MODELING AND SIMULATION OF CAR BUMPER BY CONVENTIONAL AND COMPOSITE MATERIALS

POTLADURTHI VISHNU VARDHAN[1], M. RAJESH[2], Dr. NAGAMALLESWARA RAO GUJJAR[3]

[1]PG Research scholar, [2]Asso.Professor, [3] *Professor & Principal*
[1]Mechanical Engineering Department
[1] *Gates Institute of Technology, Gooty, A.P.-515401, India.*

Abstract :   Bumper is one altogether the foremost elements that ar used as protection for passengers from front and rear collision. The aim of this study was to analyze and study the structure and material used for automobile bumper in one altogether the manufacturer. Throughout this study, the foremost necessary variables like material, structures, shapes and impact conditions are studied for analysis of the bumper beam thus on boost the crashworthiness throughout collision. During this paper we have a tendency to compare the automobile bumper on materials like composite and standard materials with reference to speed regulation and weight improvement for locating the higher material. The materials chosen during this papers are composite materials like vinyl cyanide hydrocarbon vinyl polymer (ABS PC), Polypropylene Co-polymer(PP) and standard Alloy steels like unstained steel(SS). The Model is meant during a CAD computer code (Unigraphics) and therefore the Analysis is conducted in COSMOUS computer code. The analysis is to be finished speed in line with laws and conjointly by ever-changing the speeds.

Keywords: Car bumper, Alloy steel material, composite materials like vinyl cyanide hydrocarbon vinyl polymer (ABS PC),Polypropylene Co-polymer(PP) Unigraphics, COSMOS, Stress, Strain and Displacement.

I. INTRODUCTION

Associate in Nursing automobile's bumper is that the front-most or rear-most [*fr1], apparently designed to allow the automotive to sustain an impact whereas not hurt to the vehicle's safety systems. they are uneffective of reducing injury to vehicle occupants in high-speed impacts, but ar more and more being designed to mitigate injury to pedestrians dependent on cars. Front and rear bumpers became traditional instrumentation on all cars in 1925. What were then easy metal beams connected to the front and rear of a automotive have evolved into difficult, designed elements that ar integral to the protection of the vehicle in low-speed collisions. Today's plastic automotive bumpers and fascia systems ar aesthetically pleasing, whereas giving edges to every designers and drivers. the majority of recent plastic automotive bumper system fascias ar product of thermoplastic olefins (TPOs), polycarbonates, polyesters, plastic, polyurethanes, polyamides, or blends of these with, for instance, glass fibers, for strength and structural rigidity. Plastic bumpers contain reinforcements that modify them to be as impact-resistant as metals whereas being cheaper to exchange than their metal equivalents. Plastic automotive bumpers usually expand at the same rate as metal bumpers at a lower place ancient driving temperatures and do not usually want special fixtures to remain them in place. variety of the plastic merchandise utilised in making automotive bumpers and fascias are going to be recycled. this permits the manufacturer to utilize scrap material in an exceedingly} very economical manner. a spanking new usage program uses painted TPO scrap to produce new bumper fascias through Associate in Nursing innovative and major usage breakthrough technique that removes paint from salvage yard plastic.

1.1 OBJECTIVES

Car accidents ar happening on a daily basis. Most drivers ar convinced that they will avoid such hard things. but the statistics shows that 10 thousand dead and many thousands to million wounded annually. Hence, improvement within the safety of cars is necessity to decrease the numbers of accidents. Automotive bumper system is one in every of the key systems in traveler cars. Bumper systems ar designed to forestall or scale back physical harm to the front or rear ends of traveler automobiles in collision condition. It protects the hood, trunk, grill, fuel, exhaust and cooling system likewise as safety connected instrumentation like parking lights, headlamps and taillights,
The main objectives of the project are:
1. an honest style of automotive bumper should offer safety for passengers and may have low weight.
2. Impact analysis is completed on the automotive bumper for various speeds.
3. The analysis is completed on the automotive bumper for various materials Steel, plastic and Carbon Fiber-Reinforced Poly-Ether-Imide architect
4. The bumper of 1 of the present railway car in Indian market and recommend style Improvement before bumper of a railway car victimisation Impact Analysis

1.2 BACKGROUND

Bumper beams ar one in every of the key structures in traveler cars that careful style and   nufacturing ought to be thought of so as to attain sensible impact behavior. The bumper beam is that the main structure for interesting the energy of collisions. . the foremost vital parameters as well as material, thickness, Associate in Nursingd form and impact condition ar studied for style and analysis of an automotive front bumper beam to enhance the crashworthiness style in low-velocity impact.

1.2.1 FIRST STANDARDS

In 1971, the U.S. National main road Traffic Safety Administration (NHTSA) issued the country's initial regulation applicable to railway car bumpers. Federal automobile Safety normal No. 215 (FMVSS 215), "Exterior Protection," took impact on one Sept 1972 — once most automakers would begin manufacturing their model year 1973 vehicles. the quality prohibited practical harm to such that protective parts like headlamps and equipment parts once the vehicle is subjected to barrier crash tests at five miles per hour (8 km/h) for front and a pair of.5 miles per hour (4 km/h) for rear bumper systems. In Oct 1972, the U.S. Congress enacted the automobile info and value Saving Act (MVICS), that needed NHTSA to issue a bumper normal that yields the "maximum possible reduction of value to the general public and to the consumer". Factors thought of enclosed the prices and edges of implementation, the standard's impact on insurance prices and legal fees, savings in client time and inconvenience, and health and safety issues.

1.2.2 STRENGTHENING STANDARDS

the necessities published beneath MVICS were consolidated with the necessities of Federal automobile Safety normal variety 215 (FMVSS 215, "Exterior Protection of Vehicles") and published in March 1976. This new bumper normal was placed within the u. s. Code of Federal rules at 49CFR581, become independent from the Federal automobile Safety Standards at 49CFR571. The new necessities, applicable to 1979-model traveler cars, were known as the clinical trial normal. At a similar time, a zero-damage demand, Phase II, was enacted for bumper systems on 1980 and newer cars. This Indian normal was adopted by the Bureau of Indian Standards, once the draft finalized by the Automotive Body, Chassis, Accessories and Garage instrumentation Sectional Committee had been approved by the Transport Engineering Division Council. In the formulation of this normal, help has been derived from the subsequent standards:

AIS 006 Automotive vehicles ó Bumper article of furniture on money supply class of vehicles ó check ways ECE R forty two Uniform provisions regarding the approval of vehicles with reference to their front and rear protecting devices (Bumpers, etc) JIS D1601-1995 Vibration checking ways for automotive components

1.4 VARIETIES OF BUMPERS

      Plastic Bumper   Boby Kit Bumper   Carbon Fibre Bumper   Steel Bumper

1.4.1 PLASTIC BUMPER

Most modern cars use a bolstered thermoplastic bumper, as they're low-cost to manufacture, simple to suit and absorb additional energy throughout a crash. A majority of automotive bumpers ar custom created for a particular model, thus if you're wanting to exchange a cracked bumper with an identical one, you'd got to get from a specialist dealer. However, several corporations currently supply various styles in thermoplastic, with a variety of fittings designed for various models.

1.4.2 BOBY KIT BUMPER

Modified cars usually currently have a full body kit instead of simply a front and rear bumper. These kits act as a skirt round the entire body of the automotive and improve performance by reducing the number of air flowing beneath the automotive and then reducing drag. because of every car's specifications, these got to be specially purchased and might be made of thermoplastic, sort of a normal bumper, or perhaps out of carbon fiber.

1.4.3 CARBON FIBRE BUMPER

Carbon fiber body work is often the factor of super-cars, however several automotive corporations, and specialist modifiers, ar getting down to use it for replacement part on everyday cars. this is often as a result of it's flash and is safe throughout a crash. It is, however, plenty dearer than traditional thermoplastic.

1.4.4 STEEL BUMPER

Originally plated steel was used for the whole body of a automotive, as well as the bumper. This material worked well, because it was terribly robust in a very crash, however it absolutely was terribly serious and crumpled performance. As automotive engine style has improved, steel bumpers have just about disappeared for all the world except classic cars. commutation one involves plenty of looking for scrap cars or having one specially created.

1.5 MATERIALS UTILIZED IN BUMPER

Modern cars use several safety standards designed to scale back the possibilities of significant injury or death. One such part is that the bumper. Vehicle bumpers ar situated on each the front and rear ends and ar designed to soak up shock in low speed collisions. this is often supposed to attenuate harm to different vital parts of the vehicle. Bumpers also are being designed to scale back injury in pedestrian accidents.

Type of material	Tensile strength
PS ,ABS PC/PBT(plastics)	40-60 MPa
Steel	800 Mpa
Epoxy glass	1770 Mpa
Polyethermide	106 MPA

These materials can even be used within the bumper as Associate in Nursing energy interesting device and is typically created from plastic or a plastic honeycomb. Fiberglass, whereas typically dearer than plastics, can even be used as a fabric alternative for bumper covers. fibreglass is less complicated to customise and is light-weight.

POSTSCRIPT – phenylethylene is extremely in style, ease to manufacture, however has poor resistance to light-weight|ultraviolet illumination|UV|actinic radiation|actinic ray} light. Application: equipments housings, buttons, automotive fittings, show bases,

ABS – acrylonitrile-butadiene-styrene could be a sturdy thermoplastic, proof against weather and some chemicals, in style for vacuum   Table 1.5 Materials used for bumper and strengthfashioned parts. it's a rigid plastic with rubber like characteristics, which provides it sensible impact resistance. Application: automotive dashboards, covers**PC** – polycarbonate has

weather condition and UV resistance, with transparency levels virtually sensible as acrylic. Applications: security screens, craft panels, bumpers, spectacle lenses, light lenses,

PBT – butene terephthalate has sensible chemical resistance and electrical properties, arduous and hard material with water absorption, excellent resistance to dynamic stress, thermal and dimension stability. simple to manufacture - quick crystallization, quick cooling. Application: headlight housings and bezels, sun-roof front components, protection system housings, door handles, bumpers, carburetor parts,

STEEL-steel is Associate in Nursing alloy of iron and carbon that's wide utilized in construction and different applications thanks to its hardness and strength. Carbon, different parts, and inclusions among iron act as hardening agents that stop the movement of dislocations that naturally exist within the iron atom crystal lattices. The carbon in typical steel alloys could contribute up to two.1% of its weight.

EPOXY - Epoxy is that the cured upshot of epoxy resins, likewise as a informal name for the epoxide practical cluster. Epoxy is additionally a typical name for a kind of robust adhesive used for protruding things along and covering surfaces,[1] generally 2 resins that require to be mixed along before use.

PEI - Polyetherimide is Associate in Nursing amorphous, amber-to-transparent thermoplastic with characteristics the same as the connected plastic PEEK. Relative to PEEK, architect is cheaper, however is lower in impact strength and usable temperature

II. LITERATURE SURVEY

Literatures associated with impact ar studies by several researchers. This puts extra challenge for analysis and Development units to come back up with variety of different style solutions in less time and value compared to existing styles. These best solutions ar best achieved in a very CAE atmosphere victimisation a number of the fashionable CAD and FEM tools. Such tools ar capable of effecting fast changes within the style among virtual atmosphere It was determined that, major injury because of impact rate of around 20-30 kmph was affected to the knee ligament. Davoodi et.al [4]. projected abstract style of fiber bolstered epoxy composite bumper absorbent as a pedestrian energy absorbent. The energy absorption capability was comfortable for pedestrian impact and it may attainable to use as substitute for the present materials like EPP foam for low impact collision. Mohapatra S et.al[8] mentioned that automotive development cycles are becoming shorter by the day. With increasing competition within the marketplace, the OEM's and suppliers main challenge is to come back up with time-efficient style solutions. Researchers try to enhance several of existing styles victimisation novel approaches. again and again there's conflicting performance and value necessities. Andersson R et.al[9] emphasised that to extend crash performance in automotive vehicles it's necessary to use new techniques and materials. The parts that ar connected to crash safety ought to transmit or absorb energy. The energy interesting capability of a particular part could be a combination of pure mathematics and material properties. The chosen material ought to have high yield strength and comparatively high elongation to fracture. These demands cause increase interest to use of high strength untainted steels. Carley ME et.al [8]The analysis is completed by considering the previous experiments disbursed by the researchers within the field of choice of fabric within the automotive bumper impact analysis. Researchers centered on the mechanical properties of a hybrid glass epoxy composite for utilization in a very railway car bumper beam. A hybrid material, that is invented by changed SMC methodology gift an honest mechanical properties cause by applied pressure to yield a robust bond between the hybrid-reinforced fibers. Butler M et.al[10]The style parameters for the bumper production like cross section, longitudinal curvature, fixing methodology, rib thickness and therefore the strength plays a major role. The researchers have studied on the study of impact behavior of auto to vehicle impact check and vehicle to barrier check so as to see whether or not vehicle-to-barrier tests will function surrogates for vehicle-to-vehicle tests in accident reconstruction. Witteman WJ et.al [12]The researches are done on the study to develop a numerical analytical model of linear low-speed slow crashes, the model treats the automotive body as rigid structure and therefore the bumper beam as a deformable structure connected to the vehicle. The model is additionally accustomed compare that however the structural characteristics of the vehicles' bumpers and therefore the closing speed have an effect on the crash pulse and to demonstrate a way to estimate the utmost severity of a low-speed crash that has already occurred. Evans D et.al[11] The experiments were done on the engineering thermoplastics that ar used with sensible ends up in applications like knee bolsters, structural instrument panels, head-impact-protection pillars, automotive bumpers, and body panels, wherever structural integrity, crashworthiness, and energy absorption capability ar key necessities. In the on top of mentioned literature ,There ar few studies news regarding the work done associated with improvement within the style of front bumper of railway car and therefore the pertinence of those studies for traveler cars (India) isn't valid. gift studies haven't known the impact of form, size and or material. the protection of the traveler has to be multiplied. The literature address the impact analysis of the traveler cars considering the form, material and size for the Indian cars.

III. DEVELOPMENT OF AUTOMOTIVE BUMPER MODEL VICTIMISATION UNIGRAPHICS
3.1 INTRODUCTION
Computer-aided design (CAD), additionally referred to as software and drafting (CADD), is that the use of technology for the method of style and design-documentation. laptop power-assisted Drafting describes the method of drafting with a laptop. CADD code, or environments, supply the user with input-tools for the aim of streamlining vogue processes; drafting, documentation, and manufacturing processes. CADD output is commonly within the sort of electronic files for print or machining operations. The event of CADD-based computer code is in positive correlation with the processes it seeks to economize; industry-based computer code (construction, producing, etc.) As within the manual drafting of technical and engineering drawings, the output of CAD should convey info, like materials, processes, dimensions, and tolerances, in keeping with application-specific conventions.CAD could also be accustomed style curves and figures in two-dimensional (2D) space; Two-dimensional, or 2D, CAD is employed to form flat drawings of merchandise and structures.

3.1.2 3D CAD

Three-dimensional (3D) CAD programs are available a good form of varieties, supposed for various applications and levels of detail. Overall, 3D CAD programs produce a sensible model of what the look object can appear as if, permitting designers to unravel potential issues earlier and with lower production prices. 3D CAD programs embrace Autodesk discoverer, Co produce Solid Designer, Pro/Engineer Solid Edge, Solid Works, NX and VX CAD,CATIA V5.

3.2.3 THREED WIREFRAME AND SURFACE MODELING

CAD programs that feature 3D wireframe and surface modeling produce a skeleton-like inner structure of the thing being sculpturesque. A surface is supplementary on later. These varieties of CAD models ar tough to translate into different computer code and ar thus seldom used any longer.

3.2.4 SOLID MODELING

Solid modeling normally is helpful as a result of the program is commonly ready to calculate the size of the thing it's making. several sub-types of this exist. Constructive geometry (CSG) CAD uses a similar basic logic as 2nd CAD, that is, it uses ready solid geometric objects to form Associate in Nursing object. However, these varieties of CAD computer code usually can't be adjusted once they're created. Boundary illustration (Brep) solid modeling takes CSG pictures and links them along. Hybrid systems combine CSG and Brep to attain desired styles

3.2 APPLICATIONS OF CAD/CAM

The emergence of CAD/CAM has had a serious impact on producing, by standardizing development and by reducing style effort, tryout, and epitome work; it's created attainable considerably reduced prices and improved productivity.

Some typical applications of CAD/CAM ar as follows:

1. Programming for North Carolina, CNC, and industrial robots.
2. style of dies and molds for casting, in which, as an example, shrinkage allowances ar   preprogrammed.
3. style of tools and fixtures and EDM electrodes

Quality control and inspection----for instance, coordinate-measuring machines programmed on a CAD/CAM digital computer method designing and programming

3.3 INTRODUCTION TO UNIGRAPHICS

NX is one in every of the world's most advanced and tightly integrated CAD/CAM/CAE development solutions. Spanning the whole vary of development, NX delivers Brobdingnagian worth to enterprises of all sizes. It simplifies complicated product styles, therefore dashing up the method of introducing merchandise to the market. The NX computer code integrates information based mostly principles, industrial style, geometric modeling, advanced analysis, graphic simulation, and coincident engineering.

It is used, among different tasks, for:

style (parametric and direct solid/surface modeling)

Engineering analysis (static; dynamic; electro-magnetic;thermal, victimisation the finite part method; and fluid, victimisation the finite volume method).

producing finished style by victimisation enclosed machining modules.

List of corporations victimisation Nx :

      Nissan   Fiat   Susuki   GE   Aviation   GM   Daimler

Unigraphics (NX) will be applied to a good form of industries, from part and defense, automotive, and industrial instrumentation, to high technical school, construction, trade goods, plant style, client foodstuff, life sciences, design and construction, method power and fossil fuel, and services.

DIFFERENT MODULES IN UNIGRAPHICS

• Sketcher   • Part style   • Assembly style   • Generative flat solid style   • Drafting

3.4. CAPABILITIES OF UNIGRAPHICS

Like any computer code it's regularly being developed to incorporate new practicality. the main points below aim to stipulate the scope of capabilities to present an outline instead of giving specific details on the individual practicality of the merchandise. Unigraphics could be a computer code application among the CAID/CAD/CAM/CAE class, in conjunction with different similar merchandise presently on the market. This information is then documented in a very normal 2nd production drawing or the 3D drawing normal ASME Y14.41-2003.

3.5 2D& 3D MODELLING OF A automotive BUMPER

Unigraphics could be a computer code application among the CAID/CAD/ CAM/CAE class, in conjunction with different similar merchandise presently on the market. Unigraphics could be a constant, feature-based modeling design incorporated into one info philosophy with advanced rule-based style capabilities. This information is then documented in a very normal 2nd production drawing or the 3D drawing normal ASME Y14.41-2003. Modeling of automotive bumper is completed with facilitate of Unigraphics computer code and dimensions ar elect from one in every of automotive Bumper. because the impact is additional for the front portion of bumper solely outer dimensions of automotive bumper has been thought of for Modeling, Slots provided in middle of automotive bumper is employed for Reducing drag impact in automotive bumper.

composite materials also are capable to soak up energy in conjunction with a simplified pure mathematics.

2D modeling of a automotive bumper victimisation Unigraphics computer code. sketcher tools ar utilized in modeling.

Procedure we have a tendency to utilized in this model is.

First we have a tendency to elect a data point plane and additionally the position of sketch.

Sketch totally affected with dimensions

After finishing of sketch we have a tendency to used some 3d model feature like squeeze out, EDGE mix to form the bumper in desired means.

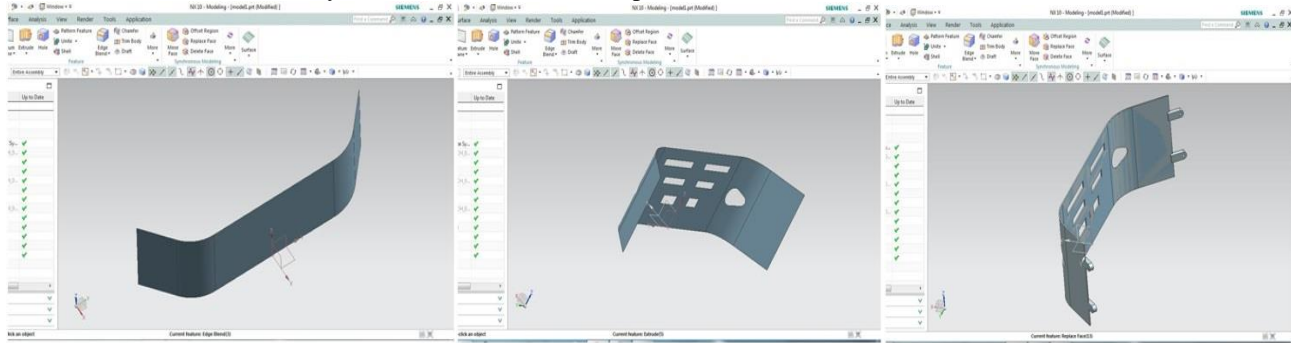EDGE BLENDS are ordinarily accustomed create the sharp corners to sleek surfaces.

| Figure1 | Figure2 | Figure3 |

IV. FINITE PART ANALYSIS ON AUTOMOTIVE BUMPER

4.1 INTRODUCTION TO FEA

Finite part analysis (FEA) could be a fairly recent discipline crossing the boundaries of arithmetic, physics, engineering and computing. the strategy has wide application and enjoys intensive utilization within the structural, thermal and fluid analysis areas. The finite part methodology is comprised of 3 major phases:

4.1.1. PRE-PROCESSING

The analyst develops a finite part mesh to divide the topic pure mathematics into sub domains for mathematical analysis, and applies material properties and boundary conditions,

4.1.2. SOLUTION

Through out that the program derives the governing matrix equations from the model and solves for the first quantities.

4.1.3. POST-PROCESSING

The analyst checks the validity of the answer, examines the values of primary quantities (such as displacements and stresses), and derives and examines extra quantities (such as specialised stresses and error indicators). benefits of FEA ar various and vital. a brand new style construct could also be sculpturesque to see its universe behavior beneath numerous load environments, and will thus be refined before the creation of drawings, once few bucks are committed and changes ar cheap. Once a close CAD model has been developed, FEA will analyze the look intimately, saving time and cash by reducing the quantity of prototypes needed. Associate in Nursing existing product that is experiencing a field drawback, or is solely being improved, will be analyzed to hurry Associate in Nursing engineering amendment and scale back its value. additionally, FEA will be performed on progressively

4.2 INTRODUCTION TO COSMOS WORKS

Cosmos works could be a helpful computer code for style analysis in technology. That's Associate in Nursing introduction for you World Health Organization would love to find out additional regarding COSMOS Works. COSMOS Works could be a style analysis automation application totally integrated with Solid Works. This computer code uses the Finite part methodology (FEM) to simulate the operating conditions of our automotive bumper styles and predict their behavior. FEM needs the answer of huge systems of equations. hopped-up by quick solvers, COSMOS Works makes it attainable for designers to quickly check the integrity of the styles and hunt for the optimum resolution.

4.3 SPECIFIC CAPABILITIES OF COSMOS

4.3.1 STRUCTURAL ANALYSIS:

Structural analysis is probably the foremost common application of the finite half methodology as a result of it implies bridges and buildings, naval, physical science, and mechanical structures like ship hulls, craft bodies, and machine housings, likewise as mechanical components like pistons, machine elements, and tools.

4.3.2 STATIC ANALYSIS:

Structural analysis is utilized to check displacements, stresses etc., to a lower place static loading conditions. COSMOS can cypher every linear and nonlinear static analyses. Nonlinearities can embrace property, stress stiffening, large deflection, large strain, hyper property, contact surfaces and creep.

4.3.3 TRANSIENT DYNAMIC ANALYSIS:

Transient Dynamic Analysis is utilized to check the response of a structure to haphazardly time varied lots. All nonlinearities mentioned to a lower place Static Analysis on prime of ar allowed.

4.3.4. BUCKLING ANALYSIS:

Buckling Analysis is utilized to calculate the bucking lots and verify the buckling mode kind. every linear (Eigen Value) buckling and nonlinear buckling analyses ar gettable. in addition to the on prime of research varieties several special purpose choices ar offered like Fracture Mechanics, material Analysis, Fatigue and every P-Method and Beam analyses.

4.3.5. STEADY STATE THERMAL ANALYSIS:

COSMOS is capable of every steady state and transient analysis of any solid with thermal boundary conditions. Steady-state thermal analyses calculate the results of steady thermal lots on asystem or half. Users typically perform a steady-state analysis before doing a transient thermal analysis, to help establish initial conditions. A steady-state analysis also can be the last step of a transient thermal analysis; performed in any case transient effects have diminished. COSMOS are going to be accustomed verify temperatures, thermal gradients, heat flow rates, and heat fluxes in Associate in Nursing object that ar caused by thermal lots that do not vary over time. Such lots embrace the following: .

4.3.6 FLUID FLOW ANALYSIS:

The COSMOS/FLOTRAN CFD (Computational Fluid Dynamics) offers comprehensive tools for analyzing two-dimensional and three-dimensional fluid flow fields. COSMOS is capable of modeling an enormous vary of study varieties such as: airfoils for pressure analysis of plane wings (lift and drag), flow in supersonic nozzles, and sophisticated, three-dimensional flow patterns terribly} very pipe bend. in addition, COSMOS/FLOTRAN is also accustomed perform tasks including:

4.3.7.COUPLED FIELDS ANALYSIS:

A coupled-field Associate in Nursingalysis is Associate in Nursing analysis that takes into account the interaction (coupling) between two or further disciplines (fields) of engineering. A electricity analysis, as Associate in Nursing example, handles the interaction between the structural and electrical fields: it solves for the voltage distribution thanks to applied displacements, or the opposite means around.

4.3.8 MODEL ANALYSIS

A modal analysis is usually accustomed verify the vibration characteristics (natural frequencies and mode shapes) of a structure or a machine half whereas it's being designed. It will even perform a begin line for an extra, further elaborate, dynamic analysis, sort of a harmonic response or full transient dynamic analysis. Modal analyses, whereas being one in each of the foremost basic dynamic analysis varieties offered in COSMOS, will even be further computationally time overwhelming than a typicalstatic analysis. A reduced convergent thinker, utilizing automatically or manually elect master degrees of freedom is utilized to drastically cut back the matter size and determination time.

4.3.9. FOURIER ANALYSIS

These analysis used extensively by corporations World Health Organization turn out rotating machinery, COSMOS Fourier analysis is employed to predict the sustained dynamic behavior of structures to consistent cyclic loading. samples of rotating machines that created or ar subjected to harmonic loading are: A Fourier analysis will be accustomed verify whether or not or not a machine style can with success overcome resonance, fatigue, and different harmful effects of forced vibrations

4.3.10. THERMAL ANALYSIS

Thermal analysis could be a branch of materials science wherever the properties of materials ar studied as they modify with temperature. many ways ar ordinarily used - these ar distinguished from each other by the property that is measured. Thermal Analysis is additionally usually used as a term for the study of warmth transfer through structures. **4.3.11. STRATEGIC PARAMETERS**

The need for laptop crash simulations with high degrees of fidelity and hardiness is changing into progressively vital to be used in constant studies and early style analysis. The numerical simulations additionally modify new style ideas to be evaluated wherever there's a requirement to ascertain Associate in Nursing optimum style with interaction between materials and structural forms. To develop and propose a natual fiber composite bumper, that may satisfy following requirements:

1. Simple to manufacture by the form. This was accomplished by removing strengthening ribs of bumper.
2. Being economical by utilizing cheap composite materials
3. Achieving reduced weight compared to the antimonial bumper
4. Achieving reduced weight compared to the antimonial bumper. The presently used antimonial structure.

4.4 GENERIC STEPS TO UNRAVEL A AUTOMOTIVE BUMPER DRAWBACK

This code uses the Finite half methodology (FEM) to simulate The operative conditions of your designs and predict their behaviour. FEM desires the solution of big systems of equations. hopped-up By fast solvers, COSMOS Works makes it gettable for designers to quickly check the integrity of their designs and explore for the Optimum resolution.

A development cycle of a automotive bumper usually includes the next

      Build your model among the UNIGRAPHICS system   Check the epitome among the sector.

Measure The results of the arena tests.   Modify the planning supported the arena check results Epitome the planning

4.5 ANALYSIS STEPS:

we've got a bent to complete a study by acting the next steps:

Create a study shaping its analysis kind and decisions. If needed, define parameters of your study. Parameters could also be a model dimension, a material property, a force price, or the opposite entity that you simply} just want to investigate its impact on the planning.

Analysis Background: Linear Static Analysis Linear Material property, Material Models, Linear Elastic identical, Plotting Results, Describes the thanks to generate a result plot and result tools. Listing Results, outline of the results that will be listed,

Graphing Results, Shows you ways in which to graph results, Results of Structural Studies, Lists results offered From structural studies, Results of Stress Check.

Lists the basics of checking stress results and completely totally different criteria used within the checking.

Like finding any downside analytically, you'd prefer to define

Solution domain,   The physical model,   Boundary conditions and   The physical properties.

To solve the matter and gift the automotive bumper results. In numerical ways in which, the foremost distinction is an extra step called mesh generation. typically|this can be} often the step that divides the difficult model into small elements that become soluble in Associate in Nursing otherwise too difficult state of affairs. Below describes the processes in language slightly further set to the pc code. Build math to Construct a two or three dimensional illustration of the factor to be sculptural and tested mistreatment the work plane co-ordinate system among COSMOS.

4.6. MATERIAL PROPERTIES

Currently that the half exists, outline a library of the required materials that compose the automotive bumper being sculpturesque. This includes mechanical properties. Providing correct material properties input is extremely vital for obtaining correct FEA results from COSMOS. Material properties will either be outlined by menu choices or by commands prompts or by mixture of each. i like to recommend learning command based mostly FEA, as this is often freelance of versions of COSMOS.

Model type: **Linear Elastic identical**   **Default failure criterion: Max von Mises Stress**

       Name: **Alloy Steel**   **Mechanical Properties**

Yield strength: $6.20422e{+}008$ N/m^2   Tensile strength: $7.23826e{+}008$ N/m^2

Elastic modulus: $2.1e{+}011$ N/m^2   Shear modulus: $7.9e{+}010$ N/m^2

Poisson's ratio: 0.28   Mass density: 7700 kg/m^3 Thermal enlargement coefficient:$1.3e{-}005$ /Kelvin

       Name: **ABS**   **Mechanical Properties**

Tensile strength: $3e{+}007$ N/m^2

Elastic modulus: $2e{+}009$ N/m^2   Shear modulus: $3.189e{+}008$ N/m^2

Poisson's ratio: 0.394   Mass density: 1020 kg/m^3

       Name: **PEI**   **Mechanical Properties**

Yield strength: $2.3e{+}008$ N/m^2   Tensile strength: $2.41e{+}008$ N/m^2

Elastic modulus: $3.38e{+}010$ N/m^2   Shear modulus: $3.189e{+}008$ N/m^2
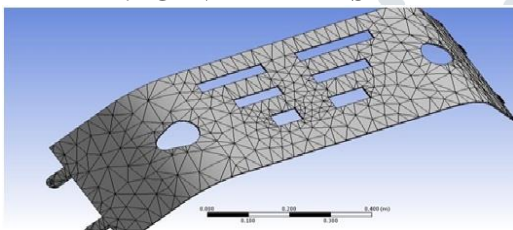
Poisson's ratio: 0.4   Mass density: 1480 kg/m^3

4.7 GENERATE MESH   4.8.1 STUDY PROPERTIES IN DROP CHECK

Study name	ally_steel_52
Analysis type	Drop Test
Mesh type	Solid Mesh
Large displacement	On
Result folder	bumper document (F)\1_part\car_bumper)

Fig.4.7 Mesh model of a automotive bumper   Table 4.8.1 Study properties in drop check

4.9 STUDY RESULTS ON steel AT SPEED 52 KM/HR

Name	Min	Max
on Mises Stress1 in N/mm^2 (MPa)	2.8551e-014 at Node: 6273	1152.85 at Node: 14495
Displacement1 in mm	0.00131926 at Node: 9658	0.332113 at Node: 139
Equivalent Strain1	0 at Element: 8041	0.002456 at Element: 6554

4.9.1 Study results analysis on steel at speed 52 km/hr
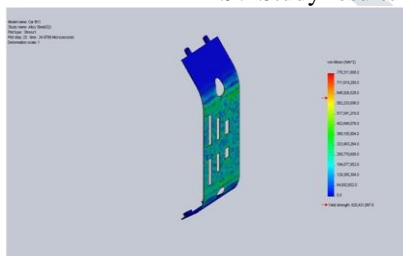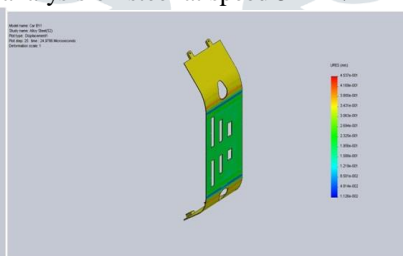

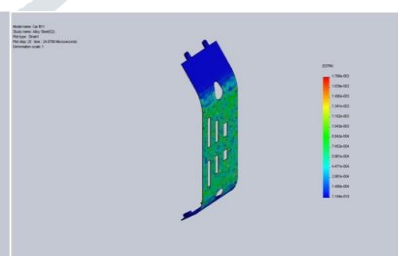Fig.4.9(a). Stress-Stress1   Fig 4.9.9(b) Displacement   Fig 4.9.9(c) Strain

4.10 STUDY RESULTS ON ABS POLYCARBONATE AT SPEED 52 KM/HR

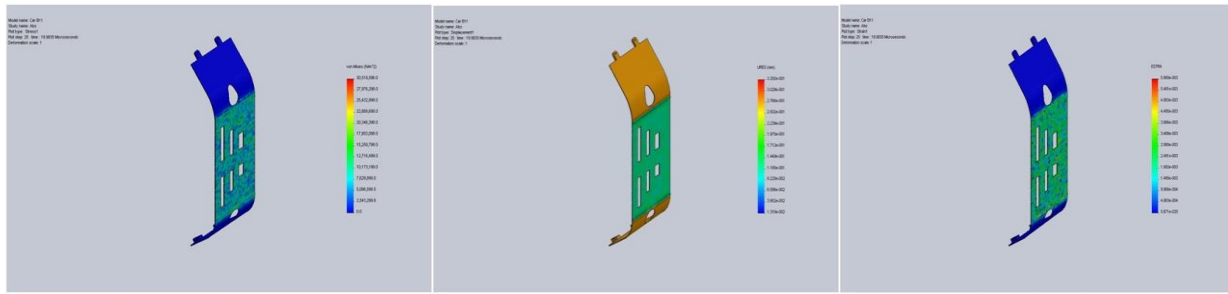| Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	1.60574e-010 at Node: 3270	3.05196e+007 at Node: 1353
Displacement1 in mm	0.0131812 at Node: 10675	0.329239 at Node: 17961
Equivalent Strain1	0 at Element: 6718	0.00597955 at Element: 8262

Table 4.10 Study Results On plastic at Speed 52 Km/hr

| Fig 4.10(a) Stress | Fig 4.10(b) Displacement | Fig 4.10(c) Strain |

4.11 STUDY RESULTS ANALYSIS ON POLYPROPYLENE AT SPEED 52 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	1.86075e-010 at Node: 3174	1.96205e+007 at Node: 1353
Displacement1 in mm	0.0271855 at Node: 10754	0.401704 at Node: 13
Equivalent Strain1	0 at Element: 2790	0.00909436 at Element: 6447

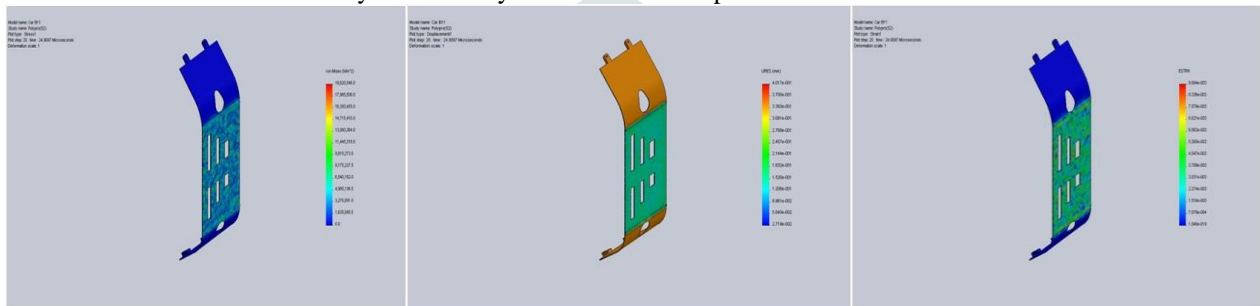Table 4.11study results analysis on architect at speed 52 km/hr

| Fig 4.11(a) Stress | Fig 4.11(b) Displacement | Fig 4.11(c) Strain |

4.12 STUDY RESULTS ON ALLOY STEEL(SS) AT SPPED 80 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	8.05518e-008 at Node: 17825	1.26059e+009 at Node: 12266
Displacement1 in mm	0.0181144 at Node: 10720	0.726922 at Node: 283
Equivalent Strain1	2.8198e-019 at Element: 3569	0.0028702 at Element: 8308

Table 4.12 Study results on steel at 52 Km/hr

| Fig.4.12(a)Stress | Fig.4.12(b).2-Displacement | Fig.4.12(c)-Strain |

4.13 STUDY RESULTS ON ABS POLYCARBONATE AT SPEED 80 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	2.93771e-010 at Node: 16240	4.89228e+007 at Node: 1353
Displacement1 in mm	0.0108404 at Node: 1364	0.527836 at Node: 17971
Equivalent Strain1	1.41844e-019 at Element: 7325	0.00934339 at Element: 6534

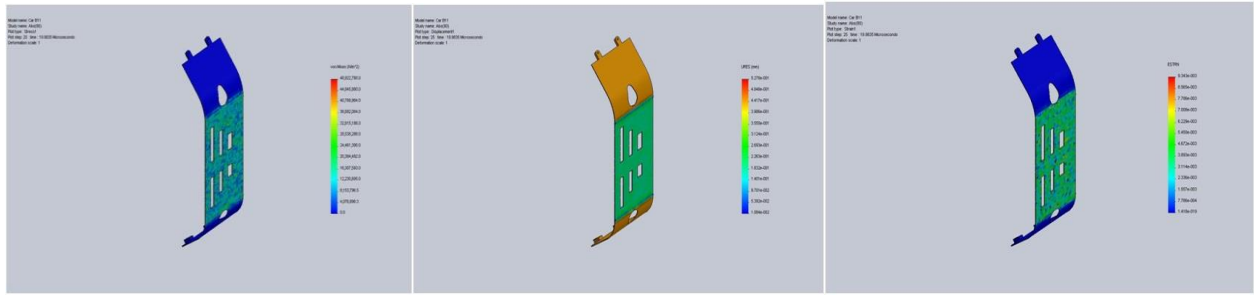Table 4.13 Study Results on plastic at speed 80 Km/hr

| Fig.4.13(a) stress1 | Fig.4.13(b) Displacement1 | Fig.4.13(c) Strain1 |

4.14 STUDY RESULTS ANALYSIS ON POLYPROPYLENE AT SPEED 80 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	2.58814e-010 at Node: 7363	2.9801e+007 at Node: 1397
Displacement1 in mm	0.0402709 at Node: 10724	0.634355 at Node: 17969
Equivalent Strain1	0 at Element: 4743	0.0157658 at Element: 4590

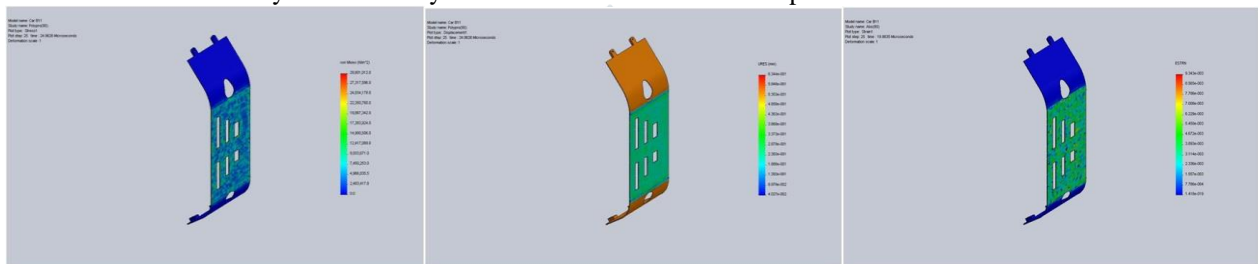Table 4.14 Study Results Analysis on POLYPROPYLENE At Speed 80 Km/hr

| Fig.4.14(a) stress-Stress | Fig.4.14 (bDisplacement | Fig.4.14(c) Strain |

4.15 STUDY RESULTS ON STEEL AT SPEED 150 KM/HR

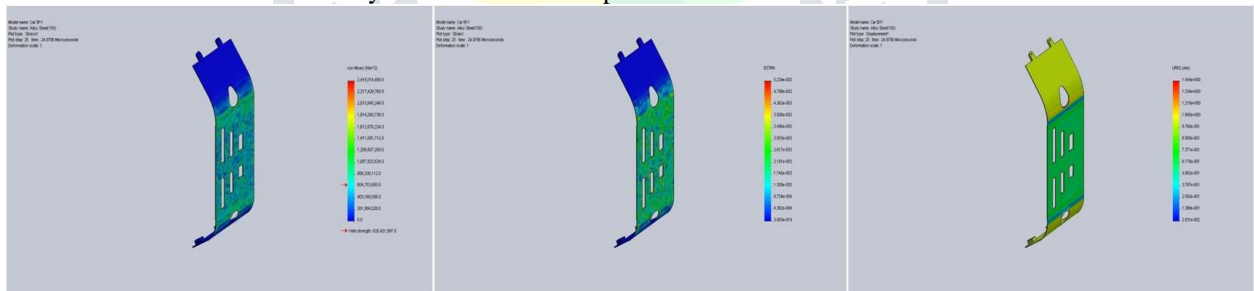| Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	8.84318e-008 at Node: 16638	2.41901e+009 at Node: 12266
Displacement1 in mm	0.0203119 at Node: 15415	1.45386 at Node: 10
Equivalent Strain1	0 at Element: 151	0.00523442 at Element: 8308

Table 4.15 Study Results on steel at Speed 150 Km/hr

| Fig.4.15(a) stress | Fig.4.15(b)Displacement | Fig.4.15(c)Strain |

4.16 STUDY RESULTS ON ABS POLYCARBONATE AT SPEED 150 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	7.98897e-010 at Node: 7528	9.42615e+007 at Node: 1037
Displacement1 in mm	0.0278332 at Node: 10742	1.30994 at Node: 17976
Equivalent Strain1	0 at Element: 4705	0.0192945 at Element: 4684

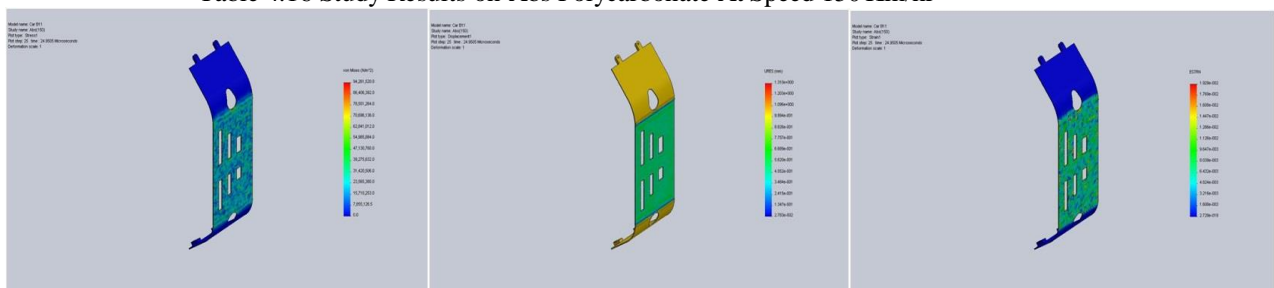Table 4.16 Study Results on Abs Polycarbonate At Speed 150 Km/hr

| Fig.4.16(a) stress | Fig.4.16(b)Displacement | Fig.4.16(c)Strain |

4.17 STUDY RESULTS ON POLYPROPYLENEAT SPEED 150 KM/HR

Name	Min	Max
Von Mises Stress1 in N/mm^2 (MPa)	2.76686e-010 at Node: 16995	5.65871e+007 at Node: 1397
Displacement1 in mm	0.0244123 at Node: 15789	1.18381 at Node: 14
Equivalent Strain1	0 at Element: 589	0.0295684 at Element: 3487

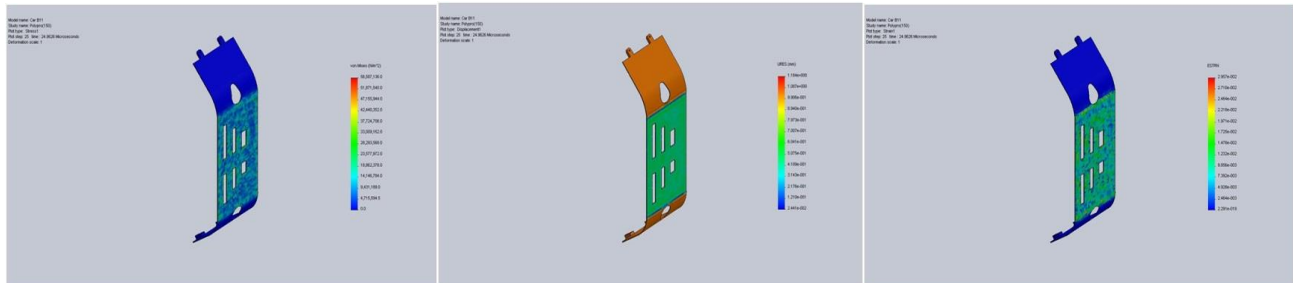Table 4.17.Study Results on POLYPROPYLENE at Speed 150 Km/hr

Fig.4.17(a) stress	Fig.4.17(b) Displacement	Fig.4.17(c) Strain

4.18 RESULTS COMPARISON BETWEEN VARIOUS MATERIALS

After the solution has been obtained, there are many ways to present 'COSMOS' results, choose from many options such as tables, graphs, and contour plots.

MATERIAL	SPEED	STRESS IN N/mm^2	DISP IN mm	STRAIN
Alloy Steel (SS)	52 Km/hr	776.312	0.453745	0.00178841
	80 Km/hr	1260.59	0.726922	0.0028702
	150 Km/hr	2419.01	1.45386	0.00523442
ABS POLYCARBONATE	52 Km/hr	30.5196	0.329239	0.00597955
	80 Km/hr	48.9228	0.527836	0.00934339
	150 Km/hr	94.2615	1.30994	0.0192945
Polyprolyene Copolymer (PP)	52 Km/hr	19.6205	0.401704	0.00909436
	80 Km/hr	29.801	0.634355	0.0157658
	150 Km/hr	56.5871	1.18381	0.0295684

Table4.18. Present the Result

CONCLUSION

The study of impact {of different|of numerous} parameters on impact behavior of antimonial bumper in various rate impact ends up in the subsequent conclusions will be drawn from the current work:

In this Finite part modelling of the bumper testing throughout frontal collision was performed in keeping with FMVSS and IIHSS standards. at the start the bumper specification was taken from normal railway car bumper beam and modelled victimisation UNIGRAPHICS computer code. Impact analysis is completed on the automotive bumper for various speeds of 52Km/hr, 80Km/hr,150km/hr.

The analysis is additionally automotiveried on the car bumper for various materials S2 Glass epoxy and Carbon Fiber-Reinforced Poly- Ether-Imide architect. at this time the fabric used for automotive bumper is steel. Steel is commutation with plastic and Carbon fiber – bolstered Poly-Ether-Imide architect.

Present used material for automotive bumper is steel. By victimisation steel the burden of the automotive   bumper is additional however by victimisation composites the burden of the bumper is reduced   since densities ar terribly less compared

with steel. By victimisation plastic, the weight {is virtually|is nearly|is sort of} reduced by 4Kgs and by victimisation architect it's almost reduced by 5Kgs.

The density of plastic and architect is a smaller amount than that of steel, thereby the general weight of automotive bumper is reduced.

By observant the analysis results, the analyzed stress values once steel and architect ar used ar safe once wedged at a speed of 52km/hr, however the strain values for those materials once wedged at a speed of 150km/hr isn't safe since their analyzed stress values ar over their various yield stress values. however the analyzed stress worths once plastic is employed wedged at each the speeds is safe since the strain values ar but its yield stress value. thus we will conclude that victimisation plastic is best.

REFERENCE

1. Mohapatra S,"Rapid style Solutions for Automotive Bumper Energy Absorbers victimisation Morphing Technique", binary star CAE users Conference 2005, Bangalore, India.
2. Andersson R, Schedin E, Magnusson C, Ocklund J, "The pertinence of tainless Steel for Crash interesting Components", SAE Technical Paper, 2002.
3. Carley ME, Sharma AK, Mallela V,"Advancements in distended plastic foam energy management for bumper systems", SAE Technical Paper, 2004
4. Plastic engineering by r.k.crawford
5. Plastic engineering from society of plastic engineers
6. Plastics engineering, producing book of facts by chicken v. Rosato
7. M.M Davoodi, S.M Sapuan, R. Yunus.. "Conceptual style of a compound composite automotive bumper energy absorber". Elsevier Ltd 2007
8. M.M Davoodi, S.M Sapuan, R. Yunus.. "Conceptual style of a compound composite automotive bumper energy absorber". Elsevier Ltd 2007
9. Marzbanrad JM, Alijanpour M, Kiasat MS,"Design and analysis of automotive bumper beam in low speed frontal crashesh", skinny walled Struct., 47 (2009), pp. 902
10. Evans D, Morgan T,Engineering Thermoplastic Energy for Bumpers", SAE Paper, 1999.
11. Witteman WJ,"Improved Vehicle Crashworthiness style by management of the Energy
12. Absorption for various Collision Situations", academic degree thesis, Eindhoven University of Technology, 2000.
13. Cheon S S, Choi JH, LeeDG. Development of the composite bumper beam for traveler cars.JComposStruct1995; 32:4919.
14. Reid SR, Zhou G. Impact behavior of fiber-reinforced composite materials and structures. England: Wood head publishing; 2000.
15. Maeda R, Ueno S, Uda K, Matsuoka T. Strength check of Al alloy bumper for automobile. Furukawa Review 1994(13).
16. Cheon SS, Dai GL, Jeong KS. Composite side-door impact beam for traveler cars. J Compos Struct 1997; 38:229–39.
17. Cheon SS, Lim TS, Lee TS. Impact energy absorption of optical fibre hybrid composites. J Compos Struct 1999; 46:267–78.
18. Feng ZS, feng SQ. analysis of CA1092 automotive body lightening. J Automob Technol momma 2002;58–62:8–