ISBN: 978-623-7525-17-2

# PROCEEDING

## International Conference on Green Technology and Design

**"A Dissemination platform for supporting green energy, green building, green automation, green transportation and environmental sustainability"**

**BANDUNG 4 – 5, DECEMBER 2019**

**BALE DAYANG SUMBI**
**INSTITUT TEKNOLOGI NASIONAL BANDUNG**
**WEST JAVA - INDONESIA**

penerbit itenas

# BOOK OF PROCEEDING

## INTERNATIONAL CONFERENCE ON GREEN TECHNOLOGY AND DESIGN

Bandung, 4 – 5 December 2019

Bale Dayang Sumbi
Institut Teknologi Nasional Bandung
West Java - Indonesia

penerbit itenas

it's good start

# ORGANIZING COMMITTEE

## INTERNATIONAL CONFERENCE ON GREEN TECHNOLOGY AND DESIGN

**GENERAL CHAIR** : Dr. Nurtati Soewarno, Ir., MT.
**CO-CHAIR** : Maya R. Musadi, Ir., MT., Ph.D
**SECRETARY** : Lisa Kristiana, ST., MT., Ph.D.

**FINANCE CHAIR**
- Dian Duhita, ST., MT.

**EXHIBITS COMMITTEE**
- Dr. Didin Agustian Permadi, ST., M.Eng
- Dr. Soni Darmawan, ST., MT.

**PROGRAMME CHAIRS**
- Vibianti Dwi Pratiwi, ST., MT.
- Arsyad Ramadhan Darlis, ST., MT.

**LOCAL ARRANGEMENT COMMITTEE**
- Lita Lidyawati, ST., MT.

**PUBLICATIONS CHAIRS**
- Agung Prabowo Sulistiawan, ST., MT.
- Ardhiana Muhsin Machdi, ST.,MT.

**WEB MASTER**
- Agus Wardana, S.Sos.
- Bhakti Herdianto

**REVIEWERS:**
- Dr. Ir. Imam Aschuri, MT. (Indonesia)
- Dr. Ir. Dewi Kania Sari, MT. (Indonesia)
- Dr. Ir. Kusmaningrum, MT. (Indonesia)
- Dr. Dani Rusirawan, ST., MT. (Indonesia)
- Emma Akmalah, ST., MT., Ph.D. (Indonesia)
- Dr. Ir. Etih Hartati, MT. (Indonesia)
- Tarsisius Kristyadi, ST., MT., Ph.D. (Indonesia)
- Prof. Meilinda Nurbanasari, ST., MT., Ph.D. (Indonesia)
- Dr. Jamaludin, S.Sn., M.Sn. (Indonesia)
- Dr. Ir. Nurtati Soewarno, MT. (Indonesia)
- Dr. Waluyo, ST., MT. (Indonesia)
- Dr. Ir. Maya Ramadianti, MT. (Indonesia)
- Taufan Hidjaz, Drs., M.Sn. (Indonesia)
- Dr. Ing. M. Alexin Putra (Indonesia)
- Dr. Andri Masri, M.Sn. (Indonesia)
- Iwan Juwana, ST., M.EM., Ph.D. (Indonesia)

**ISBN:**
First Print: December 2019

**Publisher:**
Penerbit Itenas

**Address:**
Jl. P.K.H. Mustapha No. 23, Bandung 40124 Telp: +62 22 7272215, Fax: +62 22 7202892
Email: penerbit@itenas.ac.id

# RUNDOWN ICGTD

| Day | Time | Description |
|---|---|---|
| ***Wednesday, December 4th 2019*** | *08.00 – 08.30* | *Registration* |
| | *08.30 – 09.00* | *Welcome speech:* ***ICGTD Chair, Rector of Itenas*** *and Opening* |
| | *09.00 – 09.45* | *Plenary Session: "Assessment of Solar PV Power Potential over Asia Pacific Region with Remote Sensing and GIS"* ***Jeark A. Principe, Ph.D (Philipine)*** |
| | *09.45 – 10.30* | *Plenary Session: "Emissions and Mitigation Scenarios for Residential Combustion of Solid Fuels in Developing Countries"* ***Dr. Ekbordin Winijkul (Thailand)*** |
| | *10.30 – 10.45* | *Coffee Break* |
| | *10.45 – 11.30* | *Plenary Session: "Water Resource Management Framework For West Java Province, Indonesia"* ***Iwan Juwana Ph.D (Indonesia)*** |
| | *11.30 – 12.30* | *Ishoma Break* |
| | *12.30 – 16.45* | *Parallel Sessions – as attached* |
| | *16.45 – 19.00* | *Closing* |

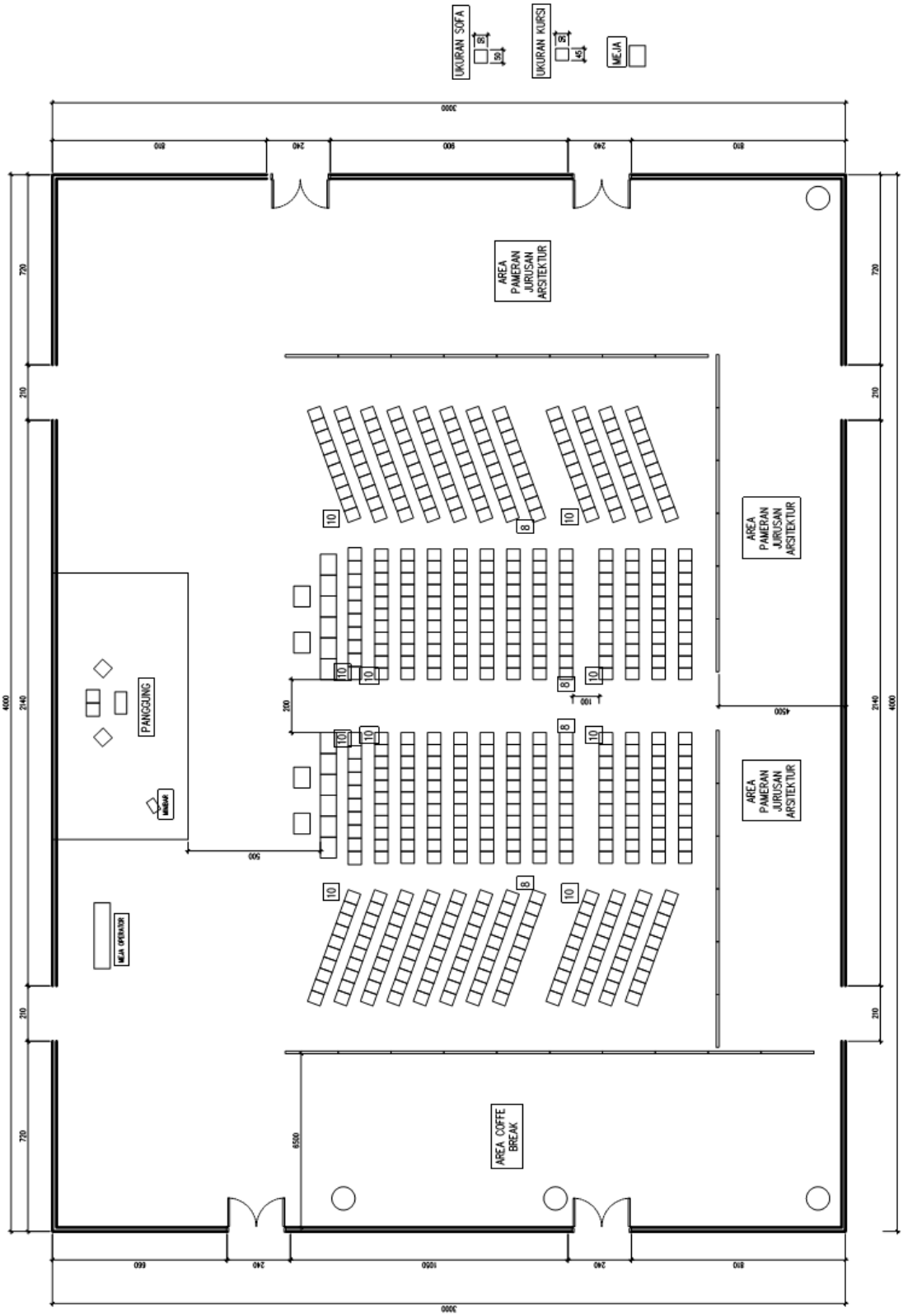
# PRESENTATION SCHEDULE

| No. | Name | Institution | Paper Topic | Presentation Time | Place |
|---|---|---|---|---|---|
| 1 | Niken Syafitri | Institut Teknologi Nasional Bandung | Green Automation | 13.00 | GSG Bale Dayang Sumbi Lt 1 (A) |
| 2 | Febrian Hadiatna | Institut Teknologi Nasional Bandung | Green Automation | 13.15 | |
| 3 | Florentinus budi setiawan | Soegijapranata catholic university | Green Automation | 13.30 | |
| 4 | Waluyo | Institut Teknologi Nasional Bandung | Green Automation | 13.45 | |
| 5 | Priyo Agus Setiawan | Politeknik Perkapalan Negeri Surabaya | Green Energy | 14.00 | |
| 6 | Lita Lidyawati | Institut Teknologi Nasional Bandung | Green Energy | 14.15 | |
| 7 | Bagus Rizky Pratama Budiajih | Institute Technologi Sepuluh Nopember | Green Energy | 14.30 | |
| 8 | Vibianti Dwi Pratiwi | Institut Teknologi Nasional Bandung | Green Energy | 14.45 | |
| 9 | Rachmad Ramadhan Yogaswara | Universitas Pembangunan Nasional (UPN) "Veteran" | Green Energy | 15.00 | |
| 10 | Lisa Kristiana | Institut Teknologi Nasional Bandung | Green IT | 15.15 | |
| 11 | Achmad Hizazi | Universitas Jambi | Green IT | 15.30 | |
| 12 | Dewi Rosmala | Institut Teknologi Nasional Bandung | Green IT | 15.45 | |
| 13 | Diki Ismail Permana | Institut Teknologi Nasional Bandung | Green Energy | 16.00 | |
| 14 | Yusup Miftahuddin | Institut Teknologi Nasional Bandung | Green IT | 16.15 | |
| 15 | Yudi Widiawan | Institut Teknologi Nasional Bandung | Green IT | 16.30 | |
| 16 | Rifqi Finaldy | Institut Teknologi Nasional Bandung | Green IT | 16.45 | |
| 17 | Hafidz Dayu Aditya | Institut Teknologi Nasional Bandung | Green IT | 17.15 | |
| 18 | Agus Hermanto | Institut Teknologi Nasional Bandung | Green Energy | 17.30 | |
| 19 | Meilinda Nurbanasari | Institut Teknologi Nasional Bandung | Green Energy | 17.45 | |
| 20 | Alfan Ekajati Latief | Institut Teknologi Nasional Bandung | Green Energy | 18.00 | |
| 21 | Lakshmanan Gurusamy | Universiti Malaysia Sarawak (UNIMAS) | Green IT | 18.15 | |

| No. | Name | Institution | Paper Topic | Presentation Time | Place |
|---|---|---|---|---|---|
| 22 | Abu Arif Jalaluddin | Universiti Malaysia Sarawak (UNIMAS) | Green IT | 18.30 | |
| 23 | Yanuar Z. Arief | Universiti Malaysia Sarawak (UNIMAS) | Green IT | 18.45 | |
| | | | | | |
| 24 | Nur Laela Latifah | Institut Teknologi Nasional Bandung | Green Building | 13.00 | GSG Bale Dayang Sumbi Lt 2 B |
| 25 | Riny Yolandha Parapat | Technische Universität Berlin (TU-Berlin), Berlin, Germany | Green Transportation | 13.15 | |
| 26 | Erwin Yuniar Rahadian | Institut Teknologi Nasional Bandung | Green Building | 13.30 | |
| 27 | Ardhiana Muhsin Machdi | Institut Teknologi Nasional Bandung | Green Building | 13.45 | |
| 28 | Tiara Anantika | Institut Teknologi Nasional Bandung | Green Building | 14.00 | |
| 29 | Wahyudi | Institut Teknologi Nasional Bandung | Green Building | 14.15 | |
| 30 | Dwi Prasetyanto | Institut Teknologi Nasional Bandung | Green Transportation | 14.30 | |
| 31 | Fred Soritua Rudiyanto Manurung | Institut Teknologi Bandung | Green Transportation | 14.45 | |
| 32 | Tarsisius Kristyadi | Institut Teknologi Nasional Bandung | Green Transportation | 15.00 | |
| 33 | Tarsisius Kristyadi | Institut Teknologi Nasional Bandung | Green Transportation | 15.15 | |
| 34 | Reza Phalevi | Institut Teknologi Nasional Bandung | Green Building | 15.30 | |
| 35 | Hendro Prasetiyo | Institut Teknologi Nasional Bandung | Green Building | 15.45 | |
| 36 | Ratna Agustina | Institut Teknologi Nasional Bandung | Green Transportation | 16.00 | |
| | | | | | |
| 37 | Jatmiko Wahyudi | Regional Development Planning Agency | Suistanability Environment | 13.00 | GSG Bale Dayang Sumbi Lt 1 (B) |
| 38 | Desti Santi Pratiwi | Institut Teknologi Nasional Bandung | Suistanability Environment | 13.15 | |
| 39 | Nguyen Thi Kim Oanh | Asian Institute of Technology (AIT) | Suistanability Environment | 13.30 | |
| 40 | Agung Pramudya Wijaya | Institut Teknologi Nasional Bandung | Suistanability Environment | 13.45 | |
| 41 | Edi Wahyu Wibowo | Politeknik LP3I Jakarta | Suistanability Environment | 14.00 | |

| No. | Name | Institution | Paper Topic | Presentation Time | Place |
|---|---|---|---|---|---|
| 42 | Taufan Hidjaz | Institut Teknologi Nasional Bandung | Suistanability Environment | 14.15 | |
| 43 | Elvira Rizqita Utami | Institut Teknologi Nasional Bandung | Suistanability Environment | 14.30 | |
| 44 | Farah Fauzia Raihana | Institut Teknologi Nasional Bandung | Suistanability Environment | 14.45 | |
| 45 | Byna Kameswara | Institut Teknologi Nasional Bandung | Suistanability Environment | 15.00 | |
| 46 | Ajeng Alya Hidrijanti | Institut Teknologi Nasional Bandung | Suistanability Environment | 15.15 | |
| 47 | Fenty Wastika Sari | Institut Teknologi Nasional Bandung | Suistanability Environment | 15.30 | |
| 48 | Yudi Adi Pratama | Institut Teknologi Nasional Bandung | Suistanability Environment | 15.45 | |
| 49 | Jono Suhartono | Institut Teknologi Nasional Bandung | Suistanability Environment | 16.00 | |
| 50 | Iredo Bettie Puspita | Institut Teknologi Nasional Bandung | Suistanability Environment | 16.15 | |
| 51 | Ronny Kurniawan | Institut Teknologi Nasional Bandung | Suistanability Environment | 16.30 | |
| 52 | Yulianti Pratama | Institut Teknologi Nasional Bandung | Suistanability Environment | 16.45 | |
| 53 | Maya Ramadianti Musadi | Institut Teknologi Nasional Bandung | Suistanability Environment | 17.00 | |
| 54 | Maya Ramadianti Musadi | Institut Teknologi Nasional Bandung | Suistanability Environment | 17.00 | |
| 55 | Soni Darmawan | Institut Teknologi Nasional Bandung | Suistanability Environment | 17.15 | |
| 56 | Soni Darmawan | Institut Teknologi Nasional Bandung | Suistanability Environment | 17.30 | |
| 57 | Rika Hernawati | Institut Teknologi Nasional Bandung | Suistanability Environment | 17.45 | |
| 58 | Ida Wati | Institut Teknologi Nasional Bandung | Suistanability Environment | 18.00 | |
| 59 | Caecilia Sri Wahyuning | Institut Teknologi Nasional Bandung | Suistanability Environment | 18.15 | |
| 60 | Fifi Herni Mustofa | Institut Teknologi Nasional Bandung | Suistanability Environment | 18.30 | |
| 61 | Enni Lindia Mayona | Institut Teknologi Nasional Bandung | Suistanability Environment | 18.45 | |
| | | | | | |
| 62 | Maharani Dian Permanasari, M. Ds., PhD. | Institut Teknologi Nasional Bandung | Green Design | 13.00 | GSG Bale Dayang |

| No. | Name | Institution | Paper Topic | Presentation Time | Place |
|---|---|---|---|---|---|
| 63 | Ibrahim Hermawan | Institut Teknologi Nasional Bandung | Green Design | 13.15 | Sumbi Lt 2 A |
| 64 | Maugina Rizki Havier | Institut Teknologi Nasional Bandung | Green Design | 13.30 | |
| 65 | Dwi Novirani | Institut Teknologi Nasional Bandung | Green Design | 13.45 | |
| 66 | Mohamad Arif Waskito | Institut Teknologi Nasional Bandung | Green Design | 14.00 | |
| 67 | Edi Setiadi Putra | Institut Teknologi Nasional Bandung | Green Design | 14.15 | |
| 68 | Sulistyo Setiawan | Institut Teknologi Nasional Bandung | Green Design | 14.30 | |
| 69 | Edwin Widia | Institut Teknologi Nasional Bandung | Green Design | 14.45 | |
| 70 | Agung Pramudya Wijaya | Institut Teknologi Nasional Bandung | Green Design | 15.00 | |
| 71 | Gita Permata Liansari | Institut Teknologi Nasional Bandung | Green Design | 15.15 | |
| 72 | M. Djalu Djatmiko | Institut Teknologi Nasional Bandung | Green Design | 15.30 | |
| 73 | Detty Fitriany | Institut Teknologi Nasional Bandung | Green Design | 15.45 | |
| 74 | Andri Masri | Institut Teknologi Nasional Bandung | Green Design | 16.00 | |
| 75 | Aditya Januarsa | Institut Teknologi Nasional Bandung | Green Design | 16.15 | |
| 76 | Bambang Arief Ruby, | Institut Teknologi Nasional Bandung | Green Design | 16.30 | |


UKURAN SOFA
UKURAN KURSI
MEJA
AREA PAMERAN JURUSAN ARSITEKTUR
AREA PAMERAN JURUSAN ARSITEKTUR
AREA PAMERAN JURUSAN ARSITEKTUR
PANGGUNG
MEJA OPERATOR
AREA COFFE BREAK

# FOREWARD

Welcome to the 1st International Conference on Green Technology and Design. This conference takes place in Bandung, 4th December 2019 and become our first international conference in green technology and design.

It is our responsibility to contribute in the national development and sustainability, the Institut Teknologi Nasional (Itenas) Bandung through its Lembaga Penelitian dan Pengabdian kepada Masyarakat (LP2M) conducts this conference and draws upon the expertise of wide range of knowledge.

The ICGTD 2019 conference aims to promote research in the field of Green Energy, Green Building Green Automation, Green Transportation, Sustainability Environment, Green IT and Green Design, and to facilitate the exchange of new ideas in these fields among academicians, engineers, junior and senior researchers, scientists and practitioners. It also includes the plenary, keynote and invited speakers.

On behalf of Organizing Committee, it is a great pleasure to welcome you in Itenas Bandung and look forward to meeting you at ICGTD2019.

Warm regards,

Chair
Dr. Ir. Nurtati Soewarno M.T.

# TABLE OF CONTENT

## Suistanability Environment

## Green Design

International Conference on Green Technology and Design
itenas

# Analysis Of Stress Against Airflow On Electric Car Bodies

Tarsisius Kristiyadi
*Mechanical Engineering, Institut Teknologi Nasional Bandung*

Alfian Eric Oktavianto
*Mechanical Engineering, Institut Teknologi Nasional Bandung*

Fery Hidayat
*Mechanical Engineering, Institut Teknologi Nasional Bandung*

***Abstract*—A concept vehicle body design four wheels with advanced aesthetic aesthetic, futuristic and aerodynamic is quite good. Evhero one of the crossover type of electric vehicles that successfully designed and realized by the National Institute of Technology Bandung. To know the behavior of Evhero electric car body plate as a whole which includes stress, deflection, and safety factor with the vehicle speed range 30, 60, and 100 km / h then in this research conducted stress analysis using SOLIDWORKS software. At a speed of 30 km / h vehicle, the shear stress is 0.04 Pa, deflection (-y) 0.1218 mm & (-z) 0,002469 mm, and safety factor 22,81. At 60 km / h speed, shear stress was 0.17 Pa, deflection (-y) 0,1219 mm & (-z) 0,009806 mm, and safety factor 13,67. And at the speed of the vehicle 100 km / hour, obtained shear stress of 0.44 Pa, deflection 0.1298 mm & (-z) 0.02714 mm, and safety factor of 6.817.**

***Keywords— body, stress, deflection, safety factor***

## I. INTRODUCTION (*HEADING 1*)

In tune with the development of the times and the increasing need for high mobility, people are the right reasons to develop inventions in the field of transportation that is more reliable, both in terms of security, efficiency, and ease without overestimating the comfort in use. Vehicles as the most effective means of transportation today are required to have the characteristics of selling nilal a reliable, strong tough, and included in the design in order to attract consumers.

Evhero is a crossover type electric car that successfully designed and realized by the National Institute of Technology Bandung. An electric car is a car that uses the driving force in the form of electric motors where electrical energy can be stored in batteries. To find out the strength of evhero electric car body then in this research conducted stress analysis on the electric car body to the airflow.

## II. RESEARCH METHOD

Step simulation of evhero electric car body voltage through several stages. The simulation method can be seen in the picture flow diagram 1.

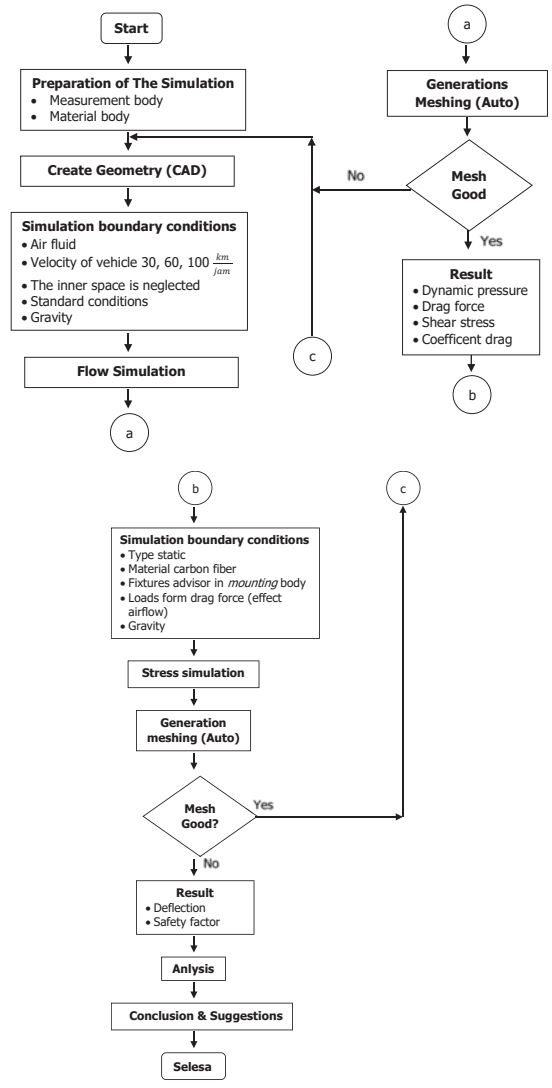



Fig 1. Flow Chart Simulation Analysis Electrical Car Body

## III. RESULT AND DISCUSSION

After running on the geometry of electric car body plate evhero to the airflow the following results are obtained

a. Speed 30 Km/Hour

In the analysis of electric car body plate capacity evhero with a speed of 30 km / h due to airflow get the following results:

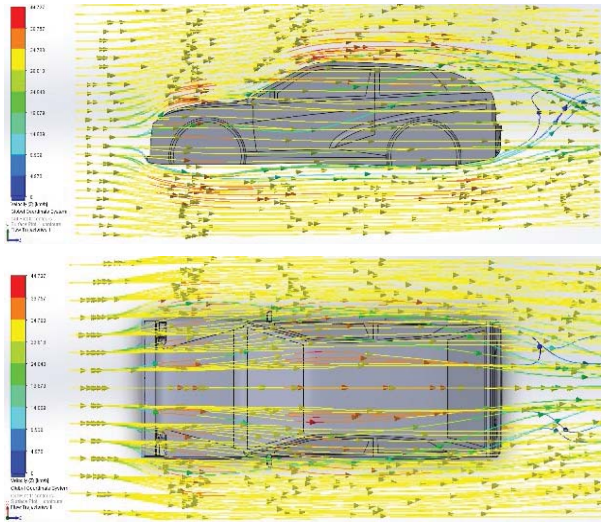


Fig 2. Velocity Air Flow View Speed 30 Km/Hour

Figure 2 shows the speed distribution. Speed is indicated by the color scale, where the red color indicates a high air velocity of 44 km / h, while the blue color indicates a low air velocity of 0 km / h. From this speed distribution can be seen to accelerate the air gradually until it reaches the maximum above the car. This shows that the shape of the front car is quite aerodynamic.

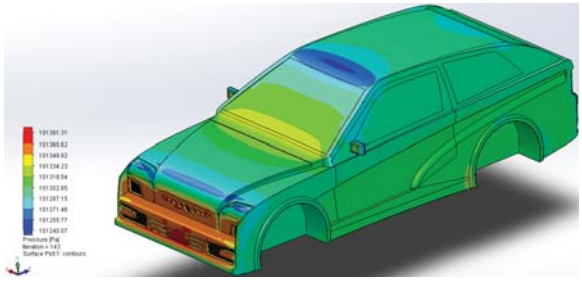


Fig 3. Surface Pressure of The Car Body at a Speed of 30 km / hour

| | |
|---|---|
| Dynamic pressure | : 39,11 Pa |
| Drag force | : 38,30267 N |
| Shear stress | : 0,04 Pa |
| Coefficient drag | : 0,574 |

At a speed of 30 Km / hour obtained degradation of color pressure on the surface of the electric car evhero produced in Figure 3. Clear visible color degradation caused by exposure to air body surface electric car evhero. Especially on the front looks a striking color that is red. This means that the section has a great pressure. This is because the front of the car first hit and split the air when the car drove.

Also visible on the front of the car there is a blue color means that the section has a low pressure. That is because there is a deflector on the front, which serves to channel the air that hit the front of the vehicle first and make the air flow is directed out, resulting in air split and formed a zone of low flow.

At the beginning of the air hit the flow deflector behind him also obstructed, that's why the rising pressure is marked with orange color. Indeed initially the pressure rises, but after some distance down the pressure seen from the degradation of orange-yellow-green-brightgreen-turquoise to blue. Similarly, on the air that hit the windshield.

On the side of the car there is also a little blue color toska and green which means there is pressure caused by the air that hit the surface of the contour of the car. Because basically when the vehicle drove the air that hit will form a layer beside

The shear stress is formed on the moving fluid due to the fluid viscosity. The maximum shear stress in the evhero electric car body is 0.04 Pa with an average number indicating the magnitude of the fluid resistance of 0.575. The resulting shear stress is small because we know that the usual fluids such as air and water have very small viscosities and are therefore reasonable if the resulting shear stress is small.

b. Speed 60 Km/Hour

In the analysis of electric car body plate capacity evhero with a speed of 60 km / h due to airflow get the following results:

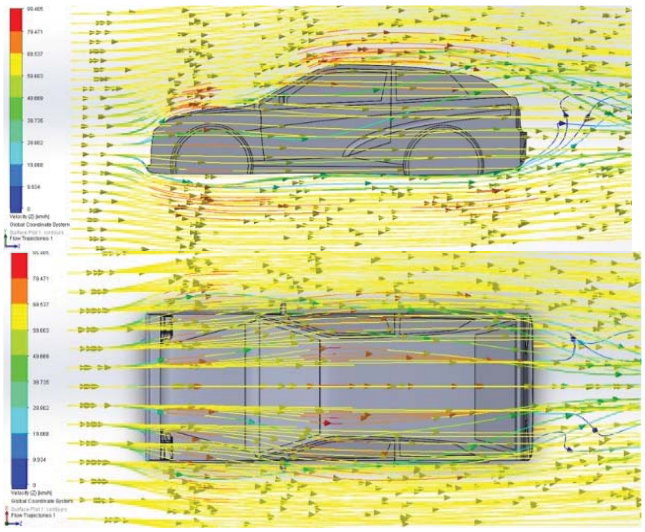


Fig 4. Velocity Air Flow View Speed 60 Km/Hour

Figure 4 shows the speed distribution for speeds of 60 km / h. As well as at a speed of 30 km / h, there is acceleration from the air gradually on the top side of the car. Speed is indicated by the color scale, where the red color indicates a high airspeed of 85 km / h, while the blue color indicates a low air velocity of 0 km / h.

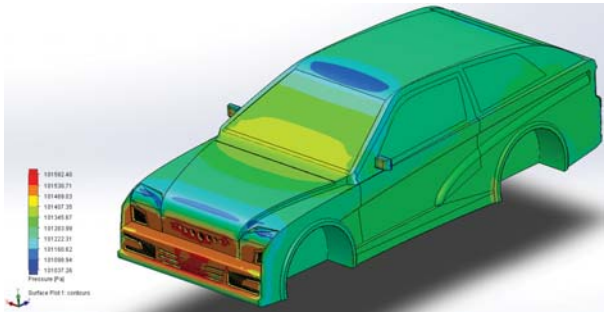


Fig 5. Surface Pressure of The Car Body at a Speed of 60 km / hour

| | |
|---|---|
| Dynamic pressure | : 156,52 Pa |
| Drag force | : 152,95094 N |
| Shear stress | : 0,17 Pa |
| Coefficient drag | : 0,5733367 |

At a speed of 60 Km / hour obtained degradation of color pressure on the surface of the electric car evhero produced in Figure 5. Clear visible color degradation caused by exposure to air body surface electric car evhero. Especially on the front looks a striking color that is red. This means that the section has a great pressure. This is because the front of the car first hit and split the air when the car drove.

Also visible on the front of the car there is a blue color means that the section has a low pressure. That is because there is a deflector on the front, which serves to channel the air that hit the front of the vehicle first and make the air flow is directed out, resulting in air split and formed a zone of low flow.

At the beginning of the air hit the flow deflector behind him also obstructed, that's why the rising pressure is marked with orange color. Indeed initially the pressure rises, but after some distance down the pressure seen from the degradation of orange-yellow-green-brightgreen-turquoise to blue. Similarly, on the air that hit the windshield.

On the side of the car there is also a little blue color toska and green which means there is pressure caused by the air that hit the surface of the contour of the car. Because basically when the vehicle drove the air that hit will form a layer beside

The shear stress is formed on the moving fluid due to the fluid viscosity. The maximum shear stress in the evhero electric car body is 0.17 Pa with an average number indicating the magnitude of the fluid resistance of 0,5733367. The resulting shear stress is small because we know that the usual fluids such as air and water have very small viscosities and are therefore reasonable if the resulting shear stress is small.

c. Speed 100 Km/Jam

In the analysis of electric car body plate capacity evhero with a speed of 100 km / h due to airflow get the following results:

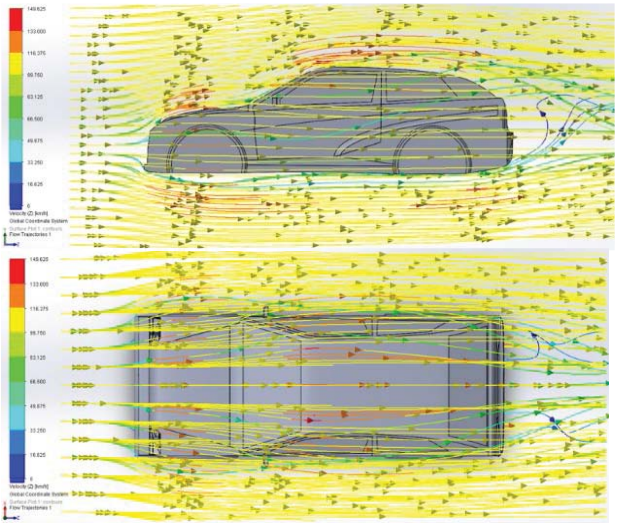


Fig 6. Velocity Air Flow View Speed 100 Km/Hour

Figure 6 shows the speed distribution for speeds of 100 km / h. Compared to previous speeds the acceleration of air that occurs in the front of the car faster and also the maximum speed reaches 143 km / h, higher than previous speeds.

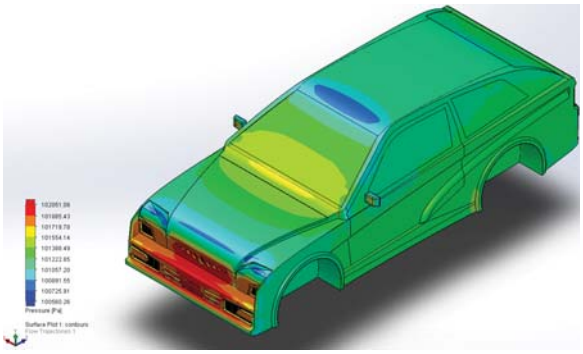


Fig 7. Surface Pressure of The Car Body at a Speed of 100 km / hour

| | |
|---|---|
| Dynamic pressure | : 434,69 Pa |
| Drag force | : 424,34944 N |
| Shear stress | : 0,45 Pa |
| Coefficient drag | : 0,5727801 |

At a speed of 100 Km / hour obtained degradation of color pressure on the surface of the electric car evhero produced in Figure 7. Clear visible color degradation caused by exposure to air body surface electric car evhero. Especially on the front looks a striking color that is red. This means that the section has a great pressure. This is because the front of the car first hit and split the air when the car drove.

Also visible on the front of the car there is a blue color means that the section has a low pressure. That is because there is a deflector on the front, which serves to channel the air that hit the front of the vehicle first and make the air flow is directed out, resulting in air split and formed a zone of low flow.

At the beginning of the air hit the flow deflector behind him also obstructed, that's why the rising pressure is marked with orange color. Indeed initially the pressure rises, but after some distance down the pressure seen from the degradation of orange-yellow-green-brightgreen-turquoise to blue. Similarly, on the air that hit the windshield.

On the side of the car there is also a little blue color toska and green which means there is pressure caused by the air that hit the surface of the contour of the car. Because basically when the vehicle drove the air that hit will form a layer beside

The shear stress is formed on the moving fluid due to the fluid viscosity. The maximum shear stress in the evhero electric car body is 0.45 Pa with an average number indicating the magnitude of the fluid resistance of 0,5727801. The resulting shear stress is small because we know that the usual fluids such as air and water have very small viscosities and are therefore reasonable if the resulting shear stress is small.

After done running on geometry plate electric car body evhero to static load got result as follows:

Speed 30 Km/Hour

In the analysis of deflection and safety factor of electric car body plate evhero with speed 30 km / h due to static load get result as follows:

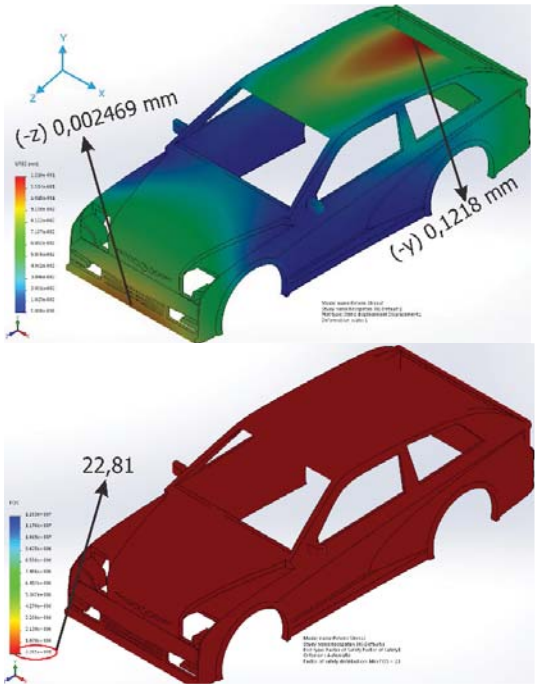



Fig 8. Deflection (1:1) and Safety Factor Speed 30 Km/Hour

Deflection : (-y) 0,1218 mm & (-z) 0,002469 mm

Safety Factor : 22,81

Due to the drag on the body of the car when the speed of 30 km / h against the exposure to air flow and gravity forces cause the car body to change shape, especially on the roof and front of the car. Can be seen clearly in Figure 8 on a 1: 1 scale where there is color degradation. The shape change on the styled car body plate in this case is curved. The curved portion of the car body plate is the red colored area of 0.1218 mm in the direction of growth -y, this is because there is a force of gravity and 0.002469 mm toward the -z axis caused by exposure to air.

The minimum safety factor value generated is 22.81 as shown in figure 8. The car body security factor is still categorized as safe. The value of the resulting safatey factor is large enough, because the body structure is designed not only for wind blowing, but also to protect the driver when a collision occurred. So in this case the burden caused by wind blowing would result safety factor it will be safe, because the body will not be damaged by the wind.

- Front

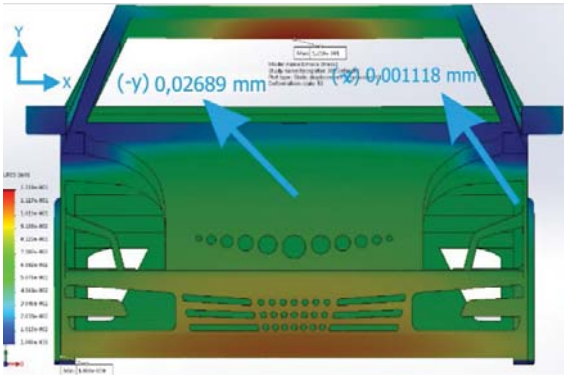



Fig 9. Front Deflection Speed 30 Km/Hour

Figure 9 shows the deflection in the hood of the car caused by gravity of 0.02689 mm in the direction of the axis -y. On the side participate is deflected due to the deflection that occurs on the hood of the car, so that on the side involved drawn toward the -x axis of 0.001118 mm.

- Right Side

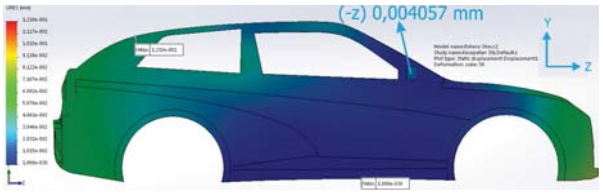



Fig 10. Right Side Deflection Speed 30 Km/Hour

On the right side of the rearview mirror is de-flexed towards the -z axis of 0.004057 mm caused by exposure to air.

- Left Side

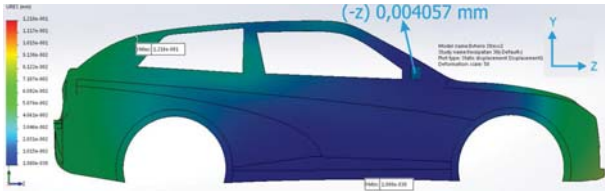



Fig 11. Left Side Deflection Speed 30 Km/Hour

Similarly, the right side, on the left side of the rearview mirror is de-flexed toward the -z axis of 0.004057 mm.

- Top

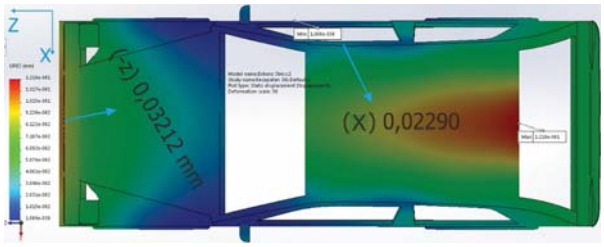



Fig 12. Top Deflection Speed 30 Km/Hour

At the top of the side side shown by the arrows are participated due to deflection occurring in the center of the roof of the car caused by the force of gravity. So on the side of the side come interested in the axis -x of 0.02290 mm. And on the front is oddly deflected by 0.03212 mm toward the -z axis

- Rear

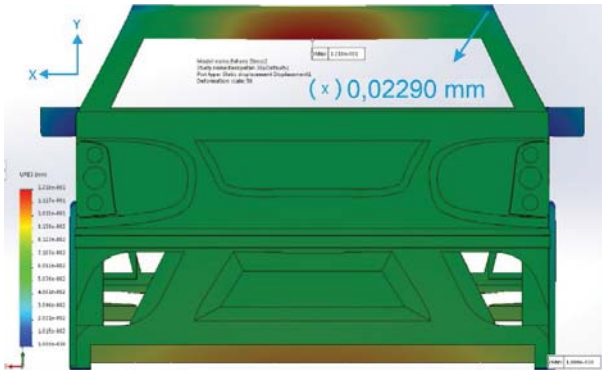



Fig 13. Rear Deflection Speed 30 Km/Hour

The same is seen in the top view. At the top, the side side indicated by the arrows is participated due to the deflection occurring on the roof of the car caused by 0.02290 mm toward the x axis

d. Speed 60 Km/Hour

In the analysis of deflection and safety factor of electric car body plate evhero with speed 60 km / h due to static load get result as follows:

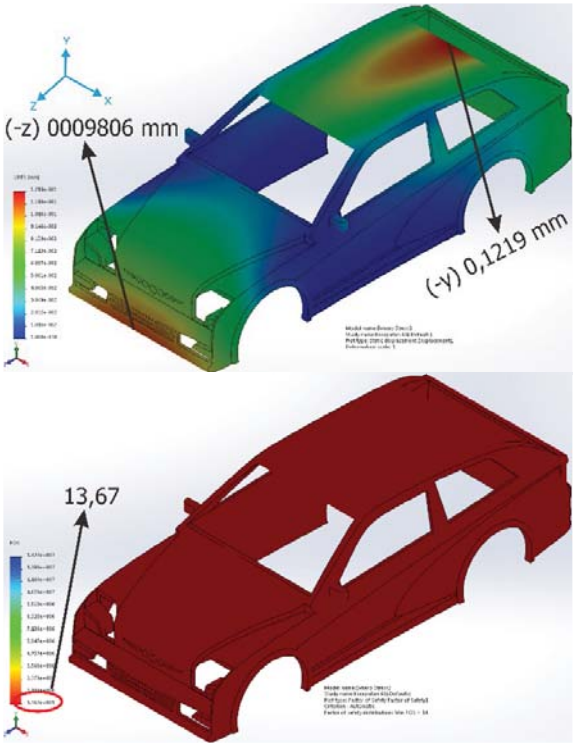



Fig 14. Deflection (1:1) and Safety Factor Speed 60 Km/Hour

Deflection : (-y) 0,1219 mm dan (-z) 0,009806 mm

Safety Factor : 13,67

As a result of the drag on the surface of the car body against exposure to airflow and gravity forces cause the car body to change shape, especially on the roof and front of the car. Can be seen clearly in Figure 14 with a 1: 1 scale of comparison where there is color degradation. The shape change on the styled car body plate in this case is curved. The curved portion of the car body plate is the red colored area of 0.1219 mm in the direction of growth -y, this is due to the presence of gravity and 0.009806 mm in the direction of the -z axis caused by exposure to air.

The value of the minimum security factor generated is 13.67 as shown in figure 14. The car body security factor is still categorized as safe to use. The value of the resulting safatey factor is quite large, because the body structure is designed not only for wind exposure, but also serves to protect the driver during a collision. So in this case the burden caused by wind blow must be the result of his safety factor will be great, because the body will not be damaged by the wind.

- Front

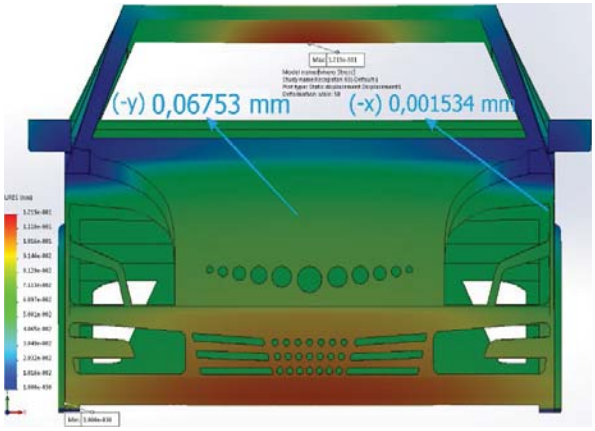



Fig 15. Front Deflection Speed 60 Km/Jam

Figure 15 shows the deflection in the hood of the car caused by gravity of 0.06753 mm in the direction of the axis -y. On the side participate is deflected due to the deflection that occurs on the hood of the car, so that on the side involved drawn toward the -x axis of 0.001534 mm.

- Right Side

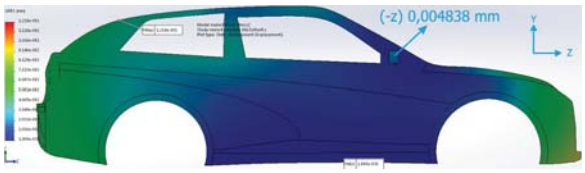



Fig 16. Right Side Deflection Speed 60 Km/Hour

On the right side of the rearview mirror is de-flexed towards the -z axis of 0.004838 mm caused by exposure to air.

- Left Side

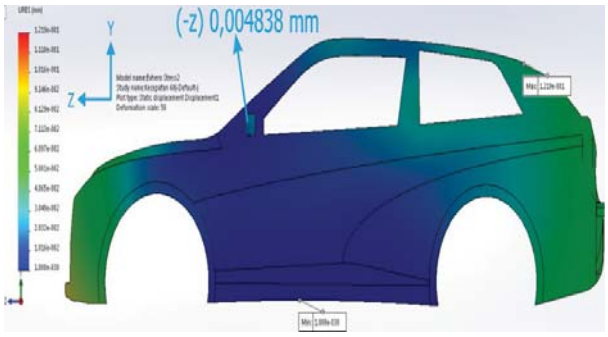



Fig 17. Right Side Speed Deflection 60 Km/Hour

Similarly, the right side, on the left side of the rearview mirror is de-flexed toward the -z axis of 0.004838 mm.

- Top

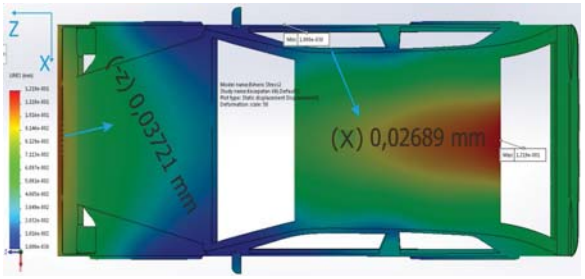



Fig 18. Top Deflection 60 Km/Hour

At the top of the side side shown by the arrows are participated due to deflection occurring in the center of the roof of the car caused by the force of gravity. So on the side of the side come interested in the axis -x of 0.02689 mm. And on the front is oddly deflected by 0.03721 mm toward the -z axis.

- Rear

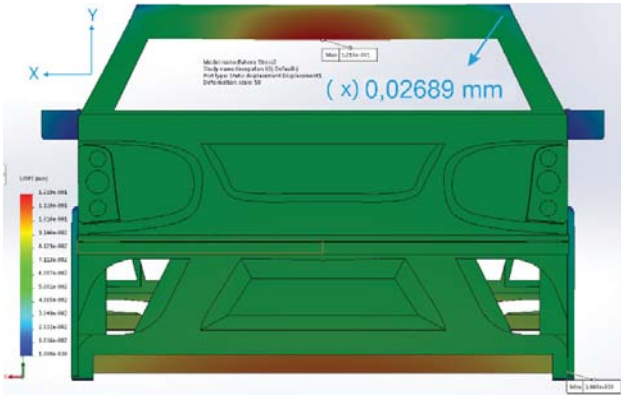



Fig 19. Rear Deflection Speed 60 Km/Jam

The same is seen in the top view. At the top, the side side indicated by the arrows is participated due to the deflection occurring on the roof of the car caused by 0.02689 mm toward the x axis.

e. Speed 100 Km/Hour

In the analysis of deflection and safety factor of electric car body plate evhero with speed 100 km / h due to static load get result as follows:

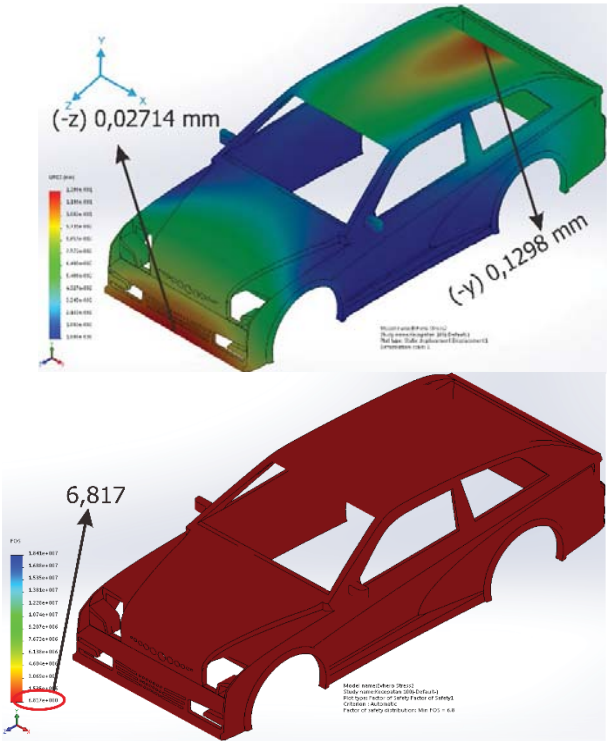



Fig 20. Deflection (1:1) and Safety Factor Speed 100 Km/Hour

Deflection : (-y) 0,1298 mm dan (-z) 0,02714 mm

Safety Factor : 6,817

As a result of the drag on the surface of the car body against exposure to airflow and gravity forces cause the car body to change shape, especially on the roof and front of the car. Can be seen in figure 20 with a 1: 1 comparison scale where there is color degradation. The shape change on the styled car body plate in this case is curved. The curved portion of the car body plate is the red colored area of 0.1298 mm in the direction of growth -y, this is due to the force of gravity and 0.02714 mm toward the -z axis caused by the exposure to air.

With the shear stress that occurs in the body of electric cars evhero car body safety factor is still categorized as safe to use. The value of the minimum safety factor generated amounted to 6.817 as shown in Figure 20. The value of the resulting safety factor is large enough, because the body structure is designed not only for wind exposure, but also serves to protect the driver in the event of a collision. So in this case the burden caused by wind blow must be the result of his safety factor will be great, because the body will not be damaged by the wind.

- Front

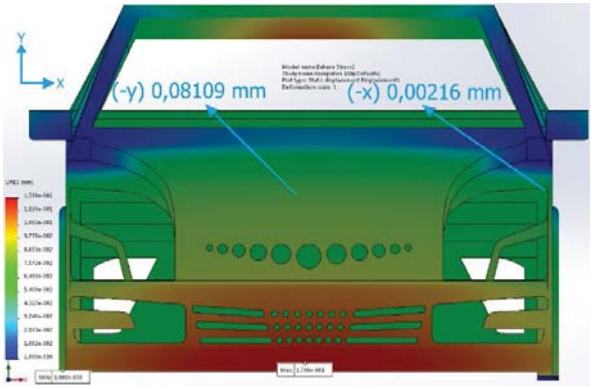



Fig 21. Front Deflection Speed 100 Km/Hour

Figure 21 shows the deflection in the hood of the car caused by gravity of 0.08109 mm in the direction of the axis -y. On the side participate is deflected due to the deflection that occurs on the hood of the car, so that on the side involved drawn toward the -x axis of 0.00216 mm.

- Right Side

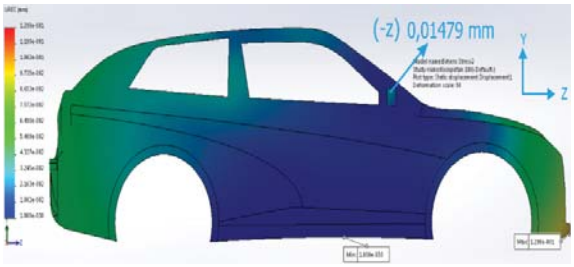



Fig 22. Right Side Deflection Speed 100 Km/Hour

On the right side of the rearview mirror is de-flexed towards the -z axis of 0.01479 mm caused by exposure to air.

- Left Side

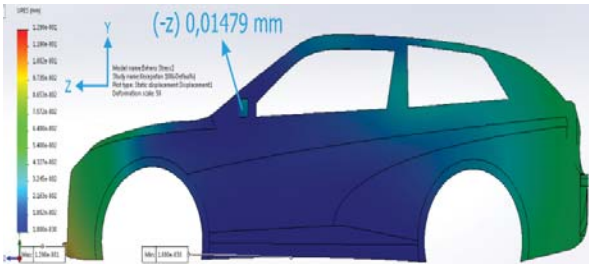



Fig 23. Left Side Deflection Speed 100 Km/Hour

Similarly, the right side, on the left side of the rearview mirror is de-flexed toward the -z axis of 0.01479 mm.

- Top

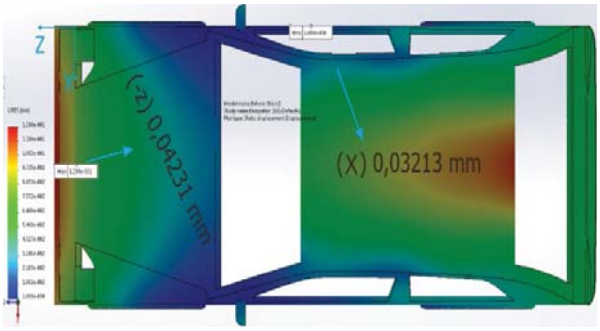



Fig 24. Top Deflection Speed 100 Km/Jam

At the top of the side side shown by the arrows are participated due to deflection occurring in the center of the roof of the car caused by the force of gravity. So on the side of the side come interested in the axis -x of 0.04231 mm. And on the front is oddly deflected by 0.03213 mm toward the -z axis.

- Rear

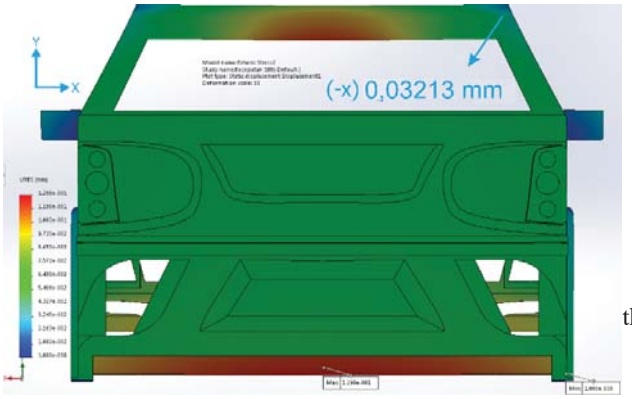



Figure 25. Rear Deflection Speed 100 Km/Jam

The same is seen in the top view. At the top, the side side indicated by the arrows is participated due to the deflection occurring on the roof of the car caused by 0.03213 mm toward the x axis.

### f. Overall Results

Based on simulation results conducted at several speeds that are 30, 60, and 100 km/h can be reported as follows:

TABLE 1. Results of Evhero Electric Car Evolution Car Plate Recap

| | Shear Stress (Pa) | Pressure (Pa) | Coefficient Drag | Deeflection (mm) | Safety Factor |
|---|---|---|---|---|---|
| 30 Km/Hour | 0,04 | 39,05 | 0,575 | (-y) 0,1218 | 22,81 |
| 60 Km/Hour | 0,17 | 156,28 | 0, 5733367 | (-y) 0,1219 | 13,67 |
| 100 Km/Hour | 0,44 | 434,02 | 0,5727801 | (-y) 0,1298 | 6,817 |

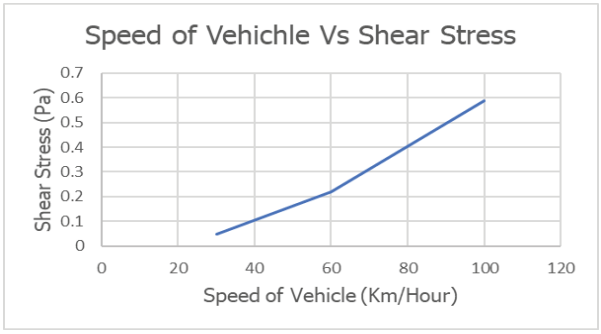



Fig 26. Speed of Vehicle Vs Shear Stress

Based on the resulting graphs found that the faster the vehicle the shear stress generated by the higher air exposure.

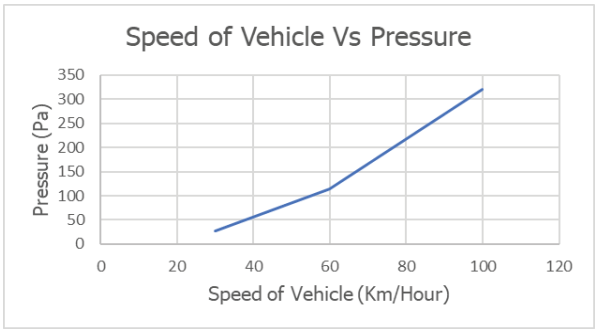



Fig 27. Speed of Vehicle Vs Pressure

Based on the graph generated it is found that the faster the vehicle the pressure generated by the higher air exposure.

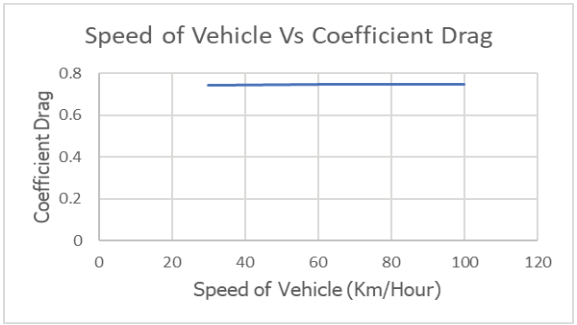



Fig 28. Speed of Vehicle Vs Coefficient Drag

Based on the resulting graph, it is found that the faster the vehicle the drag coefficient generated by the higher air exposure.

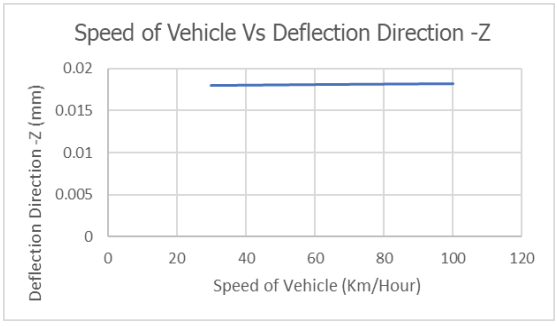


Fig 29. Speed of Vehicle Vs Deflection Direction -Z

Based on the resulting graphs it is found that the faster the vehicle then the deflection of the -z direction generated due to the air exposure force is increasing.

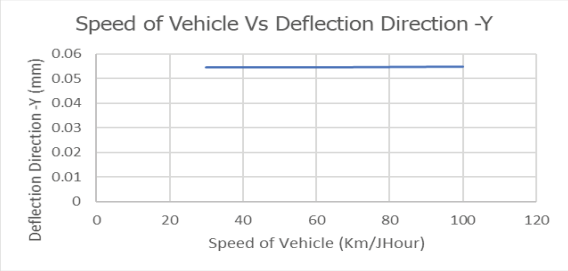



Fig 31. Speed of Vehicle Vs Deflection Direction -Y

Based on the resulting graphs it is found that the faster the vehicle the deflection direction -y generated due to the force of air exposure is increasing.

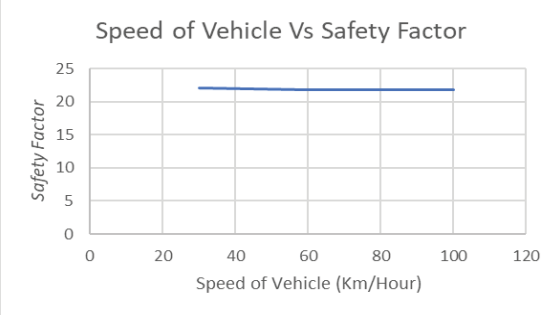



Fig 32. Speed of Vehicle Vs Safety Factor

Based on the resulting graphs found that the faster the vehicle then the safety factor generated due to the voltage that occurs decreases.

## IV. CONCLUSION

At a speed of 30 km / h vehicle obtained maximum shear stress that occurs in evhero electric car body of 0.04 Pa and a maximum deflection of 0.1218 mm direction -y and also get a minimum security factor greater than one that is equal to 22.81 . So it can be said at a speed of 30 km / h evhero electric car body is safe. At a speed of 60 km / h vehicle obtained maximum shear stress that occurs in evhero electric car body of 0.17 Pa and deformation of 0.1219 mm -y direction and also get a minimum security factor greater than one that is equal to 13.67. So it can be said at a speed of 60 km / h evhero electric car body is safe. At a speed of 100 km / h vehicle obtained maximum shear stress that occurs on the body of evhero electric car of 0.44 Pa and deformation of 0.1298 mm. and also get less than one security factor that is equal to 6,817. So it can be said at a speed of 100 km / h evhero electric car body is safe.

For the front and rear, the most attention is the front. Because the front is part of the car that first split the wind when the car drove in high speed. So to create a balance on the front should be most noticed on the bumper.

## REFERENCES


[1] Arsada, Robbi. 2012. Solidworks Professional. Bandung: Informatika Bandung

[2] Burhani, K. 2014. Aerodinamika pada Bodi Mobil. http://proyek-lebah.blogspot.co.id/2014/10/aerodinamika-pada-bodi-mobil.html dilihat 15 November 2017

[3] Fauzi, Helmi. 2013. Analisis Tegangan Pada Frame Mobil Listrik Sinisu Menggunakan Metode

[4] Elemen. Jember: Univ Jember

[5] Gunadi. 2008. Teknik Bodi Otomotif. Jakarta: Direktorat Pembinaan SMK

[6] J. Ed Akin. 2009. Finite Element Analysis Concepts via SolidWorks. Rice University, Houston,

[7] Texas

[8] J. Ed Akin. 2013. Solidwork Flow Simulation 2012 Tutorial. Rice University, Houston, Texas

[9] Munson, B. R., Young, D. F., Okiishi, T. H., Mekanika Fluida, terj. Dr. Ir. Harinaldi, Ir.

[10] Budiarso, M.Eng. (Jakarta: Erlangga, 2003)

[11] Rahmat. 2011. Perancangan Dan Perhitungan Desain Rangka Dan Bodi. Kudus:Muria

[12] Rinarta, Ananta. 2012. Evaluasi Dan Perancangan Badan Kendaraan Baru Untuk Kompetisi

[13] Shell Eco-Marathon. Bandung: ITB

[14] Popov, E.P. 1981. SI Version Mechanics Of Materials 2nd Edition. Englewood Cliffs: Prentice Hall International, Inc.

[15] Setyanto, Djoko. 2009. Kaji Teoritik Dan Eksperimental Perlakuan Dinamik Bodi Mobil

[16] Daihatsu Zebra. Bandung: ITB

[17] Victor L. Streeter, E. Benjamin Wylie. Mekanika Fluida. terj. Arko Prijono.

[18] (Jakarta: Erlangga, 1988)

[19] Vidosic, Joseph. 1957. Machine Design Projects. Michigan: Ronald Press Co

[20] Yamin, Muhammad. 2001. Analisis Aerodinamika Deflektor Pada Truk Menggunakan

[21] Software Berbasis Computional Flluid Dynamic (CFD). Jakarta: Gunadarma

penerbit itenas
Jl. PKH. Mustapha No.23, Bandung 40124
Telp. +62 22 7272215, Fax.: +62 22 7202892
e-mail: penerbit@itenas.ac.id

ISBN 978-623-7525-17-2