MODEL DESIGNED TO REDUCE INJURIES FOR MOTORCYCLIST'S AND PEDESTRIANS

G. Sunil Gavaskar[1], B. Varun[2], B. Suresh[3], D. Goutham[4], J. S. S. Yaswanth[5], G. Ratna Kumar[6].

[1]Assistant Professor, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.
[2]Student, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.
[3] Student, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.
[4] Student, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.
[5] Student, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.
[6] Student, Department of Mechanical Engineering, Raghu Engineering College, Visakhapatnam.

---***---

Abstract - Motorcyclists and pedestrians colliding head-on with heavy vehicles are the primary cause of fatalities in traffic accidents. With a straightforward modification to the heavy vehicle's design, as suggested in the project, the percentage of fatalities resulting from collisions between pedestrians and motorcyclists can be reduced. The pedestrian airbag system's design and operation will be modified according to the model suggested in this study. The modification of the pedestrian air bag system also affects the system's overall design. The modified design will be integrated as safety accessories into the heavy vehicle. In order to achieve better safety conditions when getting integrated with heavy vehicles, this study relates with redesigning and retouching the model of the pedestrian airbag system.

Key Words: Pedestrian air bag system, CATIA, L-Hood bed, Sensors.

1.INTRODUCTION

With regard to the significant advancement in the automotive industry, the consideration given to passenger safety has also improved subtly. By integrating with the following technology, vehicle automation has recently increased passenger safety even further.

- Parking sensors/Cameras
- Air bags
- ABS with EBD
- Electronic stability Control (ESC)
- Adjustable steering
- Blind spot detection and warning

This makes the car safer and reduces collision risk.

Only the passengers who were riding in the specific vehicle itself were the only focus of the a fore mentioned safety measures. As an illustration, if a pedestrian and a car were to collide, the pedestrian would likely sustain serious injuries or even die, while the driver and passenger of the car would be spared thanks to the safety features. As a result, manufacturers began putting more emphasis on the safety of the outside passengers. In 2014, Volvo made a daring move to build on its history of safety by introducing City Safety. City Safety, which is now a part of IntelliSafe, is a collection of cutting-edge technological features created to lower the possibility of a Volvo colliding with a pedestrian or cyclist anywhere in Chicagoland, working towards the automaker's objective that nobody be killed or seriously hurt.

Safety build to protect pedestrians and motorcyclist:

- **Oncoming Vehicles:** When a driver makes a left turn, City Safety can automatically apply the brakes to prevent an accident or lessen the potential damage caused by oncoming vehicles, including motorcycles and bicycles.

- **Vehicles Moving the Same Direction:** If the vehicle is moving at 30 mph or less, City Safety can react quickly enough to stop it, and at higher speeds, it can help lessen the damage and the effects of a collision.

- **Cyclists and Pedestrians:** The City Safety system can even identify when a cyclist or a pedestrian unexpectedly swerves in front of a car, stopping it at low speeds and greatly slowing it down at higher speeds.

- **Pedestrian Airbags Work:** Seven sensors in force guard the front of the car, keeping an eye out for any potential collisions. Every bit of data is received by a control unit inside, which then permits the available systems to respond appropriately.

These are the mainly used ocean power plants and the power produced from these operations are very low when compared to the hydroelectric power plants. Through this project we can have new power generation technique where we can observe an approximate level of power production when compared to the hydroelectric power plants but this operation takes place in ocean and it is only beneficial for hybrid ships, if we can store the power generated from this mechanism then we can also use it for other applications also.

In essence, the front sensors transmit data to the connected control unit just before an impact is about to occur, and the connected control unit then analyses the data to determine the shape of the object. The control unit activates the airbag if it thinks the vehicle is about to strike a pedestrian's legs.

The volvo team's initiative to increase the safety of pedestrians and motorcycle riders has been a huge success. Because heavy vehicles are designed very differently when compared to cars, the pedestrian airbag system does not function on them(heavy vehicles). Therefore, research should be conducted to increase the safety of pedestrians and motorcycle riders when they are struck by large vehicles.

Therefore, the primary goal of this research was to increase the safety of pedestrians and motorcyclists when they collide with large vehicles, such as buses and trucks.

2.METHODOLOGY

The automotive industry has made pedestrian and motorcycle protection research a major focus. The front-bumper system design for vehicles has proven to be very important and has been widely used to enhance the vehicle's performance in terms of pedestrian protection. The design of a heavy vehicle's front-bumper system is constrained by the need to accommodate simultaneous impacts from multiple pedestrians.

A new kind of front bumper airbag system needs to be developed in order to enhance the vehicle's performance for pedestrian and motorcycle protection.
However, due to the fact that the structure of heavy vehicles differed significantly from that of other automobile vehicles (cars), we had to completely redesign the pedestrian air bag system.

2.1 IDEA OF THE PROJECT:

As we all notice in India most of the service buses were having higher ground clearance. There is a higher possibility of motorcyclists or pedestrians going beneath the vehicle while in crash or in an accident. So that a model was proposed on the ongoing study which helps in minimising the percentage of deaths happening to the motorcyclists or pedestrians.

In this study a model was designed in such a way that it minimizes the impact of injuries on the pedestrian's or motorcyclists. The proposed model design was as shown below,

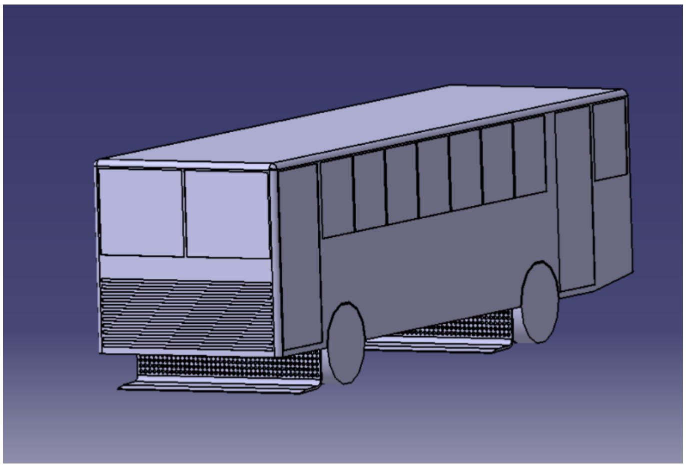

Fig-1: Representing idea of the project

2.2 Working of the model:

- **Collision detection:** When a vehicle collides with a pedestrian or motorcyclist, the pedestrian airbag system is activated by a series of sensors that detect the collision. These sensors are typically located in the front of the vehicle and can include cameras, radar, and ultrasonic sensors.

- **L-Hood opening:** When the sensors detect a pedestrian or a motorcyclist impact, the pedestrian airbag system sends a signal to the vehicle's control unit to raise the L-hood open from the bottom of the vehicle. This is done using actuators which are to be designed in such a way that it opens in minimum time before the impact. And this L-hood should also possess some cushioning effect so that it does not affect the pedestrian or motorcyclist.The L-hood opened will carry the pedestrian or the motorcyclist along with the moment of the vehicle and save the person without going beneath the vehicle tires.

- **Airbag deployment:** As the L-hood of the vehicle is opened, the pedestrian airbag is deployed. The airbag is typically located on the underside of the L-hooded bed and is designed to cushion the pedestrian's and motorcyclist body during the impact. These air bags helps in reducing the impact of hard metal with the body of the person.

- **Airbag inflation:** Once the airbag has been deployed, it quickly inflates using a small inflator. This is typically a pyrotechnic device that produces gas to inflate the airbag rapidly.

- **Airbag deflation:** After the impact, the airbag deflates after some time, allowing the pedestrian to move away from the vehicle after it was in rest motion completely. This is done using vents or small holes in the airbag material that allow the gas to escape.

- **Safety systems reset:** Once the airbag has deployed and the impact has occurred, the pedestrian airbag system must be reset. This is typically done by replacing the airbag and the L-hood actuator, and then recalibrating the system to ensure that it is functioning correctly.

2.3 Detailed view of sensors used in detecting the pedestrian's and motorcyclist:

A vital part of a pedestrian airbag system are the sensors that are used. They notice the collision with the pedestrian and start the airbag's deployment to soften the blow.

- **Cameras:** One of the most popular sensors used in pedestrian airbag systems are cameras. They are typically mounted on the front of the car and are used to detect pedestrians in the road using computer vision algorithms. In order to identify pedestrians and ascertain their location and speed in relation to the vehicle, these cameras can take pictures and analyse them in real-time.

- **RADAR:** Another typical sensor found in pedestrian airbag systems is the radar sensor. They discharge high-frequency radio waves, which re-enter the sensor after hitting nearby objects. The radar sensor can determine the distance, speed, and positioning of the pedestrian in relation to the vehicle by timing how long it takes for the waves to return.

- **LIDAR:** Lidar sensors make a 3D map of the area around the vehicle using lasers. They are employed to identify pedestrians and other objects in the path of the moving vehicle. Lidar sensors are less frequently used in pedestrian airbag systems and are typically more expensive than other sensors.

- **Ultrasonic sensors:** High-frequency sound waves are emitted by ultrasonic sensors, which are then reflected back to the sensor by objects. They frequently work in tandem with radar and cameras to provide additional information about the location and movement of the pedestrian.

- **Infrared sensors:** To find objects, infrared sensors use infrared light. They can be used to find pedestrians when there is little light, like at night or during bad weather.

By utilising the a fore mentioned sensors, the suggested model design operates more successfully, may help to reduce the risk of injury, and in some cases, may even prevent the death of pedestrians and motorcyclists.

2.4 MECHANICAL SYSTEMS DESIGN:

Mechanical systems design is the process of designing and developing the mechanical components and systems that make up a machine or a device. It involves the application of principles of mechanics, materials science, and thermodynamics to design, analyze, and optimize the performance of mechanical systems.

2.5 ENVIRONMENTAL IMPACT ASSESSMENT:

Environmental Impact Assessment (EIA) is the process of evaluating the potential environmental impacts of a proposed project or development. In the context of automobile architecture, an EIA may be conducted for a safety construction or refurbishment project to assess the potential environmental impacts of the project and to identify measures to mitigate these impacts.

2.6 COST ANALYSIS:

Cost analysis is a method of evaluating the costs associated with a project, process, or activity. In the context of automobile architecture, cost analysis is an important part of automobile design and construction, and involves estimating the costs associated with building and operating a safety auxiliaries.

3. DESIGN OF THE MODEL

All the drafting and 3D modeling work is done through CATIA V5.
The design of conventional bus model was shown below:

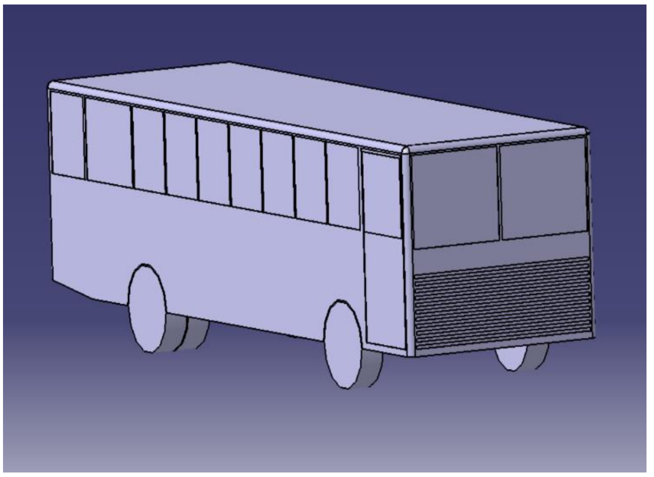

Fig -2: Conventional bus model.

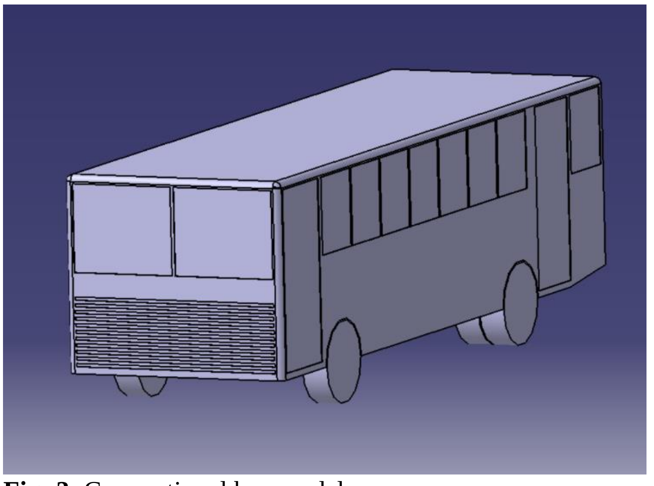

Fig -3: Conventional bus model.

The design of the L-Hood bed is shown below:

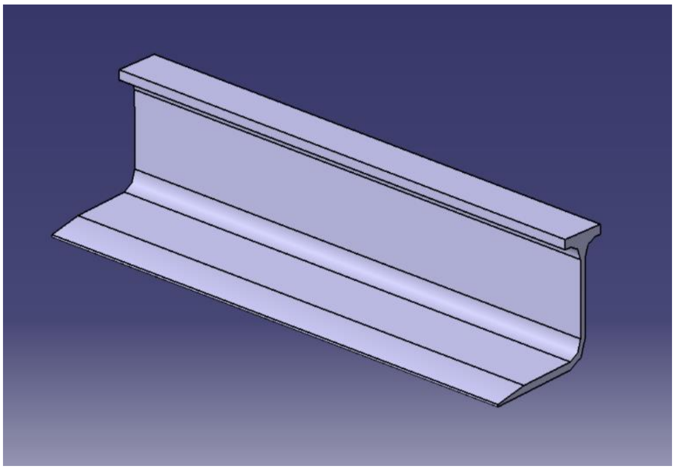

Fig -4: Design of L-Hood bed.

The final model or the modified bus model with L-Hood bed is shown below:

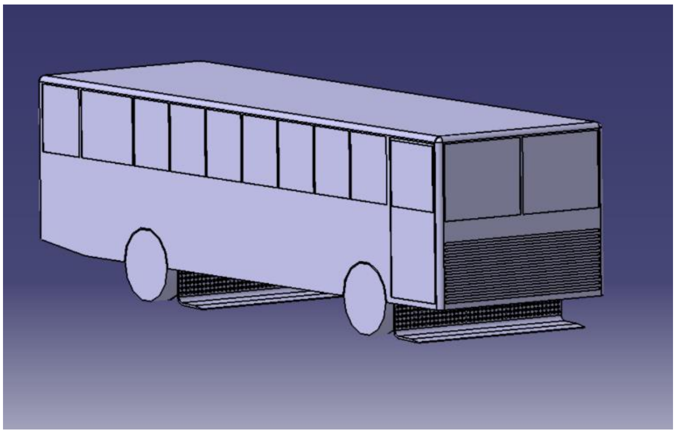

Fig -5: Final design of the modified bus model with L-Hood bed.

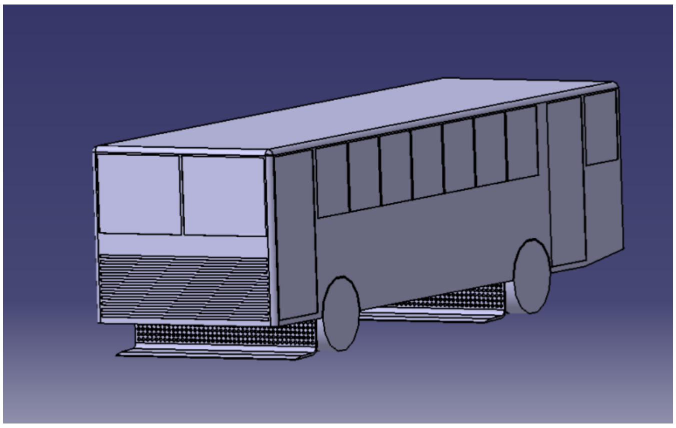

Fig -6: Final design of the modified bus model with L-Hood bed.

4. CONCLUSION

The design of the final bus model is compact and efficient. The installation of L-Hood bed will be resulting in saving the pedestrians and motorcyclist while in collision with heavy vehicles. The design L-Hood bed was further integrated with airbags to help the persons with cushioning effect. While the air bags will also result in not injuring the person while in collision with the heavy vehicles.

REFERENCES

[1] Design of an airbag system of a mid-sized automobile for pedestrian protection Joon-Hong Lim, Jong-Sun Park and Gyung-Jin Park. (16, October 2014)

[2] A. Muthuvel, M. K Murthi, N.P. Sachin, Aerodynamic exterior body design of bus, Int. J. Sci. Eng. Res. (7, July 2013)

[3] Effectiveness of Automatic Pedestrian Detection Device and Smart Lighting for Pedestrian Safety. Shashi S. Nambisan, Srinivas S. Pulugurtha. (1, January 2009)

[4] Effectiveness of Pedestrian Safety Service Provision Using Sensing Technology. Hong Ki-manSang-Hoon, SonJong-Hoon Kim. (19, August 2021)

[5] Improving Pedestrian Safety Using Ultra-Wideband Sensors: A Study of Time-to-Collision Estimation. Salah Fakhoury, Karim Ismail. (21, April 2023)

[6] Characteristics of Dangerous Scenarios between Vehicles Turning Right and Pedestrians under Left-Hand traffic. Yasuhiro Matsui, Shoko Oikawa. (25, March 2023)

[7] Petel, P. and Vijayakumar, "External Flow Analysis Over a Car to Study The Influence of Different Body Profiles Using CFD". (2001-10-16)

[8] P. Gopal, and T. Senthilkumar, "Aerodynamic Drag Reduction in a Passenger Vehicle Using Vortex Generator with Varying Yaw Angles". (9, SEPTEMBER 2012)

[9] Gilieron P. Roumeas, M. and A Kourta, Drag Reduction by Flow Separation Control on a Car After Body. Lecture Notes in Mathematics. International Journal for Numerical Methods in Fluids. (20, October 2008)

[10] Mayer, and Wickern, G. (2011) The new audi A6/A7 family-aerodynamic development of different body types on one platform. (2011-04-12)

[11] Rouméas, Mathieu, Patrick Gilliéron, and Azeddine Kourta. "Drag reduction by flow separation control on a car after body." *International journal for numerical methods in fluids* 60.11 (2009)

[12] Large Trucks Drag Reduction using Active Flow Control, A. Seifert, O. Stalnov, D. Sperber, G. Arwatz, V. Palei, S. David, I. Dayan & I. Fono. (2009)

[13] Collis S, Joslin R, Seifert A and Theofilis V, "Issues in active flow control: theory, simulation and experiment", Prog. Aero Sci., V40, N4-5. (May-July 2004)

[14] The Optimization of Body Details—A Method for Reducing the Areodynamic Drag of Road Vehicles, W. H. Hucho, L. J. Janssen and H. J. Emmelmann. (1976)

[15] Comparing three commonly used crash severity models on sample size requirements: multinomial logit, ordered probit and mixed logit models Analytic Methods in Accident Research Fan Ye, Dominique Lord. (2014)