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Safety Features Evaluation of the Vehicle Interior Using Finite Element Analysis (Fea)

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Abstract: *About 1.3 Million Individuals Pass On In Street Crashes Consistently, On A Normal 3,287 Passing's A Day. Besides, An Extra 20-50 Million Are Harmed Or Debilitated. In America, Over 37,000 Individuals Kick The Bucket In Street Crash Every Year. An Extra, 2.35 Million Are Harmed Or Incapacitated. Over A Large Portion Of All Reported Cerebrum Wounds Are The Consequence Of Car Accidents. Traumatic Mind Harm Can Happen As A Consequence Of Anything That Punctures Or Breaks The Human Skull And The Regions Which Are Defenceless Amid An Auto Crash. To Moderate This, National Highway Traffic Safety Administration (Nhtsa) Has An Authoritative Order Under Title 49 Of The United State Code, Part 301, Engine Vehicle Security, To Issue Federal Motor Vehicle Safety Standards (Fmvss) And Regulations To Which Makers Of Engine Vehicle And Gear Things Must Review And Affirm The Model Before Propelling. Fmvss 201 Is Made To Increase The Inhabitant's Security From Head Damage In Accidents. Point Of This Paper Is To Analyse The Essentialness Of Inside Trim Outline To Diminish Head Acceleration And To Figure Head Injury Criterion (Hic) Without Utilizing The Trims And With The Trims. In Useful Methodology, Fmh (Free Movement Head Structure) Accelerates At Different Focuses Inside The Vehicle Inner Part At A Speed Of 24 Km/Hr Or 15 Mph And The Information Is Gathered At The Head Structure Cg (Centre Of Gravity) And Investigated For Damage. The Methodology Is Being Completed With The Assistance Of Finite Element Analysis (Fea) And Computer Aided Engineering (Cae) Methods To Upgrade A Trim Framework. All In All, Information Is Being Analysed By Comparing Head Injury Criterion (Hic) Can Be Magnify Without Utilizing The Trim Part Over The Body In White (Biw) In A Vehicle.*

Keywords: *Vehicle Interior, Motor Vehicle Safety, Finite Element Analysis, Computer Aided Engineering***.**

I. Introduction

Safety standard FMVSS 201 [1] was made to build insurance from head harm in accidents. Contingent upon the vehicle targets, e.g. the number of pillars, there are dependent upon 23 target focuses to consider. Notwithstanding the target covering the A and B pillar and side rails (Figure 1).The head injury criterion, Hic (d), is calculated as a function of the head form acceleration and should be less than 1000 to clear the test. The Hic (d) result relies on upon trim outline, i.e. surface shape, impact space under the trim, furthermore on body stiffness.

To streamline a trim framework by testing alone is obviously infeasible; CAE methods are progressively depended on. This paper depicts the CAE procedures of analysis. In the first approach free motion head form is impacted over the desired targets and resultant head acceleration and head injury criterion is measured. Furthermore, same tests are performed by connecting trim over the body in white and then results are measured.

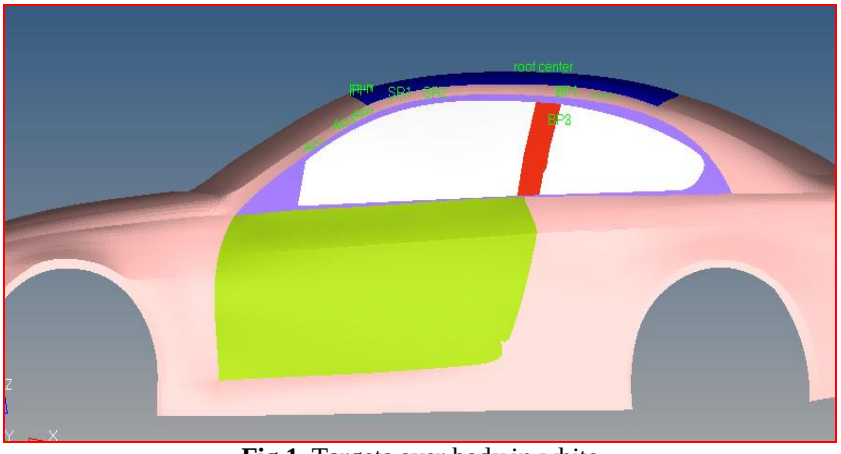

Fig.1. Targets over body in white

II. Methodology

The Free Motion Head Form (Fmh)

A finite element model of the FMH used in FMVSS 201 test is shown in (Figure 2) was developed. Practical development of head form has been performed by creating skin as a deformable and skull as a rigid material. Further, respective properties and materials have been updated to the parts of head form model. According to standards weight of head form should be 4.5 kg.

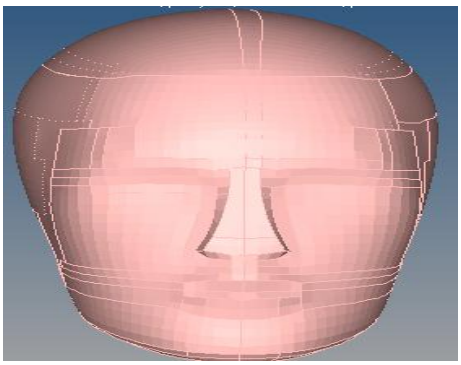

Fig 2. Free Motion Head form

Body In White

The tests are performed on a half vehicle body with a refined work in the wanted territories. Since, test on full vehicle body obliges long computing time. Examination of another outline might securely be carried out utilizing a chop down half vehicle body (see figure 3) with appropriate constraints. This lessens computing time however, changes the Hic (d) by –5% to +15%. Piece wise plastic has been used for body in white with card image (MAT24) in ls dyna. Elastic-plastic strain and stress values have been provided with varying thickness for different components.

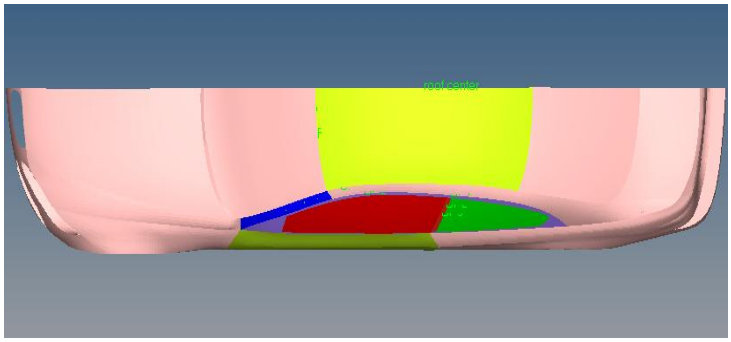

Fig 3. Body in white

Setting up the connection between target (body in white) and head form

The head is positioned according to global coordinate system and then dragged over the target in order to follow the same axis is shown in (figure 4). Hence, target and forehead of head form will be in the same axis and acceleration will be recorded over centre of gravity of head form. HYPERMESH (ls dyna) solver sets up the interface between head form and the component over which target is fixed. Because, penetration will give drastic change is result. Further, a velocity of 24km/hr or 15mph has been given to the head form and respective Head Injury Criterion (HIC) is measured.

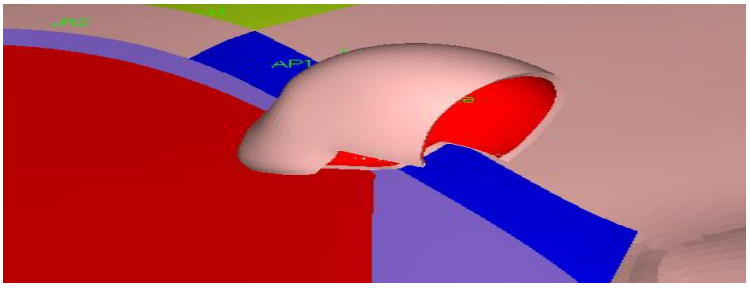

Fig 4 Head form and target

After impacting the head form over the target AP1 which is at pillar A of the vehicle we will see the result over LS dyna prepost.

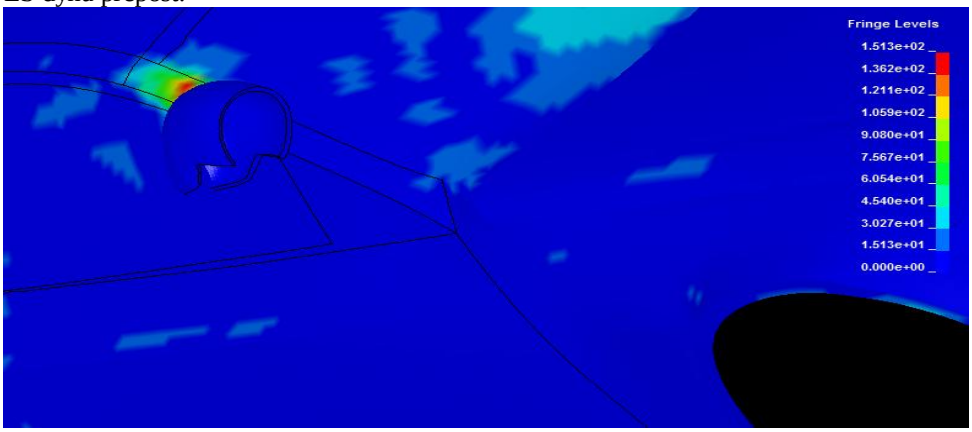

Fig. 5 Simulation of target AP1

After the noise reduction we have plotted the acceleration- time graph at target AP1 and then we have measured the head injury criteria of the free motion head form.

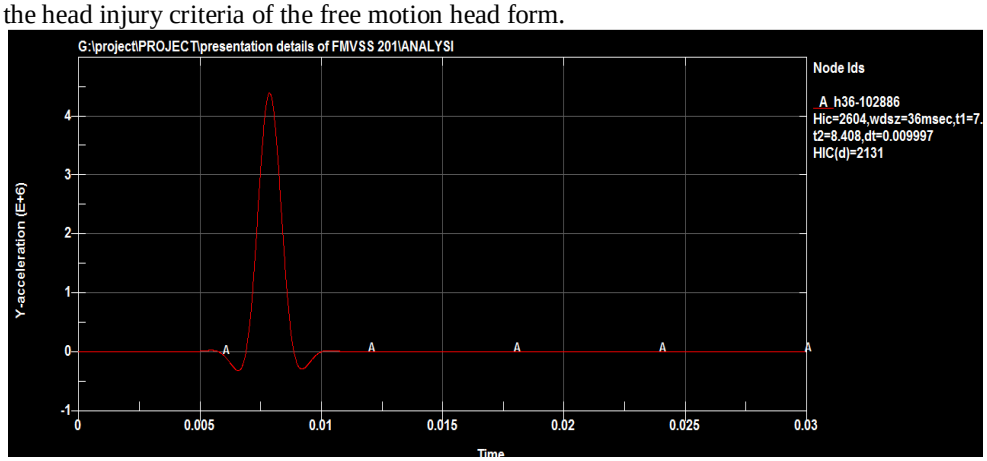

Fig.6 Target pillar A Acceleration Time curve

Now, we have translated the free motion head form over the target AP2 which is 88mm below at pillar A from target AP1. Similarly, we have translated the free motion head form over the target AP3 which is 162.865mm at pillar A from target Ap1 and performed the same simulation over these two targets. (According to NHTSA) Pillar B is major component and we will continue our simulation over pillar B. First, we had to measure the length of pillar B which is 361.643mm and further we had targeted our first point from the bottom of the pillar B. Then we have adjusted head form at target BP1 at pillar B. After the simulation, the following acceleration- time curve has been plotted and respective head injury criterion has been measured. (According to NHTSA)

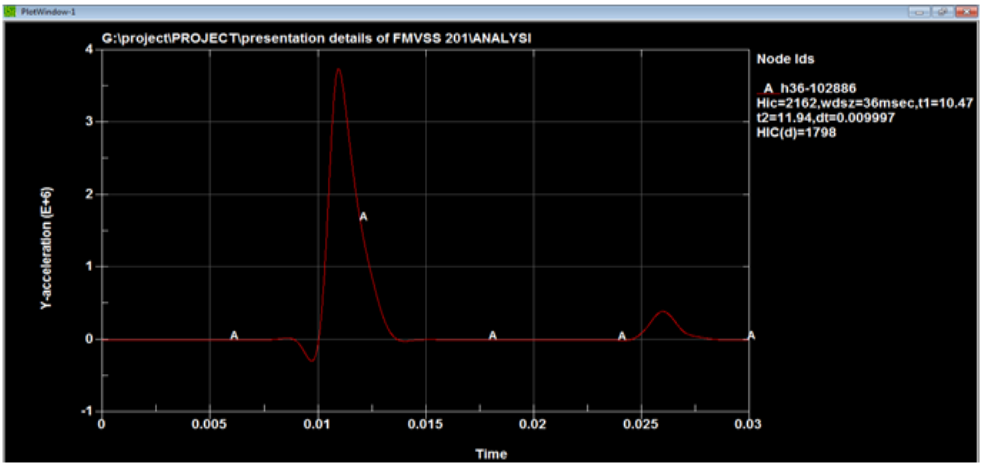

Fig. 7. Target Pillar B Acceleration Time curve

Further, same iterations have been performed over targets BP2 and BP3 which are 180.82mm and 90.410mm from the extreme bottom of pillar B respectively. (According to NHTSA)
Now, we will continue our simulation First target SR1 has been found, which is 150mm behind the target AP1 at the side rail.

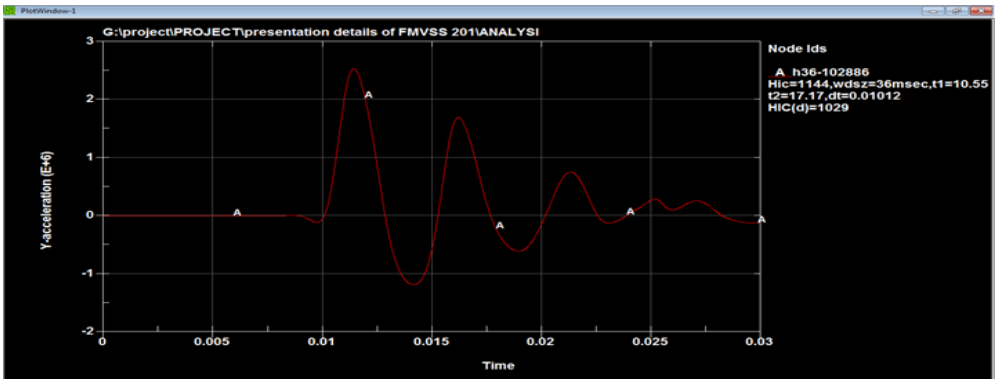

Fig.8. Target SR1 Acceleration Time curve.

Similarly, after completing simulation over target SR1 we will start our simulation over target SR2 which is 150mm behind the target SR1 at the side rail. Further on target SR3 which is 150mm from target BP1 at the side rail.

Interior Trims

A regular plastic trim (figure 5) comprises of a bended surface or substrate with essentially shaped lodgings for cuts which append to the body in white. Higher Hic (d) qualities are frequently gotten when the effect is in the district of the cut lodgings. Holding cuts may break if affected at edges that heap them in shear. The trim is generally strengthened with ribs, which may be basic or a piece of a fitted rib, to help retain vitality. They do this by twisting and pulverizing or breaking under the effect of the head. Hence, it is mandatory to model it as precisely as possible, the shape and material property of the rib structure. This can be obtained by using fine meshing on targeted points. Piece-wise plastic is being used for trim the trim component of the vehicle. Moreover, same we have created the trim component over the subjected parts and same iterations are performed over it as we have done over the parts without trims. Further, we have analyzed the result and measured the Head injury criterion of free motion head form.

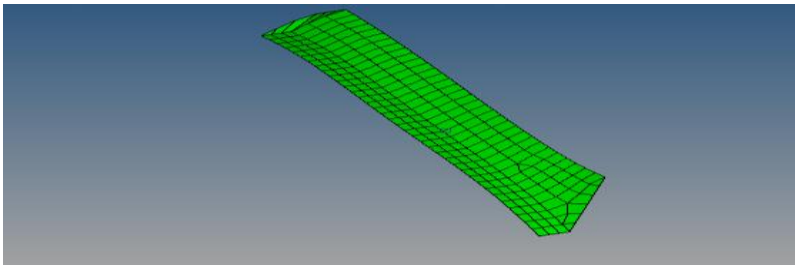

Fig.9. A pillar trim component

By using the peace wise plastic for the trim component we had measured the acceleration of head form over the same targets of A pillars and thickness of trim component will be 2mm. Simulation of target A has been depicted in figure 10.

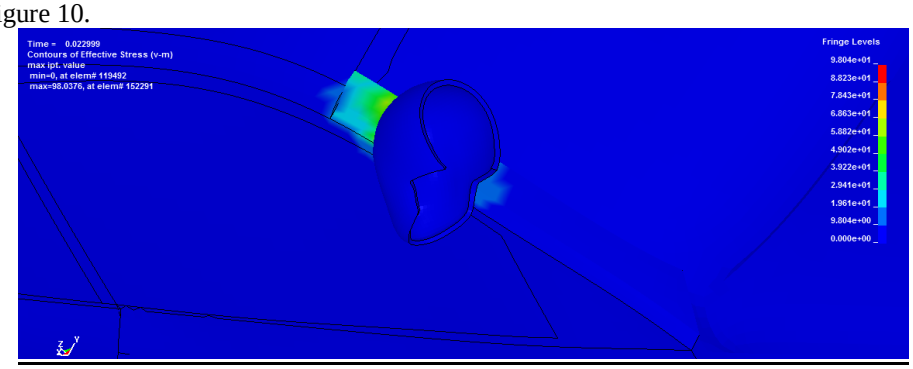

Fig. 10 Simulation of Target AP 1 with trim

By using the trim component over pillar A we have impacted the free motion head form with a same velocity over the same targets and then we have measure acceleration of head form and subsequently measure head injury criterion also. The following acceleration- time curve and its head injury criterion with trim component are shown in figure 11.

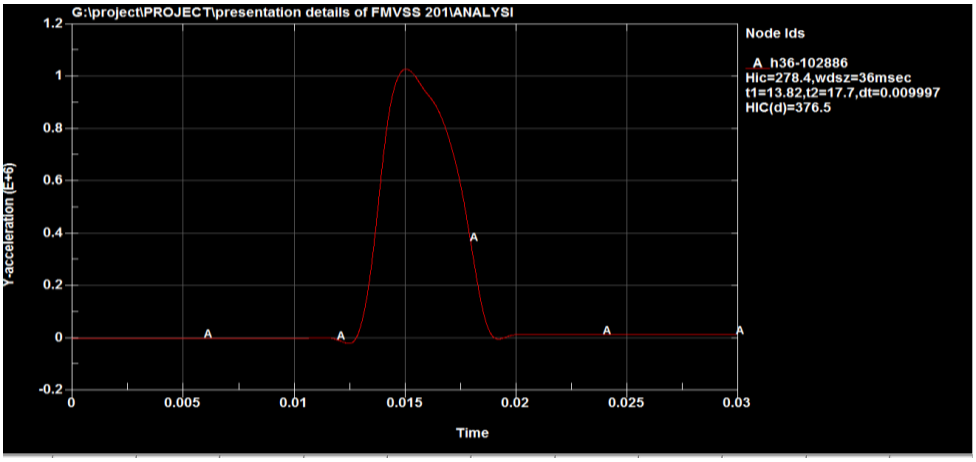

Fig.11 Target AP1 Acceleration Time curve

Same iterations have been performed for the other targets of pillar A. Similarly, we have created the trim component over pillar B also and thickness of trim component will be 2mm. simulation of trim component over pillar B is shown in figure 12.

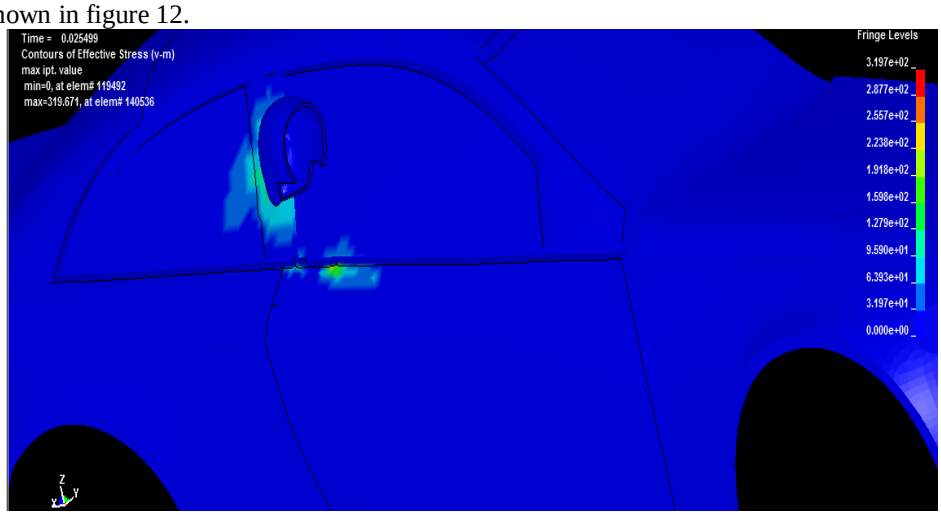

Fig. 12 Simulation of Target Pillar B

Now , we have adjusted head form is such a manner that it had impacted over the target BP1 of pillar B and following acceleration – time curve and head injury criterion is shown in figure 13.

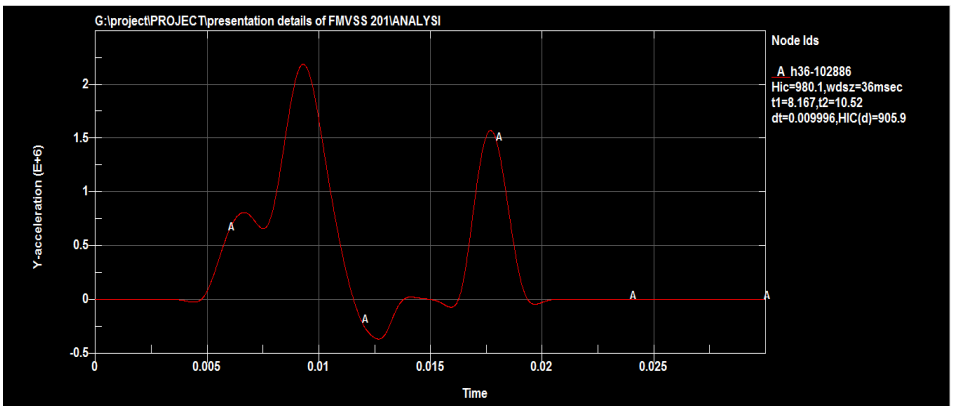

Fig.13 Target Pillar B Acceleration- Time curve

Similarly, trim components have been created over side rail components with 2mm thickness and same peace wise plastic material. Further, same iterations have been performed on respective targets SR1, SR2 and SR3 and acceleration- time curve has been plotted and head injury criterion has been measured. Side rail trim component acceleration time curve is shown in figure 14.

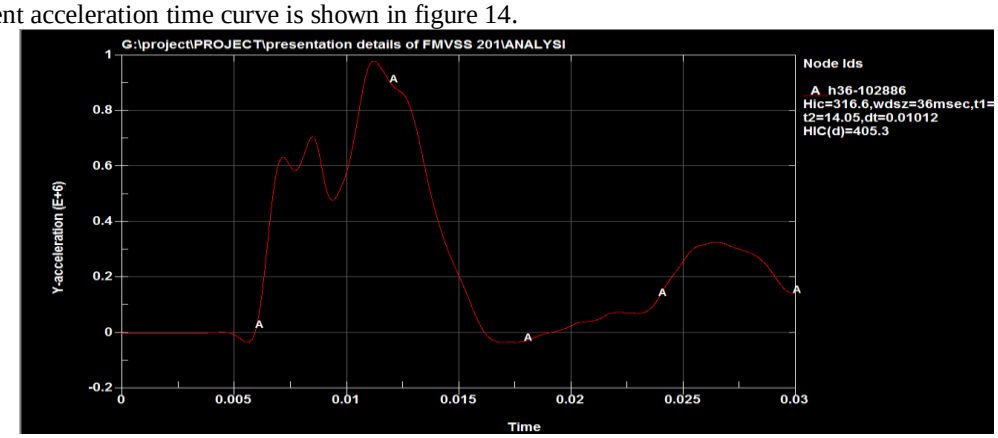

Fig.14. Side Rail Target Acceleration- Time curve

III. Results

According to above analysis, we have found that Head Injury Criteria (HIC) of free motion head form (FMH) is exceeding above standard limit 1000. Furthermore, after incorporating trim component into body in white Head Injury Criteria (HIC) is below 1000. Hence, material and property which we are using for trim component is absolutely correct for the safety point of view. Result is shown in table 1.

Table 1 Result of Head Injury Criterion (HIC) without trim and with trim

TARGETS	HEAD INJURY CRITERION(HIC)WITHOUT TRIM	HEAD INJURY CRITERION(HIC) WITH TRIM
TARGET AP1	2131	376.1
TARGET AP2	1345	444.6
TARGET AP3	1517	269.5
TARGET BP1	5607	905.9
TARGET BP2	1798	663.1
TARGET BP3	2235	705.3
TARGET SR1	1029	405.3
TARGET SR2	1275	284.8
TARGET SR3	3803	385.5

IV. Conclusion

It has clearly be seen from the previous data due to increase in head acceleration major head injury occurs in fatal accidents. We have taken the standard data from the national highway traffic safety administration (NHTSA) and performed the simulation by taking peace wise plastic material. This material is majorly being used all over the world. From the above simulation it has clearly be seen that head injury criterion (HIC) exceeds over 1000 when free motion head form (FMH) directly impacted over body in white of the vehicle. To control this effect we have decreased the head acceleration by using trim material over the body in white and seen head injury criterion is below 1000.

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