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HEAD IMPACT ANALYSIS ON AN AUTOMOTIVE VEHICLE TO REDUCE HEAD IMPACT CRITERION VALUE

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ABSTRACT

The pedestrain accidents accounts for 30% of the deaths and major fatal injury occuring on the head of pedestrainis one of the main reason for the deaths.Head injuries are unavoidabe as the kinematics of the human body plays an important role. As the head comes in contact with car, the body tends to move the head and impact with same kinetic energy of the car and thus the head injuries are very fatal in nature.Generally in a car to pedestrain collision the lower limbs come in contact first with the lower bumper of the car,then the upper legs are in contact but the main injury of fatal level occurs due to the contact between the head and the hood impact and the energy absoption in the head depends on the hood and engine assembly position.

This research work deals with the evaluation of the injury criteria for the pedestrain headfoam impact on the frontal hood of an passenger vehicle based on the kinematics of the motion of a human head during the head impact scenario.Asmost of the pedestrain fatal injuries occuring on the head are responsible for the most of the critical casses and to measure the injury criteria , we have to measure the HIC (Head impact criterion value) and must find out the various methods of design change of the frontal hood inner panel to carry out the itterations and suggest a design based on the Lower HIC value.In this project we have used two hood inner panel design to measure the Acceleration and Hic of the headfoam and compare to suggest the best hood inner panel .The two hood inner panel design is taken from the Honda Accord Model to measure and carry out the analysis.

In this project ,we have used the a preprocessor ANSA for the creation of the FE model of the hood assembly,Engine components and the headfoam.We have also used a solver of LS-DYNA for solving the dynamic analysis ad a post processor Hypergraph for plotting the acceleration and the HIC curves and compare the results.

KEYWORDS: Crash Analysis,Head impact Pedestrain,LS-Dyna,Hypergraph,Ansa,HIC,Acceleration value.

1. INTRODUCTION

Approximately 1.8 lakhs people are being killed in traffic accidents in anyear in India. Now as pedestrians account for about 30% of the victims, pedestrian protection has always been the major issue of concern to the vehicle manufacturers and to the institutes which provides ratings to the car assesment programme.The institutes like IIHS,ECE,FMVSS carry out various crash test to analyise the occupant injury criteria and also the functioning of the vehicles .

1.1 Kinematics Motion Of Pedestrain

The kinematics of the human body plays a very important role in the head impact as the vehicle comes in contact with the pedestrain, the lower part of body comes in conact with lower bumper and the upper legs comes in contact with the upper end of bumper and some part of the lower hood.The head of the pedestrain tends to rotate in such a way with a increase acceleration towards the hood assembly and inturn impact with the hood . The below figure shows the kinematics and how the head of pedestrain is impacted on the frontal hood of the vehicle.

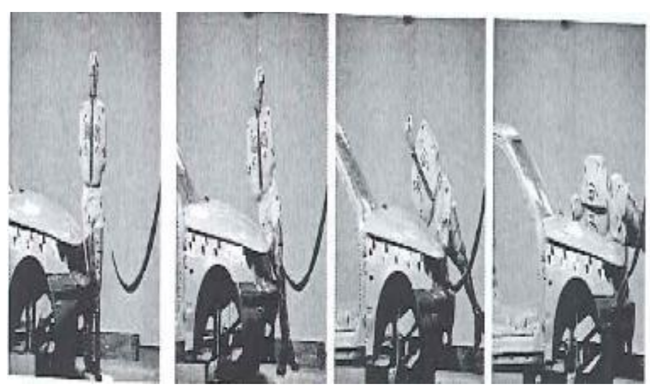

Figure 1 : Human body Kinematics

2 .LITERATURE SURVEY

In this project the literature survey is the study of experiments conducted by the Euro Ncap group who conducted the test with different head foams and carried the test.We have also studied different published papers for the safety of the pedestrian head impact and methods to

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reduce the injury levels. We have considered all the Japan and euro ncap intesting methods involving modeling and simulation of the test.

3. METHODOLOGY

The methodology followed in this project work is the preparation of the frontal hood assembly from the cad model available and discretize the elements and applying the required welds, adhesives and boundary conditions and impacting the head foam.

Generation of FE Model

↓

Applying Loads and Boundary conditions

↓

Solving the model in dynasolver

↓

Generating the acceleration and HIC values

Figure 2 :Methodology flow concept for head impact analysis.

4. HEAD IMPACT EURO NCAP TEST SETUP

The Euro NCAP (New car assessment programme) has set an experimental procedure to carry out the test for child head,Adult head and also for the leg foam impact to extract the leg injuries occuring to the pedestrain.The figure below shows the setup and impact criteria.

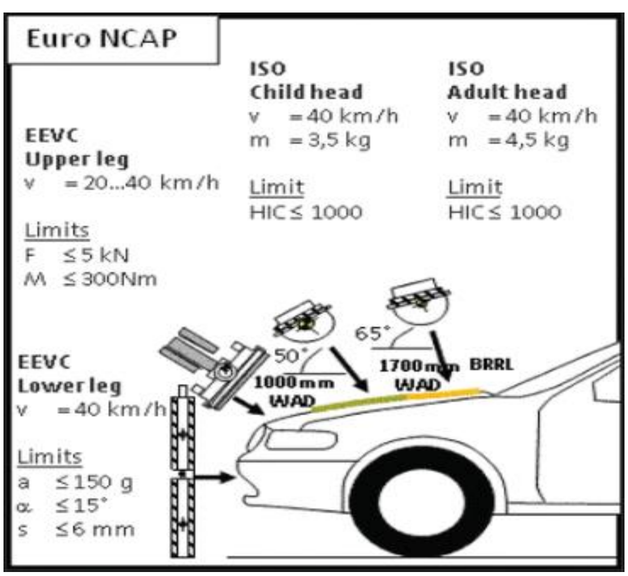


Figure 3 :.EuroNcap Setup of Leg and Head Impact

4.1WRAP AROUND DISTANCE (WAD)

The. Wrap around distance is basically the distance from the ground level to the bonnet or the hood of the car where the headfoam has to be impacted with an angle and certain velocity to find the hic value.

Generally for the EuroNacp the wrap around distance for the child foam is 1000 to 1500 mm and 1500mm to 2000mm for the adult headfoam.

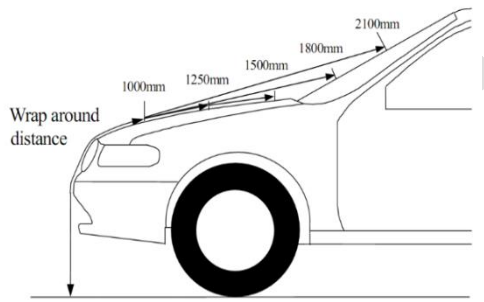


Figure 4 :Measuring Wrap around Distance

4.2 HEAD FOAM

In this project we have considered one child head foam of mass 2.5kg and is impact with wrap around distance of 1000 to 1200mm distance on the front hood of the vehicle.The head foam is impact on hood assembly at an angle of 50 degree with horizontal and velocity of 35km/hr.

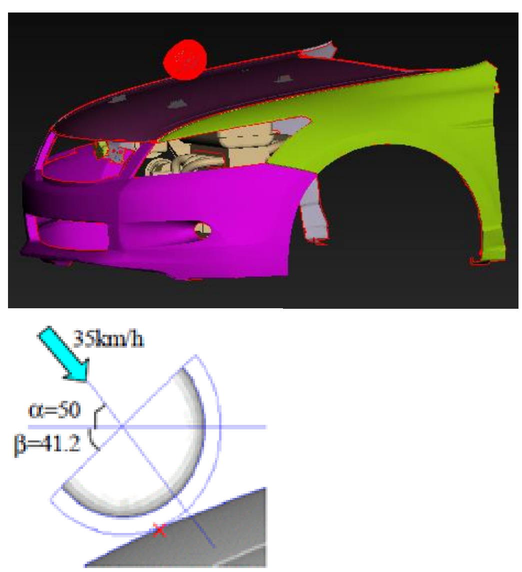


Figure 5 : Finite element representation of child Head Foam

5.HIC (HEAD INJURY CRITERION)

The calculation of HIC is the main criteria to Judge the injury level and it is measured through the acceleroeter which is attached to the head of the child foam during the impact.The formula to calculate the hic values is as below.

$$HIC=\left[1/(t2-t1)\int_{t1}^{t2} adt\right]2.5\,(t2-t1)$$

Where: t1 and t2 are the initial and final times (in seconds) of the interval during which HIC attains a maximum value.

a(t) = acceleration value with respect to time.

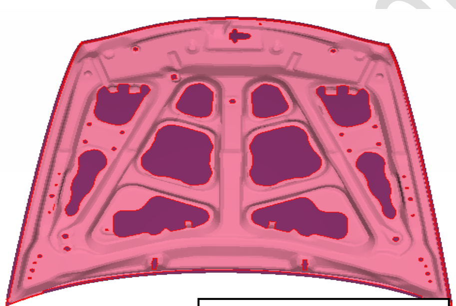
The index 2.5 ischosen for the head, based on experiments.

6.DESIGN CHANGE OF HOOD INNER PANEL

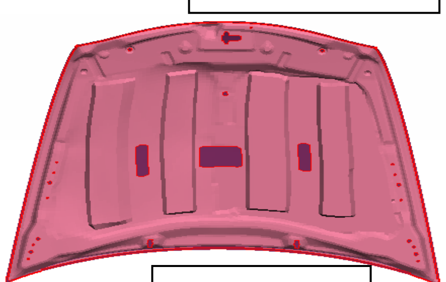
This project is carried on the two hood inner panel designe dbased on the study of various design generally prefered .Each hood is impact with two positions of child head foam to check the acceleration and the hic values and predict the injury levels.The two hoodinner panel designs are :

1.Beam Type

2.Wave Type



Beam Type



Wave Type

The childhead foam is impacted at a wrap around distance of 1200mm and is impacted at two different impact zones to measure the effect of hic at different locations.

7.IMPACT POSTIONS OF CHILD HEAD FOAM

The test is carried out for two different hood designs and at 2 impact positions with the engine assembly beneath the hood assembly and accelerometers attached will give the accelerations which in turn will be usefull to generate the HIC avlues.

Position 1

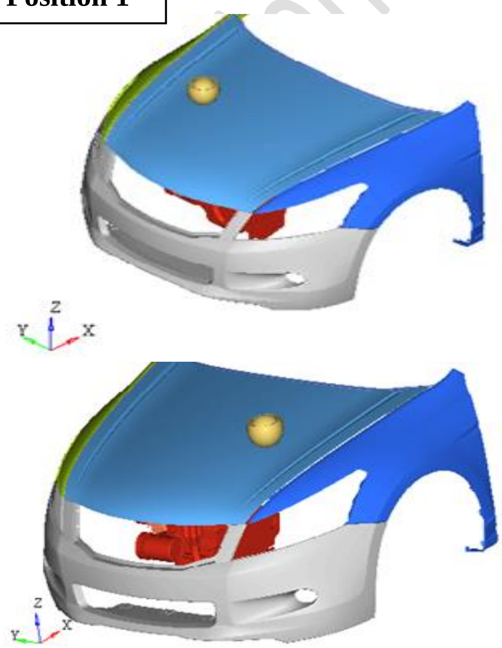


Figure 6 : Multiple Impact Positions of the child headFoam.

8.RESULTS AND COMPARISION

The required each two iterations were carried out for each of the hood inner panel design and the required acceleration curves were plotted using Hyper mesh.

8.1 HEAD IMPACT POSITION 1

The below image of head impact for the position 1 for the different beam and wave type hood inner is shown .We can observe the acceleration generated in the accelerometer of head foam is more for the Beam type compared to the wave type hood inner design.

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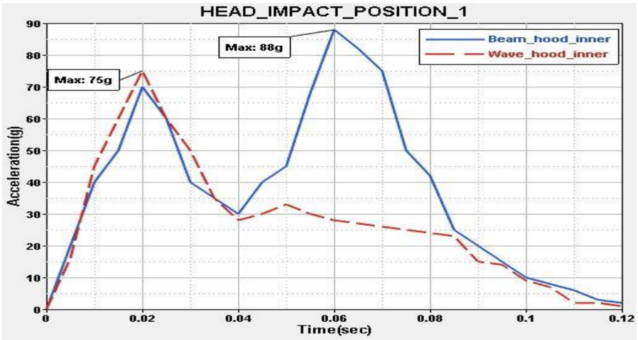

Figure 7 :Acceleration curves for position 1 for Beam and wave type hoodinnerpannel.

8.2 HEAD IMPACT POSITION 2

The below image of head impact for the position 2 for the different beam and wave type hood inner is shown Below.

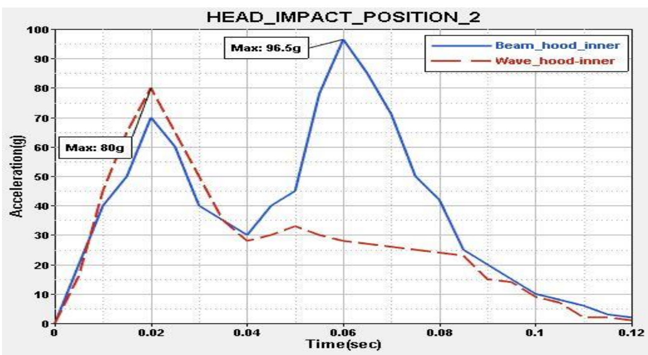

Figure 8 :Acceleration curves for position 2 for Beam and wave type hoodinnnerpannel.

8.3 HIC CALCULATION AND PLOTTING CURVES

The head impact criterion (HIC) valu is calculated by using the acceleration vs Tie graph obtained from the binout files from the lsdyna solver and the post processor used for the calculation of the hic value isHypergraph.

The generalcriteria for the validation and passing the hic for the head impact is the HIC value obtainedshouldbelessthan the 1000.

8.3.1 HIC CURVE FOR POSITION 1

The hic curves obtained for position 1 for both the design varients shows the hic valu ishigher for the beam type hoodinnerpanel ,whichis 1153 which is above the acceptance criteria of the test and for wave type is 613.23

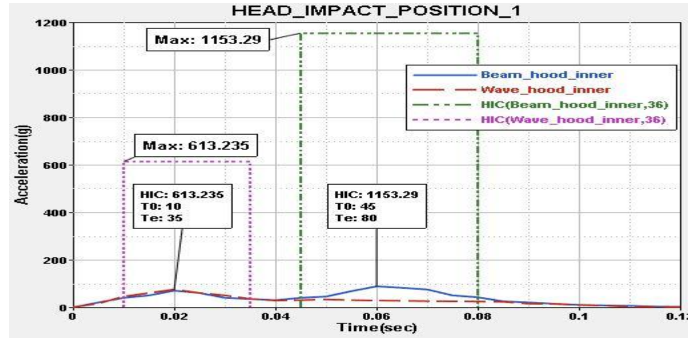

Figure 9 :HIC curves for position 1 for Beam and wave type hoodinnnerpannel.

8.3.2 HIC CURVE FOR POSITION 2

The hic curves obtained for position 2 for both the design varients shows the hic valu ishigher for the beam type hood innerpanel ,whichis 1268 which is above the acceptance criteria of the test and for wave type is 697.13

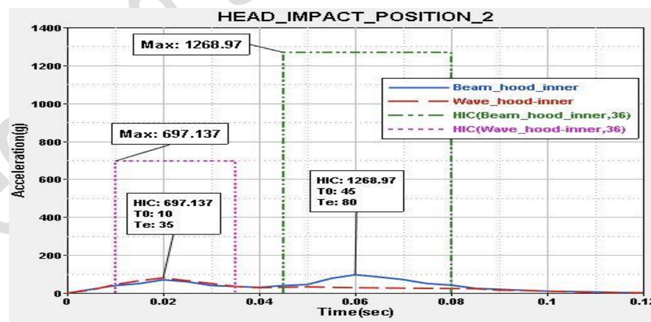

Figure 10 : HIC curves for position 2 for Beam and wave type hoodinnnerpannel.

Table 1 : Comparission of all iterations

Head Impact Positon	Hood Inner Design	Acceleration(g)	HIC Value
1	Beam Type	88g	1153.29
	Wave Type	75g	613.23
2	Beam Type	96.5g	1268.97
	Wave Type	80g	697.13

By comparring the hic values for both the positions ,we can observe that the position 1 is safe and is having the less hic value generated during the head impact .

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9. CONCLUSION AND DISCUSSION

This project work mainly deals with providing the measures to reduce the HIC values by changing the hood inner panel design by two standard designs of wave type and beamtype.By observing the itterations done in this project wecan concluded that the waveype of hoodinner panel is most suitable type of design as it reduces the injurylevel for the headfoam as the HIC generated in this wave type hood panel is below the critical value of HIC 1000.

Many other more measures to reduceteh HIC vauescanalsobeoptedlike, providing airbags near the hood cowl assembly which activates by sensing the sudden deceleration in the car during the event of impact with pedestrain ,but this method requires more cost investment and increases the cost of the vehicle.

Thus by changing the inner hood panel or the position of the engine assembly can create space between the headfoam and engine parts which in turn increase the impact response time and increases the enrgy absorption and helps in reduction of HIC values.

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