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Finite Element Analysis of Bus Structure as per ECER29

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Abstract – *As we know India is a developing country with longest and busiest route in the world after USA so the road accidents are always a huge issue on highways and every year accident gross rate increases up to 1.5 percent. In India road accidents are a leading cause of death with rank one across 199 other countries. As per National Highway Traffic Safety Administration accident statics 11,000 people have lost their life in bus accident every year. There are some common type of bus accident happed like frontal impact, side impact, rear impact and rollover. Some case study on crash worthiness shows that the frontal accident rate is higher than any other fatality in bus accidents because there is no crumple zone provided by thy bus manufacture. So in case of frontal collision the energy absorption of the frontal structure is very low and remaining impact energy directly transferred to the occupant. So in this research work we performed the frontal impact analysis of bus structure as per ECER29 using finite element analysis.*

Key Words: *ECER29, FEM, crash worthiness*

1. Introduction

The finite element analysis is a most popular method in advanced automotive industry to solve complex engineering problems including structural, fluid flow, thermal and electromagnetic etc. FEM is type of numerical method for solving partial differential equations, to solve any problem Fem subdivide the system in to small elements by discretization method [1] FEA generally helped as to reduce the number of iteration during development process, the explicit LS-Dyna code was used for this purpose.

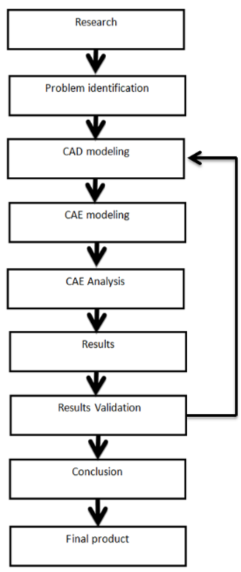
As per ECER29 standards all automotive structure should be design in such a way that at the time of accident the minimum survival space is guaranteed. This standard generally adopted by truck cabin structures only, standard should not applicable for agriculture and construction vehicle [2]. The legal requirements of driver cabin safety are fixed in ECER29 regulation. The rigid surface with the area of 2500X800 mm2 and the mass of 1500kg must be positioned below 50mm to the R point of the driver seat. The impact energy has to be in the rage of 45KJ as per vehicle maximum permissible weight.

2. Objective

The objective of this research work is to design and analysis of a bus structure to improve crashworthiness and avoid injury at the time of accident.

3. Methodology

To start this study with research on various scenario of accidents happen with buses and evaluate risk of injury accordingly. Our work starts with CAD modeling then we Export this cad data in STEP format and perform meshing using finite element method after that applied boundary condition as per ECER29 standard and check the survival space between the dummy and steering system.



4. Bus super structure CAD model

CAD model prepared using creo software all dimensions are in mm.

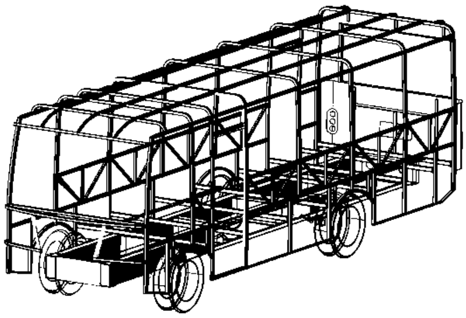
Dimensions – Maximum length – 8000MM

Maximum width – 2600 MM

Maximum Height – 3800MM

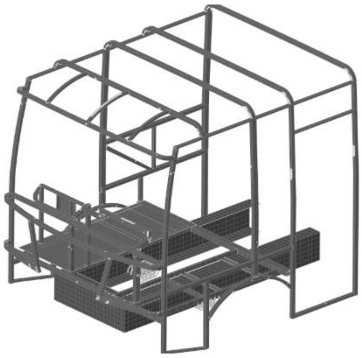
Seating Type - 2X2

Seating capacity – 32 seats



5. Finite element analysis

A finite element analysis is most common method for structural analysis using numerical technique called finite element method. This technique used to reduce number of prototype and improve product quality in design phase.



Element quality criteria-

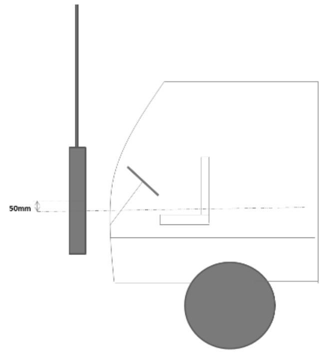
1-d						
2-d (selected)	warpage	>	15.000	length	<	3.000
3-d	aspect	>	10.000	length	>	10.000
time	skew	>	60.000	jacobian	<	0.650
user	chord dev	>	0.100	equia skew	>	0.600
group	cell squish	>	0.500	area skew	>	0.600
				taper	>	0.500

6. Boundary Condition -

a. If vehicle GVW more than 7000kg, the impact energy should be in the range of 45KJ.

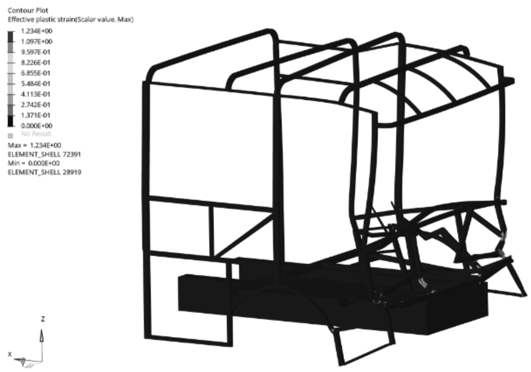
b. Pendulum should be rectangular in shape (2500X800)mm with 1500 kg ± 250 of mass.

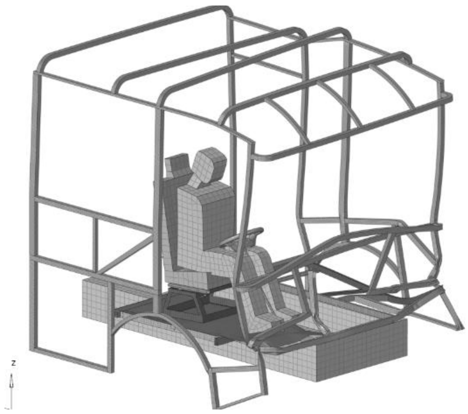
c. Center of gravity of pendulum placed at 50 ±5mm below the R point of driver seat.



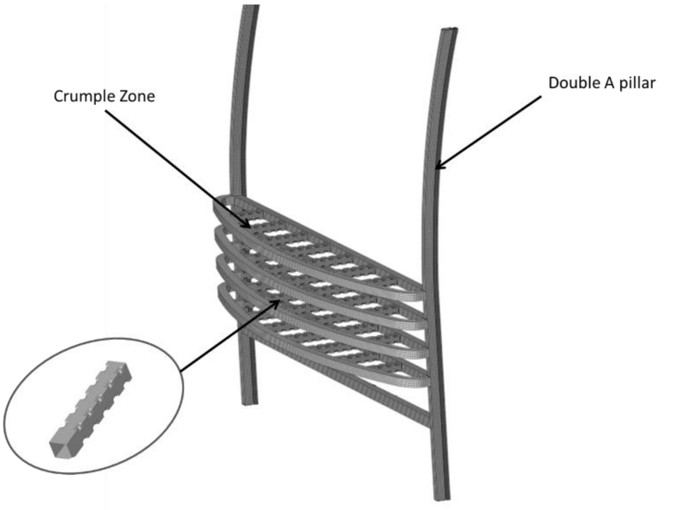
7. Results

As per the AIS standard we evaluate the deformed shape of the structure found some deformation in frontal area and we can clearly observe the minimum space between the steering system and rigid dummy model..

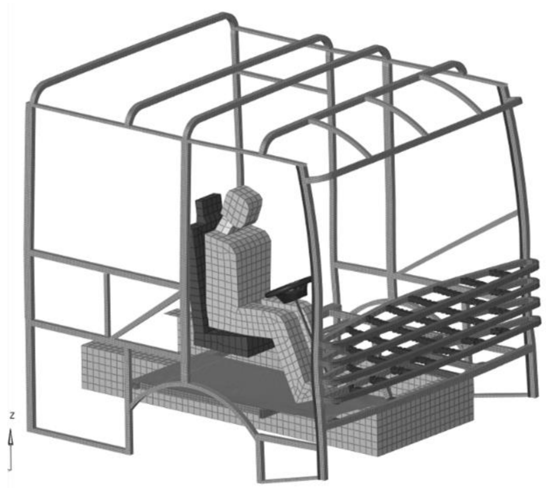




In the way of crash worthiness improvement we develop two different zones in front structure one is called crumple zone and second one is called driver compartment zone as similar to the passenger cars. The crumple zone is made in such a way that can absorb maximum deformation energy and driver compartment zone designed to resist deformation.



After modification we got sufficient survival space between dummy and steering column as shown in figure below.



8. Conclusion

The purpose of this study to perform frontal crash analysis on bus structure as per ECER29 and try to improve the crashworthiness and reduce risk of fatality. It was observed that the baseline design doesn't meet the ECER29, there is no space between dummy and steering system. To avoid failure and improve crashworthiness we develop two different zones in front structure one is called crumple zone and second one is called driver compartment zone as similar to the passenger cars which can observe maximum deformation energy.

9. References

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