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DESIGN AND ANALYSIS OF COIL FRONT BUMPER IN AUTOMOBILE

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ABSTRACT

Bumpers play an important role in preventing the impact energy from being transferred to the automobile and passengers. Saving the impact energy in the bumper to be released in the environment reduces the damages of the automobile and passengers. The goal of this project is to design a bumper with minimum weight by employing the glass material thermoplastic materials and coil spring & hydraulic cylinder absorb the shock.

Bumper which either absorbs the impact energy with its deformation or transfers it parallel to the impact direction. To reach this aim, a mechanism is designed to convert about 80% of the kinetic energy to the spring and 20% of the hydraulic cylinder. In addition, since the residual kinetic energy will be damped with the infinitesimal elastic deformation of the bumper elements, the passengers will not sense any impact. Its solving and result's analysis are done in CREO and ANSYS**.**

I. INTRODUCTION

A bumper is a shield made of steel, aluminum, rubber, or plastic that is mounted on the front and rear of a passenger car. When a low speed collision occurs, the bumper system absorbs the shock to prevent or reduce damage to the car. Some bumpers use energy absorbers or brackets and others are made with a foam cushioning material.

The car bumper is designed to prevent or reduce physical damage to the front and rear ends of passenger motor vehicles in low-speed collisions. Automobile bumpers are not typically designed to be structural components that would significantly contribute to vehicle crashworthiness or occupant protection during front or rear collisions. It is not a safety feature intended to prevent or mitigate injury severity to occupants in the passenger cars. Bumpers are designed to protect the hood, trunk, grille, fuel, exhaust and cooling system as well as safety related equipment.

The main function of a bumper is to protect the car's body in a slight collision, typically at parking speed. The bumper structure on modern automobiles generally consists of a plastic cover over a reinforcement bar made of steel, aluminum, fiber glass composite, or plastic

II. PROBLEM AND IDENTIFICATION PROBLEM

1. Existing bumper Weight is high and also rigid on impact loading time.
2. Impact energy with its deformation or transfers it perpendicular.
3. Passengers will be sense the impact load

4. Also affect the engine parts and in it front side major engine accessory
5.

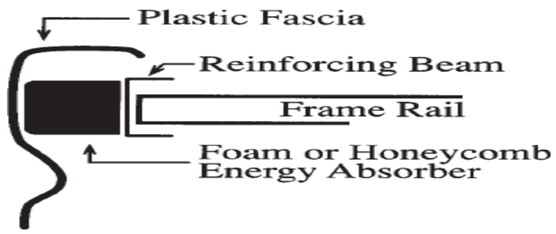
SPECIFICATION OF BUMPER

1. Toyota innova model
2. Toyota Innova Length in 4585 mm
3. Toyota Innova Width in1765 mm
4. Toyota Innova Height in 1760 mm

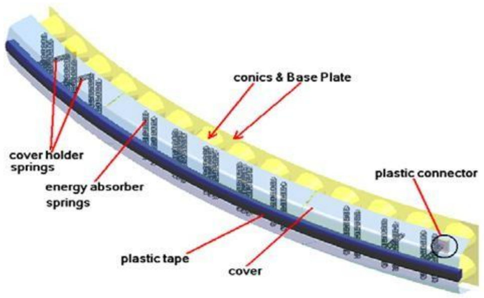
III. LITERATURE REVIEW

There are several models and systems for bumpers of passenger cars . Traditional models have corrugated open section areas for installing some car elements and increasing bending strength.

SCHMATIC CONFIGURATION OF THE BUMPER

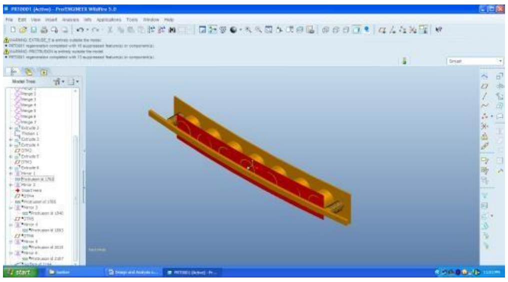


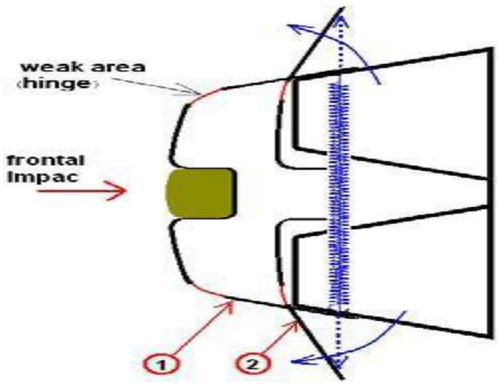
1. Front rubber tape: that is composed of polypropylene (PEP) for damping of poor contacts.
2. Fascia: it indicates the aerodynamic form of the bumper and is used as a bearing for spring system retainer.
3. Spring system: it contains 26 vertical springs for converting the kinetic energy to the spring potential energy, In addition to 4 horizontal springs for connecting the fascia to base plate.
4. Conics and base plate: they are main elements of the bumper for energy absorbing in high speed contacts (i.e. reinforcing beam).
5. Connecting plastic parts: two propylene (PEP) parts that connect the bumper of car.



SECTION VIEW OF BUMPER

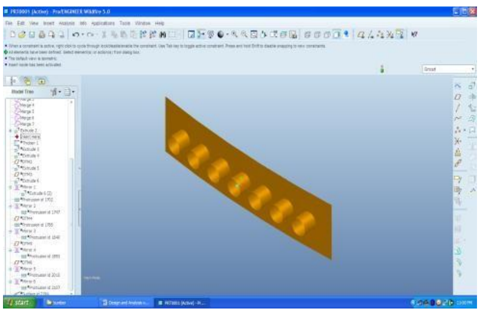
It absorbs kinetic energy in the form of spring potential energy. Also, two small areas between the cover edge and the middle part of the cover have designed with thinner thicknesses (i.e. there are two lateral notch at the top and bottom corners of the cover),which guarantee easier deformation rather than the other parts of the cover, so, the cover edges movements mechanism is completely predicted and in control. For high speed contacts, the cover reaches the conics and they deforms as a composed part. There is a concavity in the cover where the plastic tape seats on and increases the bending strength of the bumper.





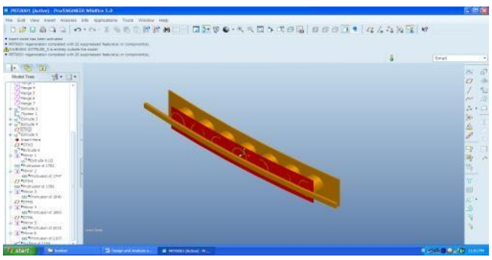
I. STEPS INVOVED DESIGING OF BUMPER USING CREO

1. BUMPER BACK PLATE DESIGN

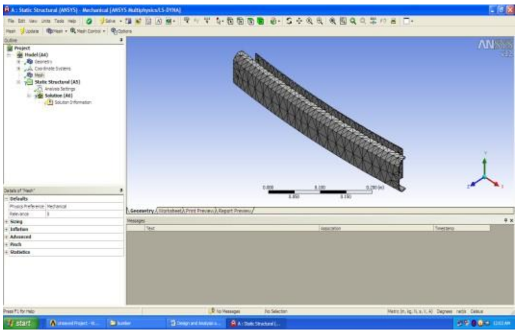


2.

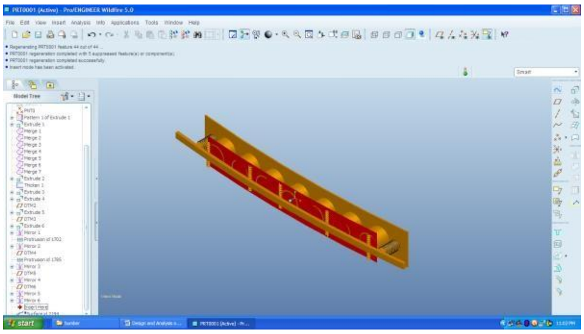
3. BUMPER FRONT PLATE DESIGN



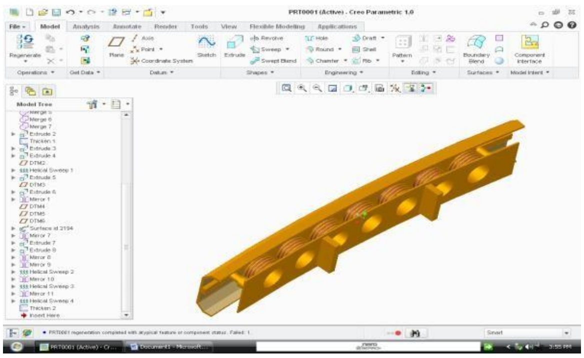
1. BUMPER WITH ENERGY SPRING HORIZONTAL 8 NO



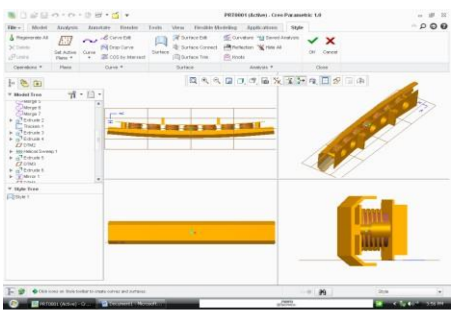
4. BUMPER WITH 2 HYDRALIC CYLINDER DESIGN



5. BUMPER WITH FRONT CHANNEL DESIGN



6. COMPLETE MODEL OF BUMPER



IV. STEPS INVOLVED IN MODEL GENERATION

1. Enter the preprocessor (PREP7) to initiate our model building session. Most often, we will build our model using solid modeling procedures.
2. Establish a working plane
3. Generate basic geometric features using geometric primitives and Boolean operators
4. Activate the appropriate coordinate system
5. Generate other solid model features from the bottom up. That is, create key points, and then define lines, areas and volumes as needed.
6. Use more Boolean operators or number controls to join separate solid model regions together as appropriate
7. Create tables of elements attributes (element types, real constants, material properties, and element coordinate systems)
8. Set element attribute pointers
9. Set meshing controls to establish our desired mesh density if desired
10. Create nodes and elements by meshing our solid model.
11. After we have generated nodes and elements, add features such as surface to surface contact elements, coupled degrees of freedom, and constraint equations.
12. Save your model data to Job named
13. Exit preprocessor.

VI. TYPES OF STRUCTURAL ANALYSIS

The seven types of structural analyses available in the ANSYS family of products are explained below. The primary unknowns (nodal degrees of freedom) calculated in a structural analysis are displacements. Other quantities such as strains, stresses and reaction forces are then derived from the nodal displacements.

Structural analyses are available in the ANSYS Multiphysics, ANSYS mechanical, ANSYS Structural and ANSYS Professional programs only.

You can perform the following types of structural analysis. Each of these analysis types are discussed in detail.

(a) Static analysis – used to determine displacements, stresses etc. Under static loading conditions. Both linear and nonlinear static analyses can include plasticity, stress, stiffening, large deflection, large strain, hyper elasticity, contact surfaces and creep.

(b) Modal analysis – used to calculate the natural frequencies and mode shapes of a structure. Different mode extraction methods are available.

(c) Harmonic analysis – Used to determine the response of a structure to harmonically time varying loads.

(d) Transient Dynamic analysis – used to determine the response of a structure to arbitrarily time varying loads. All nonlinear mentioned under static analysis above is allowed.

(e) Spectrum analysis – An extension of the modal analysis, used to calculate stresses and strains due to a response spectrum or a PSD input (Random Vibrations), varying loads. All nonlinear mentioned under static analysis above is allowed.

(f) Breaking analysis – used to calculate the buckling loads and determine the buckling analyses are possible

(g) Explicit Dynamic analysis – This type of structural analysis is only available in the ANSYS LS-DYNA program's-DYNA provides an interface to the LS DYNA explicit finite element program.

Explicit dynamic analysis is used to calculate fast solutions for large deformation dynamics and complex contact problems.

ELEMENT TYPE

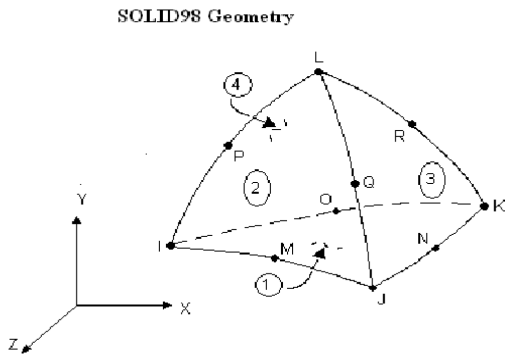
ANSYS supports the number of elements to cover various types of problems. Depending on the nature of model, the element type is defined. It is desirable if various elements can be generated to provide users with the required flexibility to meet the compatibility and completeness requirements.

In this braking system analysis both thermal loads and structural loads are acting when brake is applied. We selected an element SOLID98 Tetrahedral Coupled-Field Solid, which can resolve both thermal and structural problems. This element is a 3-D solid element.

SOLID98 ELEMENT DESCRIPTION

SOLID98 is a 10-node tetrahedral version of the 8- node solid5 element. The element has a quadratic displacement behavior and is well suited to model irregular meshes. When used in structural and piezoelectric analyses, SOLID98 has large deflection and stress stiffening capabilities the element is defined by ten nodes with up to six degrees of freedom at each node.

Analysis first consists of thermal analysis, in which results are given as an input to structural analysis. The output of thermal analysis is one of the inputs for Structural analysis. The loads acting in the component are given as another input in structural analysis. The element has a quadratic displacement behavior and is well suited to model irregular meshes. When used in structural and piezoelectric analyses, SOLID98.



Figures of 7.2 Solid 98 element

V. ANALYSIS PROCEDURE

This chapter covers the detailed steps involved in the analysis of braking system using ANSYS 12.0.

The following shows the three stages involved for the analysis:

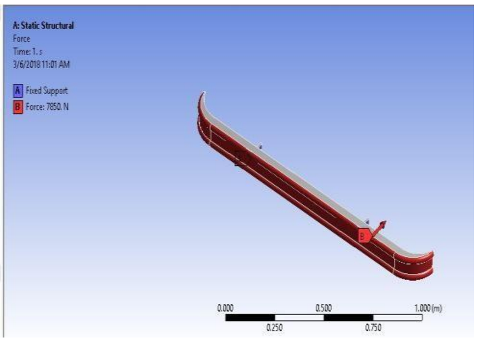
- Preprocessing
- Execution
- Post processing

The pre-processing stage consists of generation of model as per the requirement and dividing it into finite elements by using an option called “mesh”. This stage also including element selection according to our application, specifying real constants and material properties as per requirements

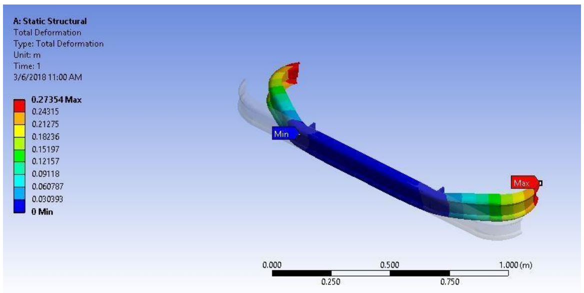
. Once the model is generated then it is taken second stage called execution. The problem is solved in this stage by applying the loads and boundary conditions to the model.

VI. RESULT AND DISCUSSION OLD MODEL:

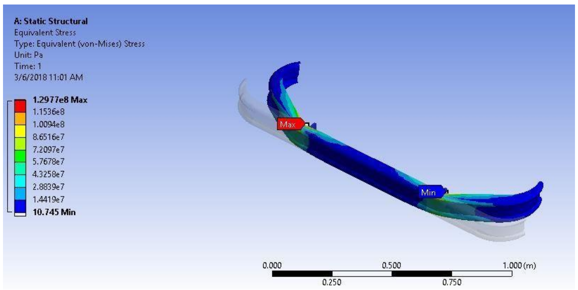
1. FORCE APPLIED:



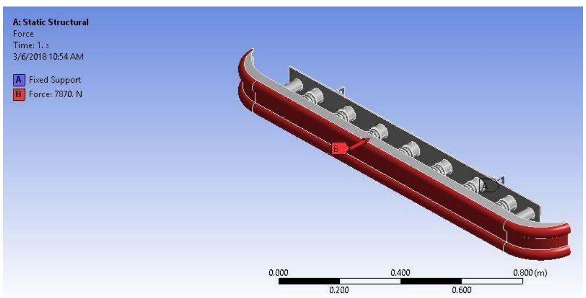
2. DEFORMATION RESULT:



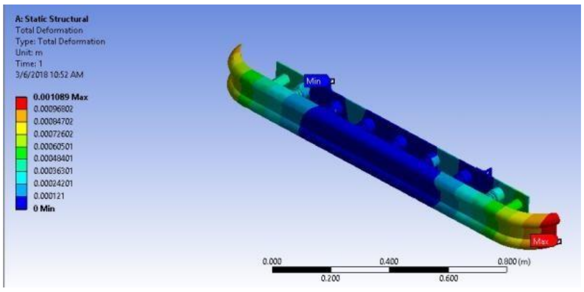
3. STRESS



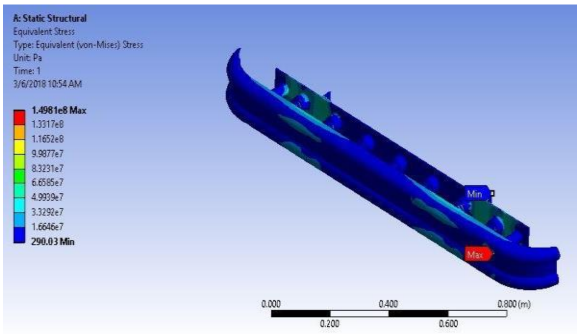
NEW MODEL: 1.BOUNDARY CONDITION



2. DEFORMATION RESULT



3. STRESS RESULT

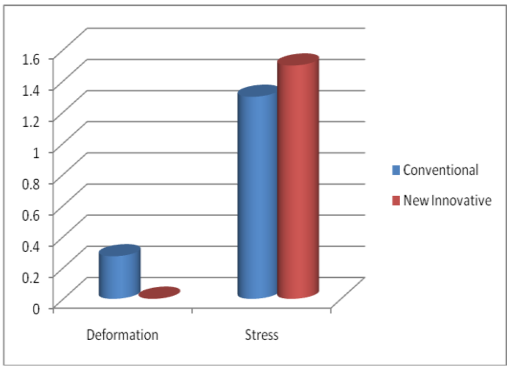


COMPARISTION TABLE AND PERFORMANCE CHART

1. TABLE OF COMPARISION:

Model	Deformation	Stress
Conventional	0.27354	1.2977
New Innovative	0.001089	1.4981

2. PERFORMANCE CHART:



From the result, it proves that the new innovative bumper model is much better than the old conventional model. According to the analysis result, the deformation of the new bumper is very lower than the conventional which shows the high damping capacity and also the stress of the new model is high than the conventional. So it is clear that our new model much greater than the previous which is verified and analyzed successfully

VII. CONCLUSION:

There are many effective factors in selection of a bumper system. The most important one is its ability to absorb impact energy especially in high speed crashes according to legal standards. Weight, manufacturability and price have secondary

Importance. Although the bumpers are designed for low speed impacts, in high speed crashes, bumper is the first part for energy absorption and also replacement. This model offers more suitable material at lower cost and easier Production process in comparison with conventional metals. Also, it can form large and complex parts with appropriate dimensional stability in a short shaping cycling. A commercial new model bumper with a mechanical spring mechanism (as energy absorber mechanism) is designed under frontal impact test. It is revealed that by utilizing this mechanical energy absorber the bumper is able to convert about 80% of the kinetic impact energy to spring potential energy and release it to the environment in the low impact velocity. The residual kinetic energy will be damped with infinitesimal elastic deformation of bumper elements. So, the passengers will sense less impact.

Finally, conventional bumper (as a conventional model) was compared with the new spring model and the results showed that new model is much better than the conventional bumper with the same safety factors. However in high speed crashes, new bumper conical part of the bumper was desired to absorb the kinetic energy of the impact or as much as possible, the believe more practical tests and simulations should be carried out to verify the advantages and stability of the proposed structure

XI: REFERENCE:

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(3) PSG design data book, Atozmatweb.com