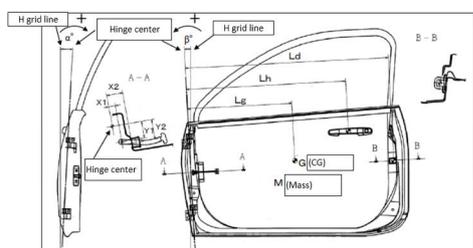
Before the assembly of the 3D model, the most critical zones in the mechanism are studied. The 3D model is performed with the software. The FEM (Finite Element Method) simulation is carried out by Analysis software.

Key Words: Chasis, Axle, Bearings, Translational, Mechanism, Analysis

1. INTRODUCTION

This project evaluates a car door opening mechanism. The design has to meet several requirements and to achieve this aim with a satisfactory result; different tests have to be performed. The analysis covers different car doors which are provided by the automobile industry nowadays. All the outcomes are arranged by means of a simple comparison between the different existing products. As a consequence, the door mechanism chosen for this project comes out taking into account all of these doors that a user can find in the industry. Besides, thanks to this study it has been possible to achieve a system that will improve this market with the main objective of creating a user-friendly door for unconventional people. This project aims to find a solution for most of the difficulties that a conventional car door causes in several situations such as parking space between cars or car and obstacles and difficulties for disabled people when .

➤ Slid



The selected mechanism is a sliding door, vertical door or disappeared door. All of them have the same functions although their design differs. Firstly, we will study the most suitable door to solve the problem of the parking space, which is the most important aim in this project. With one of those kinds of doors we will see the difficulties that people normally have when they park their cars, as it is usual to have problems of space when you get off the car in places where the parking space is very narrow. Regulations relating to parking spaces do not really consider the necessity of enough space when opening a car door. Therefore, the solution for this limitation is the main goal of the door design..

1.1 Kinds of Doors:

➤ Classic Door

The most common door which can be found in cars market is the classic door. It is the most common door used, it is well known to everyone because it opens like the typical door in a conventional house. Being very common, the assembly becomes fitting, cheap and also simple although it has a disadvantage because a huge lateral space is needed for its manipulation. The same disadvantage can be found in a gull wing door although this door makes easier the entrance as its opening is in the upper side of the car.

➤ Scissor Door

The scissor door should be mentioned as a very similar kind of door. This one has also a vertical opening and it is fixed in the area near the end of the windshield. Its look is very pleasing but it needs a considerable height to work properly.

➤ Suicide Door

There is another fantastic door in the cars market, although not very usual, appreciated by vintage drivers who love cars. It is called the suicide door. This sort of door is opened by the opposite direction to the conventional. It becomes very comfortable and aesthetically as it provides a wide and easy entry at the time when the car is converted into a very sophisticated one, totally different to the rest.

➤ Canopy Door:

It is placed in the top of the car and it can be opened by many different ways. The hinges can be placed on the front, side or backwards. It provides an aesthetically pleasing look but it has a great complex and expensive system.

The sliding door appears in the car world. This door is opened by sliding out on rails so that small lateral space is needed for

its handling. With these features the entrance and the exit are facilitated but the bodywork must be modified.

➤ Dihedral Door:

Dihedral doors are similar to scissor doors; the only difference is that these doors open by moving outward while rotating at 90 degrees at the door hinge. Dihedral Doors are the latest invention in the car industry, and some popular car models that feature this door type are the Agera R, the Agera RS, the Koenigsegg Agera, the Koenigsegg CC8S, CCR, and Regera.

2. Literature Survey

[1] **Cheng et al.** Sliding doors and plug sliding doors share many similarities as both systems require rail or guide ways to guide the opening and closing motion. The required installation space is 9 relatively smaller when compared with swing doors. Plug sliding doors are more favored in some applications like high speed trains or metro trains, since door rail or guide ways is not placed on the surface of the car. This will reduce the air drag while vehicles travel at a high speed. Crush protection can be easily achieved by monitoring parameters like motor torque (electric powered) and air pressure of the actuator (pneumatic powered). Drawbacks can be found in the reliability issue as more components are involved.

[2] **Furman et al.** Door system design for an ATN vehicle must consider various aspects. First of all, the geometry layout of the door mechanics is required to fit into the indoor space of the vehicle. Selection of the proper door mechanics is based on vehicle design and station configuration. The first part of the literature review contributes introduction and discussion for the choice of door mechanism.

[3] **Van der Gucht et al.** The geometry layout and the physical mechanism of the onboard door system should meet the space requirement and users' convenience. Among the current products in the market, the door mechanism in use can be summarized as, swing plug door, sliding door and plug sliding door. These designs can also be classified as pneumatic powered and electric powered by the category of power supply. Swing door design is the simplest approach and its high reliability is resulted from the mechanism simplicity.

[4] **M.Raghuveer.** Car door is one of the main parts which are used as protection for passengers from side collisions. Presently steel is used for car doors construction. The aim of the project is to analyze the car door with presently used material steel and replacing with composite materials like Aluminum, Carbon Epoxy, S-glass epoxy, E-Glass epoxy. Impact analysis is conducted on door for different speeds by varying the materials. Best of the result we will consider for the door design. Also we are going to reduce weight of the door by using composite materials replacing with steel. By this we have to reduce the damage percentage of the car and passenger protection.

[5] **Ganti Satya Prakash.** The side impact door should have the ability to absorb as much deformational energy as possible without breaking. Steel is still the most widely used material for beam members, but the steel increases the total weight of the car. However, breakthroughs in the application of lighter

materials, such as composite, are being initiated in the automotive industry. Correct fiber orientation and stacking sequence of the cross-ply laminate contribute to higher energy absorption when compared to steel equivalent.

[6] **Darwish.** Cars have various types of doors. The swinging doors which are the most common are almost the most complicated parts in a car since they not only determine the general guidelines of car style, but also are vital for passenger's safety by protecting humans from side crashes.

[7] **H.M.A Hussein.** Comparison between FEA results and targets led to the necessity to split lower opening of front door into two parts to increase stiffness. Also, thickness of window regulator engine fixing in both front and rear doors are increased. Predetermined values from previous works conducted on a similar existing SUV vehicle were used as targets to be achieved by Finite Element Analysis (FEA) of car doors. Mobile hinge fixing is duplicated for both front and rear doors. Inner panel opening in front door window lower mechanism are also decreased.

[8] **Pradhya R. Nehete.** Today people are facing more problems about security in all over world, nowadays security is the most essential issue everywhere in the world; so security of everything gains higher and higher importance in recent years. Here in this paper, trying to reproduce the comprehensive literature study related to the various door locks and gate security systems that are necessary in the fields such as home, industries and vehicle security where possibilities of incursion are increasing day by day. In past days, the research is gone on various door lock security systems like traditional security systems which provide indications using alarm. Due to the advancement in recent techniques, some door lock security systems are based on microcontroller, GSM, GPS, many sensors, software like MATLAB, PROTEUS, biometrics like face recognition, Iris scanner, RFID, Smart Card and password etc.

[9] **Haren S Panchal.** PMSM is widely used for its high efficiency and stable performance. The control precision and quality of PMSM become important, and it is very crucial to know the advantages and disadvantages of control strategies. FOC is the most common control strategy in PMSM control system and the bandwidth of the current loop is a critical factor that influences the dynamic performance of FOC system, because of its inherent characteristics.

[10] **O.M. Terciu, I. Curtu :** He has done research on FEA of an automotive door trim panel made of lignocelluloses composites in order to determine the stresses and displacements in case of a door slam simulation. On his research a new lignocelluloses composites made of polymers reinforced with woven fabrics of natural fibers and wood particles was created. The mechanical properties of these material were determined experimentally and used as input data in FEM simulations. The finite element method result emphasized that new material improves component stiffness compare with classical materials used. The modeling part of the complex geometry requires specialized software to achieve the required model. Since the composite material has high of fixing areas to the metal structure there is equivalent stress distribution and the displacement of the lignocellulose material is 43% smaller than the other polypropylene panel

when compared by Finite Element Method. Since smaller displacement results it is due to high rigidity and low weight of the material this decreases the overall weight by 1.81kg to 1.49kg.

[11] **S. Vinay Seeba, S. Srikari** He had studied The design and analysis methodology design adopt plastic door module plate to replace existing steel door module plate, this door modules where directly shipped to the OEM's, which saves assembly time and cost in mass manufacturing. The application of long fibers reinforced thermoplastic has improved structural and material properties over conventional materials like steel. The final design of plastic door module is 33% lesser in weight with improved structure, when compared to steel. The same can be adopted to replace semi- structural automotive parts currently made from steel.

[12] **Tan Wei, Wang Yan, Li Lingyang** He had studied the Design of The Vehicle Door Structure Based on Finite Element Method. The performance of the door assembly is very significant for the vehicle design. In the present paper, the FEM is used in the development processes of the door assembly. The modal characteristic, stiffness, strength, and anti-extrusion of a newly developed passenger vehicle door assembly were calculated and evaluated by several finite element analysis software's. The structural problems were discovered by finite element analysis and had been modified and finally achieved the expected door structure performance target of this new vehicle, and its issue in focus is to predict performance of the door assembly by powerful finite element analysis software, and optimize the structure to meet the design targets and it is observed that this method have been used to forecast the performance of vehicle door efficiently when it was designed.

[13] **Sandeep Bunde** The drawbacks of existing automotive door structure and suggest design changes to overcome the present drawbacks. This research paper details out the analysis of the existing structure and identifies the drawbacks and explains the process of door system design. Changes required can be found out with correct method as explained in this paper. Validation of the design parameters is of vital importance so the way by which validation of newly designed or modified parts

[14] The composite materials are replacing most of the steel structures. Rotors manufactured using RTM (Resin Transfer Molding) for air compressor or superchargers of cars are used to substitute for metal rotors which are hard to manufacture.

[15] The composite material was for the first time introduced to the formula-1 in 1980 by McLaren team. Since then the crashworthiness of the racing cars has improved beyond all recognition. They used the carbon fiber composite to manufacture the body, which is low weight, high rigidity and provided the high crash safety standards.

[16] The lightweight composite materials are already finding the exciting break in the automotive field as a means to increase the fuel efficiency. The vehicle weight directly contributes about 75 percent of fuel consumption. The vehicle industry can anticipate an aggressive 6 to 8 percent reduction in fuel consumption with 10 percent decrease in vehicle weight.

This reduces around 20 kilogram of carbon dioxide emission per kilogram reduction in weight over the vehicle's lifetime.

[17] The report from the united states and Canada predicted that plastics and composites would be widely used applied to body panels, bumper systems, flexible components, trims, drive shaft and transport parts of cars. Also rotors manufactured using RTM (Resin Transfer Moldings) for air compressor or superchargers of cars have been used to substitute for metal rotors which are difficult to machine [4]. Composites have been used to substitute flexi spline materials in harmonic drives.

[18] The current loop force the current feedback to follow the current reference command, which increases the static and dynamic characteristics of FOC system. To increase the control performance the control cycle should be as small as possible.

[19] This paper includes the PI control which is used in FOC system. The mutual coupling between the quadrature axis and the direct axis affects the static and dynamic response of current, though PI control can achieve no static error in the rotating coordinate system.

[20] design of Automated Lift Door Mechanism. In existing lift door mechanism, standard controllers are used. As this controllers are costly hence, increase the cost of the lift. In order to reduce the cost, Field Oriented Control is used to design the driver. The supporting frame analysis is carried out in ANSYS 16.0 and observed that there is a deformation in the ranger of e-6mm and hence system is found to be safe.

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