Re-engineered beam design & evaluation to sustain high Impact for mid -size four wheeler's using finite element analysis: A case-study

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Abstract- **Objective of this research paper is to replace the current car door side impact beam with re-engineered design and use a high strength steel of yield stress 1.2 GPa, instead of low strength steel of yield stress 0.366 GPa, in order to reduce the intrusion of side closure structure which in turn reduces injuries of the occupant during fatalities. The usage of high strength impact beam on the car door has been implemented and its effect in the reduction of intrusion of the door structure has been evaluated.**

Keywords: Re-engineered design, Impact Beam, High Strength Steel, Yield Stress, Intrusion.

INTRODUCTION

India has the highest number of road accidental deaths in the world. Statistics say that there were 105,725 deaths reported as per the recent data provided by the World Health Organization (WHO), in the year 2013-14. Plot-1 shows the total number of road accidents, persons injured and persons killed from 2000 to 2013.Therefore to reduce the accidental fatalities, safety regulations of passenger cars have a major role in the automotive industry. Gov't of India has keenly taken up this issue and legislations have been passed and notified to the manufacturers. These industries have to meet the needs of a particular crashworthiness standard by manufacturing the nearest dimension design change in the vehicle structure and by implementing necessary structural parts that suit the overall design requirements. This research starts with the design modification of the door side impact beam, then comparing current steel beam with the newly designed steel beam, for the capability of total energy absorption. The material of the newly designed beam is replaced from low strength steel to high strength steel. Effect of the current side door impact beam and newly designed high strength steel beam are studied by finding the intrusion, acceleration and displacement at the central node of the beam, by incorporating them into the FE model of a car door and tested as per the new FMVSS214regulation.

To reduce the accidental risk of occupants in the event of side impact crash, the car doors are manufactured with impact beams. The major objective of the side door intrusion beam is to reduce injuries to the occupants by providing high strength to car door structure. Car door impact beam is mounted to the car side door inner structural part in three locations which is shown in the above figure. The door frame and three beams are designed in such a way that it minimizes the door intrusion in the event of side crash.

The resistance to the force per unit deformation of the material plays a major role in the optimization of car door structure design. The effect of the intrusion by the car door structure should be a little possible and the force developed on the car door structure during the side impact crash must be equally divided in such a way that the occupants in the car are minimally affected. In regard to these safety precautions FMVSS 214 of American standards is one of the regulations which should be taken into consideration at the time of designing the side closures.

Several studies have been carried out by many researchers in order to analyze and modify side impact beams. Harijono Djojodihardjo[1], 2010 compared results by considering steel and composite material and found 5.71% weight reduction and 57.2% increased energy absorption in composite beam. Černiauskas,A. Keršys,V. Lukoševičius and J. Sapragonas[2] Presented a paper on anti impact beams in 2010 by considering the old FMVSS 214 regulation. They analyzed impact beams by considering different cross sections and different grades of steel material. They also explained the importance of analyzing individual parts rather than complete vehicle.

Divakara H Basavaraju [6], 2005 compared the energy absorption and displacement of a side impact beam by considering carbon fiber composite material and steel., Final conclusions were that the weight has been reduced considerably, deformational energy absorption capability of composite material impact beam is more, composite materials can be used where high stiffness and strength are needed, but the cost to manufacture the composite material beam is very high. Hence it cannot match the lower end priced cars. Martin J Wilson[8], 2003 presented a thesis on applications of glass reinforced thermoplastic composites for structural automotive components. He considered side impact beam and performed both implicit and explicit analysis to develop and validate predictive models for the intra-laminar damage behavior of long glass fiber reinforced polypropylene matrix composites.

