Journal of Global Engineering Research & Science (J-GERS)
Vol. 1, No. 1, June 2022, pp. 29-35
e-ISSN:2830-5418,p-ISSN:2830-5906,DOI:10.56904/jgers.v1i1.15

Aerodynamic Simulation on Roof for 3,000 Watt Electric Car With Ansys R1 2022 Modeling

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Article Info

Article history:

Received April 21, 2022
Revised May 19, 2022
Accepted June 1, 2022

Keywords:

Electric Car;
Aerodynamics;
Simulations Of Ansys;

ABSTRACT

Technological advances in electronics and machinery, especially in the design of electric motors, are the first step in the development of electric cars. The body is the main part of the car that functions as a construction protection and electrical panel from external factors such as sunlight, rain, and others. In this study, an analysis of the body and roof of an electric vehicle will be carried out to determine the flow of fluid or air that occurs in the car body. How to design the body and roof of a car, how is the air velocity vector that occurs around the roof of the car at speeds of 10 km/hour, 40 km/hour, and 70 km/hour. Before the method starts, literature studies, data collection, the process of designing an electric car body model, aerodynamic analysis through the ansys R1 2022 software, taking test results and conclusions, simulation data analysis techniques are conducting searches on the frontal area, entering geometry in the ansys model, setting sizes and setting of mesh clauses and airflow calculations. The results of the aerodynamic simulation of speeds of 10 km/hour, 40 km/hour, and 70 km/hour. There are parts or positions that block the air the most as shown in red, while those with the least air resistance are dark blue, the maximum speed results are shown in dark blue, while the minimum speed is shown in red so that the area has the greatest resistance air.

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1. INTRODUCTION

Technological advances in the field of electronics and machines, especially in the design of electric motors, are the first step in the development of electric cars, this technology has long been developed in various countries, even in Indonesia, it has been implemented as seen by several vehicle manufacturers designing electric cars and now it has become a domestic product. . This progress is evidenced by the fifth period of the Indonesian Electric Car Competition (KMLI) which was held at the Bandung State Polytechnic (Polban). "Mandalika EV" as a representative [1].

The body is the main part of the car that functions as a construction and electrical protection panel from external factors such as sunlight, rain, and others. In addition, the body also functions as a regulator of fluid flow on the outside of the car so that it affects the performance of the car[2]. The smaller the radius of the front surface of the body, the smaller the drag received so that it can reduce the burden on engine performance to drive the vehicle so that fuel consumption will be more efficient [3].

External aerodynamics refers to the flow around solid objects of various shapes, while internal aerodynamics refers to the flow of solids, such as the flow of air through a jet engine [4]. Aerodynamic problems can be divided into the following categories, namely the flow speed is less than the speed of sound, subsonic, the flow

e-ISSN: 2830-5418, *p*-ISSN: 2830-5906

speed is equal to the speed of sound, it is transonic, and supersonic speed is the characteristic of the flow is greater than the speed of sound, this is called hypersonic. The amount of drag that occurs affects fuel consumption when operating the vehicle, because the energy used by the engine to drive and accelerate the vehicle is lower because the drag force acting on the vehicle is opposite to the vehicle speed [5].

2. METHODOLOGY

The study was conducted using a simulation method, the independent variable used in this study is the aerodynamic flow of an electric car with a capacity of 3,000 watts having dimensions of 200 cm long, 100 cm wide, and 133 cm high to determine the air velocity vector that occurs around the roof and body of the car at a speed of 10km/h, 40km/h, and 70km/h. The tools and materials used in this research are Lenovo laptops, SolidWorks 2020 software and Ansys R1 2022 software.

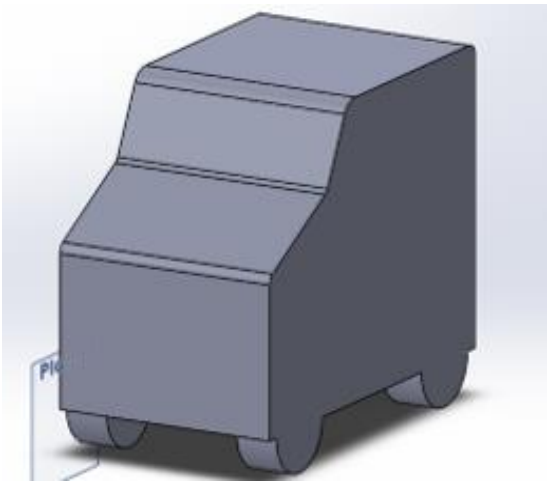

Figure 1. Design of an Electric Car Body with a Capacity of 3,000 Watt

Figure 2. Design of a 3,000 Watt Capacity Electric Car Roof Top View

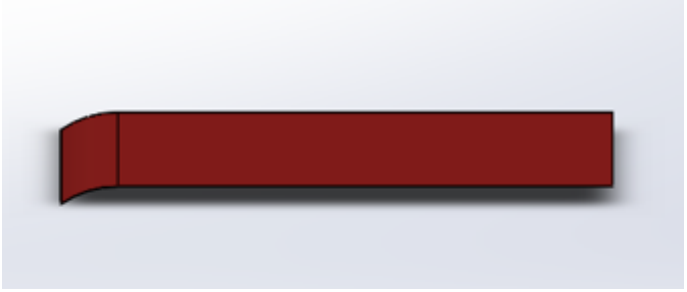

Figure 3. Roof Design of an Electric Car with a Capacity of 3,000 Watts Side View

To make an electric car model with a capacity of 3,000 watts using Solidworks Software and Ansys Software as a simulation application for the aerodynamic testing of the Car Roof Body. This research is descriptive to explain the forms of wind flow patterns. Then, determining the wind pattern is done by simulating several roof variables with the help of a CFD computer program.

3. RESULTS AND DISCUSSION

Aerodynamic simulation test results with a speed of 10 km / h show parts of the electric car which in certain positions strongly impede the air, where the red color indicates the part or the highest position inhibits air flow when flowing in the area, while the dark blue color it shows the area that if flowed with air is the part of the least air resistance. From the analysis results, the maximum velocity of the air velocity is 10 km/hour which is indicated by the dark blue color. While the minimum velocity obtained is 0 km/hour, which is indicated by the red color, which means that if the area is flowing with an air velocity of 10 km/hour, it is the area that provides the greatest air resistance.

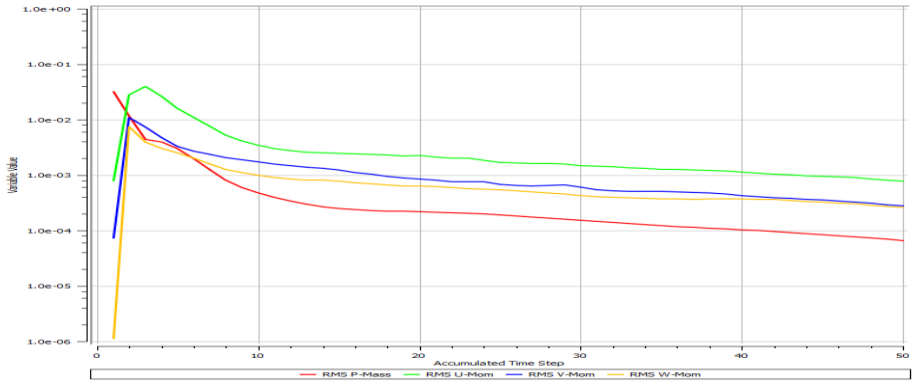

Figure 4. Graph of Flow Velocity 10 km/hour

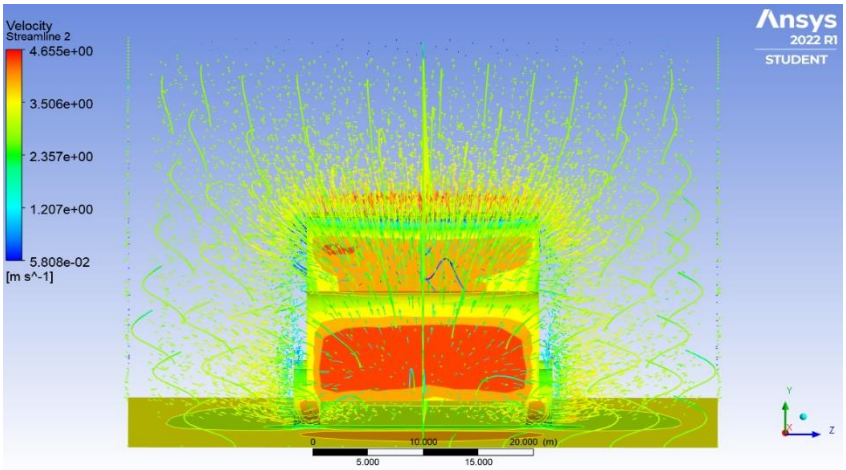

Figure 5. Simulation of Roof and Side View Speed 10 Km/hour

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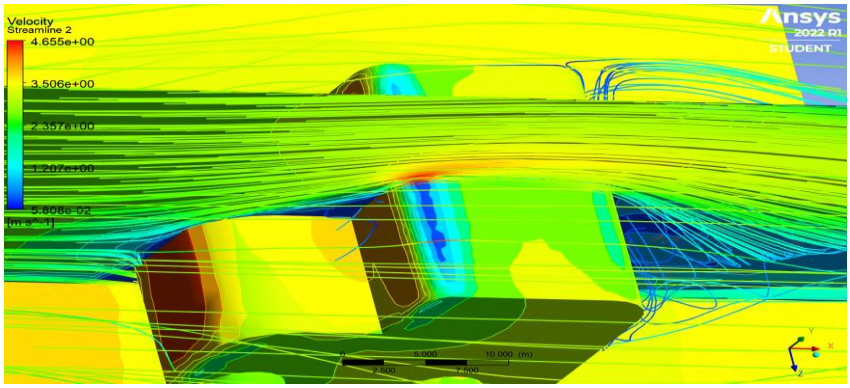

Figure 6. Simulation of the front hood, glass and roof of a car with a speed of 10 km/hour

The top view simulation with a speed of 10 km/hour can be seen clearly that the roof is dominated by green, yellow on the left and right and there is also a blue color on the front of the car roof. The green color on the roof of the car means the roof of the car if air flows at a speed of 10 km/hour then the roof has moderate resistance, and for the blue color on the front it means that the area has small obstacles, and for the left and right sides it is shown with yellow has a resistance that is not too big. It can be concluded that the roof of an electric car with a capacity of 3,000 watts does not hamper the car's performance because most of it is dominated by green.

Aerodynamic simulation test results at a speed of 40 km / h show parts of the electric car which in certain positions strongly impede the air, where the red color indicates the highest part or position inhibits the flow of air, when air flows in the area, while the color The dark blue indicates the area where air flows through the area with the least air resistance. From the analysis results, the maximum velocity of air velocity is 40 km/hour which is indicated by the dark blue color. While the minimum velocity obtained is a value of 0 km / h which is indicated by the red color, which means that the area if flowing with an air velocity of 40 km / h is the area that provides the greatest air resistance.

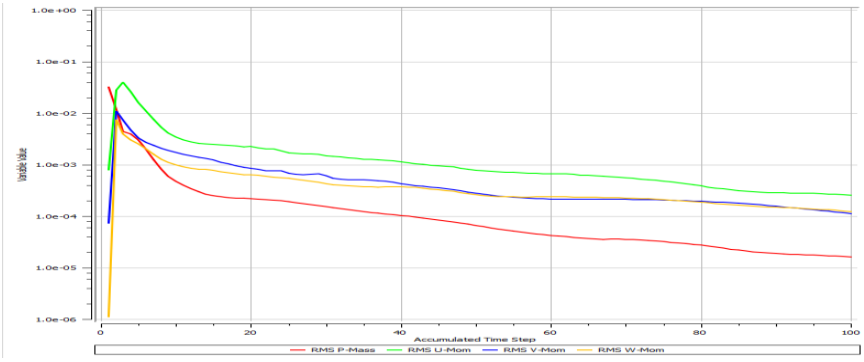

Figure 7. Graph of Flow Speed 40 Km/hour

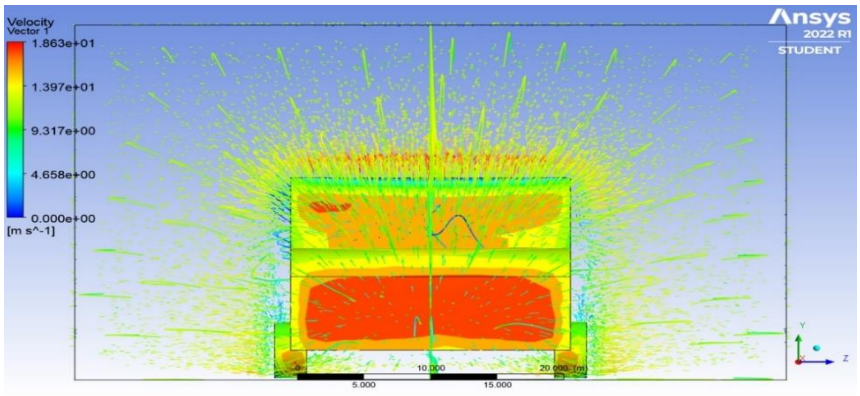

Figure 8. Simulation of Roof and Side View Speed 40 Km/hour

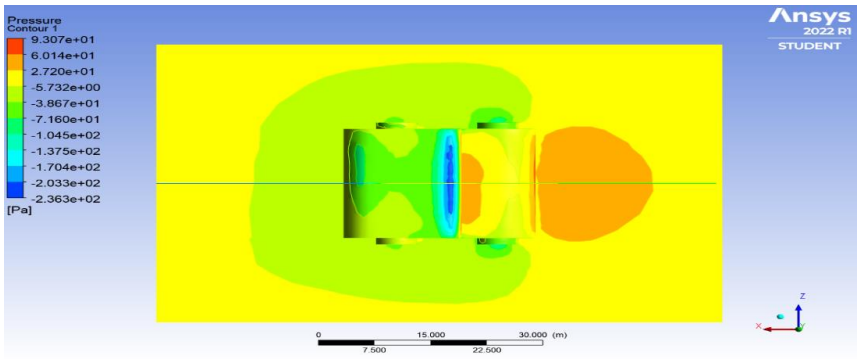

Figure 9. Simulation of Roof View Speed 40 Km/hour

Simulation of Roof View with a speed of 40 Km / h it is clearly seen that the roof is dominated by green color and there is also a blue color on the front of the car roof. The green color on the roof of the car means that the roof of the car if air flows at a speed of 40 km/hour then the roof has moderate resistance, and for the blue color on the front it means that the area has small obstacles, and for the left and right sides it is shown with yellow has a resistance that is not too big. It can be concluded that the roof of the 3,000 watt electric car is not too burdensome for the performance of the car because most of it is dominated by green and blue colors on the front end of the car roof.

Aerodynamic simulation test results with a speed of 70 km / h show parts of the electric car which in certain positions strongly impede the air, where the red color indicates the highest part or position inhibits air flow when air flows in the area, while the blue color The old figure shows the area where air flows through the area with the least air resistance. From the analysis results, the maximum velocity of air velocity is 70 km/hour which is indicated by the dark blue color. while the minimum velocity obtained is 0 km/hour, which is indicated by the red color, which means that if the area is flowing with an air velocity of 70 km/hour, it is the area that provides the greatest air resistance.

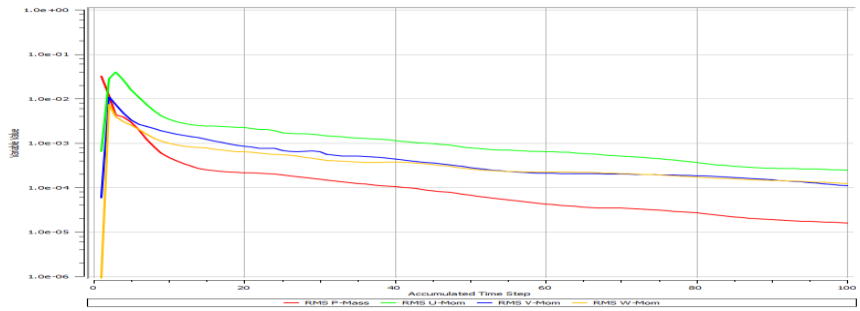

Figure 10. Graph of Flow Velocity 70 Km/hour

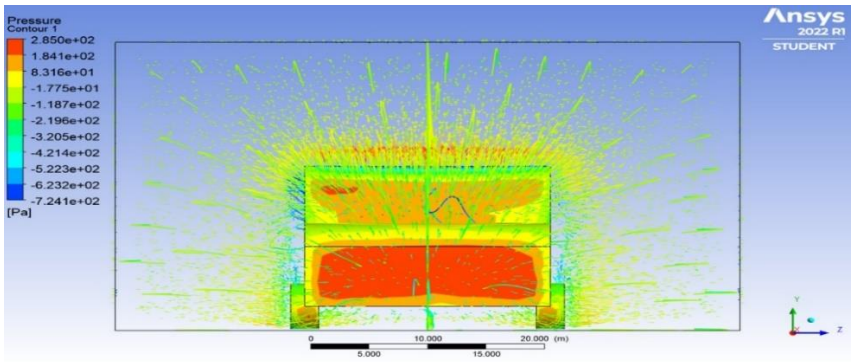

Figure 11. Simulation of Roof and Side View Speed 70 Km/hour

e-ISSN: 2830-5418, *p*-ISSN: 2830-5906

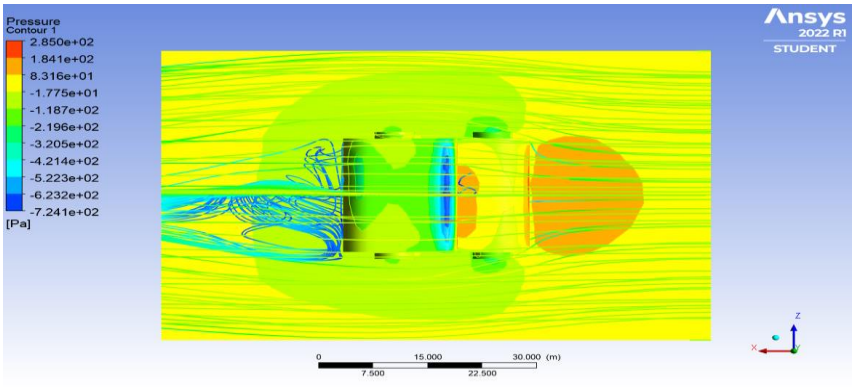

Figure 12. Airflow Simulation Top View of a Car Speed 70 Km/hour

Simulation Looks Roof Speed 70 Km / h clearly visible part of the roof is dominated by green and there is also a blue color on the front of the roof of the car. The green color on the roof of the car means that the roof of the car if air flows at a speed of 70 km/hour then the roof has moderate resistance, and for the blue color on the front it means that the area has small obstacles, and for the left and right sides it is shown with yellow has a resistance that is not too big. It can be concluded that the roof of the 3,000 watt electric car is not too burdensome for the performance of the car because most of it is dominated by green and blue colors on the front end of the car roof.

From the results of the analysis, it shows that there are several streams that experience obstacles at a speed of 10 km/hour, obstacles at a speed of 40 km/hour, obstacles at a speed of 70 km/hour. There are several parts of the electric car body that inhibit the rate of fluid flow, in this case the fluid is air. This causes the air flow to turn red, which means that there is a decrease in air speed due to resistance from several parts of the body, especially the part that has been indicated by the color mark, which is the area that has the most influence on the air flow, namely the front hood, the top of the body which also affects the airflow. causes the air to flow red after passing through, and then the corners of the car body roof that look curved. while the dark blue color indicates the area where air flows is the part with the least air resistance. the results of the maximum velocity of the maximum air velocity are shown in dark blue. While the minimum velocity obtained is 0 km/hour, which is indicated by the red color, which means that the area is flowing with air velocity so that the area is the area that provides the greatest air resistance.

4. CONCLUSION

From the results of research and calculations that have been carried out, the following conclusions can be drawn.

1. After determining the schedule for designing an electric car with a capacity of 3,000 watts, the results of the discussion of the design start from the initial process of preparing an electric car body design using solidWorks 2020 software, then the process of preparing work tools, followed by material preparation, then enters the stage work after completion enters the finishing stage.
2. The results of the aerodynamic simulation of speeds of 10 km/hour, 40 km/hour, and 70 km/hour there is a section or position that has the highest inhibition of air flow when air flows, the area is shown in red, while the part that has the least air resistance is in dark blue.
3. The results of the maximum velocity of air speed of 10 km/hour, 40 km/hour, and 70 km/hour are shown in dark blue. While the minimum velocity obtained is 0 km/hour, indicated by the red color, which means the area is flowing at speeds of 10 km/hour, 40 km/hour, and 70 km/hour so that the area is the largest providing air resistance.

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