



Design and Manufacture of Electric Car Chassis Frame for Two Passengers With Solidworks Modeling 2020

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ABSTRACT

An electric car is a car that is driven by a DC motor using energy stored in the battery. The use of electric cars is considered more effective in addition to not causing air pollution and a simpler engine construction and as an alternative means of transportation. The frame/chassis is the main part of the car that functions to support other components such as the engine, battery, steering system, braking system, driver's seat and other vehicle equipment, and also as a vibration damper if the vehicle runs on various types of road surfaces and various modes of motion. From the vehicle, the frame used is a ladder frame which has a simpler and stronger structure. This study aims to design and manufacture the frame of an electric car and analyze the load received and the maximum load that the frame can withstand. This research begins with the design of the frame, then the assembly of the frame will be carried out then data will be collected on the frame which will then be processed to determine the load received by the frame and analyze the value of the welding stress on the frame.

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1. INTRODUCTION

Transportation facilities are a necessity for every human being to support his work. One form of land transportation is vehicles such as bicycles, motorcycles, cars, trains, and others. Generally, automobiles use internal combustion engines. This internal combustion engine has a disadvantage in the pollution it produces.

The development of environmentally friendly cars such as electric cars, hybrid cars, or hydrogen cars continues to be carried out. The Minister of Energy and Mineral Resources (ESDM) estimates that the government's reason for accelerating the electric car program is to reduce pressure on imports of fuel oil (BBM) and reduce the effects of global warming (Kuswaraharja, 2019)

An electric car is a car that moves using electrical energy (Broadbent, 2019). The electrical energy is stored in a battery which stores electric potential. The electric potential stored in the battery is what will drive the electric motor so that the car can run in general.

Chassis is a component in a car that functions as a frame to support the vehicle body. Because this chassis will support the vehicle, a strong yet lightweight chassis is needed so as not to burden the power-producing performance. Therefore, the chassis used is a ladder frame type chassis. This type of chassis can support the vehicle and provide a strong stand from the weight of the load and its main advantage lies in strength. In addition, this type of chassis is also easy to design. The ladder frame has two long members to withstand longitudinal loads due to acceleration and braking and a cross member to keep the chassis rigid.

Designing a chassis needs to be analyzed to determine the strength of the chassis design. The design is said to be safe if the maximum stress is less than the maximum allowable stress of the material. To determine the stress that occurs in the chassis, various methods of design analysis can be used, either manually or with the help of a computer. With the rapid development of computer and simulation technology, chassis structure testing can be done through simulation.

Various packaged programs on the computer can be used to assist the analysis activities and other activities carried out in the phases of the design process. Harsokoesoemo (2004: 34) states that the package programs used in the analysis in the design process steps are as follows: Finite Element Analysis (FEA) program, Computer Aided Design (CAD) program, and dynamic package program. All of these bundled programs are available in the SolidWorks 2020 software.

SolidWorks is a type of Computer Aided Drawing (CAD) software that emphasizes solid modeling. Solidworks provides complete facilities for visualizing digitally created 3D models. This digital document helps in visualizing, simulating, and analyzing a product design. This software is very helpful in the design process although it cannot completely replace the function of the designer. Harsokoesoemo (2004: 35) reveals some of the advantages of using a CAD system in the design process are as follows: Shorten design time, increase productivity and product quality, reduce design costs, and can make simulations of analyzed models without making physical prototypes.

Based on several problems that have been described previously, the authors are motivated to design and analyze the strength of the ladder frame chassis for electric car vehicles, which will be analyzed using SolidWorks 2020 software. This analysis is used to determine the strength of the chassis design in supporting the vehicle's load.

2. METHOD

The research was conducted using the simulation method, the independent variables used in this study are Design and Manufacturing of Electric Car Chassis Frames for Two Passengers with SolidWorks 2020 Modeling. To determine the quality of the chassis made, a load test was carried out using the SolidWorks 2020 application with a load of 50 kg, a load of 100 kg, and a load of 150 kg.

The tools used in the research to be carried out are the Asus ROG Strix G531GD Laptop and the SolidWork 2020 software.

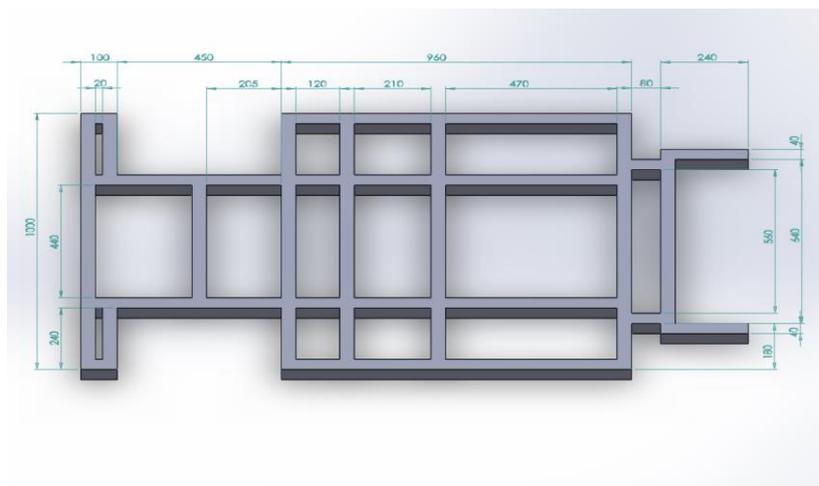


Figure 1. Electric Car Chassis Design

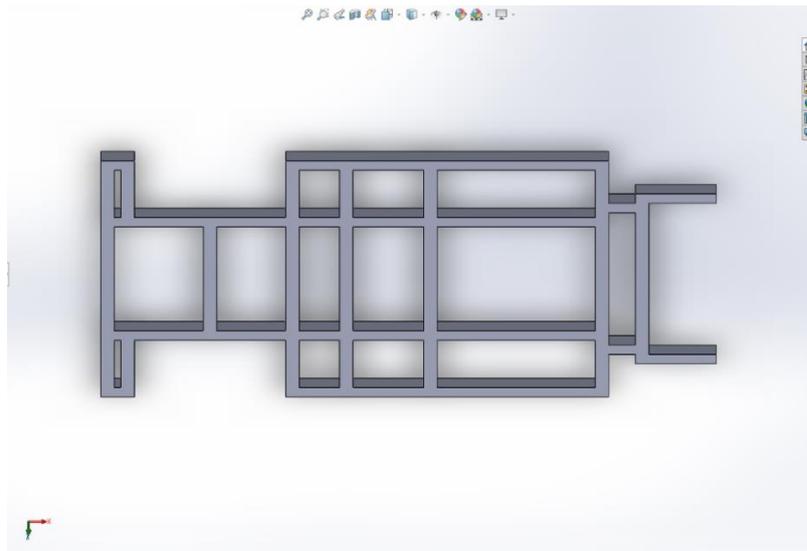


Figure 2. Electric Car Chassis Design Top View

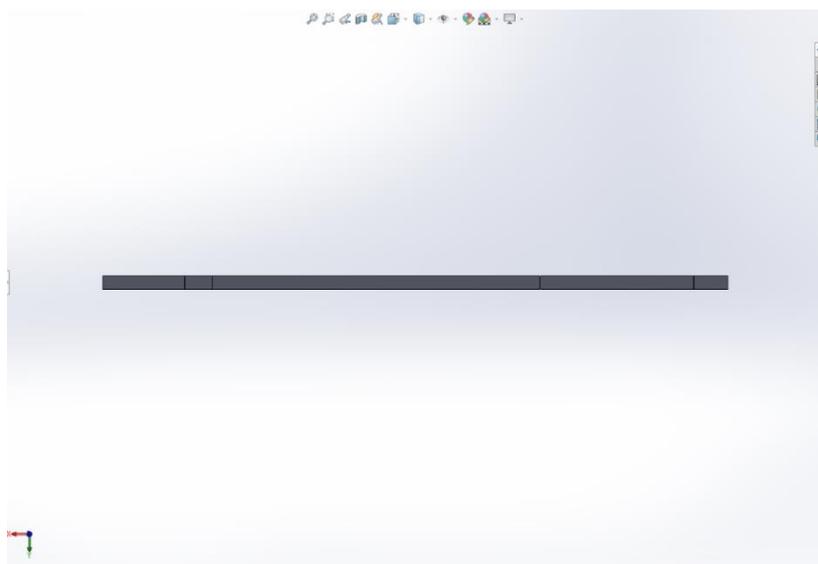


Figure 3. Electric Car Chassis Design Side View

3. RESULTS AND DISCUSSION

In this section, we will discuss the results of a load test simulation on an electric car chassis using SolidWorks 2020, using SolidWorks 2020 Software to find the area that has the highest stress, with a load of 50 kg (490.3 N), a load of 100 kg (980.7 N), and a load of 150 kg (1470 N).

The results of testing the load of an electric car with a load of 50 kg, a load of 100 kg and a load of 150 kg. Shows the parts of the electric car chassis which in certain positions experience stress (voltage), marked with red color indicates the highest stress, while the dark blue color indicates areas that experience the least stress. From the analysis of the load test of 50 kg, 100 kg, and 150 kg, it was found that minimal stress occurred which was shown in dark blue in the chassis section.

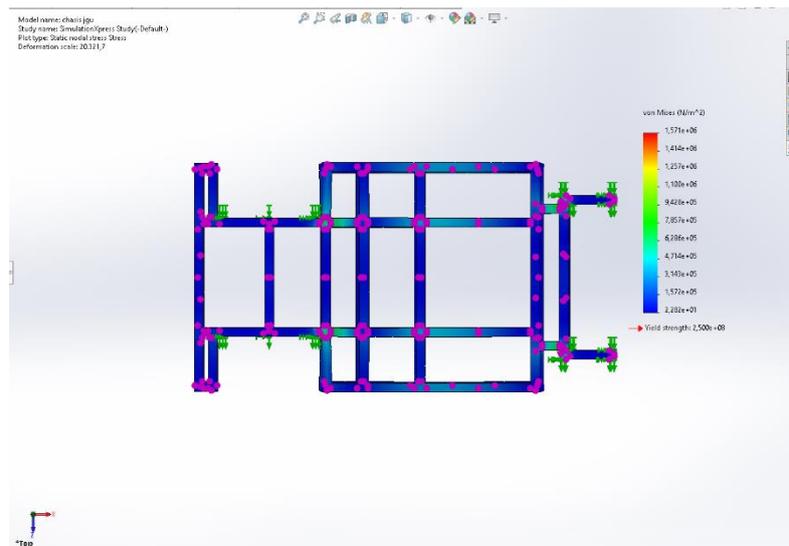


Figure 4. Simulation Results of 50 kg . Load Test

The results of the 50 kg load test show that the parts of the electric car chassis which in certain positions experience the highest stress (voltage). The red color shows the part that is experiencing the maximum stress, while the blue color shows the part that is experiencing the least stress. And the results of the analysis showed that with a load test of 490,3 N, the electric car chassis was able to withstand the load, which was indicated by the maximum value (red color) = $1,571e+06$ not exceeding the yield strength ($2,500e+08$).

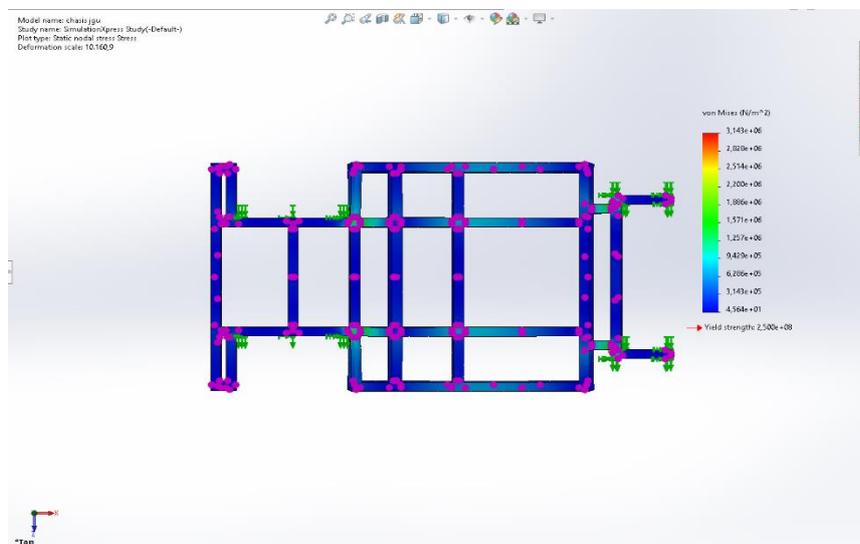


Figure 5. Simulation Results of 100 kg . Load Test

The results of the 100 kg load test show that the parts of the electric car chassis which in certain positions experience the highest stress (voltage). The red color shows the part that is experiencing the maximum stress, while the blue color shows the part that is experiencing the least stress. And the results of the analysis showed that with a load test of 980.7 N the electric car chassis was able to withstand the load, which was indicated by the maximum value (red color) = $3.143e+06$ not exceeding the yield strength ($2.500e+08$).

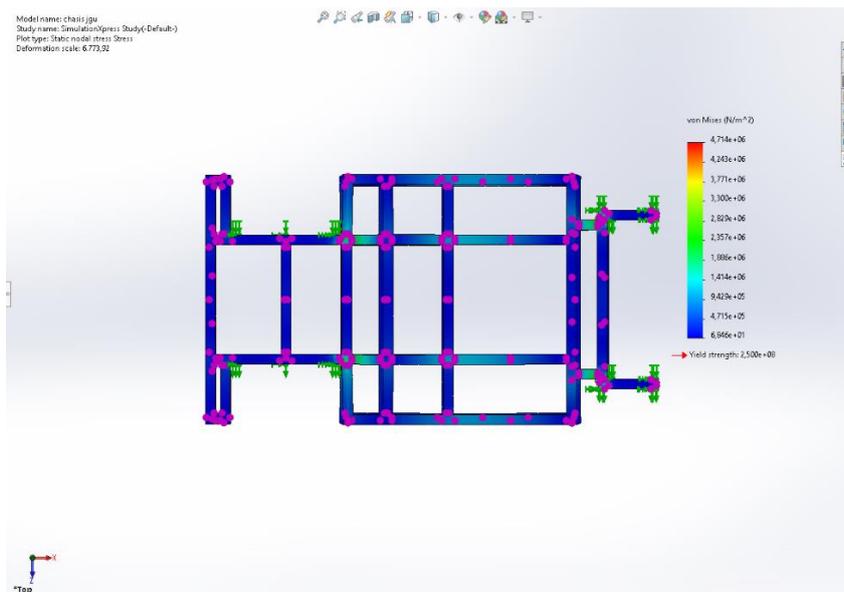


Figure 6. Simulation Results of 150 kg . Load Test

From the results of the 150 kg load test, it shows that the parts of the electric car chassis which in certain positions experience the highest stress (voltage). The red color shows the part that is experiencing the maximum stress, while the blue color shows the part that is experiencing the least stress. And the results of the analysis showed that with a load test of 1470 N, the electric car chassis was able to withstand the load, which was indicated by the maximum value (red color) = $4.714e+06$ not exceeding the yield strength ($2,500e+08$).

4. CONCLUSION

From the results of the research that has been carried out on the design and analysis of the strength of the chassis, the following conclusions can be drawn.

1. Chassis design type ladder frame with specifications of length 2000 mm, chassis width 1000 mm, wheel base 1450 mm.
2. The results of the 50 kg load test simulation, the maximum value is $1.571e+06$, the 100 kg load test has a maximum value of $3.143e+06$, and the 150 kg load test has a maximum value of $4.714e+06$.
3. And from the load test simulation results using SolidWorks 2020 with a load of 50 kg, a load of 100 kg, and 150 kg, it can be concluded that the chassis is able to support an electric vehicle with a capacity of 2 passengers as indicated by the maximum value (red color) not exceeding the yield strength.

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