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Design of Bumper as a Collision Energy Absorbing System

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ABSTRACT : In a vehicle Bumper is the front most or rears most Part and designed to allow car to sustain an impact without damage to the vehicle's safety systems. It is increasingly being designed to minimise the flow of collision energy struck by cars. In this paper I worked to minimises the flow of energy by making some modification with the front bumper of the car. Results are carried out on the basis of collision test. These tests are performing on the software (Auto desk).These tests are performing with the normal bumper and the modified bumper. The results are correlated to find out the flow or distribution of the energy at the time of front end collision of the vehicle.

Key Words-Bumper, Collision Energy, Auto desk, Impact

I. INTRODUCTION

Accident studies indicate that a number of fatalities and serious injuries are caused by serious weaknesses of the weak bumper design. A bumper is design or fabricated to absorb the impact energy at the time of collision.

But now days, the styling of the bumper has become more important than the structural design of the bumper. Nevertheless, the standards and regulations governing the design of the bumper should not be compromised in any circumstances. The same goes for the correct selection of the bumper material. Any attempt to by-pass the standards of regulations and material selection would badly affect the structural integrity as it would be next to impossible to provide protection neither to the vehicle body nor the occupant during a crash. In this paper bumper is modified with the energy absorber to protecting occupants or reducing vehicle damage during a crash. Although the primary function of the vehicle body structure in this respect is to dissipate the kinetic energy of the vehicle, effective protection depends upon careful management of this energy in order to achieve the optimum collapse mechanism.

II. PREVIOUS RESEARCH

Many researchers have been experimented on the given title. Gintautas Dundulis et al. [1], Static analytical and experimental research of shock absorber to safe guard the nuclear fuel assemblies. C. Ferreira et al. [2], a novel monolithic silicon sensor for measuring acceleration, pressure and temperature on a shock absorber. Shinichi Nishizawa and Tadashi Sakai [3], Reverse Engineering Based Coil Spring Design Method. Ping Yang et al. [4], Design, test and modeling evaluation approach of a novel Si-oil shock absorber for protection of electronic equipment in moving vehicles. Alessandro Beghi et al. [5], Grey-box modeling of a motorcycle shock absorber for virtual prototyping applications. A.K. Samantaray [6], Modeling and analysis of preloaded liquid spring/damper shock absorbers. J.M. Gallardo et al. [7], Investigation of service failures in automobile shock absorbers. Choon-Tae Lee et al. [8], Simulation and experimental validation of vehicle dynamic characteristics for displacement-sensitive shock absorber using fluid-flow modelling. Yang Ping et al. [9], Measurement, simulation on dynamic characteristics of a wire gauze–fluid damping shock absorber. T. Pranoto and K. Nagaya [10], Development on 2DOF-type and Rotary-type shock absorber damper using MRF and their efficiencies.

III. RELATED WOKS

A buffer is a part of the Railways of many countries, among them most of those in Europe, for attaching railway vehicles to one another. Fitted at the ends of the vehicle frames, one at each corner, the buffers are projecting, shock-absorbing pads which, when vehicles are coupled, are brought into contact with those on the next vehicle. Buffers also used in the elevators for to provide soft suspension at the time of ground landing.

IV. DATA COLLECTION AND EXPERIMENTATION

For better experimentation of work Vehicle frame is designed by the help of Autodesk software. After the design work experimentation is carried out by the help of simulation process to analysis the stress, strain behaviour of the frame under The Application of forces.

A. Von misses diagram

The "Von Misses stresses" is given by FEA program. This is generally accepted as being the best "theory of failure" for ductile materials.

B. First Principal stress

The 1st principal stress gives you the value of stress that is normal to the plane in which the shear stress is zero. The 1st principal stress helps you understand the maximum tensile stress induced in the part due to the loading conditions.

C. Third Principal stress

The 3rd principal stress is acting normal to the plane in which shear stress is zero. It helps you understand the maximum compressive stress induced in the part due to the loading conditions

First simulation is done with ordinary frame of the vehicle and find out the rate of failure under the application of load. Input values are given in the following tables.

Table1. Load type and Force

Load type	Force
Magnitude	11240.450 lb force
Vector X	11240.450 lb force
Vector Y	0.000 lb force
Vector Z	0.000 lb force

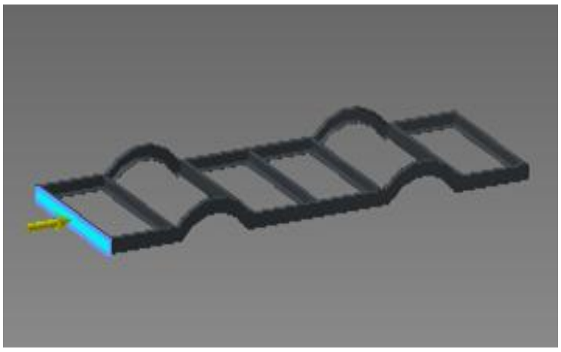

Fig.1 Design of ordinary frame

Table2. Properties of Grey Iron

Mass density	0.25831 lb mass/in³
Yield Strength	29027.6 psi
Young's modulus	13062.4 ksi

Table3. Result Summary

Name	Minimum	Maximum
Volume	1485.2 in³	
Mass	383.643 lb mass	
Von misses stress	0.00000612577 ksi	235.614 ksi

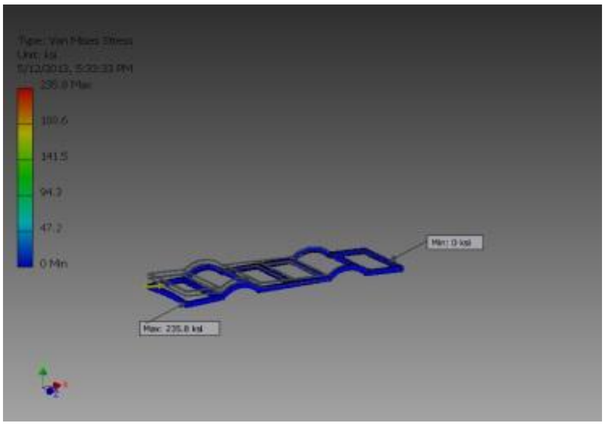

Fig.2 Von misses diagram of ordinary frame

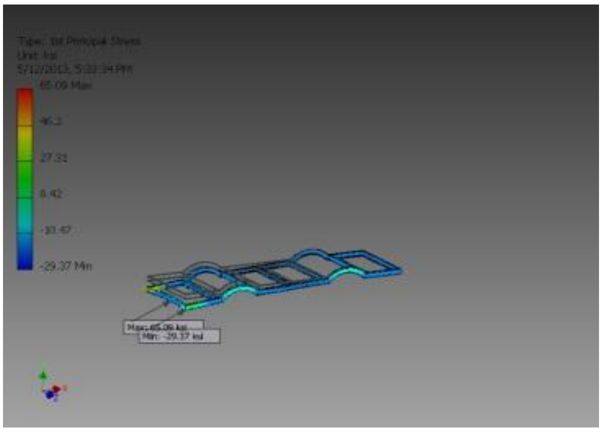

Fig.3 First principal stress diagram of ordinary frame

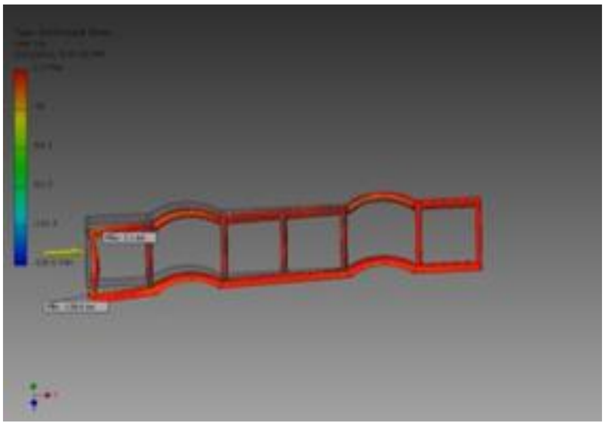

Fig.4 Third principal stress diagram of ordinary frame

Second simulation is done with modified frame of the vehicle and find out the rate of failure under the application of load. Input values are given in the following tables.

Table4. Load type and force

Load type	Force
Magnitude	5648.990 lb force
Vector X	5648.990 lb force
Vector Y	0.0 lb force
Vector Z	0.0 lb force

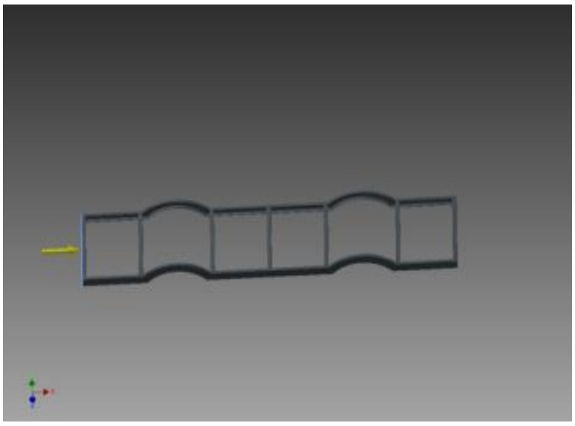

Fig.5 Design of modified frame

Table5. Result Summary

Reaction force Reaction Moment

Constraint Name	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)
Fixed Constraint:1	5648.99 lb force	-5648.99 lb force	35.6049 lb force ft.	0 lb force ft.
		0 lb force		0 lb force ft.

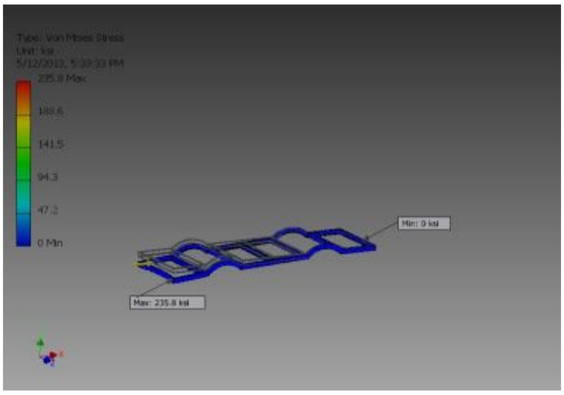

Fig.6 Von misses diagram of modified frame

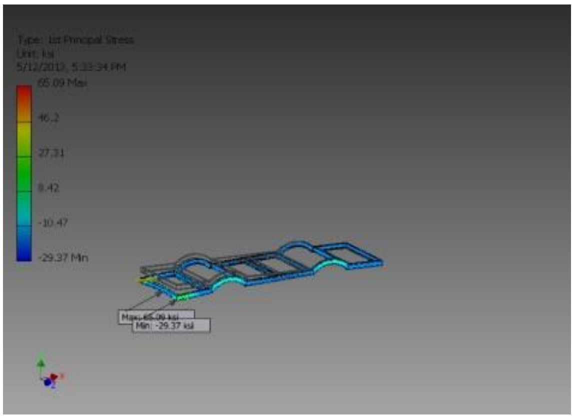

Fig.7 First principal stress diagram of modified frame

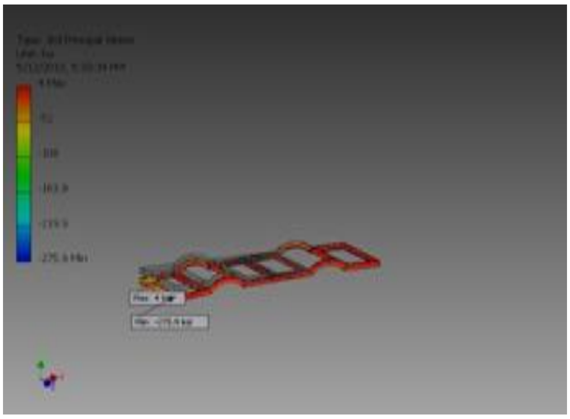

Fig.8 Third principal stress diagram of modified frame

V. RESULTS AND DISCUSSIONS

From the FAE simulation result of impact testing we can improve the load absorption rate of the frame. In simple frame we applied the load of 11240.450 lb force and the results are given below

Table6. Results for ordinary frame

Applied load	Von misses stress	1st principal stress	3rd principal stress
11240.450 lb force	118.4 max	32.71 max	2.1 max

Table7. Results for modified frame

Applied load	Von misses stress	1st principal stress	3rd principal stress
11240.450 lb force	235.8 max	65.09 max	4 max

VI. CONCLUSIONS

According to the above mentioned stress diagrams and data of ordinary and modified frame we correlate the values for both of the respected frames then it can be concluded that load bearing capacity at the time of impact is increased by little modification. Shock absorber at the front of frame improves the safety of the vehicle as well as occupants inside the vehicle.

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