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Polypropylene Using Fabrication of Industrial Workers Safety Helmet

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Abstract: *All helmets attempt to protect the user's head by absorbing mechanical energy and protecting against penetration. Their structure and protective capacity are altered in high-energy impacts. Beside their energy-absorption capability, their volume and weight are also important issues, since higher volume and weight increase the injury risk for the user's head and neck. Every year many workers are killed or seriously injured in the construction industry as a result of head injuries. Wearing an appropriate safety helmet significantly reduces the risk of injury or even death. Protective headwear could save your life. The aim of the project is to increase the strength of industrial helmet by making the modify material in existing one*.

I. INTRODUCTION

A composite material is made by combining two or more materials to give a unique combination of properties, one of which is made up of stiff, long fibres and the other, a binder or 'matrix' which holds the fibres in place. Composites can be stated that the composites should not be regarded simple as a combination of two materials. In the broader significance; the combination has its own distinctive properties. In terms of strength to resistance to heat or some other desirable quality, it is better than either of the components alone or radically different from either of them.

Composite materials as heterogeneous materials consisting of two or more solid phases, which are in intimate contact with each other on a microscopic scale. They can be also considered as homogeneous materials on a microscopic scale in the sense that any portion of it will have the same physical property**.**

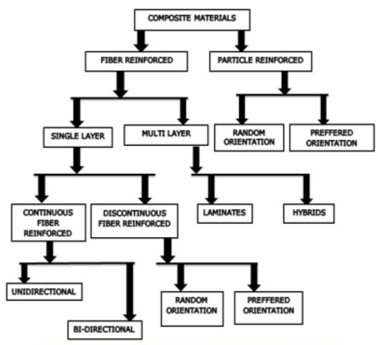
II. CLASSIFICATION COMPOSITE MATERIAL

The two broad classes of composites are

- Particulate composites
- Fibrous composites.

Particulate Composites

A particulate composite is composed of particles suspended in a mixture.As the name signifies itself that reinforcement is of particle nature. It may be spherical, cubic, tetragonal, a platelet, or other shape, but it is approximately equal. Normally, particles that are not very effective in improving fracture resistance; they increase the stiffness of the composite to a limited extent.There are two subclasses of particulates, flake and filled/skeletal. A flake composite is generally composed of flakes with large ratios of platform area to thickness, suspended in a matrix material. A filled composite is composed of a continuous matrix filled. Particle fillers are widely used to improve the properties of matrix materials to modify the thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface hardness and reduce shrinkage.



Fibrous Composites

A fiber is defined by its length which is much greater than its cross-sectional dimensions. Fibers are very effective in improving the fracture resistance of the matrix because reinforcement having a long dimension opposes the growth of cracks normal to the reinforcement that might otherwise lead to failure, particularly with brittle matrices. Fibers, because of their small cross- sectional dimensions, are not directly usable in engineering applications. They are, therefore, embedded in matrix materials to form fibrous composites. The matrix serves to bind the fibers together, transfer loads to the fibers and protect them against environmental attack and damage due to handling. Fibrous composite can be subdivided into - continuous fiber (large aspect ratio), discontinuous (short) fiber (low aspect ratio) and hybrid.

Continuous Fibers

Continuous fiber composites can be either single layer or multilayered. The single layer continuous fiber composites can be either unidirectional or woven, and multilayered composites are generally referred to as laminates. The material response of a continuous fiber composite is generally orthotropic. .

Natural Fibre Composites

Natural fibre composites mostly consists fibres of jute, cotton, hemp and non-conventionalfibres such as coir and many empty fruit bunches. Natural fibre thermoplastic composites are attractive as they are cheaper, stiffer, paintable, rot-resistant and also can be given the look of wood in addition to all this they have more life-cycle.. These composites are gaining importance due to their non-carcinogenic and bio-degradable nature. Natural fibre composites are very cost effective material especially in building and construction purpose packaging, automobile and railway coach interiors and storage devices. These can be potential candidates for replacement of high cost glass fibre for low load bearing applications. However, the main disadvantages of natural fibers and matrix and the relative high moisture absorption. Therefore, chemical treatments are considered in modifying the fiber surface properties.

Metal Matrix Composites

Metal matrix composites, as the name implies, have a metal matrix. Examples of matrices in such composites include aluminum, magnesium and titanium. The typical fiber includes carbon and silicon carbide. Metals are mainly reinforced to suit the needs of design. For example, the elastic stiffness and strength of metals can be increased, while large co-efficient of thermal expansion, and thermal and electrical conductivities of metals can be reduced by the addition of fibers such as silicon carbide.

Ceramic Matrix Composites

Ceramic matrix composites have ceramic matrix such as alumina, calcium, alumina silicate reinforced by silicon carbide. The advantages of CMC include high strength, hardness, high service temperature limits for ceramics, chemical inertness and low density. Naturally resistant to high temperature, ceramic materials have a tendency to become brittle and to fractureThere are four classes of ceramics matrices: glass (easy to fabricate because of low softening temperatures, include borosilicate and alumino silicates), conventional ceramics (silicon carbide, silicon nitride, aluminum oxide and zirconium oxide are fully crystalline), cement and concreted carbon components.

III. MATRIX MATERIALS

The matrix acts as a binder for the reinforcement while controlling the physical shape and dimensions of the part. Its primary purpose however is to transfer the load, or stress, applied to the part to the reinforcement. The matrix also protects the reinforcement from adverse environmental effects. The reinforcement's function is to enhance the mechanical properties of the composite and is typically the main load bearing element. Reinforcements are usually in the form of either fibers or particles. Matrix and reinforcement materials can be polymers, metals, ceramics, or carbon.

Some of the common thermoset matrix materials (resins) include:

i) Polyester Resins
ii) Vinyl Ester Resin
iii) Phenolic Resin
iv) Epoxy
v) Polyimide

Fabrications Methods Of Composite Materials.

i) Hand-lay-up method
ii) Spray-up method
iii) Compression moulding
iv) Resin injection moulding

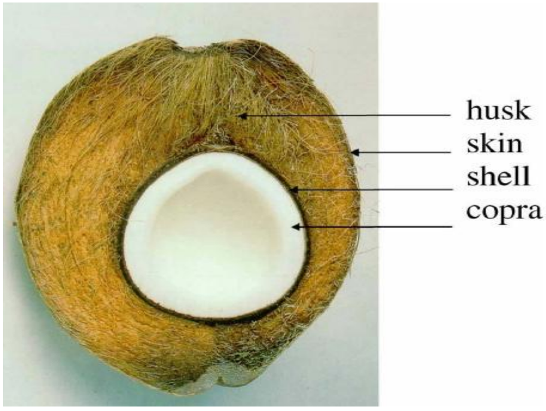
Material To Be Used In The Industrial Workers Safety Helmet

Raw materials to be used in safety helmet are listed below:

1. Coconut fiber
2. Banana fiber
3. Epoxy resin

Coconut Fiber

Coconut palms are mainly obtained from tropical regions of the world and the product form the coconut are applied in food and non-food products, which sustain the livelyhood of people all over the world. The coconut palm comprises of a white meat which has a total percent by weight of 12 and 35 respectively . The husk from the coconut palm comprises 30% weight of fiber and 70% weight of pith material.



Chemical Composition Of Coir

A better understanding of the chemical composition and surface adhesive bonding of natural fibre is necessary for developing natural fibre-reinforced composites. The components of natural fibres include cellulose, hemicelluloses, lignin, pectin, waxes and water soluble substances. The composition may differ with the growing condition and test methods even for the same kind of fibre. Cellulose is a semi crystalline polysaccharide made up of D-glucopyranose units linked together by β-(1-4)-glucosidic bonds and the large amount of hydroxyl group in cellulose gives natural fiber hydrophilic properties when used to reinforce hydrophobic matrix; the result is a very poor interface and poor resistance to moisture absorption . The first function is to react with hydroxyl group of cellulose and the second is to react with functional groups of the matrix.

Sr.No	Chemical composition	Percentage
1	Hemi-cellulose	31.1
2	Cellulose	33.2
3	Lignin	20.5

Coconut Fibre Properties	
Density (kg/m^3)	1288
Tensile strength (M pa)	3-13
Young's modulus (G pa)	4-6
Poison ratio	0.3

Advantages

- It is a renewable resources and CO_2 neutral material.
- The fiber is abundant, non- toxic in nature, bio-degradable, low density and cheap.
- The fiber has a high degree of retaining water and also rich in micro nutrients.

Banana Fiber

Banana fiber, a ligno-cellulosic fiber, obtained from the pseudo-stem of banana plant (Musa sepientum), is a bast fiber with relatively good mechanical properties. The ‘‘pseudo-stem’’ is a clustered, cylindrical aggregation of leaf stalk bases. Banana fiber at present is a waste product of banana cultivation and either not properly utilized or partially done so. The extraction of fiber from the pseudo stem is not a common practice and much of the stem is not used for production of fibers. This is reflected from the relatively expensive price of banana fibers when compared to other natural fibres. The buyers for banana fibers are erratic and there is no systematic way to extract the fibres regularly. Useful applications of such fibers would regularize the demand which would be reflected in a fall of the prices.

Sr.No	Constitutents	Percentage
1.	Cellulose	31.27
2.	Lignin	15.07
3.	Moisture	9.74
4.	Ashes	8.65

BANANA FIBRE PROPERTIES	
Density (kg/m^3)	1101
Tensile strength (M pa)	22-26
Young’s modulus (G pa)	7.7-20
Poison ratio	0.3

IV. INDUSTRIAL WORKERS SAFETY HELMET

Introduction

A helmet is a form of protective gear worn on the head to protect it from Injuries. Ceremonial or symbolic helmets (e.g., English policeman's helmet) without protective function are sometimes used. The oldest known use of helmets was by Assyrian soldiers in 900BC, who wore thick leather or bronze helmets to protect the head from blunt object and sword blows and arrow strikes in combat. Soldiers still wear helmets, now often made from lightweight plastic materials.

In civilian life, helmets are used for recreational activities and sports (e.g., jockeys in horse racing, American football, ice hockey, cricket, and rock climbing); dangerous work activities (e.g., construction, mining, riot police); and transportation. (e.g., Motorcycle helmets and bicycle helmets). Since the 1990s, most helmets are made from resin or plastic, which may be reinforced with fibers such as aramids.Some helmets have other protective elements attached to them, such as a face visors or goggles or a face cage, and ear plugs and other forms of protective headgear, and a communications system. Sports helmets may have an integrated metal face protector .

Head Protection

Hard hats can protect employees from head impact, penetration injuries, and electrical injuries such as those caused by falling or flying objects, fixed objects, or contact with electrical conductors. Employees must cover and protect long hair to prevent it from getting caught in machine parts such as belts and chains.

Inspection And Care

- A daily inspection of the hard hat shell, suspension system, and other accessories for holes, cracks, tears, or other damage that might compromise the protective value of the hat is essential.
  Paints, paint thinners, and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats.

Parts Of Industrial Workers Safety Helmet

- Brim
- Chin strap
- Crown strap
- Head band
- Peak

Definitions Of The Parts

1.Brim

An integral part of the shell extending outward over the entire circumference toProtect the face, Neck and shoulders.

2.Chin Strap

An adjustable strap. Attached directly or indirectly to the shell and fitting under secure the helmet to the head.

3.Crown Strap

That part of the suspension which passes over the head

4.Head B

That part of the suspension which encircles the head. Helmet. A rigid device that is worn to provide protection for the head or portions thereof against impact Flying particles or electric shock or any combination thereof: and which is held in place by a suitable suspension.

5.Peak

An integral part of the shell extending forward over the eyes only.

Dimensions Of The Helmet According To Bsen 397:1995

Sr.No	**Parts**	**Dimensions**
1	External vertical distance	not more than 80 mm.
2	Internal vertical distance	not more than 50 mm
3	Horizontal distance	not less than 5 mm.
4	Wearing height	80 mm for helmets mounted onheadform
5	Cradle	width shall be not less than 15 mm

V. INDUSTRIAL WORKERS SAFETY HELMET MODEL

Introduction To Pro-E Software

Creo Elements/Pro (formerly Pro/ENGINEER), PTC's parametric, integrated 3D CAD/CAM/CAE solution, is used by discrete manufacturers for mechanical engineering, design and manufacturing. Created by Dr. Samuel P. Ginsberg in the mid-1980s, Pro/ENGINEER was the industry's first successful rule-based constraint (sometimes called "parametric" or "vibrational") 3D CAD modeling system. The parametric modeling approach uses parameters, dimensions, features, and relationships to capture intended product behavior and create a recipe which enables design automation and the optimization of design and product development processes.

Companies use Creo Elements/Pro to create a complete 3D digital model of their products. The models consist of 2D and 3D solid model data which can also be used downstream in finite element analysis, rapid prototyping, tooling design, and CNC manufacturing.The capabilities of the product can be split into the three main headings of Engineering Design, Analysis and Manufacturing. This data is then documented in a standard 2D production drawing or the 3D drawing standard ASME Y14.41-2003. . All data are associative and interchangeable between the CAD, CAE and CAM modules without conversion. A product and its entire bill of materials (BOM) can be modeled accurately with fully associative engineering drawings, and revision control information.

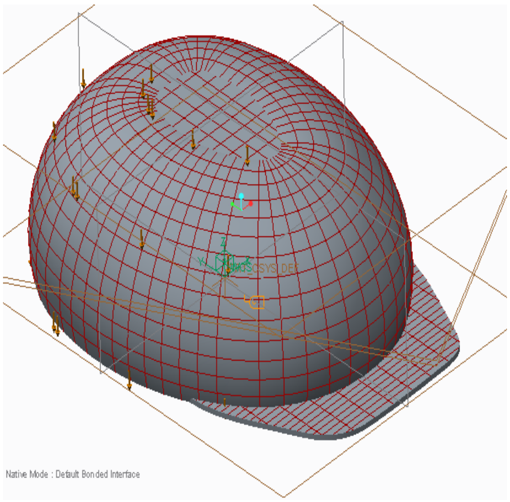
Engineering Design

Creo Elements/Pro offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface.

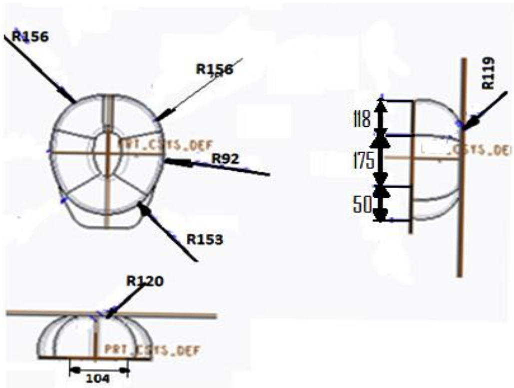
Analysis

Creo Elements/Pro has numerous analysis tools available and covers thermal, static, dynamic and fatigue finite element analysis along with other tools all designed to help with the development of the product. These tools include human factors, manufacturing tolerance, mould flow and design optimization. The design optimization can be used at a geometry level to obtain the optimum design dimensions and in conjunction with the finite element analysis.

Steps To Create The Helmet In Pro-E
Step1: All dimensions should be noted down clearly in.
Step2: As per the dimensions and the shape of the helmet, helmet model is designed
Step3: Here helmet thickness is increased to 5mm to check whether the helmet withstand the applying load or not.
Step4: Then save the created model..



Detailed Diagram Of The Industrial Workers Safety Helmet

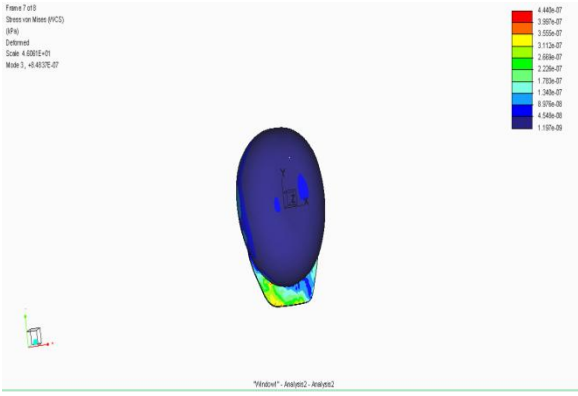


VI. ANALYZING THE INDUSTRIAL WORKERS SAFETY HELMET

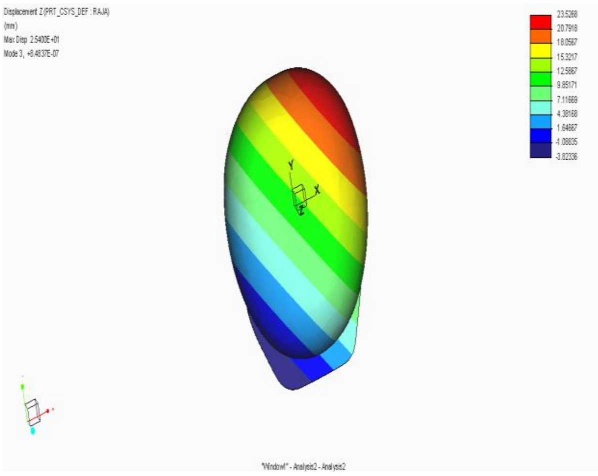
Steps To Analyze The Deisgned Model
Step1: After importing the pro-e model into the pro-e analysis page, bottom surface of thehelmet is kept fixed.
Step2: 25N load is applied on the helmet at left side. The applied is approximately equal to one brick.
Step3: Material properties are given to the material assignment (1.Nylon, 2.Natural fiber) as shown in the table.
Step4: Mesh the entire surface of the helmet
Step5: Then analyze the model using analyzing structure.
Step6: Then obtain the results from the result review page
Step7: Properties to be required is entered on the displaying menu.
Step8:then required result is displayed in separate menu.

Materials	**Properties**			
	Density (kg/m^3)	**Tensile strength(M pa)**	**Young's modulus (G pa)**	**Poison ratio**
Polypropylene	1140	55-83	1.2-2.9	0.4
Coconut fiber	1288	3-13	4.0-6.0	0.3
Banana fiber	1101	22-26	7.7-20.0	0.3

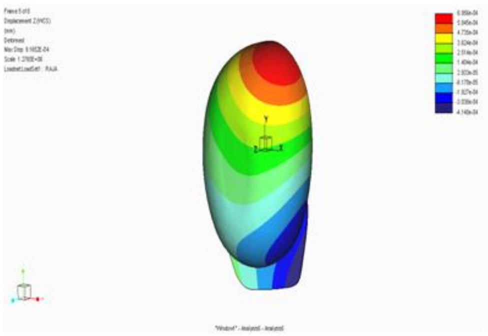
Von-Misses Stress Analysis For The Industrial Workers Safety Helmet Made Of Polypropylene
The properties of the polypropylene are given as input to Analyze the designed model of the helmet. The output of the model is obtained. Von-misses stress and displacement of the designed model is obtained.



Maximum von-misses stress =4.4 e^{-7}kPa
Minimum von-misses stress =1.197e^{-9}kPa



Displacement analysis for safety helmet made of polypropylene
Maximum Displacement =23.5268mm
Minimum Displacement =1.64667mm



Displacement analysis of the safety helmet made of banana fiber and coir
Maximum Displacement =6.89 e^{-2}mm
Minimum Displacement =4.148e^{-2}mm

Comparing The Analysed Results Of Natural Fiber Helmet And Polypropylene Helmet

Helmet materials	Properties	
	Von misses stress (kPa)	**Displacement (mm)**
Polypropylene (existed material)	$4.4e^{-7}$	23.42
Natural fiber	0.08248	$6.89\ e^{-2}$

The table 8.1 shows the Results of the natural fiber helmet and polypropylene helmet are determined using the Pro-E software. Displacement in the polypropylene helmet shows less displacement and natural fiber shows greater displacement than polypropylene.

VII. SCOPE OF THE FUTURE WORK

Now analysis for natural fiber helmet is completed. On Phase-II fabrication of helmet is to be done and testing to be done on helmet whether it withstand heavy load or not.

Sr.no	Testing	Testing equipment
1.	Impact test	Impact test machine
2.	Compressive test	Universal testing machine

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