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A REVIEW DESIGN AND ANALYSIS OF BUMPER BEAM SYSTEM IN LOW SPEED FRONTAL IMPACT

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ABSTRACT:

Bumpers are structural components installed to reduce physical damage to the front and rear ends of a light/heavy motor vehicle from low-speed collisions. Damage and protection assessments are the commonly used design criteria in bumper design. For damage assessment, the relative displacements representing stiffness performance are examined and crash test will be done. The purpose of a crash analysis is to see how the car will behave in a frontal or rear collision. In this study impacts and collisions involving a car bumper beam model are simulated and analyzed using Ls-Dyna software. The bumper should support the mechanical components and the body. It must also withstand static and dynamic loads without undue deflection or distortion. The given model is tested under frontal collision conditions and the resultant deformation and von-Misses stresses are determined. The crash analysis simulation and results can be used to assess both the crashworthiness of current bumper and to investigate the ways to improve the design. Different cross section designs used to determine the performance of the bumper beam in crash test. The comparison of baseline design (C-section) with modified cross section designs of bumper beam are presented in the study. The suitable cross section is then suggested to improve the stiffness and crashworthiness of the beam. This type of study methods are an integral part of the design cycle and can reduce the need for costly destructive testing program.

KEYWORDS: Bumper, LS-dyna, CATIA, Hypermesh.

I. INTRODUCTION:

In recent days, in development of technology mostly in engineering field the engineers more creative and innovative in designing or creating new product. They always accurate and showing best result by implementing the desired product in this stratergy the engineer always leads to automobile sector in recent automotive vehicle model have a short zone for crash energy absorption one of the reason to reducing energy consume by reduce the weight. so, the designer should be know that in order to minimize the weight, the safety of the car passenger must not be ignore. A new idea in technology material was refer polymeric based composite materials, which gives the high stiffness so, its have low weight and corrosion resistive property, and it has ability to produce complex shapes, high specific strength, and high impact energy absorption.

Adding polymeric based composite material in car components was successfully implemented for reducing the fuel and weight . The components in the automobile industry by polymeric based composite materials are the bumper beam, bumper fascia, spoiler, connecting rod, pedal box system, and door inner panel. The car bumper consists of three main element there are bumper beam, bumper fascia and energy absorber. The automotive body is critical system in automobile, and it having different function functions. It should clamp the part together it reducing the vibration and noise. So, it should protect its acessories when accidents happen. To do this designer should modify a different structure with specific levels of strength, stiffness, and energy absorption. The rate of vehicle accidents are increases when number of vehicle coming in to the road. In many country rate of accident are same. It is calculated that 1.2 million people are killed in road accident and nearly 50 million are injured in every year. This minimized of road safety research is to reduce the instant and improve the traffic of road . On this effect reduce the impact at medium speeds (40 km/h to 56 km/h)considering rolling impact the design criteria should be improved . The automotive industry has always know that the competitor aware its design and material usage . The bumper is a structural component of an automotive vehicle which contributes to occupant protection during frontal impact and rear impact. The bumper of car protects the trunk, fuel, hood, cooling system and exhaust

as well as safety related equipments such as parking lights, head lamps and taillights, etc.

II. PROBLEM STATEMENT:

Bumper beam is one of the key structures in passenger cars for which careful design and manufacturing is necessary. From the previous research and analysis of bumper beam, basically they focus on material optimization and design. However, these analysis are carried out by focusing on stress analysis on car bumper by applying various loads on static condition only. In real situation, there is much point that bumper mounting to the car which make it stronger or can absorb more energy during impact. For simulation, just take fixed points at both ends. The only fascia part of the bumper will take into account. The stiffness of the bumper beam should be strong enough during low speed impact so that, the design should not get deformed more and induced stress in the beam should not beyond yield strength of material.

III. METHODOLOGY:

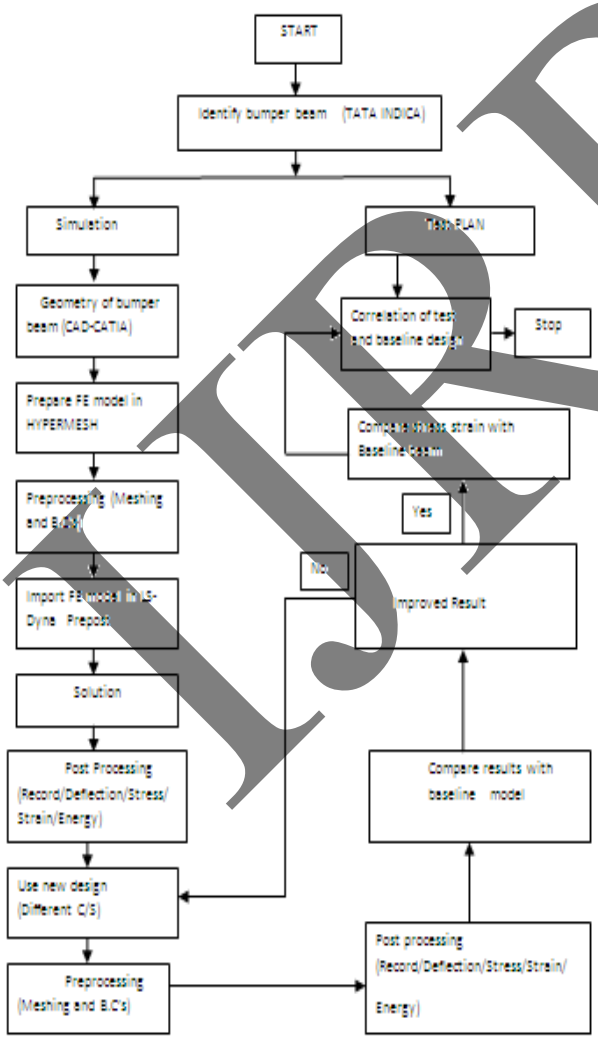

FIG 1: FLOW CHART

IV. OBJECTIVE:

The aim of this work is to study front bumper of one of the existing passenger car in Indian market (TATA INDICA) and suggest design Improvement in front bumper of a passenger car using Impact Analysis such that the following objective will be served.

- To model and Simulate the existing Car bumper beam for the impact at the centre of the beam.
- To use **different cross section designs** in simulation to generate design parameters for better impact attenuation bumpers.
- To Propose designs of a bumper beam that the impact energy of vehicles travelling at low speeds of 16 km/hr as per Standard FMVSS part 581 (Federal Motor Vehicle safety standard)
- To Compare the existing design of the bumper with different cross section designs and modify the crashworthiness.

LITERATURE REVIEW:

Javad Marzbanrad et.al, studied analysis of bumper with different material with low modulus of elasticity and thickness, shapes due to different impact condition in low velocity as per the standard of E.C.E. and using high strength of material effect on good behaviour due to impact and use the aluminium material due to adding the ribs the deflection are reduces.(1) **M.S.A. Samad et.al,** concluded the experimental fatigue life and fatigue strain of jounce bumper by using calcium carbonate with FEA software. (2) **M.M. Davoodi et.al,** Analysed impact property of composite material with different composite geometrical shapes and focussed on the composite material and resulted composite material has more potential to use automotive structural component.(3) **Yasuhiro Matsui et.al,** studied biomechanical experiments using foam material to the cross member it reducing the injury and determine the safety performance and they use the TRL impactor for safety of car .(4) **M.M. Davoodi, et.al,** Analysed the bumper beam with the different material for the impact test with low speed and high speed that design of bumper system specified with safety regulation it verify the comprehensive information to determine optimum design of bumper beam development that result can be help for performing functional analysis of the bumper beam determinant variable.(5) **L. Farkas et.al,** Studied crashworthiness of car bumper system find the optimal design using OPTIMUS software.(6)

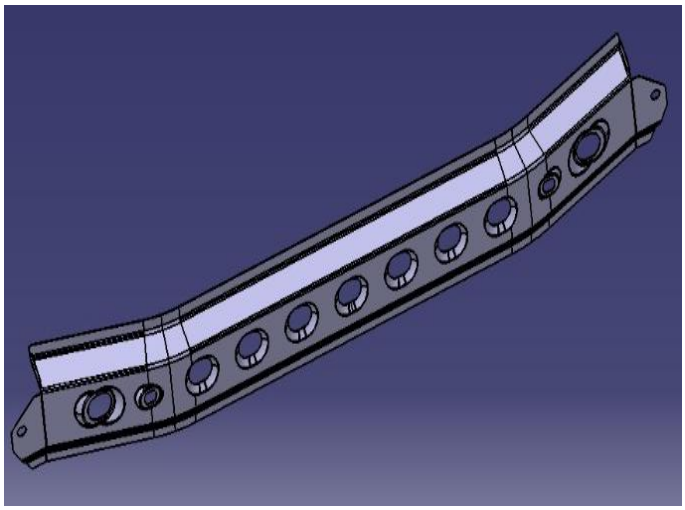

Fig : CAD model – Bumper beam system

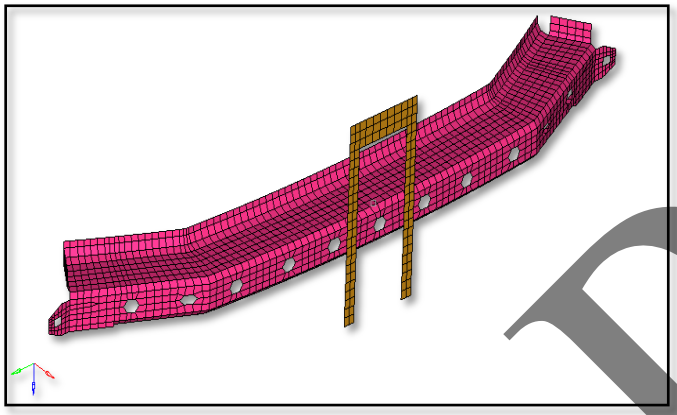

Fig.: Meshed model of bumper and Rigid wall

VI. RESULT AND DISCUSSIONS:

DISPLACEMENT RESULTS:

The effect of impact loading on bumper beam system is investigated by comparing the displacement between five different materials within model. The deflection contour plots are shown in the following pictures.

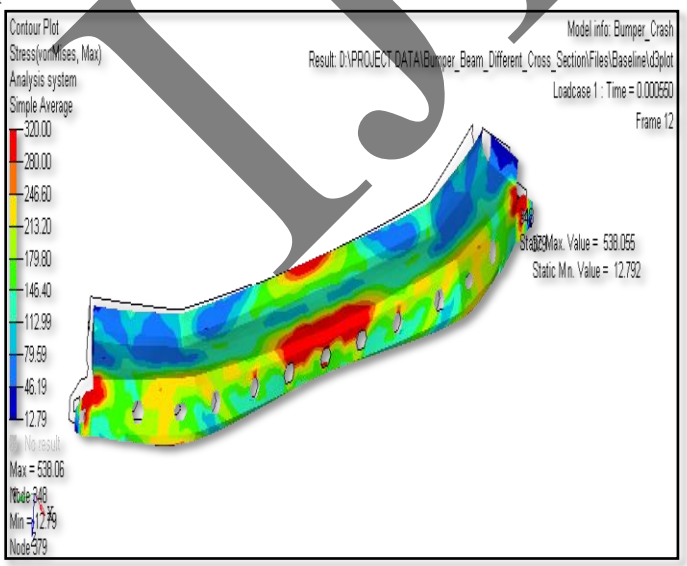

Fig.: Vonmises stresses for baseline model

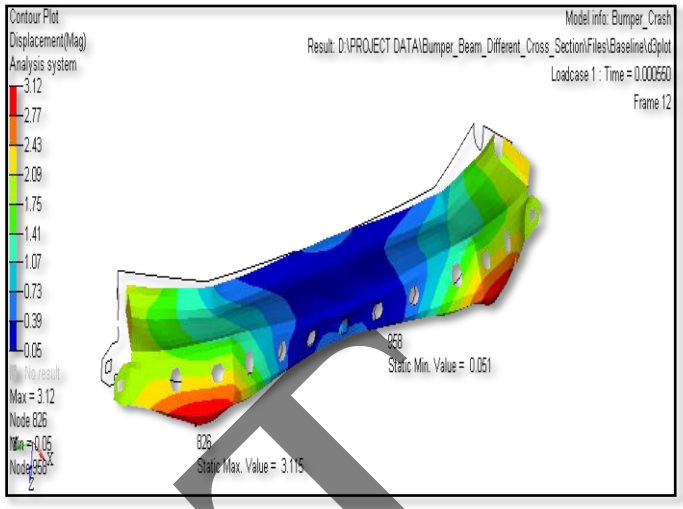

Fig.: Displacement contour plot for Bumper System

V. CONCLUSION:

The analysis of baseline bumper conclude that due to the central impact force act on the bumper beam the maximum von-misses stress induced it affects on the accessories of the car and human health so,proposed different crossection & as per the changing the c/s of bumper and when the width of bumper increases also the stiffness increases thats should minimizes the von-misses stress safety hazards.

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