Rear Underride Protection Devices Methods For Design And Testing

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Abstract- *Improvements to highway safety is a major concern. The application of rear under ride protection devices upon tractor-trailers is studied as a method to improve crash compatibility between passenger vehicles and automotive tuck involved in highway crashes. The work presents variation to RUPD design boundary conditions. A three tier design strategy is proposed and implemented in an effort to guide development of RUPD for improved performance and robustness. Extensive testing is under taken in establishing guidelines for further development and testing of rear under ride protection devices. In this work study of effectiveness of these devices is done in order to enhance the safety of the passengers in the real world of accidents.*

Keywords- ISO 39001, UN 58 and IS 14812. Catia v5, Hyper mesh, LS-DYNA (steel material) etc.

I. INTRODUCTION

The basic principle of an under ride protector for tractor trailor or straight truck is to prevent small passenger cars from going underneath these heavy vehicles. Due to high ground clearance of the heavy vehicles and the low height of the small vehicle's front bumper, there is a huge space between them when they collide.

1.1 Existing regulations

Because of the heavy goods vehicles (HGV) major points such as their design, weight and dimension may lead to serious consequences for other vehicles and pedestrians if there is an accident. For the safety of commercial vehicles road regulation should be strictly followed. Road Traffic Safety (RTS) analyses the factors responsible for accidents and based upon that they set rules and regulations for maintaining the traffic. Even these guidelines are provided to HGV transport organizations. By ISO 39001 Road transport companies are expected to reach road traffic safety targets.

- Force requirements should be higher.
- Ground clearance should be reached.
- Longitudinal location has to be reached.
- height of cross member section of RUPD should be increased and
- Test conditions for the vehicles have to be slightly improved.

1.2 SURVEY

In the year 2016, a report on Road Accidents in our country, distributed by Transport Research wing under Ministry of Road Transport and Highways, Government of India, reveals that number of people died in the year 2016 are more, when seen the number deaths in the year 2015. The information additionally reveal that in our nation two states, Uttar Pradesh and Tamil Nadu have recorded or represented most extreme number of deaths this year. As indicated by the information referred to in the report, in the year 2016 nation has recorded no less than 4,80,652 collisions, resulting in 1,50,785 deaths. From records it is seen that no less than 413 individuals die regularly in 1,317 road collisions. Further the records show that atleast 17 deaths happen in 55 road accidents. When we compare the new survey and information gathered from previous years it show that despite recording less accidents in 2016, more deaths have happened in the current year as in 2015. In 2015 the information reveal that 1,46,133 individuals had died in 5,01,423 accidents. When we calculate the accidents seriousness, which is measured as the quantity of people died per 100 was found to be 29.1 as in 2015 which is lower than 31.4 which is in 2016.

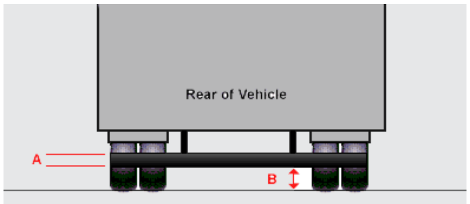
Table No.1 %age of death in crashing among a HGV and little vehicles[1]

Inhabitant type	Deaths	%
Traveler vehicle occupants	2,100	97
Vast truck occupants	71	3
All inhabitant deaths	2,171	100

In the year 2015 the percentage of death in crashing among a HGV and Little vehicles

1.3 REQUIREMENT AND FITTING

RUPD is to be installed near to backside as practicable and further must not advance more than 400 millimeters from the back of the vehicle. The allowed width (without rear side guards) is to be close to the farthest edge of the peripheral tire, with the base width of 100 millimeters.



A. Refer minimum clearance of 100mm from tyre
B. Refer maximum clearance of 550mm from ground.

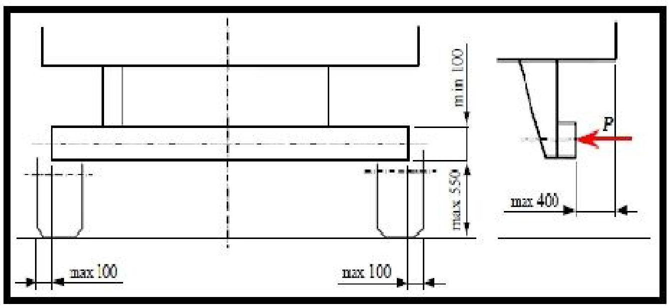


Fig 1.3(a)[2]

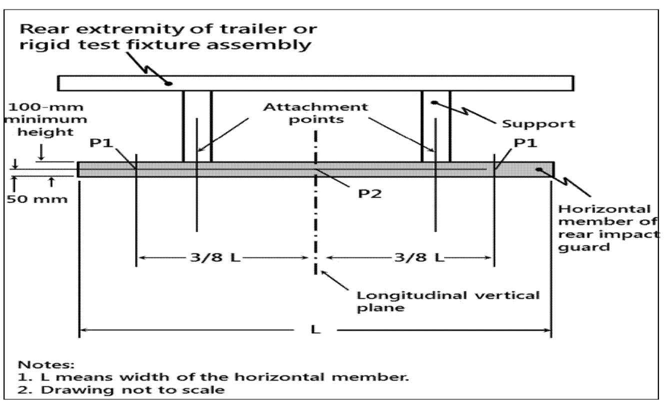


Fig 1.3(b)[3]

II.RIGID AND ENERGY ABSORBING UNDERRIDE PR OTECTION

There are two main design concepts in the development of underside protection. The rigid RUPD concept consists of stiff structural components. Sufficiently stiff RUPD components provide the inherit crash worthiness features of the passenger vehicle with a reaction interface. With the design of an ideally rigid RUPD, all energy absorbed throughout the collision would be experienced by the components of the passenger vehicle. In reality the rigid RUPD will experience some form of deformation, and may still be termed as rigid on a relative basis. An alternative approach taken by energy absorbing RUPD, attempts to further reduce crash severity by allowing both the passenger vehicle and tractor to absorb energy in the collision. One analysis of such energy absorbing systems has suggested a design with the ability to absorb 130kJ may provide protection at vehicle closing speeds elevated by 25-30% over a rigid application.

2.1 Requirements for successful Passenger Vehicle Occupant Protection

Fig 2.1(a) Car collision [4]

Requirements for successful Passenger Vehicle Occupant Protection when passenger vehicle comes in contact with HGV then crush zone area will absorb energy so to prevent occupants save during collision.

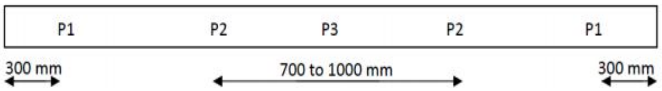
Fig 2.1(b) car collision [4]

HGV under run insurance gadget needs to agree to UNECE R58 Test1 affirms mischance inquire about discoveries Under run assurance gadget severs instantly after effect Passenger auto under-runs the HGV at high remaining velocity Passenger auto lodge is completely crushed Sum of 480KN most extreme power on the RUPD amid the effect.

Fig 2.1 (c) After collision [5]

A back under run insurance framework is the back "guard" of a

HGV It is intended to keep the affecting vehicle from getting wedged under the HGV It is intended to cause the crush zone of the affecting auto to absorb force.More stable under the protection of the device running a higher static load type needs to be approved, under Run protection device specifications, in order to test the load of 25 KN (P1 and P3), 100 KN (P2), respectively, for the three test points at the same time - rather thancontinuous.



The lower mounting height of the impact on passenger car absorb the energy better in its support structure to reduce the RUPD maximum mounting height is 450mm, both for HGV with hydraulic suspension and steel spring support vehicles running under the protection of the rear panel, the distance between the device and the rear panel reduces valuable crumple the distance from the vehicle in a collision, especially if the vehicle is short of RUPD Maximum Offset to move the REAR 100mm - two for the HGV has and does not have a lift platform.

III. DESIGN AND ANALYSIS PART

- CAD Modeling using Catia V5
- Preprocessing in Altair Hyperworks version 13/14.
- Analysis: LS-DYNA static stiffness analysis as per the regulation.
- LS-DYNA: dynamic behavior of RUPD
- Hyperview 14 for post processor

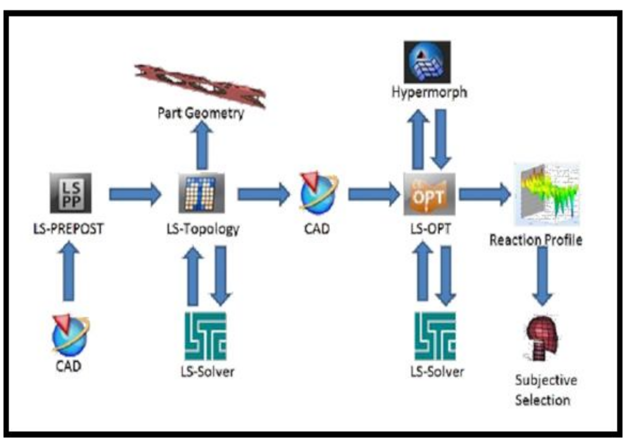


Fig 3(a) Flow Diagram

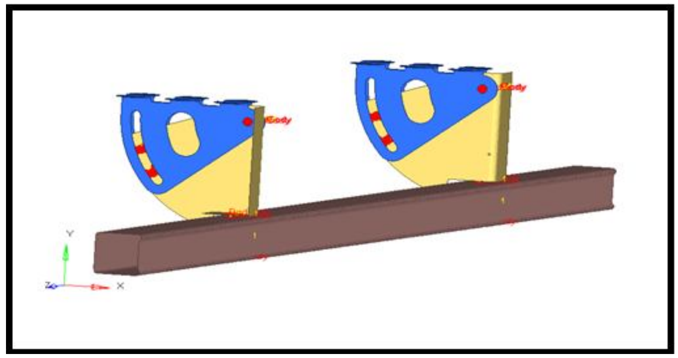


Fig 3(b) FE model

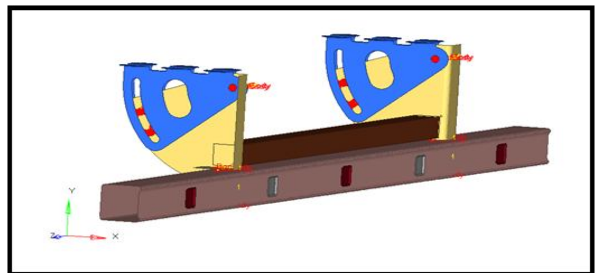


Fig 3(c) modified FE model

Table. No 1 Model Meshed With Following Quality Criteria

Sr. No	Quality criteria	Target Element Size = 4
1	Minimum Element Length	2
2	Maximum Element Length	8
3	Warpage	15
4	Jacobian	0.6
5	Minimum Quad Angle	45
6	Maximum Quad angle	135
7	Minimum Tria angle	30
8	Maximum Tria angle	120
9	Aspect Ratio	5
10	Skew angle	60
11	Percentage of Tria	<15%

Table.No 2 Material Details

Material (23°C)	Density (kg/m3)	Young's Modulus (MPa)	Poisson's Ratio	Yield value (Mpa)
AS1020 Mild steel	7.85e-9	210e3	0.3	224
Steel Punch	7.85e-9	210e3	0.3	Rigid

3.1 Load curve for Impactor

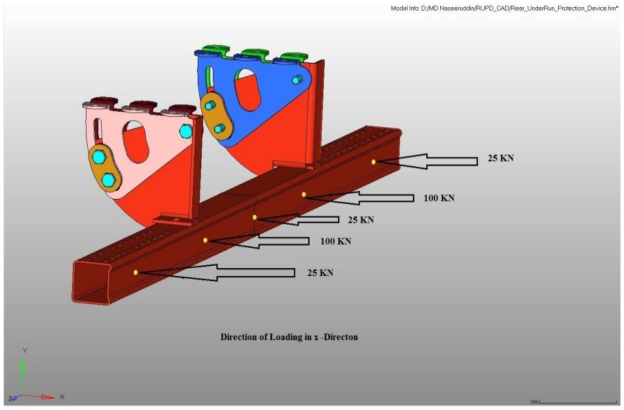


Fig 3.1 Load applied on RUPD

Table No 3 True Stress StrainCurve For 6 Mm Thickness Plate

SN	Strain	Stress
1	0.0	224.25999
2	0.02	272.84
3	0.04	305.42001
4	0.06	326.47
5	0.08	345.29999
6	0.1	359.26001
7	0.12	371.84
8	0.14	382.51001
9	0.16	393.45999
10	0.18	402.23001
11	0.2	410.70999
12	0.3	444.63
13	0.5	491.37
14	0.6	509.20999
15	0.8	538.69
16	1.0	562.72998

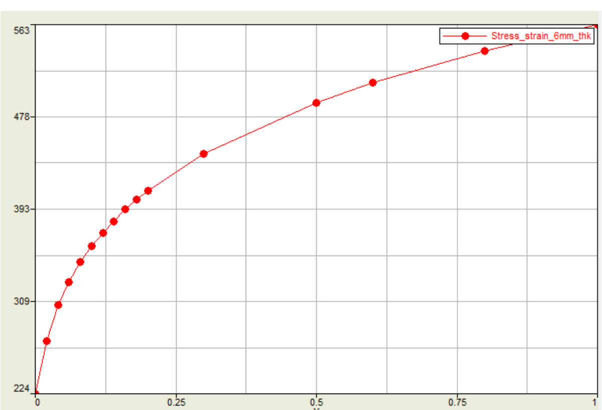


Fig 3.1(a)Graph True Stress Vs Strain For 6mm Plate

IV. RESULTS

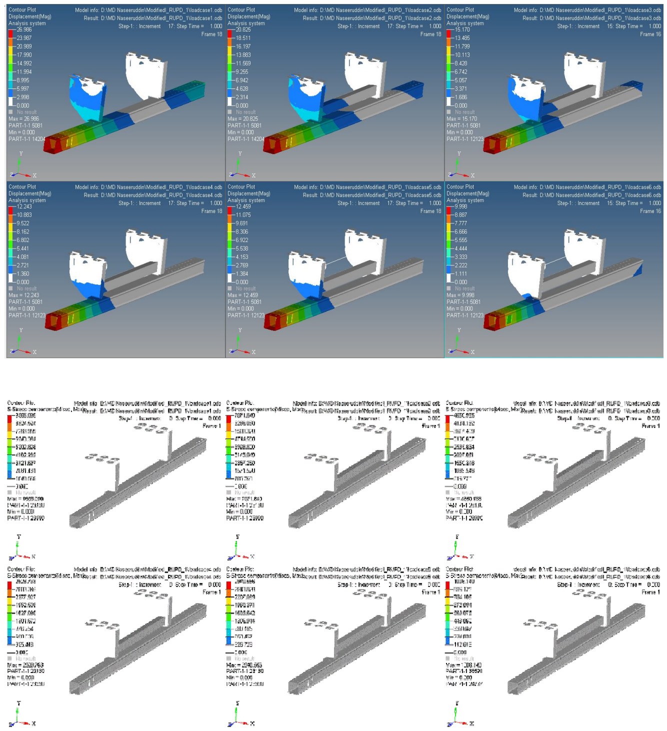


Fig 4 Results

4.1 Modified RUPD Results

- **LOAD CASE 1**

force applied in X Direction

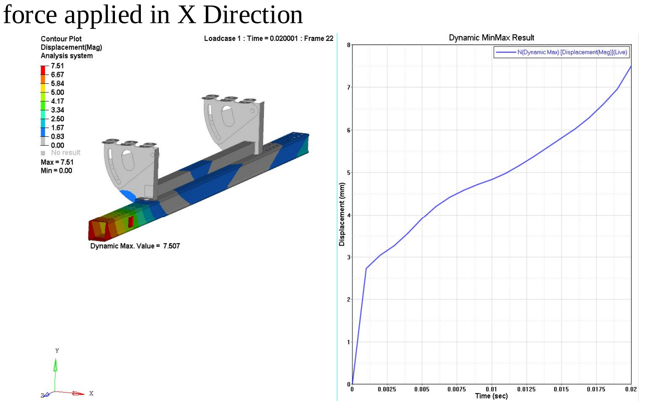


Fig 4.1(a) Displacement Plot for the loadPoint P1

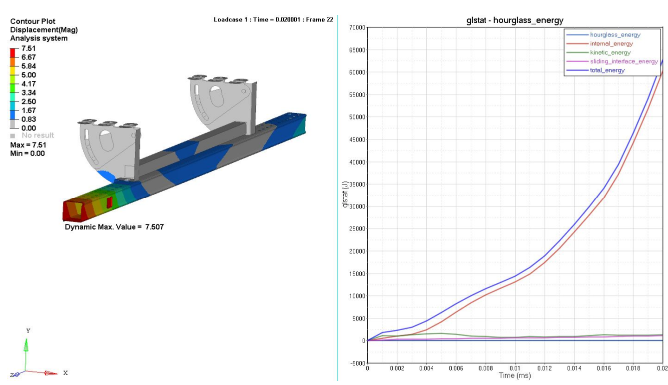


Fig 4.1(b) Energy plot for the loadPoint P1

Fig 4.1 shows internal energy is more than kinetic energy hence total force of 25kn is converged , such that maximum displacement at load point P1 25 kN which is less than 50mm as per the regulation .

4.2 Stress Counter Plot

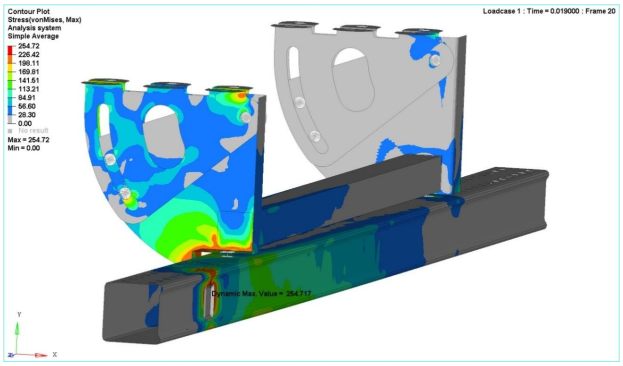


Fig 4.2(a) Maximum Von Misses Stress induced 254.72 Mpa which is less than Ultimate Yield valure

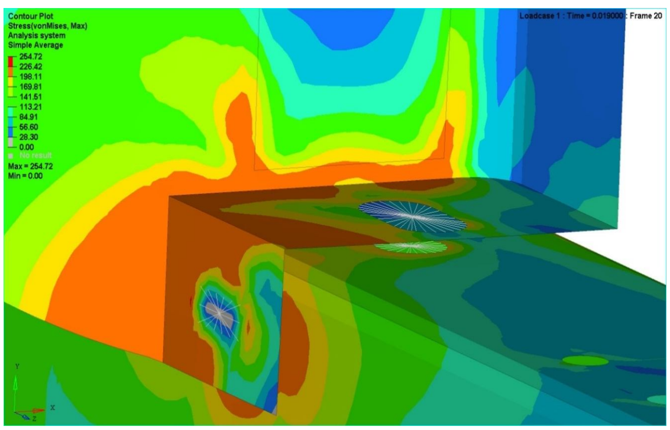


Fig 4.2(b) Microscopic view of stress at Mounting location Maximum stress were observed at bolt location

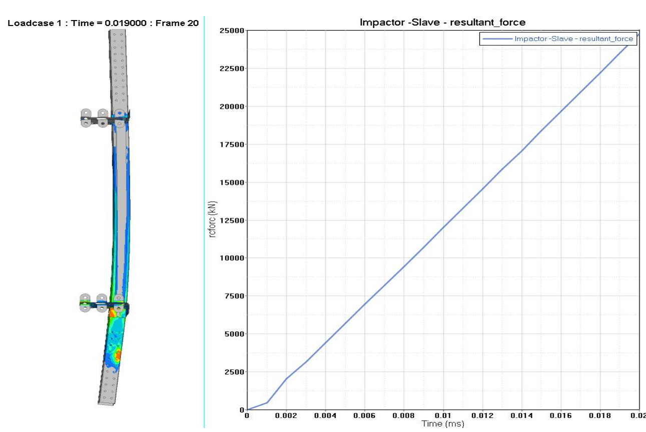


Fig 4.2(c) Reaction force of 25 kN force

In above said design, the maximum displacement of RUPD bar is limited to 50mm and the plastic strain is limited to 15% hence it meet the requirements as per IS 14812:2005.

But this needs to be confirmed with physical testing in future. The virtual simulation is a tool which can be used to avoid or reduce the physical testing of mechanical systems and components. Overall effect of this is reduction in development cost as compared to real time physical testing.

V. CONCLUSIONS

The design approach proved to be an effective method of studying and developing Rear-Underride Protection Devices. The proposed design approach allowed for resolution of disconnected parameter consideration which may have been present in the design of previous structural support systems. The continuous improvement and search scope refinement method produced further contributions to general design efficiency. One such case involved the suggestion of simultaneous rather than sequential quasi-static point loads, allowing for improved design continuity. An additional concept for simplified RUPD testing involved the use of a dual spring component level system. Tuning of the springs provided a more realistic collision response in comparison with simplified rigid and fixed systems. The refinement allows one to draw greater insight in to the relationship of parameter variation in question with respect to its influence on collision performance.

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