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DESIGN AND FEA ANALYSIS OF BUMPER USING HONEYCOMB STRUCTURE

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ABSTRACT

In this thesis, analysis is to be done for the bumper used for Ford Endeavor according to regulations and also by increasing the speeds. Simulation using Finite Element Analysis software, which is ansys, is to be conducted. The present used material for bumper is plastic. In this thesis analysis is to be done by replacing the bumper material with Polypropylene Honeycomb structure and Aluminum Honeycomb structure. Impact analysis is to be done by varying the speeds.

INTRODUCTION TO BUMPER OF A CAR

An automobile's bumper is the front-most or rear-most part, ostensibly designed to allow the car to sustain a STRUCTURAL without damage to the vehicle's safety systems. They are not capable of reducing injury to vehicle occupants in high-speed STRUCTURALs, but are increasingly being designed to mitigate injury to pedestrians struck by cars.

MATERIALS USED FOR BUMPER

At one time, most car bumpers were made of steel. Then, most were made of chrome or a chrome-plated material. Today, car bumpers can be made from anything from chrome-plated material to a variety of different rubber materials or plastics. This makes detailing car bumpers somewhat more complicated, as bumpers made from different materials require very different detailing treatments. For the purposes of this article, we will assume that your car bumper is chrome-plated. Detailing a chrome-plated bumper requires a bit of patience and a light sanding touch, but it is certainly something that even the most casual car owner can accomplish in a day or less. The primary enemy of chrome-plated bumpers is oxidation (rust). The longer you allow rust spots to remain on your bumper, the more difficult the detailing process is going to be.

Bumpers on most new cars are color-coordinated plastic "wrappers," molded sleekly around the front and back ends of the vehicles. They may please the eye, but whether these bumpers protect the vehicle they surround from damage in low-speed STRUCTURALs is another matter.

LITERATURE SURVEY

PAPER1 - DESIGN IMPROVEMENT IN FRONT BUMPER OF A PASSENGER CAR USING STRUCTURAL ANALYSIS - A REVIEW by Nitin S Motgi, P.R.Kulkarni & Sheelratan S Bansode

Car accidents are happening every day. We must take into account the statistics – ten thousand dead and hundreds of thousands to million wounded each year.

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These numbers call for the necessity to improve the safety of automobiles during accidents. Automotive bumper system is one of the key systems in passenger cars which help to protect the vehicle during STRUCTURALs. The following paper deals with the design improvements in the front bumper of passenger cars in
India, using STRUCTURAL analysis. The modification will be made considering size, shape and material.

PAPER2 - Effect of the Composite Material of the Car's Bumper on its Fundamental Natural Frequency and Response as A Result of Car Vibration by Ruaa Yaseen Hammoudi

Effect of vibration on the car's bumper was studied in this paper. Composite materials are used in manufacturing the car's bumper. The methods that used in this investigation are Rayleigh' s formula for lumped masses in addition to super position method and the mixture rule. By using these techniques it can be found the natural frequencies, mode shapes and deflection for the car' s bumper. Different matrix material (resin), fibers and volume fraction are used in this investigation. MATLAB program are built in this study. The results of this program are compared with the results of the ANSYS 11 program.

The comparisons show good agreement.

PAPER 3 - STRUCTURAL Experimental Analysis and Computer Simulation by Yucheng Liu,

In this paper, an automotive bumper system (a bumper connected to a frame through joints/connections) is set up for small STRUCTURAL tests (nondestructive tests). During the tests, a steel bar is raised to certain highs then released from there and hit onto the bumper system, the bumper system is fixed to the ground through fully constraining the end of two shocks, the reaction forces at the end of shocks during the whole STRUCTURAL process are measured and investigated in order to determine how they are transferred to the joints then to the rest part of the frame. Also, other important experimental data are collected and studied to reflect the actual STRUCTURAL process. A finite element model is created for the automotive bumper system and the STRUCTURAL test is also simulated on the computer using ANSYS. The results from the experimental tests are compared and correlated to the finite element simulation. From the comparison, it is found that the experiment results and FEA results matches very well and the validity of the computer model is then verified. Additionally, this paper also includes a hand calculation of the STRUCTURAL problem, where the bumper system is modeled as a simple spring-damping system and solved using classical dynamic theory; the hand solutions are also compared to the experimental results and the FEA results to verify the correctness and reliability of the STRUCTURAL tests and computer simulation.

PAPER 4 - Research on the Crash Safety of the Car Bumper Base on the Different Standards by Q.H. Ma, C.Y. Zhang, S. Y. Han and Z.T. Qin

The bumper is an important part of a vehicle safety performance evaluation. In this paper, a domestic A-class car bumper as the object of study.CAE model was established by using HyperMesh software, and the finite element method is applied to solve the calculation of the model. The bumper were studied in C-NCAP and E.C.E R42 two different standards. The bumper is optimized by changing the structure size of the way. Appropriate to increase the thickness of the metal bar bumper can improve its safety performance, while its weight changed little.

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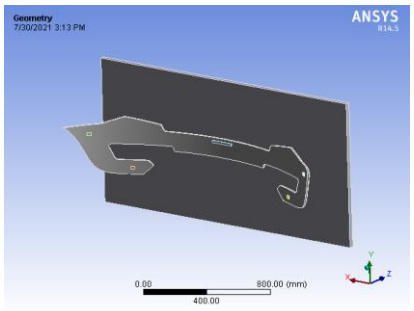
MODEL 1

STRUCTURAL ANALYSIS OF A BUMPER HAVING 70Km/hr SPEED BY USING ABS PLASTIC

GEOMETRY



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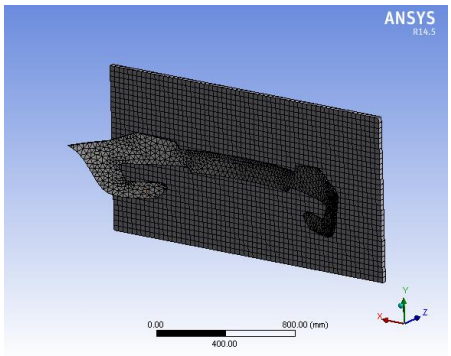
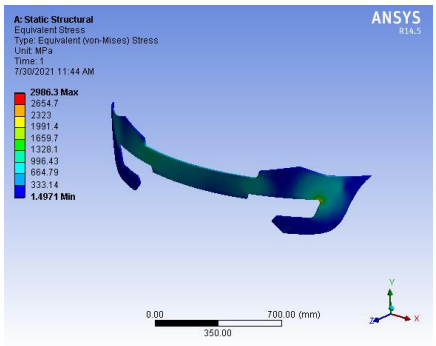
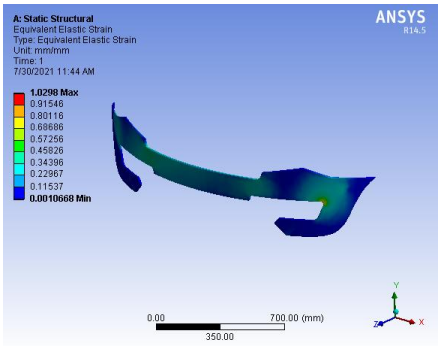


STRESS



STRAIN



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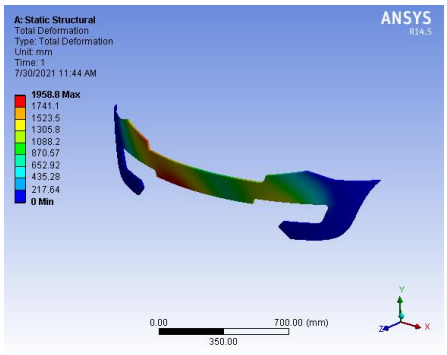
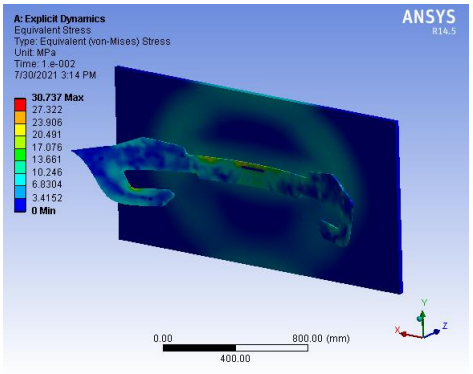


IMPACT RESULTS

STRESS



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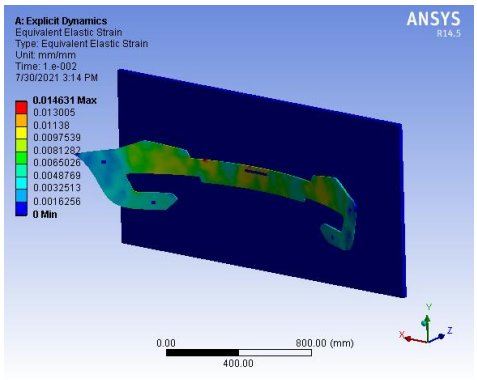

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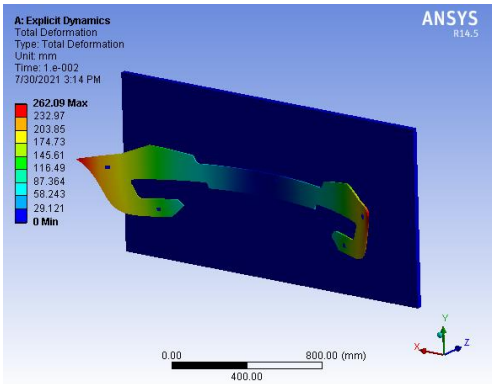

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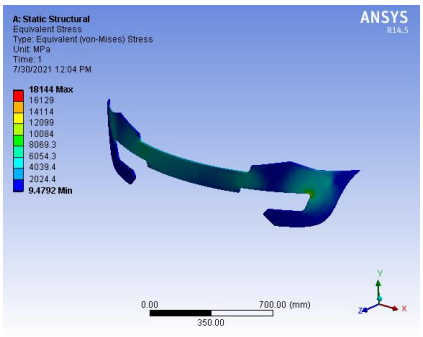
STRUCTURAL ANALYSIS OF A BUMPER HAVING 170Km/hr SPEED BY USING AL 1100

STRESS



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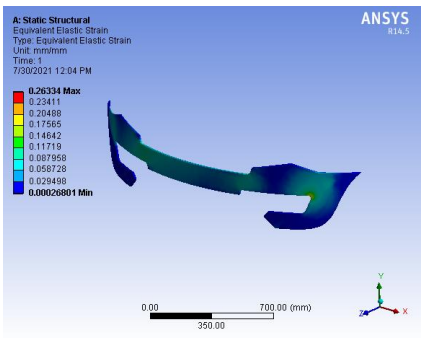

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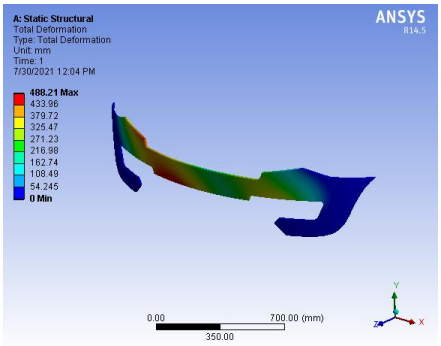

IMPACT ANALYSIS RESULTS

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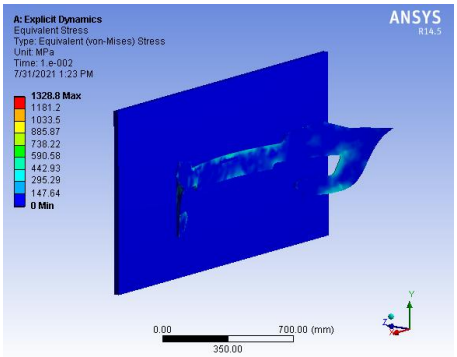

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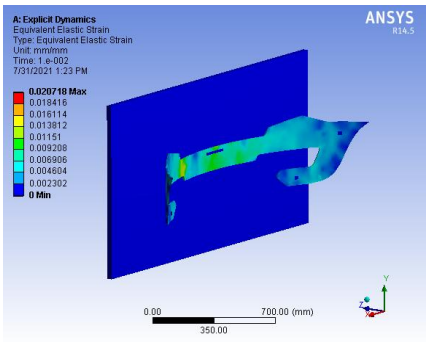

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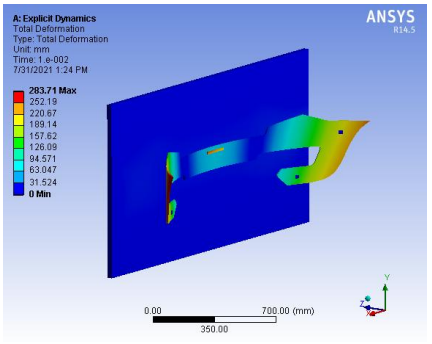
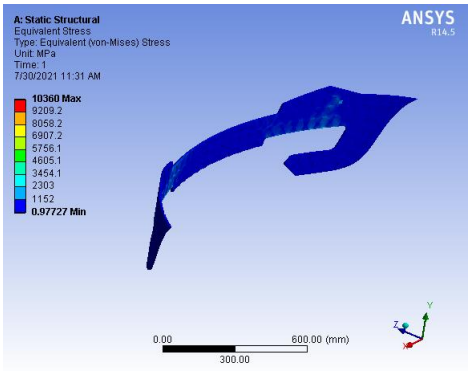


STRUCTURAL ANALYSIS OF A BUMPER HAVING 70Km/hr SPEED BY USING POLYETHERIMIDE

STRESS



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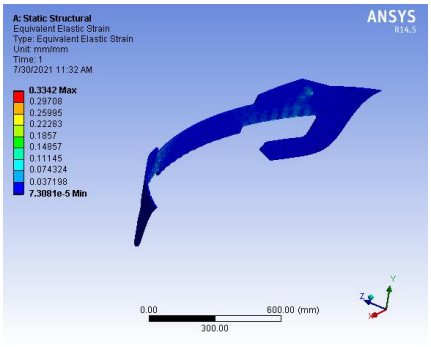

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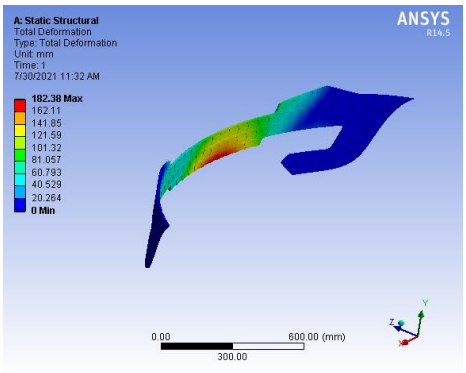
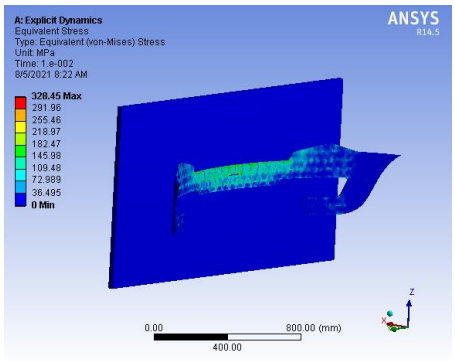


IMPACT ANALYSIS RESULTS

STRESS



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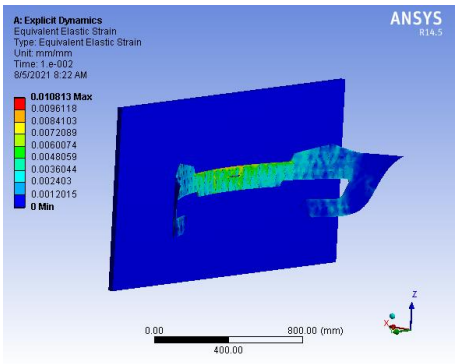

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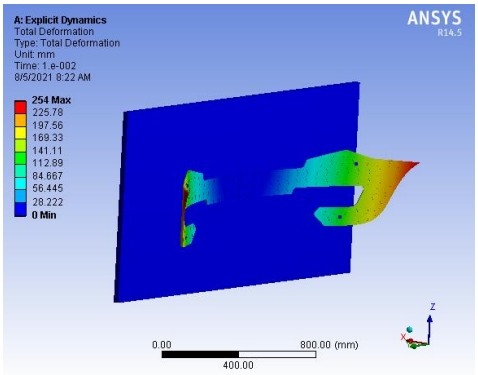

RESULTS AND DISCUSSION

TABLES

STRUCTURAL ANALYSIS

MODEL	SPEED (kmph)	MATERIAL	STRESS (MPa)	STRAIN (mm/mm)	TOTAL DEFORMATION (mm)
MODEL 1	70	ABS PLASTIC	2986.3	1.0298	1958.8
		AL 1100	3075.2	0.044633	82.746
		POLYETHERIMIDE	2986.3	0.096332	183.24
	170	ABS PLASTIC	17619	6.0757	11557
		AL 1100	18144	0.26334	488.21
		POLYETHERIMIDE	17619	0.56837	1081.1
MODEL 2	70	ABS PLASTIC	10360	3.5725	1949.6
		AL 1100	10554	0.15317	82.325
		POLYETHERIMIDE	10360	0.3342	182.38
	170	ABS PLASTIC	61126	21.078	11503
		AL 1100	62267	0.90373	485.72
		POLYETHERIMIDE	61126	1.9718	1076

IMPACT ANALYSIS

MODEL	SPEED (kmph)	MATERIAL	STRESS (MPa)	STRAIN (mm/mm)	TOTAL DEFORMATION (mm)
MODEL 1	70	ABS PLASTIC	30.737	0.014631	262.09
		AL 1100	840.53	0.012672	258.87
		POLYETHERIMIDE	286.02	0.0099588	271.08
	170	ABS PLASTIC	1132.2	0.40464	318.76
		AL 1100	1328.8	0.020718	283.71
		POLYETHERIMIDE	672.74	0.023397	344.13
MODEL 2	70	ABS PLASTIC	51.012	0.017831	241.61
		AL 1100	702.59	0.010417	245.84
		POLYETHERIMIDE	328.45	0.010813	254
	170	ABS PLASTIC	288	0.9785	339.1
		AL 1100	1324.9	0.019963	365.98
		POLYETHERIMIDE	907.26	0.029737	319.1

CONCLUSION

In this thesis, design of a bumper used for Ford Endeavor is modified with honeycomb structure and analyzed for its strength. The original and modified models are designed in Catia and Simulation using Finite Element Analysis software, which is ANSYS is conducted.

The present used material for bumper is steel. In this thesis analysis is to be done by replacing the bumper material with Kevlar. Impact analysis is done by varying the speeds 70Km/hr, and 170Km/hr.

By observing the analysis results for ABS

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Plastic, for original model, the displacement is almost same when compared with the modified model and stresses are more for modified model than original model. But while we compare with respect to the materials here the al 1100 and the polyetherimide materials obtained the best outputs in terms of deformation and a slight increase in stress also obtained.

By observing the analysis results for impact test, here the stress is very less for the abs plastic and same for original and modified model. But when we compare for the deformations here the abs plastic is less for the lower speeds while in the higher speeds the impact is less for the al 1100 and polyetherimide materials.

As here in the graphical results the abs plastic stress is exceeded the yield limit at higher speeds for the original model, so here we can observe the modified model has obtained the lesser stress and below the limit for the abs material, as if we compare the results of al 1100 and polyetherimide the modified model has observed the better results than the original model in all terms when compared. .

It can be concluded that the modified model is better with use of polyetherimide at speeds of 70Km/hr and even at the highest speed 170Km/hr.

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