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RESEARCH ARTICLE OPEN ACCESS

FE Analysis on Car Bumper Using Spring

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Abstract:

A bumper is a mechanical part which is attached to vehicle from front and rear end and it's used for absorb impact on vehicle. So design of bumper in such way that is absorbs impact (Purpose of Safety). Bumper is made from steel, aluminium and many more. Bumper is important part and it is connected to directly to chassis so there is no linkage to drop that impact force, But in this paper we proposed new bumper with spring to absorb that impact force. Spring is used to absorb impact energy. A new bumper is designed in AutoCAD 3d and structural analysis is done in ANSYS Workbench. For structural analysis steel and aluminium is used.

Keywords — **Bumper, Impact Force, AutoCAD 3D, ANSYS, Steel, Aluminium.**

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I. INTRODUCTION

A bumper is the structure connected to vehicle from front and rear side .the purpose of bumper is to absorb impact force in collision to minimize service cost So design of bumper with economic and safety have been great challenge. And the safety of passengeris important so used right bumper is necessary. So bumper is places in such way that after collision it goes towards chassis and minimizes impact on vehicle. Material used for bumper is steel, aluminium and many others. At the time of design several factor considered the material, ability to absorb shocks, weight, Manufacturing Process Ability. Now a day's bumper is connected to directly chassis so there is no mechanism to absorb energy so design of new bumper is necessary to absorb that energy. So the designed spring bumper in which spring is used to break that linkage that is necessary to absorb energy and it does not allow transfer that energy as possible as to other part of vehicle.

IILITERATURE REVIEW

G.Ravikumar Reddy, M.Suneetha [1] designed a bumper using spring to absorb impact forces. In this paper, materials material used are GMT, carbon fibre composite and aluminium B390 materials are used. The bumpers with springs and without spring's analysis are done. The stresses, deformation and frequencies are calculated at different speeds. Frequency is less for GMT material and deformation is high as compare to other.

Maheshkumar V. Dange1, Dr. Rajesh al. [2] has studied at the time bumper beam design use material having high yield strength and high modulus of elasticity. Plastic deformation avoided at the time designed. Material M220 is best material for bumper beam.

Dharmateja Kruthiventi and M. Venkaiah [3] has studied Modelling of a car bumper is done using 3D software. Impact forces analyzed on bumper for different speeds.. At present material used for bumper is steel. Density of ABS Plastic, Polyetherimide, s2 glass and glass fibre composes is less compare to steel. By observing stress value is less for s2 glass than other material

Bilal Abdullah Baig and Hakimuddin. A. Hussain[4] has studiedfrom the literature it can be stated that bumper is an important part of an automobile. Thus the analysis of bumper will help to increase safety.

III METHODOLOGY

A.Material Selection

Bumper Material: A bumper is used for absorbing shock or impact when accidental hitting. Material should have high capability of absorb the impact either reduce effect of strike. So the bumper are manufactured by using conventional material like steel .To reduce weight alloy are used.

TABLE I
PROPERTIES OF MATERIAL

SR	Material	P kg/m^3	V	UTS (MPA)	E (GPA)
1	Steel	7750	0.27	510	190
2	Aluminum	2710	0.33	180	70

B. Problem Definition

Force Calculation for Bumper

Here considered Mahindra Thar Bumper for design i.e., bumper drawings and load purpose.

Mass of car =1703

Mass of two passengers = 150kg i.e., 75kg each=150kg

Total Mass of vehicle in motion

m = 1703 +150

m = 1853 kg

Hence

F=m * a

a - Acceleration in m/s2 a = v- final velocity (m/s); u- initial velocity (m/s); t- time (s)

Assumptions: 1. Initial Velocity = 0 m/s 2. Time = 1 s

Case 1 For V = 50kmph v= 13.5m/s

a= 0-13.5/1

a = 13.5 m/s^2

F= m×a

F=1853 x 13.5

F=25015.5 N

F =25015 N

Case 2 for v=90kmph

v=24.3m/s

a=0-24.3/1 a=24.3 m/s^2

F=m×a

F= 1853×24.3

F=45027.9

F=45027N

IV MODELING

AutoCAD is used for bumper designed. It is computer aided design and drafting software and it is used to create precise 2D and 3D drawing. Here modelled Bumper For analysis is bumper without spring or Bumper with spring attachment.

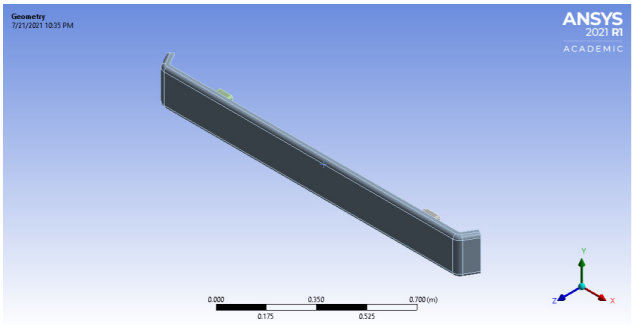

Fig. 1Bumper withoutspring

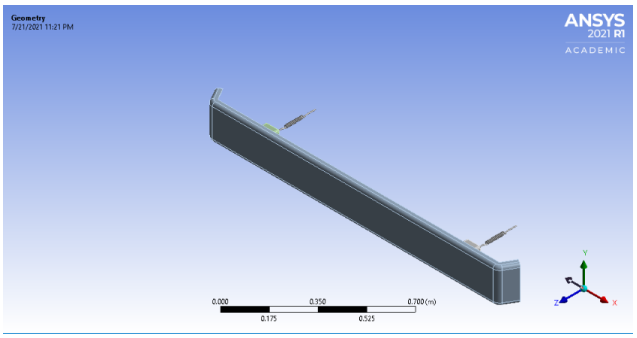

Fig.2 Bumper with spring

V ANALYSIS

A. Introduction to ANSYS

ANSYS is a finite element analysis software.it is a numerical method of deconstructing a complex system into very small pieces. This result can be presented in tabulated or graphical form

B. Structural Analysis

Structural Analysis involves determining behaviour of material when it is subjected to load. In this structural analysis

done at different speed like 50km/hr., 90km/hr. and different material like steel and aluminium B390 respectively

1 Bumper without spring:

STEEL

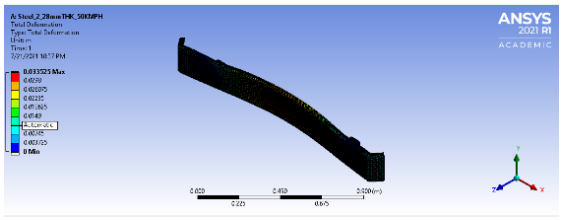

Fig.3 Total Deformation at 50km/hr.

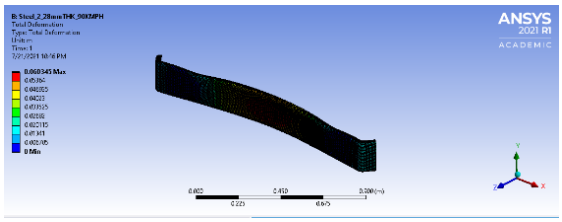

Fig. 4 Total Deformation at 90km/hr.

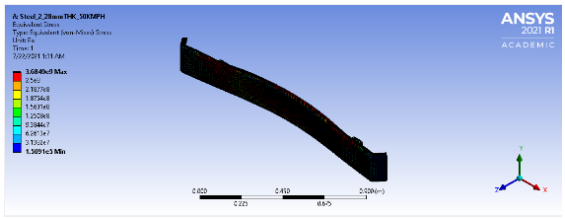

Fig. 5 Equivalent Stress at 50km/hr.

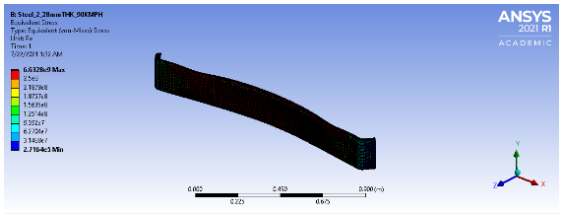

Fig. 6 Equivalent Stress at 90km/hr.

Similarly Structural analysis For Bumper without spring for Aluminium B390 material and speed like 50,90km/hr. done respectively. The comparison result shown in in tabular column in result.

2 Bumper with spring

STEEL

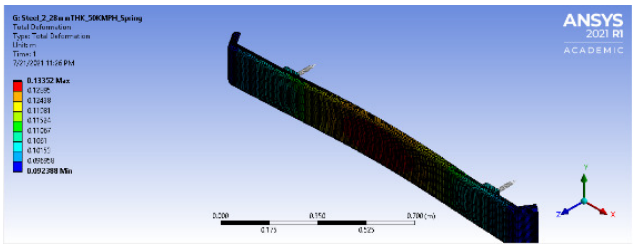

Fig.7Total Deformation at 50km/hr.

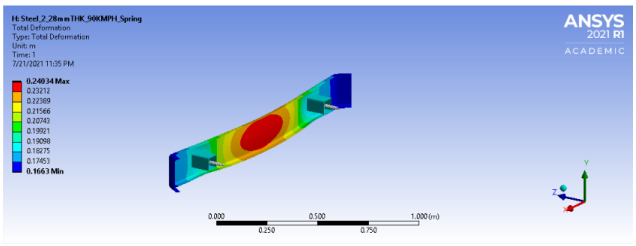

Fig . 8 Total Deformation at 90km/hr.

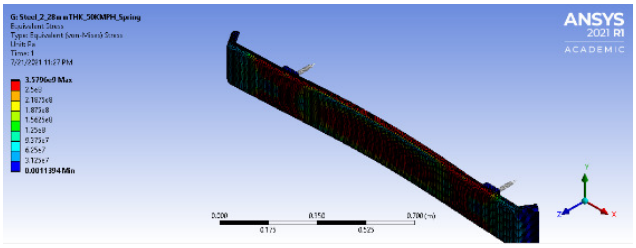

Fig.9Equivalent Stress at 50km/hr.

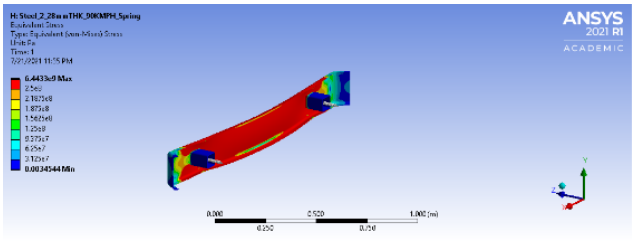

Fig.10 Equivalent Stress at 90km/hr.

Similarly Structural analysis For Bumper with spring for Aluminium B390 material and speed like 50,90km/hr. done respectively. The comparison result shown in in tabular column in result.

C. Modal Analysis

A modal analysis is used to determine the vibration of a structure while it is being design.

1. Bumper without spring

STEEL

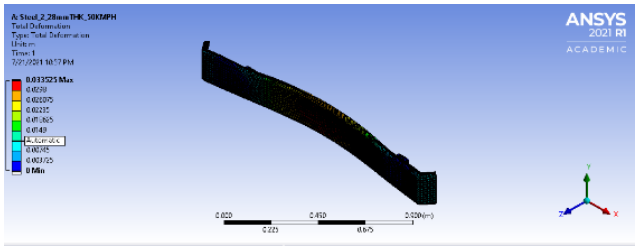

Fig.11Total Deformation at node 1

ALUMINIUM B390

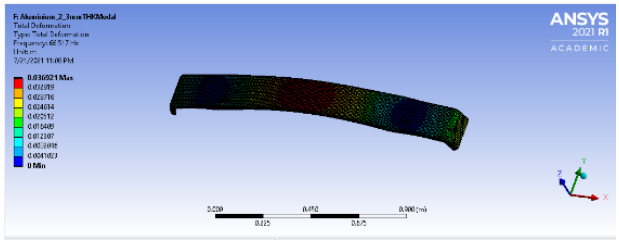

Fig.12Total Deformation at node 1

Similarly modal analysis for bumper without spring steel Aluminium B390 is done at different nodes. The comparison and deformation are done.

2 Bumper with spring

STEEL

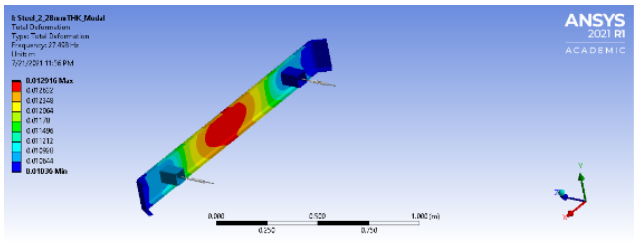

Fig.13 Total Deformation at node 1

ALUMINUM B390

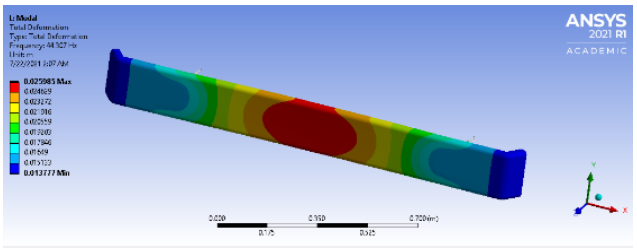

Fig.14Total Deformation at node 1

Similarly modal analysis for bumper without spring steel Aluminium B390 is done at different nodes. The comparison and deformation are done.

VI RESULTS

Analysis of bumper with spring or without spring is done in structural analysis and modal analysis at different speed and on different material.

TABLE II.

COMPARISON OF STRUCTURAL ANALYSIS BUMPER WITHOUT SPRING

Material	Speed	Deformation(m)	Equivalent Stress
Steel	50	0.033	3.684
	90	0.060	6.632
Aluminium B390	50	0.080	3.73
	90	0.144	6.72

Table III

Comparison of Structural Analysis bumper with spring

Material	Speed	Deformation	Equivalent Stress
Steel	50	0.133	3.57
	90	0.24	6.44
Aluminium B390	50	0.17	3.64
	90	0.32	6.56

TABLE IV
COMPARISON OF MODAL ANALYSIS OF BUMPER WITHOUT SPRING

Material	Node	Frequncy(HZ)	Deformation(m)
Steel	1	60.97	0.021
	2	80.84	0.031
	3	116.29	0.034
	4	123.27	0.031
	5	126.87	0.054
	6	133.26	0.047
Aluminium B390	1	66.51	0.036
	2	87.81	0.053
	3	127.27	0.059
	4	135.23	0.053
	5	138.71	0.081
	6	146.13	0.080

TABLE V
COMPARISON OF MODAL ANALYSIS OF BUMPER WITH SPRING

Material	Node	Frequncy(HZ)	Deformation(m)
Steel	1	27.49	0.012
	2	33.07	0.018
	3	69.49	0.023
	4	85.06	0.031
	5	133.29	0.053
	6	137.3	0.048
Aluminium B390	1	44.30	0.025
	2	52.34	0.034
	3	77.71	0.042
	4	92.43	0.053
	5	145.93	0.090
	6	150.58	0.081

VII CONCLUSION

Bumper is important automobile part from the passenger safety point of view. The bumper With Spring and without spring is designed and analyzed.The Stresses, deformation, frequency are determined at different speed stresses and deformation is less in Bumper with spring as compared to Bumper without spring. In Modal Analysis frequency and deformation is less of Bumper with spring as compared to Bumper without spring.

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