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DESIGN & ANALYSIS FOR STRENGTH OF SCHOOL BUS SEAT TO AVOID THE FAILURE

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ABSTRACT:

Advanced manufacturing engineering is a move towards to build an object with the insertion of all technical features including sturdiness and safety. In automobile manufacturing approach, it can be a great opportunity to save life of inhabitant if safety parameters were intended successfully. Business commuter vehicles can carry several people at a time, and if accident happens, numerous people can die overall. These types of vehicle can have impact from different sides i.e. front, side, rear etc. Among these types of collisions impact of frontal collision is the most ruthless. In front impact traveler can get injured by hitting the seat structure mounted just next front to them. In order to design these seats properly to avoid such injuries, government also imposed some policies related to seat design. In order to overcome on such the compulsory regulations, accurately designed seat has to be sent to the government authorized organization to have the test certificate. Advanced simulation tools can also help out to improve the design .In this paper, simulating the H1, H2 test on bus seat to decide its bending strength and modifying the design to pass AUTOMOTIVE INDUSTRY STANDARD -023 test. The CAD geometry of 2 leg seat is made of using CATIA and is pre-processed by using HYPERMESH software. The simulation is carried out with LS-DYNA software to assess the seat to satisfy the requirements mentioned in Automotive industry standard 'Automotive industry standard -023'. The result of the FEA analysis is correlated with the experimental outcome.

KEY WORDS: Stricture analysis of seat, traveler seat, two leg seat

1. INTRODUCTION:

A great number of accidental hazards take place every year which results severe injuries to the travelers. Bus safety is a major anxiety in many developing countries where bus transport plays a major role in assuring convenience to the majority of people. High rate of accidents have been reported in many developing countries like India, Nepal, Tanzania, Sri Lanka for buses as compared to other types of vehicles. The seating system is a very important system in an automotive. The seating system plays a significant role as it directly affects human comfort. Travelers are directly associated with the vehicle through seating system. The seating system is one of the most costly systems in any vehicle. The malfunction of seating system has a direct impact on service and warranty claim cost. From safety point of view, it is important to design and test seat of an automobile for its strength. Seat, seat belts and seat belt anchorages etc plays an important role for the passenger in case of sudden accelerations or decelerations and also during an accident or in the case of frontal crash. The most important function of seatbelt is to protect head and body of the travelers in frontal impact since majority about 65% severe and critical injuries take place in such accidents.

Several regulations have been implemented and different tests are performed according to those regulations for seat belts and anchorage points. The different agencies across the world have different regulations for seat belts and anchorage points. As per Automotive Industry Standard -023 standards the seat to be used for a school bus was found to be failing during the test performed. During the test the seat back shown excessive bending and some design modifications were required to reduce the bending and make the seat to pass the test. The seat occupants may collide on next seat In the event of an accident such as frontal crash and due to sudden stoppage of vehicle, because of the momentum gained by occupants the seat back structure may bend.

In order to avoid injury to the seat occupant, the seat structure must have adequate bending stiffness to avoid excessive bending of seat back structure. In this paper the effect of modifications will be studied and discussed. The result of the FEA analysis will be compared with the experimental result

A. OBJECTIVES

1. To simulate the H1, H2 test on bus seat to determine its strength.
2. To amend the failed design in order to pass the test.
3. To match up to the FEA result with experimental result.

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B. METHODOLOGY:

1. Study of Indian Automotive industry standard -023
2. Prepare the CAD geometry using CATIA software.
3. Pre-process the CAD model using HYPERMESH software.
4. Simulate the mesh model using LS-DYNA software.
5. Determine the weak section, weak zone and suggest alteration to improve strength.
6. Validate FEA result with experimental result.

2 .PRESENT SEAT MODEL ANALYSIS:

A.MODEL MAKING:

Present seat (14 Kg) CAD model was introduced to Hyper Mesh software for meshing. Final mesh model is shown in Figure 1.

Element quality criteria followed

- Average size of element – 6mm
- Minimum size of element – 3mm
- Maximum size of element – 8mm
- Min. quad angle – 45 deg
- Max. quad angle – 135 deg
- Min. tria angle – 30 deg
- Max. quad angle – 120 deg
- Warpage – 15 degrees
- Jacobian – 0.6
- Aspect ratio – 4

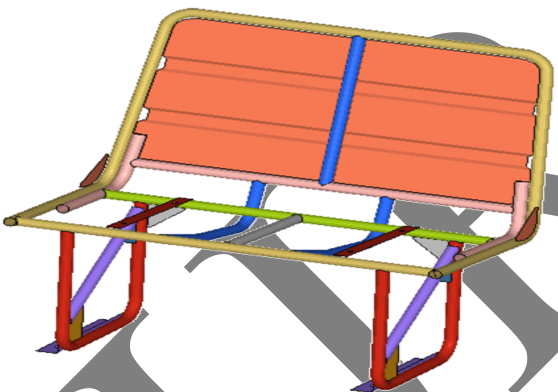

Figure 1 CAD Model of existing seat

B. MATERIAL DETAILS:

Material properties that are used in a bus seat examination are listed below.

1. Yield Strength (YS)

Yield strength is maximum stress that can be developed in a material without causing a permanent deformation

2. Tensile Strength (TS)

It is the property of a material to resist breaking or tearing under tensile load.

3. Percentage Elongation

It is the ability of the material to stretch up to its breaking point

Material properties for tube and HR sheet is given,

Tube: YS= 328.6MPa

TS= 363MPa

Max. Elongation= 32%

HR sheet: YS= 360MPa

TS= 475.8MPa

Max. Elongation= 37%

C. TEST PROCEDURE:

This model was analyzed using first test force to 2.67KN shall be applied by using a plunger; to the rear part of the seat. H1 is at 750mm above the reference plane. The direction of application of the force shall be horizontal and from the rear to front of the seat and at a height H1.Second test force equal to 8KN shall be applied at the same time to the rear part of the seat in the same vertical plane and in the same direction at the height H2 which shall be 500mm above the reference plane. Test set-up is shown in Figure 2.

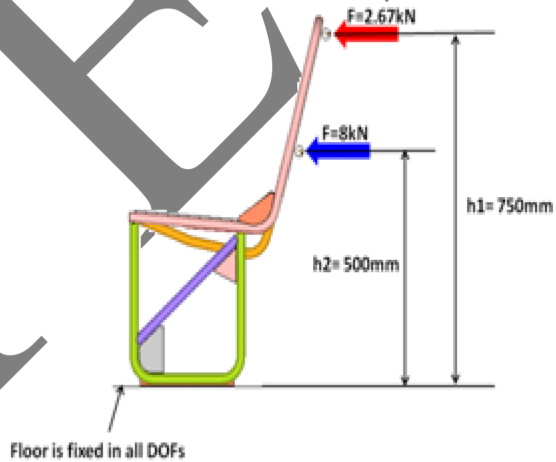

Figure 2 Test Set up

The loading and boundary conditions are acting on seat is as shown in figure 2.

Here, forces 2.67kN and 8kN are acting on a seat at height 750mm and 500mm from reference plane respectively. Seat is fixed on floor in all degrees of freedom. The deformations in seat will be analyzed by using simulation software.

Table 1 Standard Displacement range

Sr.No	Hight from reference floor (mm)	Applied Load (KN)	Displacement Range as per standard
1	H1-750	2.67	100-400
2	H2-500	8.00	>50

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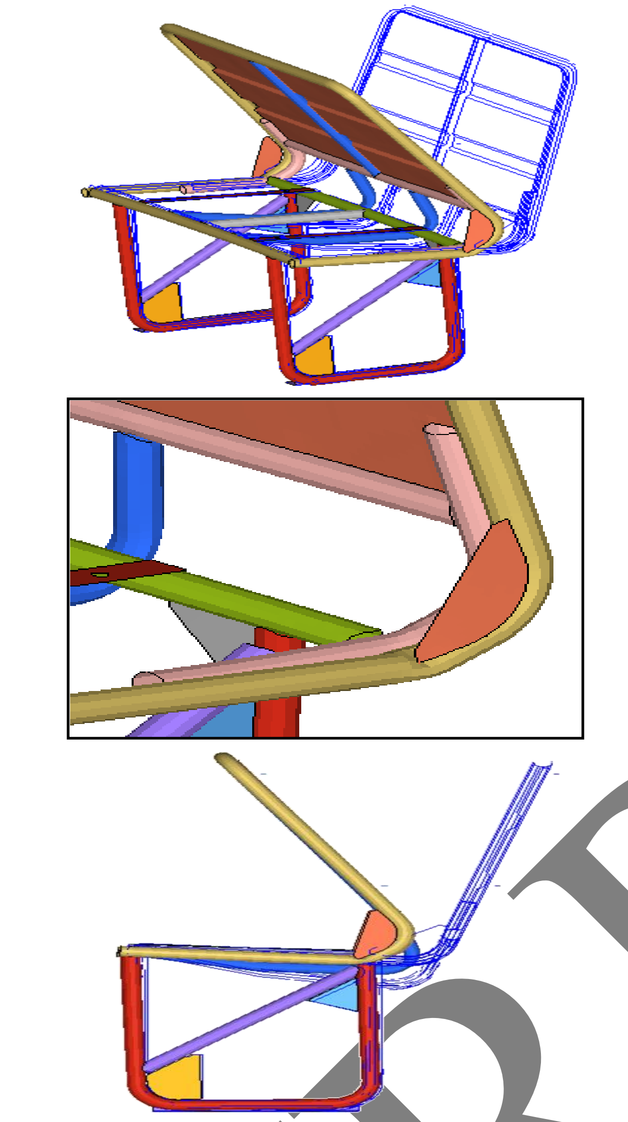


Figure 3 Deformation plot And collapse structure

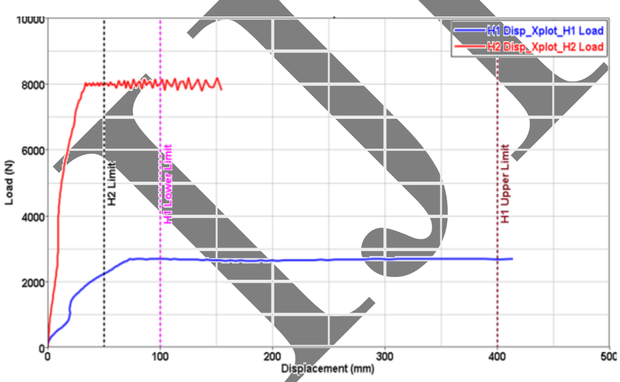


Figure 4 Displacement VS Load Plot

3. SUGGESTIONS AND MODIFICATIONS:

A.PROBLEM DEFINITION:

From the above analysis it is shown that due to front impact, back structure collapses for the rated load and deflections are beyond the specified limits, so the seat structure should be enhanced. In the front impact, the stress mainly concentrated in the side gusset, cushion support tubes, central back & cushion supports

B. MODIFIED DESIGN:

In an excessive bending the bus seat used for analysis is failed. Now, the aim is to modify the existing structure to pass the H1, H2 test. The modified design of seat structure is shown in figure 5 . In this design, the side gusset, back panel, cushion support tubes and centre backs are removed from the existing structure. The mass of the base structure is 14 kg. In modified design, side gusset with 3mm thickness, support tubes with 3mm thickness and the back strips with 3mm thickness are added. Now, the mass of seat structure is 12.5kg.

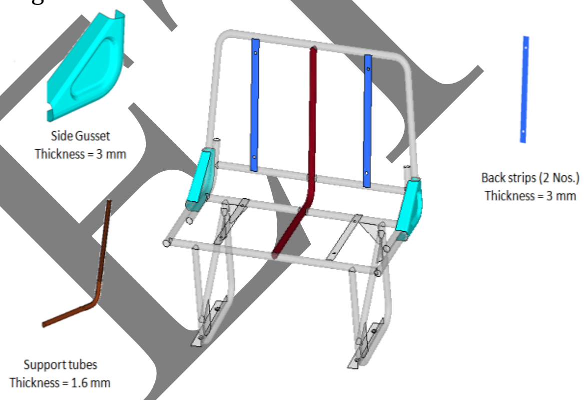
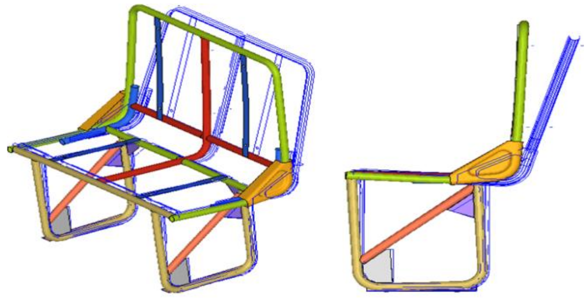


Figure 5 Design Modification

C. MODIFIED DESIGN ANALYSIS:

On the basis of the improvement of structure, the modified seat finite element model was prepared. The analysis of modified model was done again in LSDYNA, software and comparing with the simulation results with existing model. The displacement, Load Vs Displacement graph is plot for modified seat was shown in Figure 6 & 7



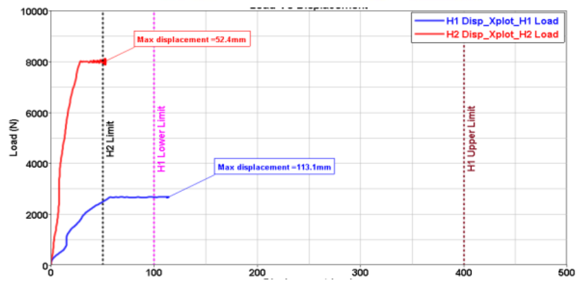


Figure 6 Displacement VS Load Plot for modified design

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4.CONCLUSION

A. Conclusion of this paper encompasses the performance of improvement using finite element analysis, enhancement in the bending strength, and decrease in the cost of seat failure, the passenger safety improvement, design modification and optimization of seat.

B. Mass of present seat was 14kg and after modification mass of seat is 12.5 kg. That is we can achieve 1.5 kg reduction of mass per seat and seat will meet all structural performance requirements as per Automotive industry standard-023 with near about 11% weight saving

REFERANCES

1) Anon., Traffic Safety Facts 1999: *A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System,* National Highway Traffic Safety Administration, National Center for Statistics and Analysis, U.S. Department of Transportation, Washington DC 20590.December 2000
2) Mohan D Karambe et. al (2013) "*Stress analysis of seat backrest of car*" international Journal Of Mechanical Engineering and Robotics Research Vol. 2, No. 4, October 2013ISSN 2278 – 0149.
3) *Conceptual Design of an Integrated Bus Passenger Seat World* Applied Sciences Journal 28 (5): 722-725, 2013 ISSN 1818-4952
4) *Vehicle Seat Structure Optimization in Front and Rear front impact* Yali Yang, Hao Chen, Ruoping Zhang, Haining Chen and Xuhua Qiang, The Open Mechanical Engineering Journal, 2014, 8, 599-606
5) *Comfort and structural (FEA) analysis on light weighted car seat design optimized with EPP material,* Brahim Bahadır Çelik, 1Bahadır Atmaca, Ergun Nart, The Online Journal of Science and Technology - January 2015
6) Majid M. Sadeghi, *Universal coach safety seat; Cranfield Impact Centre,* United Kingdom, Paper No.217.
7) Abhinand Chelikani, *Simulation of a backrest moment test for an automotive front seat using nonlinear contact Finite Element Analysis*; Clemson University, 2007.
8) Ankit Jhinkwan1, Jaswinder Singh; *Simulation of Moment Deflection Test on Driver Seat of Car Using Finite Element Analysis;* International Journal of Science and Research (IJSR),2012, Volume 3 Issue 7, 299-303.
9) Minakshi Das et al (2014) "*Commercial Passenger Vehicle Seat Design And Testing Using Advanced Simulation Procedure*" International journal of engineering science & research technology, September 2014 ISSN: 2277-9655
10) AIS Standards 005,015,016,023

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