

Concept of Rear Anti-Collision Equipment in Truck/Trailer to Prevent Rear Car Crashes

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ABSTRACT: Nowadays, there are maximum trucks/trailer running on the highways transporting raw material or goods. By the observing maximum road accidents between cars and trucks, we need to put more attention to the rear side of the truck/trailer and for that we have deigned a concept of anti-collision equipment. We design equipment which can be fixed and act as an absorber on the rear portion of the truck chassis. Which we called as anti-collision equipment to protect the cars as well as motorcycle crash into the truck tail. The height of the anti-collision is made adjustable on highways and on working area depending upon the ground surface.

Keywords: Truck/trailer, Crashes, Anti-collision equipment, Highways, Rear Accident, Energy absorption.

I. INTRODUCTION

Highway accident happened every day and 17 deaths on Indian roads occur every hour and that bring great loss. However India is one of the countries which has high death toll in accident. As per the survey report 4, 80,652 accidents in 2016 which leads to 1, 50,785 deaths. The specific 13 states accident data can be seen in Figure 1. Nowadays, with the popularity and overuse of this kind of truck, more and more accidents happen. [5]

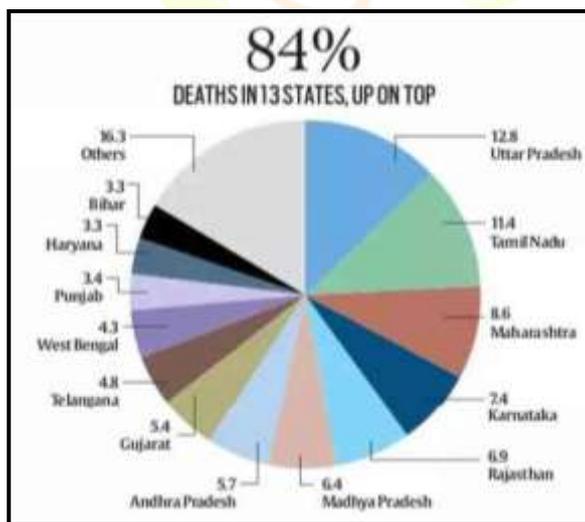


Fig. 1 Accident Death in major 13 states [5]

As per the survey there were total 98, 897 (19.7% out of the total accident in country) truck and other articulated vehicles accident occurs in which 37, 458 (25.6% out of the total persons died in country) persons were killed.

The sedan & hatchback car which is behind the truck/trailer has the frontal height smaller as compare with the clearance between truck rear end and road. As a result, the car sometimes totally gets inserted into underbody of the truck rear end. The crash impact between the car and the truck starts from the frontal engine to the windshield in some cases which is more disastrous that killed the driver & passenger life. Because the rear end of truck body is higher, so that the car easily move into the truck underbody and the frontal bumper of the car can hardly endure the impact forces from collision which causes serious damages to the vehicle, driver and passengers. In that case the airbags and safety devices could not provide sufficient protection, this is the phenomenon which is called as Guillotine Effect. The research of truck rear-end collision prevention, which is

the study of anti-collision (energy absorber) structure which can avoid the car moving into the underbody of truck. [6]

Every countries in the world has its own regulations and standards, by comparing, the European regulations are more detailed and complete. FMVSS223, the regulation of the U.S., is more intensive on the rear device safety, so there is a particular requirement for the plastic deformation of energy absorption effect.

From all countries truck collision protection is so simple and made from iron and steel in order to fill-up the gap from the ground to the truck rear which is shown in figure 2.



Fig. 2 Rear Simple Underride Protection in truck

II. SURVEY & SELECTION OF VEHICLE

Designing of a safety equipment like anti-collision equipment or energy absorber which can be installed on the rear beams of the truck chassis. Though there are many anti-collision types of equipment functional on trucks, they are not so better. We want to design a new device in order to avoid cars crash under the rear body of the truck/trailer.



Fig.3 The car crashed into the truck [2]

In a car rear-ended truck crash test held by Insurance Institute of Highway Safety (IIHS), it was shown that a good set of device can effectively prevent the car into the bottom of the truck. In the crash tests, rail car was 2010 Chevrolet Malibu, the car won the IIHS Top Safety Pick (highest safety rating), has the very good safety performance, The rear-ended trucks were extracted in the United States and eight trucks sold located in the Top eight. But the test result is not satisfactory. [4]



Fig. 4 A test for the anti-collision equipment's [3]

Table 1: - The result of a car rear-ended truck crash test [4]

Conditions	Trailer	Guard performance	Under ride	Max. longitudinal A-pillar deformation [cm]
56 km/h, full-width	2007 Hyundai	Attachments failed	Catastrophic	80
2011 Wabash	Good	None		0
40 km/h, 50% overlap	2007 Vanguard	Attachments failed	Moderate	0
56 km/h, 50% overlap	2007 Vanguard	Attachments failed	Severe	27
56 km/h, 30% overlap	2011 Wabash	End bent forward	None	6
2011 Wabash	End bent forward		Catastrophic	87

The results showing the relationship between the type of crash and the amount of vehicular damage were supported by the reversion analysis. The results specify that, comparative to collisions including the front end crashes into the right or left side of the vehicle were considerably more costly. [4]

III. DESIGN & METHOD OF WORK

In this project we have design and added add on devise i.e. anti-collision equipment (energy absorber) under truck rear body. The height of anti-collision equipment or energy absorber is made adjustable according to ground surface. We have done a comparative analysis with and without energy absorber.

For our research work the truck we chosen is the heavy-duty truck of Ashok Leyland Captain 3118 dimension which is one of the main truck in India. For the same research we have selected Maruti Swift dzire car dimension. The dimension of both the truck and car is given in tables.

Table 2:- Ashok Leyland Captain 3118

Load Body Type	High side deck
	Fixed side deck
Loading Span	24 ft
Chassis Frame	Ladder Type joggled bolt
Tyres	10R20-16 PR radial
Wheelbase	5350 mm
Ground Clearance	260 mm
Overall Length	7475 mm
Overall width	2595 mm
Height	1636 mm
Front Track	1978 mm
Rear track	1816 mm
Chassis Depth	275 mm
Chassis Thickness	7 mm

Table 3:- Maruti Swift Dzire

Tyre size	165/80 R14
Length	3995 mm
Width	1735 mm
Height	1515 mm
Gross Weight	1405 kg
Ground Clearance	163mm
Wheel Base	2450 mm

Figure is showing installed anti-collision equipment on truck body.

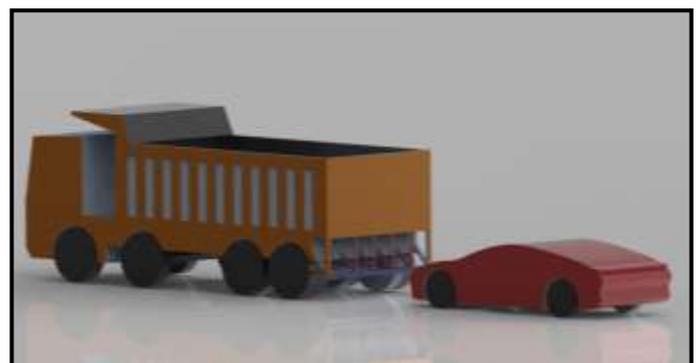


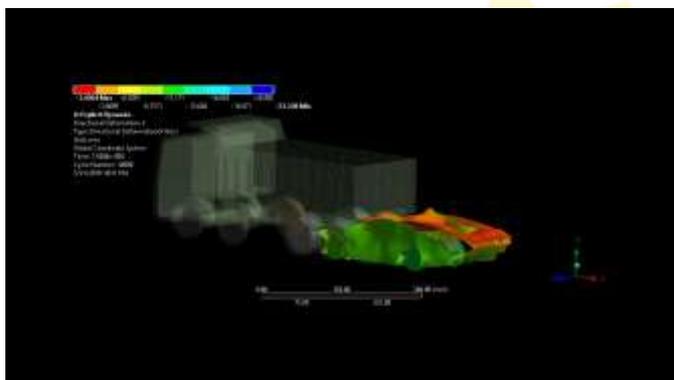
Fig. 5 Anti-collision equipment design in truck rear body

Table 4:- Analysis Details

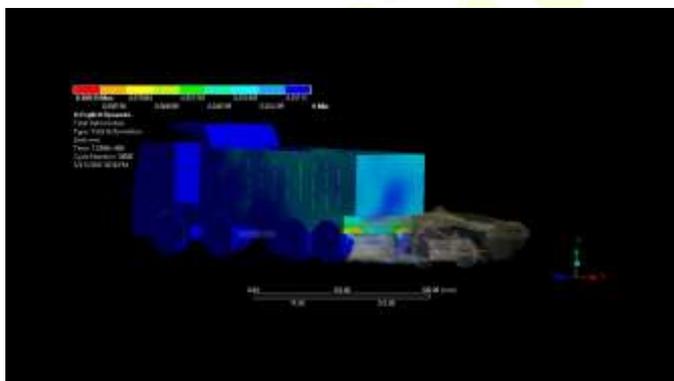
	Total Velocity		Directional Velocity (x)		Total Deformation	
	Absorber	Car	Absorber	Car	Absorber	Car
Min	0 km/hr	8.7288 km/hr	-12.384 km/hr	-181.4 km/hr	0 mm	-0.2129
Max	50.8968 km/hr	193.51 km/hr	13.72 km/hr	399.97 km/hr	0.22151	1.8326s-002 mm

The analysis result is shown in this paper. The car speed was 120 km/hr which crashes with truck. By crash test we found that there were major damage on car bonnet or we can say that engine compartment when there is no anti-collision bar on truck body.

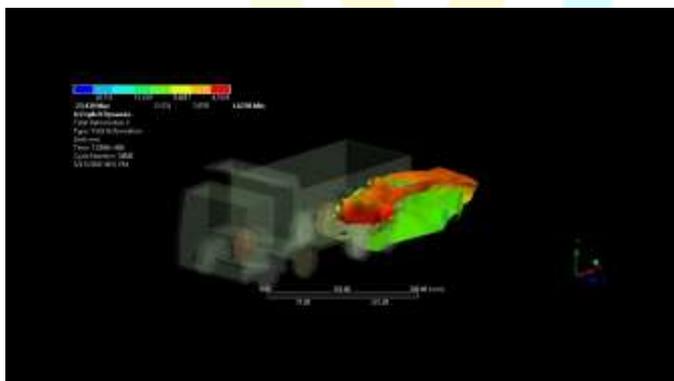
The material of energy absorption is steel with good elasticity. It did not cause major damage when cars are in relatively low speed collisions. It can reduce the vehicle maintenance cost effectively.



(A)

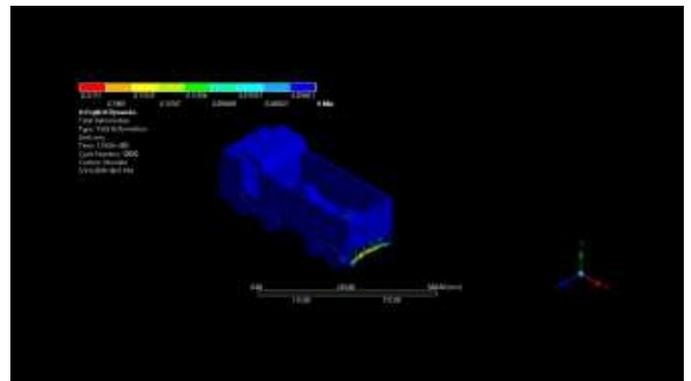


(B)

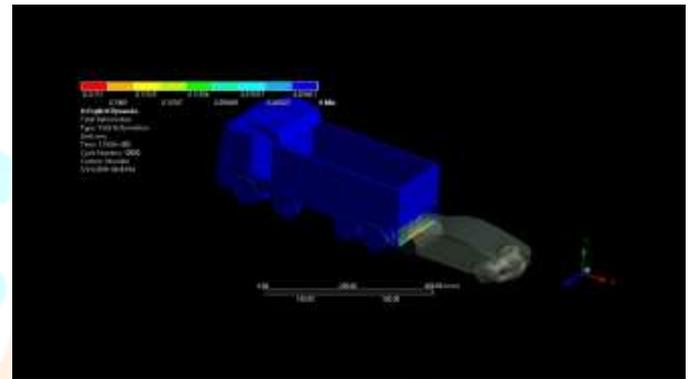


(C)

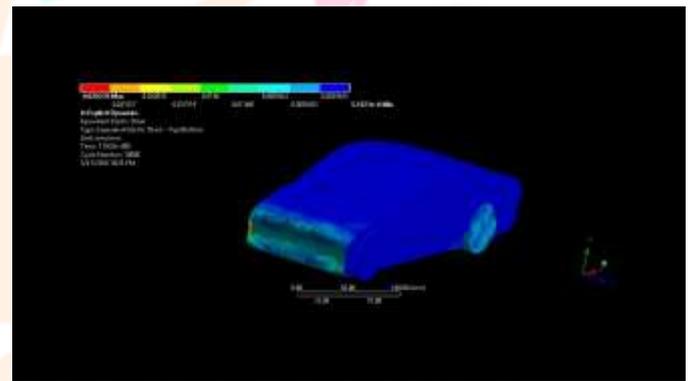
Fig.6 (A,B,C) Damage without energy absorber



(A)



(B)



(C)

Fig.7 (A,B,C) Damage with energy absorber installed

The above figure showing the damages with and without anti-collision equipment (energy absorber) in which the car get more damage when energy absorber is not installed. Another figure show the damage on car body with anti-collision equipment. The energy absorber consist of coil spring, frontal plate which is of rubber and the body of steel.

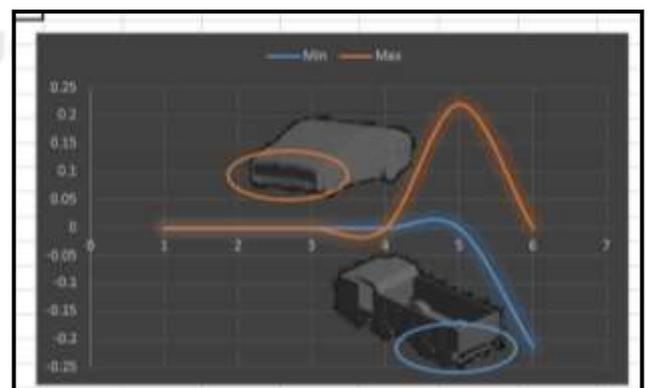


Fig.8 Velocity Deformation Graph

IV. CONCLUSION AND FUTURE SCOPE

This system can reduce the damages on car body and also on truck rear body also. At a heavy damage the energy absorber may save the driver and passenger life.

The anti-collision equipment enables small and large vehicles to make bumper-to-bumper contact. This really reduces losses & serious injuries to the occupants in the car.

The height of the anti-collision is made adjustable on highways and on working area depending upon the ground surface.

The truck underride regulation must be made valid to all trucks and trailers that may present an underride risk. Mainly due to their long rear overhang profile and rear underride dangers as well.

Reference

- [1] Hwa Won Lee and Sung Kuk Jang, "Bumper design using computer simulation", 1993.
- [2] Anti-collision Equipment Applied on Truck, Huan Han, Lujun Gu, Shaojie Lou
- [3] Google, 'crash test performance of large truck rear underride guards'.
- [4] Crash test performance of large truck rear underride guards' Matthew L. Brumbelow, Insurance Institute for Highway Safety, United States, Paper No. 11-0074.
- [5] indianexpress.com/article/india/road-accidents-in-india-2016-17-deaths-on-roads-every-hour-chennai-and-delhi-most-dangerous-4837832/ (online Survey) web source.
- [6] www.business-standard.com/article/news-cm/road-accidents-in-india-decrease-by-4-1-during-2016-fatalities-rise-by-3-2-117090700268_1.html (online Survey) web source.
- [7] Rear End Protection, 49 Code of Federal Regulations (CFR), Paragraph 393.86. Effective January 1, 1953. Established first rear guard requirements.
- [8] Amendments to the Initial Federal Motor Vehicle Safety Standards, 32 Federal Register 14278 (October 14, 1967). Consideration of a Federal Motor Vehicle Safety Standard for Rear Underride Guards for Trucks, Buses. and Trailers. Established the NHTSA Docket No. 1-11.
- [9] Congressional Report on Truck Underride Guards. by NHTSA Office of Vehicle Safety Standards, Nov. 1993. Included summary of car-into-truck crash tests conducted at VRTC.

