CHARACTERIZATION OF NFRP COMPOSED OF NON BIODEGRADABLE POLYMER AND CROP RESIDUES MATRIX

A Project Report

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CERTIFICATE

This is to certify that the project report titled, **CHARACTERIZATION OF NFRP COMPOSED OF NON BIODEGRADABLE POLYMER AND CROP RESIDUES MATRIX** submitted to **Anjum-i-islam's Kalsekar Technical Campus, Panvel,** submitted by **Mujawar Abuzar, Khan Rashid, Khan Shoaib, Mansoori Ab Kalam,** In **MECHANICAL ENGINEERING** is the bonafide record of project work done by them under our supervision. The contents of this report, in full or in parts, have not been submitted to any other institute or university for the award of any degree or diploma.

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In the name of Allah, the Most Benevolent, the most Merciful. I wish to record immeasurable gratitude and thankfulness to the One and The Almighty Creator, the Lord and Sustainer of the universe, and mankind in particular. It is only through His mercy and help that this work could be completed and it is ardently desired that this little effort be accepted by Him to be of some service to the cause of humanity.

We wish to thank *University of Mumbai* and A.I. KALSEKAR TECHNICAL CAMPUS for giving us the opportunity to pursue our BE project.

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ABSTRACT

In this work, chemically treated wheat straw fibres were used to reinforce polymer Polypropylene in order to ascertain the effect of the treatments on the mechanical and water absorption properties of the composites produced. Wheat straw fibre was first extracted from its husk by soaking it in water and was dried before it was cut into fibres form. It was then chemically treated in alkali solution of sodium hydroxide (NaOH) and potassium hydroxide (KOH) in a shaker water bath. The treated wheat straw fibres were used as reinforcements in polypropylene matrix to produce composites of varied fibre weight and random fibre orientation were used. Tensile and flexural properties were investigated using universal testing machine while water absorption test was carried out on the samples for 24 hours. It was observed from the results that, NaOH treated samples gave the best tensile properties while KOH treated samples gave the best flexural and water repellent properties.

CHARACTERIZATION OF NFRP COMPOSED OF NON BIODEGRADABLE POLYMER AND CROP RESIDUES MATRIX

CHAPTER 1

INTRODUCTION

1.1 Introduction

Natural fibres are now considered as serious alternative to synthetic fibres for use in various applications in human endeavor. The use of natural fibres as reinforcing materials in both thermoplastic and thermoset matrix composites provide positive environmental benefits with respect to ultimate disposal and best utilization of raw materials. Due to the relatively high cost of synthetic fibres like glass, plastic, carbon and Kevlar that are been used in fibre reinforced composites, and the health hazards of asbestos fibres, it has become necessary to explore natural fibres as source of alternative reinforcement materials for composites development. Natural fibres produced from renewable resources, are biodegradable and relatively inexpensive compared to the traditionally used synthetic fibres. Fibres of these types, for instance, hemp and flax have been successfully used as packaging material, interior decorations of automobiles and building components among others. Other advantages of natural fibres over traditional reinforcing materials like glass and carbon fibres are their specific strength properties, easy availability, light weight, ease of separation, enhanced energy recovery, high toughness, non-corrosive nature, low density, low cost, good thermal properties, reduced tool wear, reduced dermal and respiratory irritation, less abrasion to processing equipment, renewability and bio-degradability. In light of this, researchers have focused their attention on natural fibre composites for various engineering applications. Accordingly, manufacturing of high-performance engineering materials from renewable resources have been pursued by researchers across the globe because renewable raw materials are environmentally sound and do not cause health problem.

However, high moisture sorption, low strength and poor compatibility of natural fibres in matrix have restricted their use in engineering applications. These problems can be solved by carrying out chemical treatments on fibres before being used as reinforcements for composites development. Commonly used chemical treatments for fibre modification are alkalization, silane, acrylation, maleic acid, acetylation and benzoylation. This present work aimed to contribute to knowledge by investigating the effect of alkali treatments of selected natural fibre on the mechanical and water absorption properties of the developed composites.

In this work, Homopolymer Polypropylene, a thermoplastic polymer was used as the matrix while wheat straw fibre was used as reinforcement to develop the composites using compression moulding process. The effect of alkali treatment of coconut fibre using sodium hydroxide (NaOH) and potassium hydroxide (KOH) was investigated on the flexural, tensile, impact and water absorption properties of the developed composites.

1.2 Project Motivation

When we were in 3rd of engineering we did some researches on utilization of waste material to make some useful products and came across the conclusion that there should be a make of composites which directly or indirectly can be of some used without wasting the material or things.

We early researched on wastage material of wood for decorative purpose. This time we got something new called used of natural fibre to reinforced the polymer matrix. So to enhance in science and material technology, used of waste fibres which were burnt and emits harmful gases like greenhouse gases (CO_2, N_2O, CH_4), air pollutants (CO, NH_3, NO_x, SO_2, NMHC, volatile organic compounds), particulates matter and smoke thereby posing threat to human health. Collectively we had studied all of the papers regarding this study and found it cool to make a composites. Although many types of composites are made and used but this type of matrix is bit different including fibre orientation, molding process, combination process, etc.

So we finally decided to make a wheat straw fibre composed of polypropylene matrix to check the mechanical properties that is impact, tensile, and flexure properties. Also to check and compare the water absorption level of the composite. And at the very first month of 7th sem we started working on it.

1.3 Problem Definition

Despite having outcomes of the composites, we faced many different types of problems not focusing on all of them, but the two main problems are as follows: -

Mold Failure

Very firstly we had made a wooden mold in wood saw cutting machine with a precise dimension as per the ASTM standards to make samples of composites for testing. Molds prepared so many efforts tend the samples to produce with the cracks and blow holes in it due to wood properties. So we used metals to make the molds with the help of CNC milling machine to get the best finish in order to prevent the failure. Thus we had achieved a great success to make the samples for testing with an accurate dimension as per ASTM standards.

fig 1: Wooden molds

Polymer Failure

The polymer we used first is recycled HDPE which was unsuccessful to produce the samples in metallic molds. Recycled HDPE released chemical foams which generates the cracks and air pockets and also some times blow holes in the composites samples, so we decided to select the fresh raw material as a HDPE granules, but in case of fresh HDPE granules when composed with the fibres and compessed in the compression molding machine got weaked and tend to breaks the composite sample before it can removed from the mold.

So we again had select the next polymer matrix called PP Polypropelyne and successfully achieved our aim. Thus, this is how we faced and came through out the difficulties to make our research study into useful experiments.

Fig 2: HDPE failure

1.4 Objectives

I. To make the use of waste crop residues

II. To produce the useful composite, hence enhances the level in material and science technology, hereby increasing the employment opportunities.

III. It reduces the air pollution, and global warming causes due to burning of wheat straw residues.

CHAPTER 2

LITERATURE REVIEW

2.1 Natural Fibre

Natural fiber reinforced composites is an emerging area in polymer science. These natural fibers are low cost fibers with low density and high specific properties. These are biodegradable and non-abrasive. The natural fiber composites offer specific properties comparable to those of conventional fiber composites. However, in development of these composites, the incompatibility of the fibers and poor resistance to moisture often reduce the potential of natural fibers and these draw backs become critical issue. This review presents the reported work on natural fiber reinforced composites with special reference to the type of fibers, matrix polymers, treatment of fibers and fiber-matrix interface.

Comparing natural fibre and other reinforced composites found that natural fibres were superior in industrial application. Moreover, due to the usage of natural fibres in different engineering application and construction industries, it provides way for economic development in rural areas. The results in the investigation indicate that, there is a possibility to enhance the properties of coconut fibre and palm fibre reinforced composites. But very few investigations carried out on combination of natural fibre reinforced epoxy composites and properties. Literature showed that there was no much information available on combination of coconut fibre and palm fibre to find the dynamic properties of the composites. Development of a suitable hybrid with a known stacking sequence will have applications in automotive industry for weight and cost reduction; this leads way for the investigation on mechanical properties of coconut fibre and palm fibre reinforced epoxy hybrid composites by using hand layup method.

Burning of crop residues

Open crop stubble burning events were observed in and around Patiala city, India. A ground level study was deliberated to analyze the contribution of **wheat** (Triticum aestivum) and **rice** (Oriza sativa) crop stubble burning practices on concentration levels of aerosol, SO2 and NO2 in ambient air at five different sites in and around Patiala city covering agricultural, commercial and residential areas. Aerosols were collected on GMF/A and QMF/A (Whatman) sheets for a 24 h period throughout the year in 2017. Simultaneously, sampling of SO2 and NO2 was conducted and results obtained during stubble burning periods were compared to the non-stubble burning periods. Results clearly pointed out a distinct increase in aerosol, SO2 and NO2 levels during the crop stubble burning periods.

Agricultural crop residue burning contribute towards the emission of greenhouse gases (CO2, N2O, CH4), air pollutants (CO, NH3, NOx, SO2, NMHC, volatile organic compounds), particulates matter and smoke thereby posing threat to human health. Total amount of residue generated in 2018–19 was 620 Mt out of which ~15.9% residue was burnt on farm. Rice straw contributed 40% of the total residue burnt followed by **wheat straw** (22%) and sugarcane trash (20%). Burning of crop residues emitted 8.57 Mt of CO, 141.15 Mt of CO2, 0.037 Mt of SOx, 0.23 Mt of NOx, 0.12 Mt of NH3 and 1.46 Mt NMVOC, 0.65 Mt of NMHC, 1.21 Mt of particulate matter for the year 2018–19. The variability of 21.46% in annual emission of air pollutants was observed from 2000 to 2019.

From the above reasons **wheat straw** as a natural fibre is used to composed with polymer matrix PP polypropylene to test the mechanical and water absorption properties of the composite.

2.2 List of papers

PAPER TITLE	MATERIAL	ABSTRACT	IMPORTANT/ CONCLUSION	DATE
Natural Fiber Polymer Composites: A Review	Natural fibres	The incompatibility of the fibers and poor resistance to moisture often reduce the potential of natural fibers.This review presents the reported work on natural fiber reinforced composites with special reference to the type of fibers, matrix polymers, treatment of fibers and fiber-matrix interface.	THE PAPER CONSIST OF TYPES AND CHEMICAL COMPOSITION OF NATURAL FIBRE. ALSO INCLUDES A STUDY OF THERMAL STABILITY, MOISTURE CONTENT, BIODEGRADATION AND PHOTODEGRADATION, Dispersion of the Fibers in the Matrix, Chemical Treatments Used for Modification of Natural Fibers, Mechanical Properties of Natural Fiber Composites, THERMOSET COMPOSITES, THERMOPLASTIC COMPOSITES, Chemcal composition.	2012
Ambient air quality during wheat and rice crop stubble burning episodes in Patiala	wheat and rice stubble	A ground level study was deliberated to analyze the contribution of wheat (Triticum aestivum) and rice (Oriza sativa) crop stubble burning practices on concentration levels of aerosol, SO2 and NO2 in ambient air at five different sites in and around Patiala city covering agricultural, commercial and residential areas. Results clearly pointed out a distinct increase in aerosol, SO2 and NO2 levels during the crop stubble burning periods.	Wheat stubble burning starts from the middle of April and continues up to mid- May every year in different regions of India, especially Punjab, Haryana and western Uttar Pradesh. After harvesting of these crops a large amount of stubble is left in the fields. Farmers burn this stubble to clear the fields for the next crop. The aerosol load during the wheat stubble burning months (April and May) was very high. The level increased from 217 mg m 3 in March to 371 mg m 3 in April. Thus a 40% increase was observed in the ambient aerosol level from March to April. An almost similar increase (35%) in the concentration was observed from March to May	2005
Performance of structural concrete with recycled plastic waste as a partial replacement for sand	Performance of structural concrete with recycled plastic waste as a partial replacement for sand	it is proposed to process waste plastic to create a partial replacement for fine sand in a novel mix for structural concrete. In this paper eleven new concrete mixes are evaluated to study five plastic material compositions, three groups of particle sizes, three different aspect ratios, and two chemical treatments and establish an appropriate choice of material to act as partial replacement for sand. The results show that replacing 10% sand by volume with recycled plastic is a viable proposition that has the potential to save 820 million tonnes of sand every year.	**important tables are given which shows the properties and strenght of different polymers such as PET, HDPE, LDPE, etc**	2008

Effect of Rice Husk Surface Modification by LENR the on Mechanical Properties of NR/HDPE Reinforced Rice Husk Composite	rice husk (RH) with alkali	Surface modification of rice husk (RH) with alkali pre-treatment (NaOH solution 5% w/v) was carried out at the initial state to investigate the effect of surface treatment of fibre on the surface interaction between fibre and rubber Result showed that pre treatment of RH treated with 5% NaOH followed by treatment with 10% LENR solution given the maximum interaction between fibre and matrix that gave rise to better mechanical properties of the composites.	**The paper deals with the study of Alkali treatment,LENR Coating, Fibre Surface Treatment, Preparation of Rice Husk Filler, etc.**	2016
EFFECT OF RICE HUSKS AS FILLER IN POLYMER MATRIX COMPOSITES	unsaturated polyester resin (UPR), rice husks	In this study, rice husk-filled polyester composites were produced with rice husks (RH) as the filler and unsaturated polyester resin (UPR) as the matrixThe tensile strength of the RH-filled UPR composites was found to decrease as the filler loading increased;The tensile strength of the RH-filled UPR composites was found to decrease as the filler loading increased;	From this study, it can be concluded that the tensile strength of the composites decreased when the filler loading was increased. This is due to weak interfacial adhesion between the filler and the matrix caused by porosity and micro cracking.	2013
A REVIEW ON NATURAL FIBRE REINFORCED POLYMER COMPOSITES	Natural fibres	Natural fibres are rich in cellulose and they are cheap and available in abundant for polymer reinforcement and it is also a potential alternative to the fibers of glass, carbon and other synthetics materials used for the manufacturing of composites. This review paper summarizes the hybrid composites of natural fibre reinforced polymer characteristics and its applications.	Comparing natural fibre and other reinforced composites found that natural fibres were superior in industrial application. The results in the investigation indicate that, there is a possibility to enhance the properties of coconut fibre and palm fibre reinforced composites. But very few investigations carried out on combination of natural fibre reinforced epoxy composites and properties.	1998
THERMOPLASTI C ELASTOMERS	THERMOPLAS TIC ELASTOMERS	Thennoplastic elastomers are materials that combine the properties of thennoplasticity and rubber-like behaviorn That is, they are processed on conventional plastics equipment, such as injection molders, blow molders, sheet and profile extruders, and so forth, but develo,p their final rubber-like PJQPerties immediately on cooling.	this papers deals with thermoplastic, and their types.	2001

X-ray photoelectron spectroscopy of rice husksurface modi!ed with maleated polypropylene and silane	rice husks	Rice husks were subjected to dry-grinding and steam-explosion to reduce their sizes. Subsequently, the surface of rice husk particles was modi!ed using two di9erent coupling agents, maleated polypropylene (MAPP) and -aminopropyltriethoxysilane (-APS, A-1100) to induce chemical reactions between the husksurface and the coupling agents used.	it involves surface properties of rice husk byusing two di9erent coupling agents, maleated polypropylene (MAPP) and -aminopropyltriethoxysilane (-APS, A-1100) to induce chemical reactions between the husksurface and the coupling agents used. Also differnt typesof treatment and analysis is shown.	2000
Long-term moisture absorption and thickness swelling behaviour of recycled thermoplastics reinforced with Pinus radiata	Pinus radiata wood flou, HDPE, PP polymer	Composite materials were made from Pinus radiata wood flour, and recycled and virgin polyolefin, mainly high density polyethylene (HDPE) and polypropylene (PP) polymer, by using hot-pressing mouldingLong-term water absorption and thickness swelling (TS) kinetics of the composites was investigated with water immersion. It was found that the water absorption and TS increase with wood content and water	The long-term water absorption of the composites panels were monitored by full water immersion over a period of 63 days During this period, the polymers exhibited negligible water absorption while the wood flour induced significant water absorption. Water absorption was the maximum for composites made of wood flour–rHDPE and wood flour–vHDPE with 50 wt.% wood content, having water contents of 19.5% and 23.5%,	2016
Effects of Surface Treatment of Ground Rice Husk on the Polyurethane Based on Castor Oil	PUrice husk composites polyurethane	Polyurethane was composited with rice husk with average particle size less than 200 µm. Ground rice husk was pretreated by steam and sodium hydroxide solution in order to study and evaluate the effect of different surface treatment methods on the properties of the polyurethane composites. Scanning Electron Microscopy (SEM) was used to investigate dispersion and fracture surfaces of the composites. Mechanical test (hardness), Thermogravimetric Analysis (TGA), and Differential Scanning Calorimetry (DSC), were employed to characterise the developed composite materials in details.	The paper consist of Measurement of Glass Transition Temperature, Mechanical Test Microscopy Measurements SEM Analysis TGA of Treated and Untreated Rice Husk Polyurethane SynthesisThermogravimetric Analysis.Results which made PU a good candidate for diverse applications such as parquet, shoe heels and covering the basket, volley and hand ball playgrounds.	2014

BIO-BASED COMPOSITES FROM WASTE AGRICULTURAL RESIDUES: MECHANICAL AND MORPHOLOGICAL PROPERTIES	rice husk and coir pith	This investigation aims to study the potential of waste agricultural residues, such as rice husk and coir pith particulates, as reinforcement in epoxy matrix as an alternative to wood and plastic based components. This investigation suggested the possibility of introducing hybrid bioparticulates obtained from waste agricultural residues in polymer matrix composites.	This paper includes a study of Preparation of bio-composite Flexural strength of bio-particulate composites Mechanical testing and morphological study SEM analysis of fractured surfaces. From the experimental results, it was found that the average tensile, flexural and impact strength values for coir pith and rice husk hybrid bio-particle reinforced epoxy composite were 12.7 MPa, 24.3 MPa and 2.6 J, respectively	2018
Chemical and Thermal Characterization of Potato Peel Waste and Its Fermentation Residue as Potential Resources for Biofuel and Bioproducts Production	potato peel waste (PPW)	The PPW and PPW-FR were characterized by a combination of Fourier transform infrared (FTIR) and nuclear magnetic resonance (NMR) spectroscopies, gas chromatography−mass spectrometry (GC-MS), and thermogravimetric analysis (TGA) to quantify changes after fermentation. Fermentation of PPW resulted in fermentation of starch and concentrating lignin plus suberin and lipids in PPW-FR. TGA analysis showed that decomposition peaks differed for PPW (423 °C) and PPW-FR (457 °C)	Chemical, elemental, and calorific value analyses were performed to obtain base chemical properties of the PPW and PPW-FR materials and establish what classes of components have been removed by fermentation. PPW and PPW-FR compositions, elemental contents, and calorific values are given in Table 1, which were significantly different. The PPW contained approximately 17% starch and 22% nonstarch polysaccharides.	2006
Comparison of rice husk-filled polyethylene composite and natural wood under weathering effects	RHPE composites	The weathering performance of rice husk-filled high-density polyethylene (RHPE) and natural wood was investigated in this study. The injection molded RHPE, in column end-cap (CECap) shapes, was exposed to both natural and accelerated weathering attacks. The durability of RHPE was compared to Kempas wood (Koompassia malaccensis) and neat polyethylene. Wood underwent the greatest losses in properties among the specimens.	This paper deals with the study of Properties of RHPE composite Compounding process Color and optical analysis.	2009
Investigation on emission factors of particulate matter and gaseous pollutants from crop residue burning	rice straw, wheat straw, corn stover, and cotton stalk,	Emission factors have been experimentally determined for aerosols, gaseous pollutants, and water-soluble ions from the simulated domestic burning of four types of crop residues in China: rice straw, wheat straw, corn stover, and cotton stalk. Combustion tower experiments indicate that wheat straw has the highest emission factor	it involves emission factors for various straw types (g/kg), e chemical composition in PM (%), emission factors of crop residues burning (g/kg)	2006

Dimensional stability and mechanical behaviour of wood–plastic composites based on recycled and virgin high-density polyethylene (HDPE)	wood–plastic composites	This paper investigated the stability, mechanical properties, and the microstructure of wood–plastic composites, which were made using either recycled or virgin high-density polyethylene (HDPE) with wood flour (Pinus radiata) as filler. The post-consumer HDPE was collected from plastics recycling plant and sawdust was obtained from a local sawmill. Composite panels were made from recycled HDPE through hot-press moulding exhibited excellent dimensional stability as compared to that made from virgin HDPE	In this work, WPCs were made from both recycled and virgin HDPE with Pinus radiata wood flour. The dimensional stability and mechanical properties, which are important properties in product utilisation, and the microstructure of the fracture surfaces with regards to the coupling agent, wood flour content and plastic types were investigated.	2002
Comparative study of polystyrene/chemically modifed wheat straw composite for green packaging application	wheat straw composite with polystyrene	This paper examined the efect of various chemical pre-treatment procedures in improving surface morphology of wheat straw. Moreover, polystyrene (PS), PS (60 wt%)/native WS (40 wt%), PS (60 wt%)/NaOHtreated WS (40 wt%), PS (60 wt%)/HCl-treated WS (40 wt%), and PS (60 wt%)/ H_2SO_4-treated WS (40 wt%) composite flms were prepared using solution casting method.	this paper consist of Water absorption test, Mechanical testing, Soil burial test, Alkali treatment, Acid treatment	1995
Emission of Air Pollutants from Crop Residue Burning in India	rice straw, wheat straw, corn stover, and cotton stalk,	Agricultural crop residue burning contribute towards the emission of greenhouse gases (CO_2, N_2O, CH_4), air pollutants (CO, NH_3, NO_x, SO_2, NMHC, volatile organic compounds), particulates matter and smoke thereby posing threat to human health. Burning of crop residues emitted 8.57 Mt of CO, 141.15 Mt of CO_2, 0.037 Mt of SO_x, 0.23 Mt of NO_x, 0.12 Mt of NH_3 and 1.46 Mt NMVOC, 0.65 Mt of NMHC, 1.21 Mt of particulate matter for the year 2008–09.	this paper consist of Crop wise production, residue generated and coefficients used for inventory. Crop wise residue generated in various states of India.Crop residues burnt in various states of India in 2008–09.State wise emissions of air pollutants from crop residue burning for the year 2008–09. Loss of nutrients due to burning of crop residues.	2010
Rice straw fiber-reinforced high-density polyethylene composite: Effect of fiber type and loading	rice husk, rice straw leaf, rice straw stem, and whole rice straw	Composite panels using virgin and recycled high-density polyethylene (VHDPE and RHDPE) and five types of natural fibers including four rice straw components (i.e., rice husk, rice straw leaf, rice straw stem, and whole rice straw) and wood fiber as control were made by melt compounding and compression molding. Fiber characteristics and the influences of fiber type and loading rate on HDPE crystallization behavior and composite mechanical properties were investigated	Composites based on virgin and recycled high-density polyethylene and five types of natural fibers were made and their properties characterized This study showed that rice straw fibers can work well with both VHDPE and RHDPE as reinforcing filler. Also, different components of rice straw had no significant influence on mechanical properties of composites	2011
Preparation and properties of recycled HDPE/natural fiber composites	RHDPE/fiber composites	Composites based on recycled high density polyethylene (RHDPE) and natural fibers were made through melt blending and compression molding. The effects of the fibers (wood and bagasse) and coupling agent type/concentration on the composite properties were studied. The use of maleated polyethylene (MAPE), carboxylated polyethylene (CAPE), and titanium-derived mixture (TDM) improved the compatibility between the bagasse fiber and RHDPE, and mechanical properties of the resultant composites compared well with those ofvirgin HDPE composites	this study, RHDPE/fiber (i.e., bagasse and pine) composites were made by melt compounding and compression molding. The influence of coupling agent type and contents on the compounding rheology, RHDPE crystallization behavior, and properties of RHDPE/fiber composites were investigated.	2015
Mechanical properties of soil buried kenaf fibre reinforced thermoplastic polyurethane composites	kenaf fibre reinforced thermoplastic polyurethane composites	A study on mechanical properties of soil buried kenaf fibre reinforced thermoplastic polyurethane (TPU) composites is presented in this paper. Kenaf bast fibre reinforced TPU composites were prepared via melt-mixing method using Haake Polydrive R600 internal mixer. Tensile and flexural properties of the composites were determined before and after the soil burial tests for 20, 40, 60 and 80 days.	Kenaf fibre reinforced TPU composites were prepared and buried in the soils. The properties of the soil buried composites have been studied. The reduction in the tensile properties of kenaf fibre reinforced TPU composites, in natural soil burial tests, was reported. The flexural strength and modulus did not show significant changes after 80 days of soil burial.	2017

Recent progress on natural fiber hybrid composites for advanced applications: A review	natural fiber hybrid composites	Natural fibers, as replacement of engineered fibers, have been one of the most researched topics over the past years. This article intends to cover recent developments from 2013-up to date on hybrid composites, based on natural fibers with other fillers. Hybrid composites preparation and characterization towards their applicability in advanced applications and the current challenges are also presented.	it consist of Classification of the fibers, Natural fibres advantages and their short-comes, Chemical composition of selected vegetable fibres, Synthetic fillers, List of fibres, origin and physical properties	2000
Sustainable thermal insulation biocomposites from rice husk, wheat husk, wood fibers and textile waste fibers: Elaboration and performances evaluation	rice husk, wheat husk, wood fibers and textile waste fibers	Building materials derived from agricultural and industrial waste are becoming more attractive in the civil engineering and architectural applications because of their sustainability and lower environmental impact. In addition, substantial value can be added to the wastes by producing value added products from them. Therefore, four different types of locally available by-products (rice husk, wheat husk, wood fibers and textile waste fibers) were used to produce composites with a biodegradable poly(butylene adipate-co-terephthalate)/poly(lactic acid) (PBAT/PLA) blend binder by hot pressing.	this paper deals with Differential scanning calorimetry, Density and thermal conductivity of the composites. Morphology analysis, Water absorption,	2001
Physical Properties of Wheat Straw Varieties Cultivated Under Different Climatic and Soil Conditions in Three Continents	wheat straw	e. Wheat straw is abundantly available and renewable and can be used as an energy source in gasification and combustion systems. The wheat straw varieties collected from different countries had different physical properties due to variations in climatic conditions, soil type and used fertilizer. Also, significant differences were observed among the varieties grown under same climatic and cultivation conditions.	The moisture contents of wheat straws were in the range of 5.02-7.79%. The majority (56.87-93.36%) of the wheat straw particles were less than 0.85 mm and the average particle sizes were in the range of 0.38-0.69 mm. The bulk density of the wheat straws was in the range of 97.52-177.23 kg m-3.	2003
Physical, chemical and surface properties of wheat husk, rye husk and soft wood and their polypropylene composites	wheat husk, rye husk and soft wood,polypropylene composites	The main objective of this research was to study the potential of grain by-products such as wheat husk, rye husk as reinforcements for thermoplastics as an alternative or together with wood fibres. Thermal degradation characteristics, bulk density, water absorption and solubility index were also investigated. The particle morphology and particle size was investigated by scanning electron microscopy	this papers contains Bulk density, water absorption and solubility index of wheat husk, rye husk and soft wood. Chemical compositions of wheat husk, rye husk and soft wood.	2011
Potential of Jute Fibre Reinforced Polymer Composites: A Review	Jute Fibre Reinforced Polymer Composites	Scientist and researchers have challenge to reduce the immense use of synthetic fibre and its composite's cost. Natural fibres may be suitable replacement of synthetic fibre as a reinforcement of polymer composites for healthy environment. Natural fibres have many advantages such as low cost, low density, renewability etc. The effect of various factors such as fibre loading, fibre size, fibre orientation and chemical treatment on the mechanical properties of JFRPC is also explained.	This paper contains Classification of composite materials, Chemical Treatment, Mechanical and physical properties of polymers	2013
Preparation and Properties of Wood Plastic Composites Made of Recycled High-density Polyethylene	Wood Plastic Composites Made of Recycled High-density Polyethylene	This article deals with experimental investigation of composites based on recycled high-density polyethylene (RHDPE) and poplar fibers (Populus deltoids) formed by air-forming and hot-pressing. The effects of the fiber content (55, 70, and 85 wt%) and compatibilizing agent (0, 2, and 4 wt%) concentration on the mechanical properties and water absorption were evaluated.	the paper consist of compatibilizing agent, compounding, polymer matrix, reinforcing filler Mechanical Properties and Water Absorption Test,	2012
Some of the Properties of Wood Plastic Composites	Wood Plastic Composites	In this study some of the important properties of experimentally manufactured wood– plastic composites (WPC) were determined. Specimen having 60% and 80% particle and fibre of radiata pine (Pinus radiata) were mixed with polypropylene (plastic) and four different additives, namely Struktol TR 016 which is coupling agent, CIBA antimicrobial agent (IRGAGUARD F3510) as fungicide,	In this work, particles and fibres from radiata pine along with different chemicals as additives used to make experimental WPC panels. In the light of the preliminary results of this study both physical and chemical properties of the samples were improved with addition of four types of chemicals into the panels	2008

NATURAL FIBRE REINFORCED BIODEGRADABLE POLYMER COMPOSITES	NATURAL FIBRE REINFORCED BIODEGRADABLE POLYMER COMPOSITES	Currently, numerous research groups have explored the production and properties of biocomposites where the polymer matrices are derived from renewable resources such as poly lactide (PLA), thermoplastic starch (TPS), cellulose and polyhydroxyalkanoates (PHAs). This review is carried out to evaluate the development and properties of natural fibre reinforced biodegradable polymer composites. T	Natural fibre reinforced biodegradable polymer composites appearto have very bright future for wide range of applications. These biocomposite materials with various interesting properties may soon be competitive with the existing fossil plastic materials. However, the present low level of production and high cost restrict them for to be applied in industrial application	1996
State of the art on tribological behavior of polymer matrix composites reinforced with natural fibers in the green materials world	polymer matrix composites reinforced with natural fibers	Natural fiber reinforced polymer composites have emerged as a potential environmentally friendly and cost-effective alternative to synthetic fiber reinforced composites. Therefore, in the past decade, a number of major industries, such as the automotive, construction and packaging industries, have shown a considerable interest in the progress of new natural fiber reinforced composite materials. The availability of natural fibers and the ease of manufacturing have tempted researchers to study their feasibility of their application as reinforcement and the extent to which they satisfy the required specifications in tribological applications. However, less information concerning the tribological performance of natural fiber reinforced composite material is available in the literature	Natural fiber reinforced polymer composites are attractive and demanding materials to replace conventional materials in order to solve critical environmental problems. As demands for utilization of bio-degradable materials increase due to environmental concerns and government regulations, several industries attempt to replace the conventional materials in automobiles with biodegradable materials where friction and wear are important. This paper reviews the tribological behavior of key natural fiber reinforced polymer composites, such as jute, kenaf, sisal, coir, rice husk, date and oil palm, sugarcane, and bio-waste products	2013
Utilization of agricultural and forest industry waste and residues in natural fiber-polymer composites: A review	natural fiber-polymer composites	Natural fiber-polymer composites (NFPCs) are becoming increasingly utilized in a wide variety of applications because they represent an ecological and inexpensive alternative to conventional petroleumderived materials. On the other hand, considerable amounts of organic waste and residues from the industrial and agricultural processes are still underutilized as low-value energy sources.	it contains Modification of natural fibers, Polymer matrix, Properties of thermoplastics and thermosets used in NFPCs, Basic properties of some natural fibers. Chemical composition of some natural fibers.	2016
Effect of MAPE on Mechanical and Morphological Properties of Wheat Straw/HDPE Injection Molded Composites	Wheat Straw/HDPE	The effect of MAPE as compatibilizer on mechanical and morphological properties of a wheat straw/high density polyethylene composite was investigated. Tensile strength, tensile modulus, tensile energy absorption, failure strain, and notched Izod toughness were much higher for composites with compatibilizer as compared with the composites with no compatibilizer	This study demonstrated that wheat straw flour could be successfully used as a reinforcing fiber material in high density polyethylene. MAPE coupling agent improves the compatibility between wheat straw particles and HDPE resin. The addition of MAPE as compatibilizer improved the composite performance by enhancing the adhesion between wheat straw particles and HDPE	2017
Evaluation of Mechanical Properties and Morphological Studies of Rice Husk (Treated/Untreated)–CaCO3 Reinforced Epoxy Hybrid Composites	Rice Husk Reinforced Epoxy Hybrid Composites	The manufacturing of natural fiber composite is done by reinforcing fibers in the particulate form, fiber form or in woven mat form. Natural fiber composites also utilize industrial wastes as a secondary reinforcements like fly ash, sludge etc. By keeping all these point of views in the present investigation the effect of rice husk flour (chemically treated/untreated) and micro sized calcium carbonate with epoxy resin have been evaluated. T	this paper indicates rice husk composition, Chemical Treatment of Fibres, Preparation of Composite,	2007
Rice Husk/Poly(propylene-co-ethylene) Composites: Effect of Different Coupling Agents on Mechanical, Thermal, and Morphological Properties	Rice Husk/Poly(propylene-co-ethylene) Composites	Poly(propylene-co-ethylene) composites with rice husk were prepared in a corotating intermeshing twin-screw extruder using four different coupling agents. While modified maleic anhydrides such as maleated polypropylene (MAPP) and maleated polyethylene (MAPE) are commonly used as compatibilizers to improve interfacial adhesion between lignocellulosic filler and matrix, in this study,	For the modified composites, improvement in interfacial bonding strength, flexural modulus, and other mechanical properties was mainly related to the compatibilizing agent's type, functional group, concentration, and chain structure.	2001

Thermal transitions and temperature dependent mechanical behavior of wheat straw/talc isotactic/impact modified polypropylene composites	wheat straw/talc isotactic/impact modified polypropylene composites	Dynamic mechanical thermal analysis was used to evaluate temperature-dependent mechanical performance of wheat straw/talc polypropylene composites intended for automotive components as well as thermal properties of the produced formulations. Dynamic mechanical thermal analysis results were also correlated with impact tests and static bending test results. Isotactic and impact-modified copolymer polypropylene composites with various amounts of wheat straw or talc were prepared using extrusion followed by injection molding. Different thermal transitions as well as mechanical performance of the composites were evaluated and the effects of fiber loading, matrix type, filler type and hybridization were studied	The present study dealt with the study of temperaturedependent mechanical performance of wheat flour/talc PP composites produced using different PP matrices. Relationships between some static and dynamic mechanical properties of the composites were also evaluated. From the results and discussions presented,	2000
Use of recycled plastic in concrete: A review	plastic	Numerous waste materials are generated from manufacturing processes, service industries and municipal solid wastes. The increasing awareness about the environment has tremendously contributed to the concerns related with disposal of the generated wastes. Solid waste management is one of the major environmental concerns in the world. With the scarcity of space for landfilling and due to its ever increasing cost, waste utilization has become an attractive alternative to disposal.	the paper consist of Plastic consumption and plastic waste data, Uses of plastics and recycled plastics, Utilization of waste/recycled plastics, Management option/recycling methods.	2016
Analysis of the Wheat Straw/Flax Fiber Reinforced Polymer Hybrid Composites	Wheat Straw/Flax Fiber	The production of plastic composites from agro waste materials is receiving the substantial consideration currently. In this work, we suggest to use the Wheat straw in its whole shape instead of shredded one for forming the green composite. The hybrid composite was formed of Wheat straw, flax fiber, and jute fabric. This study targets at the mechanical properties of Wheat straw. The results indicate the possibility of manufacturing of the thin plates and shafts from such hybrid combinations after the increasing the crushing force of Wheat straw.	The potential use of treated Wheat straw/flax fiber as reinforcement in PVA was investigated. The study focused on whole stems of Wheat straw which were reinforced with injection of the animal glue to improve the strength and crushing force of the Wheat straw. Wheat straw tenacity increased by about 165%, breaking strain by 125%, and the Young's Modulus of elasticity by 125%.	2012
Response Surface Models for Optimization of Wheat StrawPolypropylene Composite Formulations	Wheat StrawPolypropylene	he insertion of wheat straw fiber in polypropylene matrix can increase the flexural properties of the thermoplastic composite. This increase, however, is accompanied by the decrease of impact strength. The objective of this study is to dev\elop response surface models which correlate the flexural and impact properties of the composite as functions of its formulation. A constrained pseudo-simplex design of three component mixture was designed for the experiments.	This paper shows the successful application of product design approach and mixture design methodology in developing property models of wheat straw polypropylene composite in a relatively advanced level. Real product specifications of automotive parts have been used as the targets for new composite product.	2014
Mechanical, Thermal and Rheological Properties of Polypropylene/ Wheat Straw Composites and Study of the Effect of Nanoclay on Their Mechanical Properties	Polypropylene/ Wheat Straw Composites	Polymer–wood fi bre composites utilize wood fi bres as reinforcing fi ller in the polymer matrix and are advantageous over the pure polymers in terms of the materials cost and some mechanical properties such as modulus and strength. The results showed that for untreated fi bres, an increase in fi bre content up to 20% (wt) led to an increase in the tensile strength of the composite. However, beyond this amount, tensile strength decreased. By using silane treated fibres, both tensile strength and modulus increased, but the viscosity was reduced because of better dispersion of the treated fibres.	Environmentally-friendly composites comprising wheat straw fi bres and a polypropylene matrix, modified with γ-aminopropyltrimethoxy-silane coupling agent and nano-clay, Cloisite 20A, have been prepared. Addition of wheat straw fi bres to PP increased the crystallization temperature (Tc) and reduced the melting temperature (Tm).	2010

2.3 Conclusion

From the above papers and studies we have decided to select the polymer matrix which is composed of natural fibres i.e **polypropylene composed with wheat straw fibres** in order to make the useful composite. In the above papers, there are various type of composite matrix are made. In spite of doing work on same composite, we decided to composed a different matrix.

Polymer matrix which contains wheat fibres as reinforcing filler in the polymer matrix and are advantageous over the pure polymers in terms of the materials cost and some mechanical properties such as modulus and strength.

CHAPTER 3

METHODOLOGY

3.1 Materials

Wheat straw fibres were obtained from local farms and Wheat straw used in this study was a soft white winter wheat straw (AC Mountain) harvested in late 2018 from the region of Uttar Pradesh. Injection moulding grade PP, ________, melt index of 8 gr/10 min, was supplied by Avenue polymer engineering, Pune. After a milling and screening process on wheat straw fibres by using different mesh screens, two ranges of fibre lengths were obtained: 5mm and 10 mm. Distilled water, sodium hydroxide (NaOH) and potassium hydroxide (KOH) were procured from chemistry lab of AIKTC, Panvel.

3.2 Methods

Wheat fibres were locally sourced and were cut into 10 mm with scissors before they were subjected to alkali treatments. The selected fibres were divided into 2 parts where one part was treated with NaOH solution while the other part was treated with KOH solution. The process involved immersing the fibres into 1M NaOH and KOH each in a shaker water bath operated at 50°C for 24 hours, respectively. After the treatments, the fibres were washed thoroughly with tap water and then with distilled water until a pH of 7 were achieved. Then, the fibres were sun dried for 4 days to remove moisture.

The purpose of chemical treatment is to remove the moisture content of fibre, increase the tensile strength and roughened the surface of the fibre to enhance its interfacial bonding with the matrix as well as reduces the susceptibility of the fibres to fungi attack.

The composite samples for mechanical properties measurement were prepared according to the standards used in testing methods. The standards are ASTM D570, ASTM D256, and ASTM D638 and ASTM D790 for water absorption, izod impact test, and tensile test, and flexure test respectively.

CHAPTER 4

EXPERIMENTAL DETAILS

4.1 Mold preparation

To produce the samples of composite in order to test the mechanical properties i.e impact, tensile, flexure and water absorption property, there is a need of mold of a particular dimension as per the ASTM standard. So the mold was made up of steel and to create the molds two machining process had done are as follows: -

4.1.1 Milling

Milling is the process of machining using rotary cutters to remove material by advancing a cutter into a work piece. This may be done varying direction on one or several axes, cutter head speed, and pressure. Milling covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes for machining custom parts to precise tolerances.

Milling can be done with a wide range of machine tools. The original class of machine tools for milling was the milling machine (often called a mill). After the advent of computer numerical control (CNC) in the 1960s, milling machines evolved into *machining centers:* milling machines augmented by automatic tool changers, tool magazines or carousels, CNC capability, coolant systems, and enclosures. Milling centers are generally classified as vertical machining centers (VMCs) or horizontal machining centers (HMCs).

The integration of milling into turning environments, and vice versa, began with live tooling for lathes and the occasional use of mills for turning operations. This led to a new class of machine tools, multitasking machines (MTMs), which are purpose-built to facilitate milling and turning within the same work envelope.

Fig 3 : milling process

Fig 4: finished product

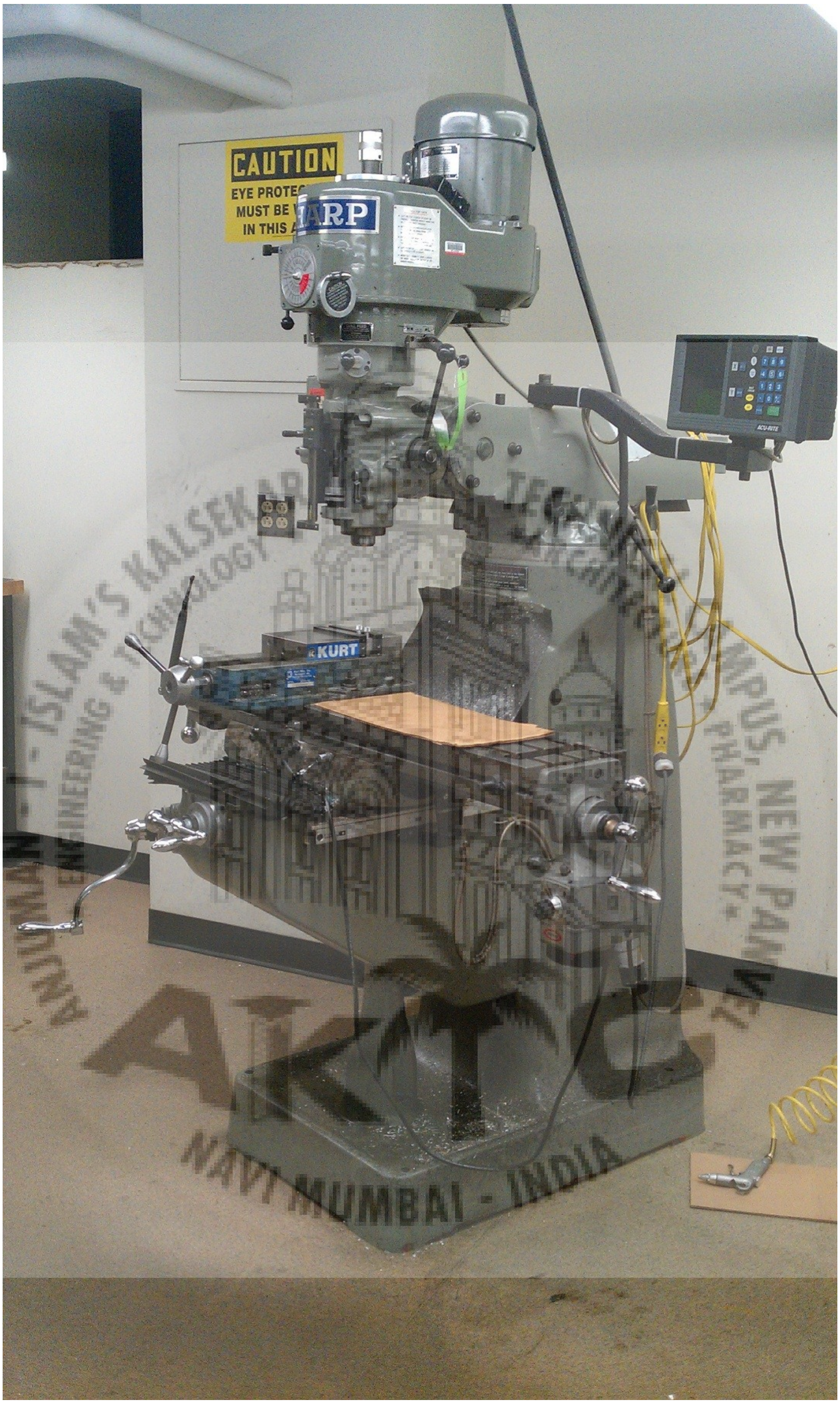


Fig 5: Milling Machine

4.1.2 CNC Machining

Most CNC milling machines (also called machining centers) are computer controlled vertical mills with the ability to move the spindle vertically along the Z-axis. This extra degree of freedom permits their use in die sinking, engraving applications, and 2.5D surfaces such as relief sculptures. CNC machines can exist in virtually any of the forms of manual machinery, like horizontal mills. The most advanced CNC milling-machines, the multiaxis machine, add two more axes in addition to the three normal axes (XYZ). Horizontal milling machines also have a C or Q axis, allowing the horizontally mounted work piece to be rotated, essentially allowing asymmetric and eccentric turning. But the skill to program such geometries is beyond that of most operators. Therefore, 5-axis milling machines are practically always programmed with CAM.

The operating system of such machines is a closed loop system and functions on feedback. These machines have developed from the basic NC (NUMERIC CONTROL) machines. A computerized form of NC machines is known as CNC machines. A set of instructions (called a program) is used to guide the machine for desired operations. Some very commonly used codes, which are used in the program are:

G00 – rapid traverse

G01 – linear interpolation of tool.

G21 – dimensions in metric units.

M03/M04 – spindle start (clockwise/counter clockwise).

T01 M06 – automatic tool changes to tool 1

M30 – program end.

Fig 6: CNC process

Fig 7: finished product

Fig 8: CNC Milling Machine

4.2 Fibre Preparation

Fig 9: Wheat Straw From Field

Firstly, wheat straws were cut down from the field as shown in fig no. 9 and then they were cut by scissor in order to make sure that there were no nodes during the cutting of straw to make them in fibres form in order to reduce the failure of mixer blade. This preparation of wheat fibres were done in following machine i.e. mixer blade machine and cutting machine for better accuracy. Wheat fibres were locally sourced and were cut into 10 mm with scissors before they were subjected to alkali treatments as shown in fig no. 10 and 11.

Fig 10: Cut Piece Of Straw

Fig 11: Wheat Fibres

4.3 Composites Fabrication

The composites were produced by compression moulding process. Random fibre orientation was used with varied fibre content. The treated fibres were mixed with polypropylene in the moulds before taking them to compression moulding machine to produce the composites. The mixtures were heated up to melting temperature of about 160°C and maintained at this temperature for about 30 minutes which then caused them to flow in the moulds. After, cooling and solidification, the composites were separated from the moulds and were allowed to cool for 2 hours before carrying out tests on them.

The composite samples were made according to the following order given below:

Polymer matrix	**Fibre composition**	**Weight percentage**
Polypropylene	Untreated wheat fibre	95% PP 5% Wh
Polypropylene	Treated wheat fibre with NaOH	95% PP 5% Wh NaOH
Polypropylene	Treated wheat fibre with KOH	95% PP 5% Wh KOH
Polypropylene	Glass fibre and untreated wheat fibre	90% PP 5% Wh 5%Gl

Table No. 1: Order Of Composite Sample

Untreated fibre　　treated fibre NaOH　　glass fibre　　treated KOH

Fig 12: samples of tensile composite

CHAPTER 5

TEST RESULTS

5.1 Tensile Test

Stress Analysis Report of Polypropylene

Physical

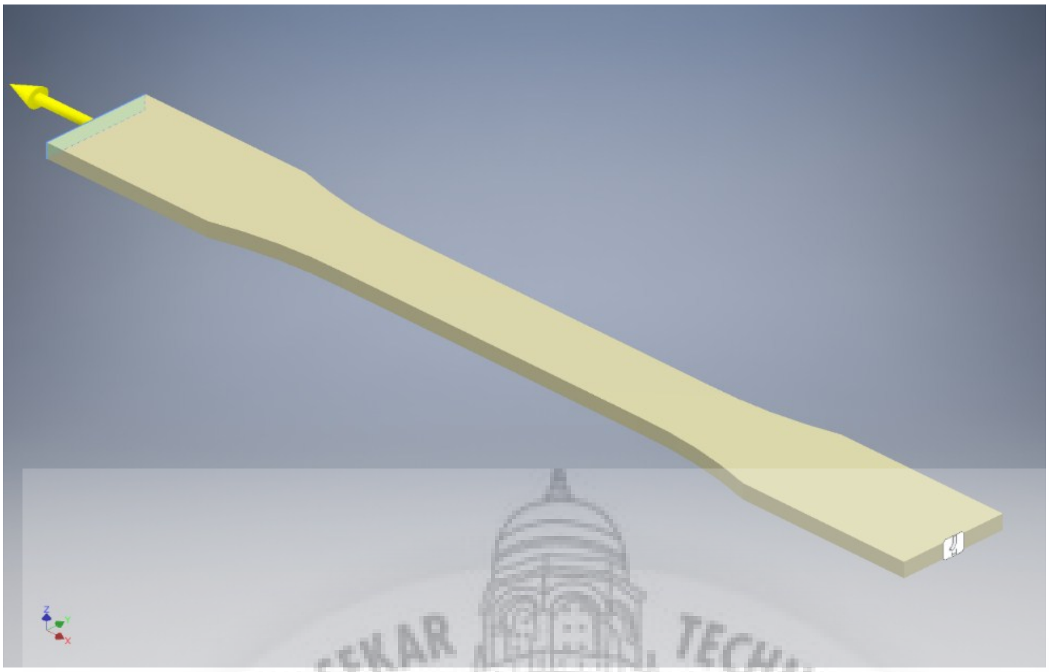
Material	Polypropylene
Density	0.899 g/cm^3
Mass	0.00747934 kg
Area	6381.02 mm^2
Volume	8319.62 mm^3

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Forces:

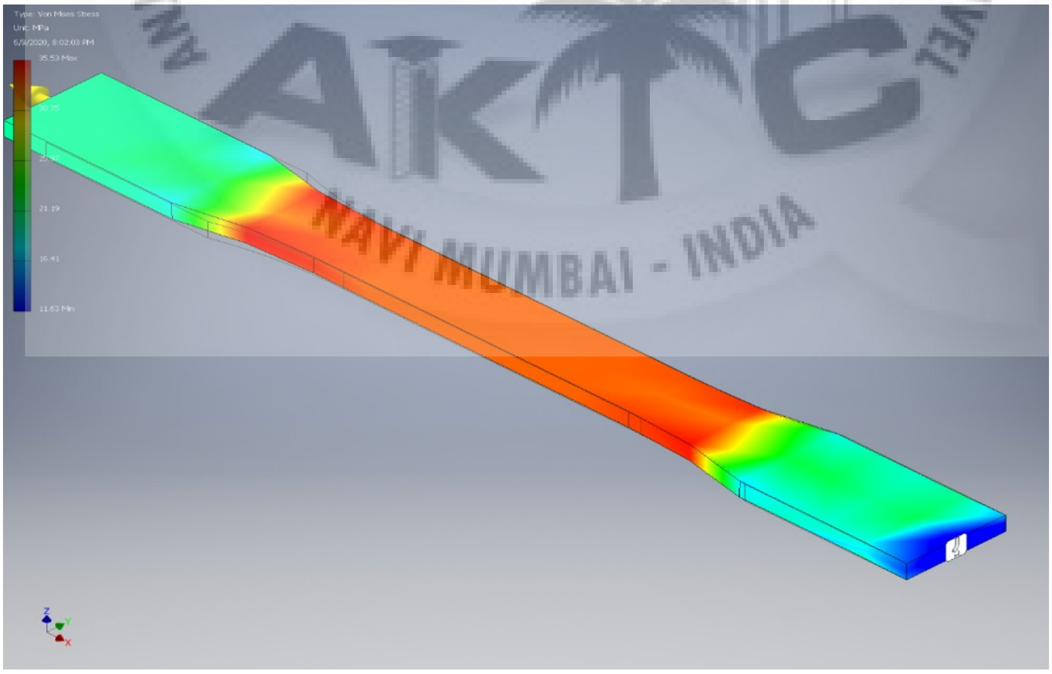
Load Type	Force
Magnitude	1400.000 N
Vector X	-1400.000 N
Vector Y	0.000 N
Vector Z	0.000 N



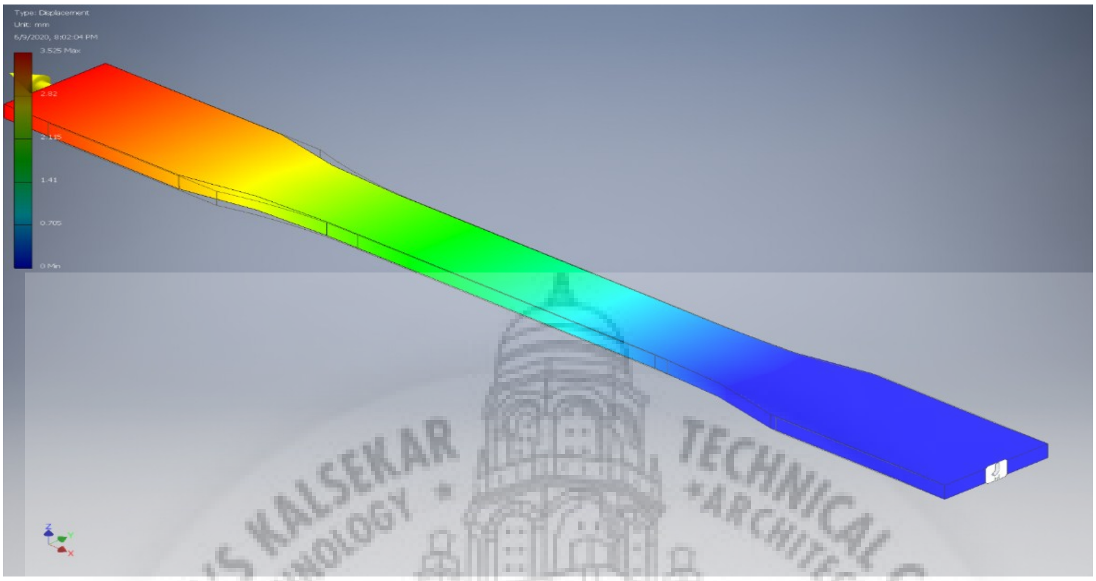
Result Summary

Name	Minimum	Maximum
Volume	8319.62 mm^3	
Mass	0.00747934 kg	
Von Mises Stress	11.634 MPa	35.5301 MPa
Displacement	0 mm	3.52534 mm
Safety Factor	0.852797 ul	2.60444 ul

Von Mises Stress:



Displacement:



Safety Factor:

Stress Analysis Report of PP- wheat straw composite

Physical

Mass	0.00580528 kg
Area	16780.5 mm^2
Volume	8319.62 mm^3

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Name	Wheat Straw	
General	Mass Density	0.295345 g/cm^3
	Yield Strength	14.7003 MPa
	Ultimate Tensile Strength	14.6996 MPa
Stress	Young's Modulus	4.76 GPa
	Poisson's Ratio	0.43 ul
	Shear Modulus	1.66434 GPa

Force:

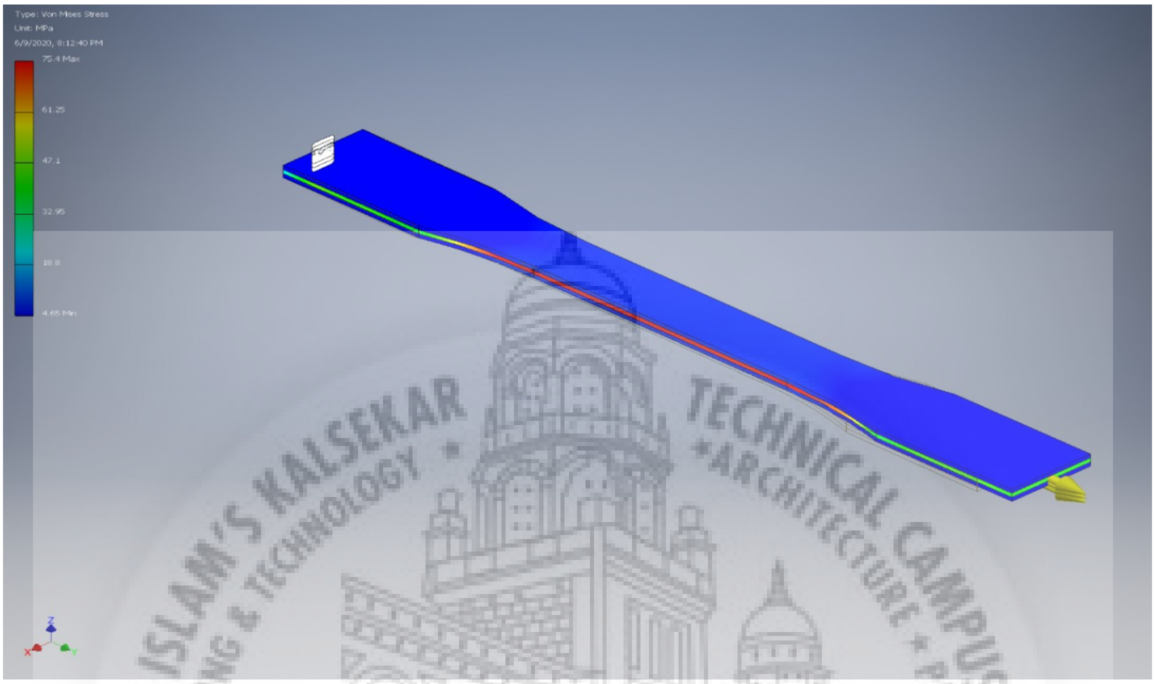
Load Type	Force
Magnitude	1600.000 N
Vector X	-0.000 N
Vector Y	1600.000 N
Vector Z	0.000 N

Result Summary

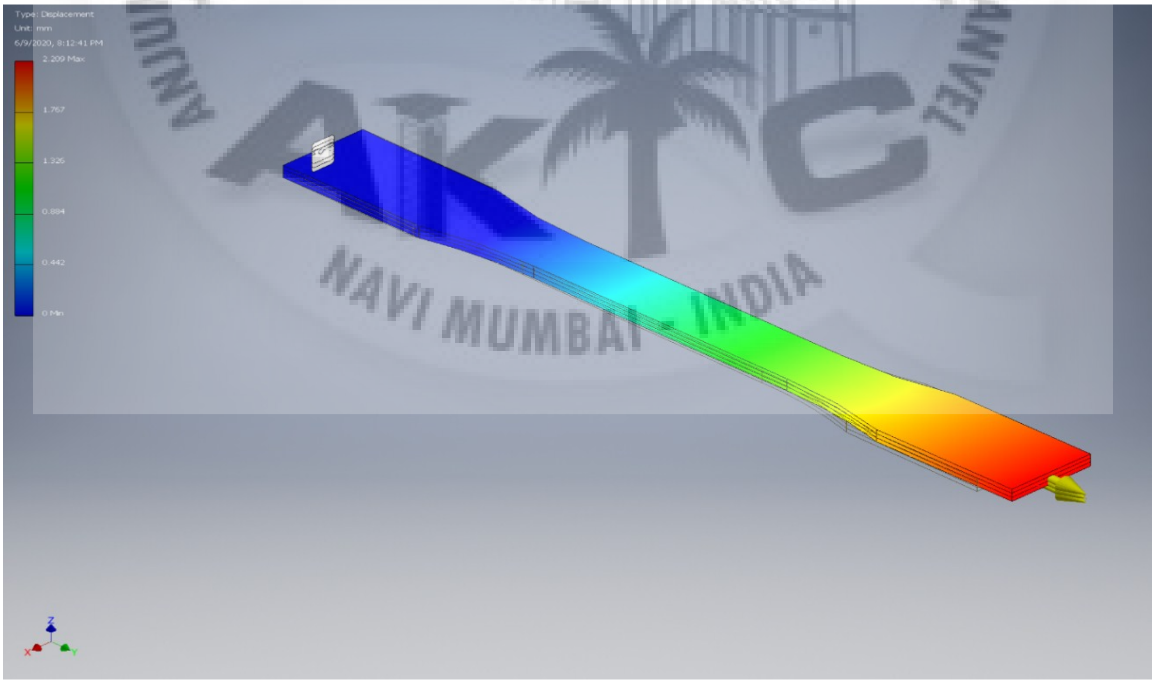
Name	**Minimum**	**Maximum**
Volume	8319.62 mm^3	
Mass	0.00580528 kg	

Von Mises Stress	4.64933 MPa	75.3992 MPa
Displacement	0 mm	2.20934 mm
Safety Factor	0.194966 ul	6.51706 ul

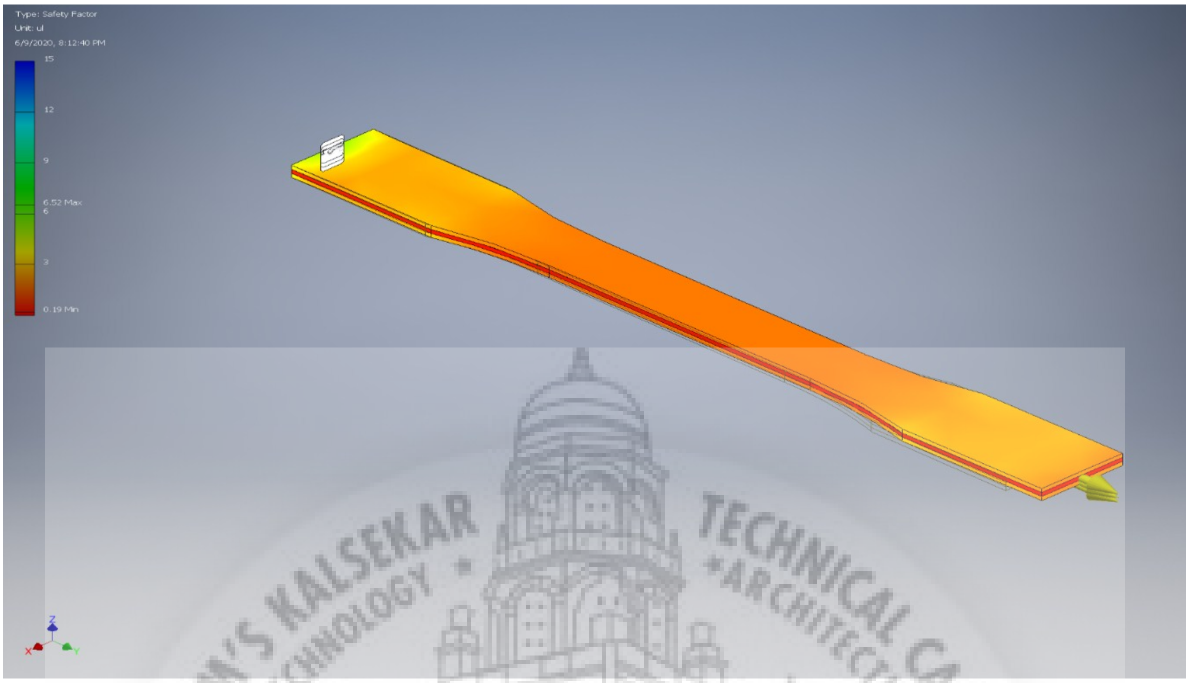
Von Mises Stress



Displacement



Safety Factor



Stress Analysis Report of PP- Glass composite

Physical

Mass	0.0110318 kg
Area	16780.5 mm^2
Volume	8319.62 mm^3

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa
Name	Glass	

General	Mass Density	2.18 g/cm^3
	Yield Strength	33 MPa
	Ultimate Tensile Strength	33 MPa
Stress	Young's Modulus	68 GPa
	Poisson's Ratio	0.19 ul
	Shear Modulus	28.5714 GPa

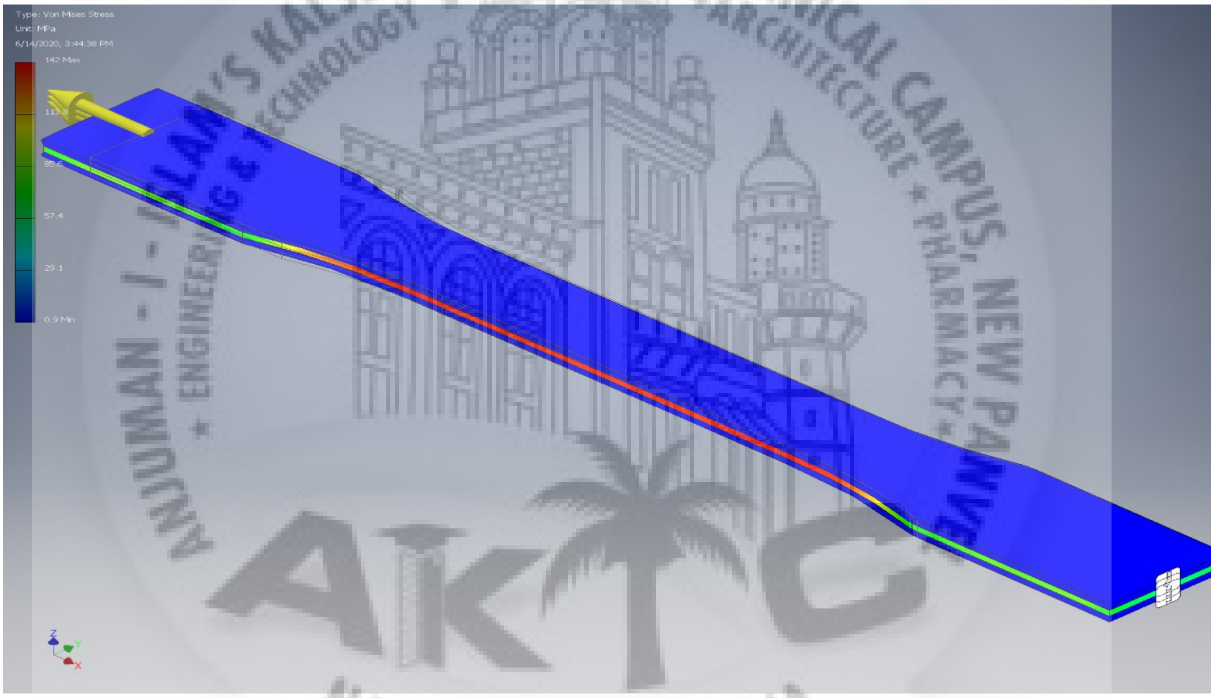
Force:

Load Type	Force
Magnitude	2000.000 N
Vector X	-2000.000 N
Vector Y	0.000 N
Vector Z	0.000 N

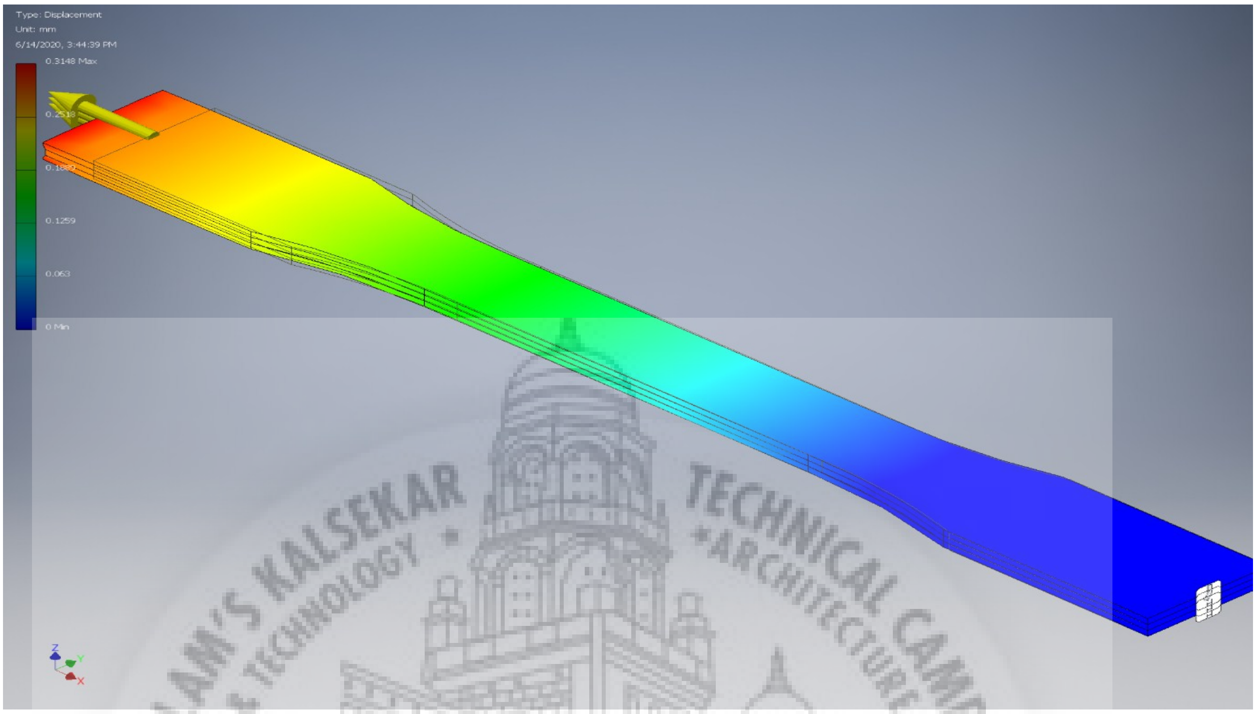
Result Summary

Name	Minimum	Maximum
Volume	8319.62 mm^3	
Mass	0.0110318 kg	
Von Mises Stress	0.91963 MPa	142.031 MPa
Displacement	0 mm	0.314775 mm
Safety Factor	0.232344 ul	15 ul

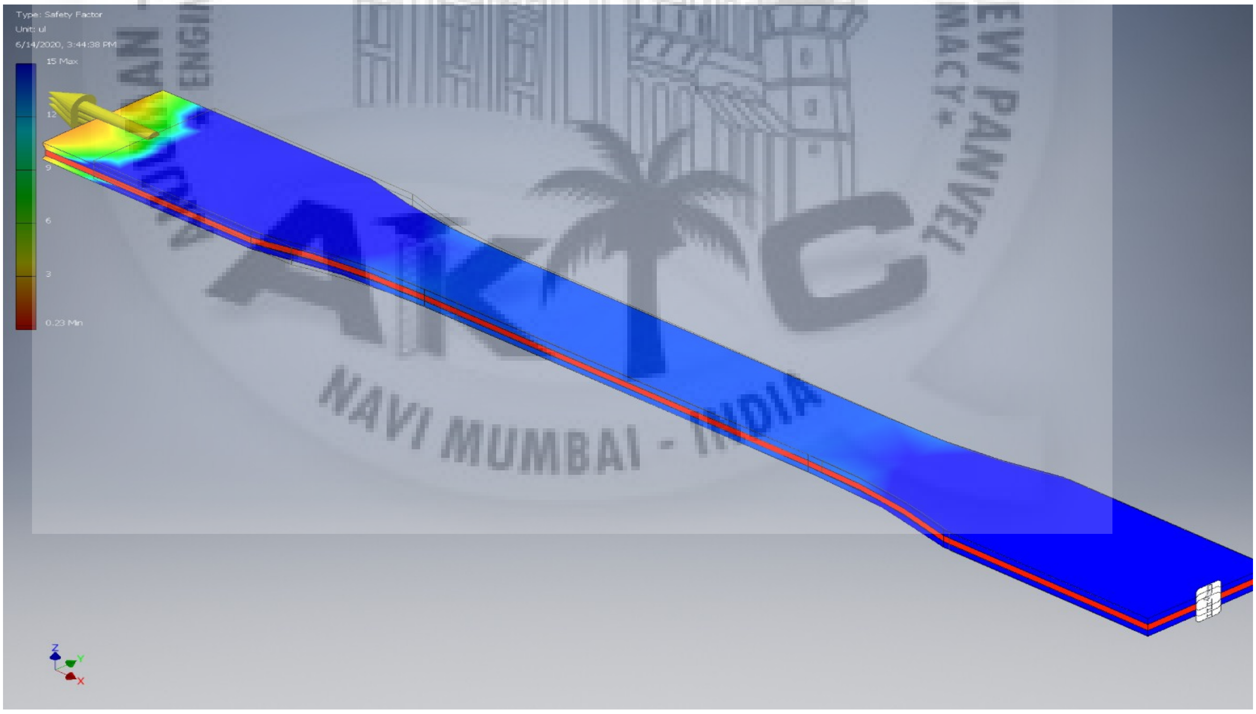
Von Mises Stress



Displacement



Safety Factor



5.2 Impact Test

Stress Analysis Report of Polypropylene

Physical

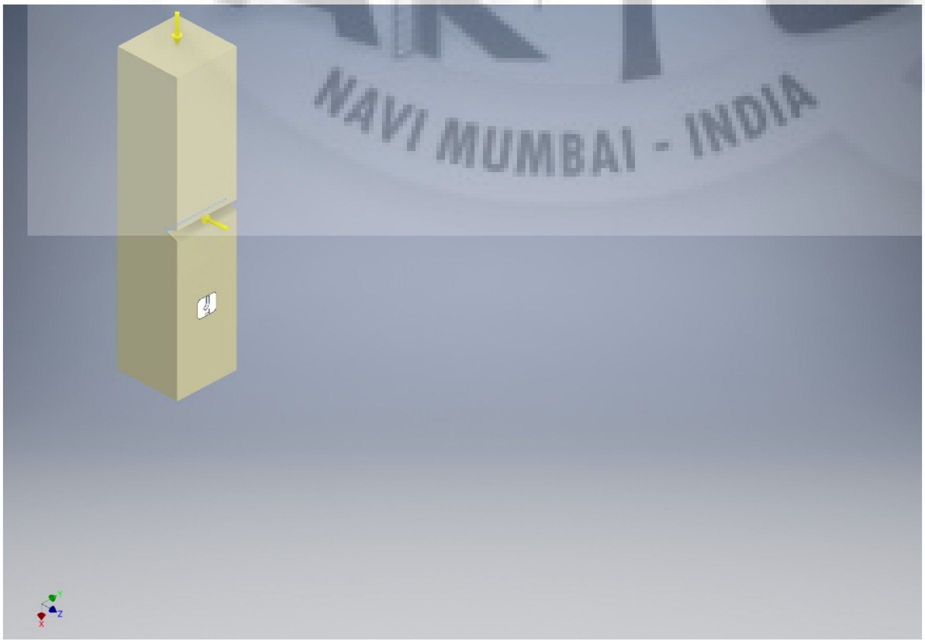
Material	Polypropylene
Density	0.899 g/cm^3
Mass	0.00939413 kg
Area	3658.81 mm^2
Volume	10449.5 mm^3

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Force:

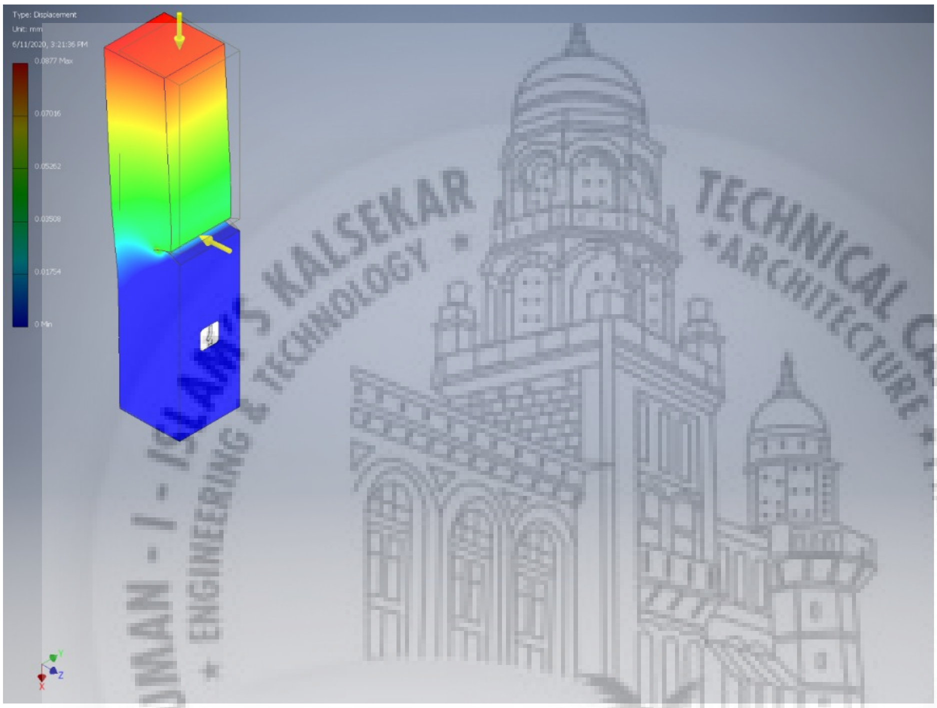
Load Type	Force
Magnitude	500.000 N
Vector X	38.924 N
Vector Y	0.000 N
Vector Z	-498.483 N



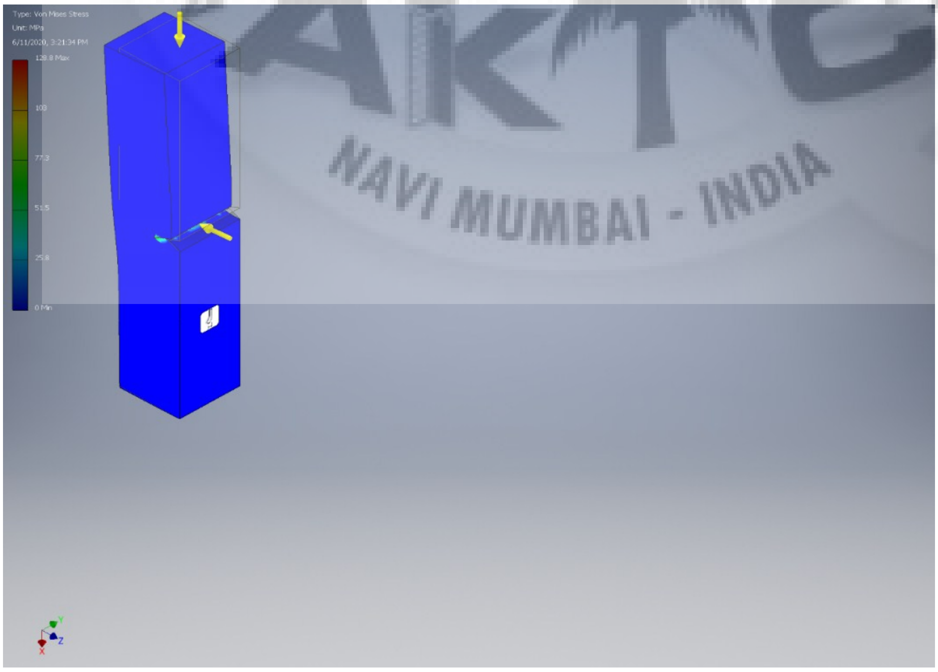
Result Summary

Name	Minimum	Maximum
Volume	10449.5 mm^3	
Mass	0.00939413 kg	
Von Mises Stress	0.000157066 MPa	128.777 MPa
Displacement	0 mm	0.0876956 mm
Safety Factor	0.23529 ul	15 ul

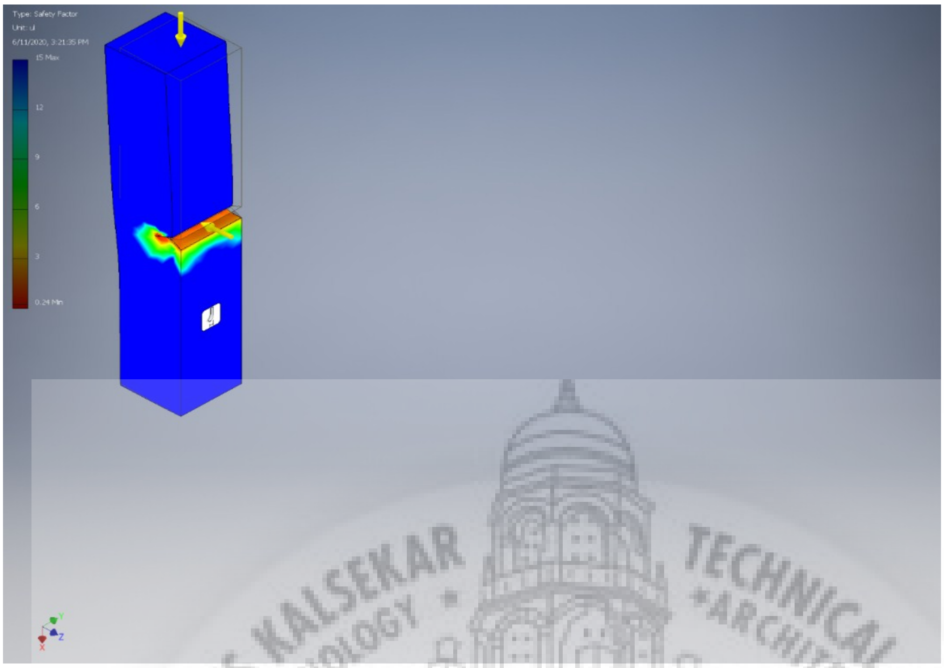
Von Mises Stress



Displacement



Safety Factor



Stress Analysis Report of PP-Wheat straw composite

Physical

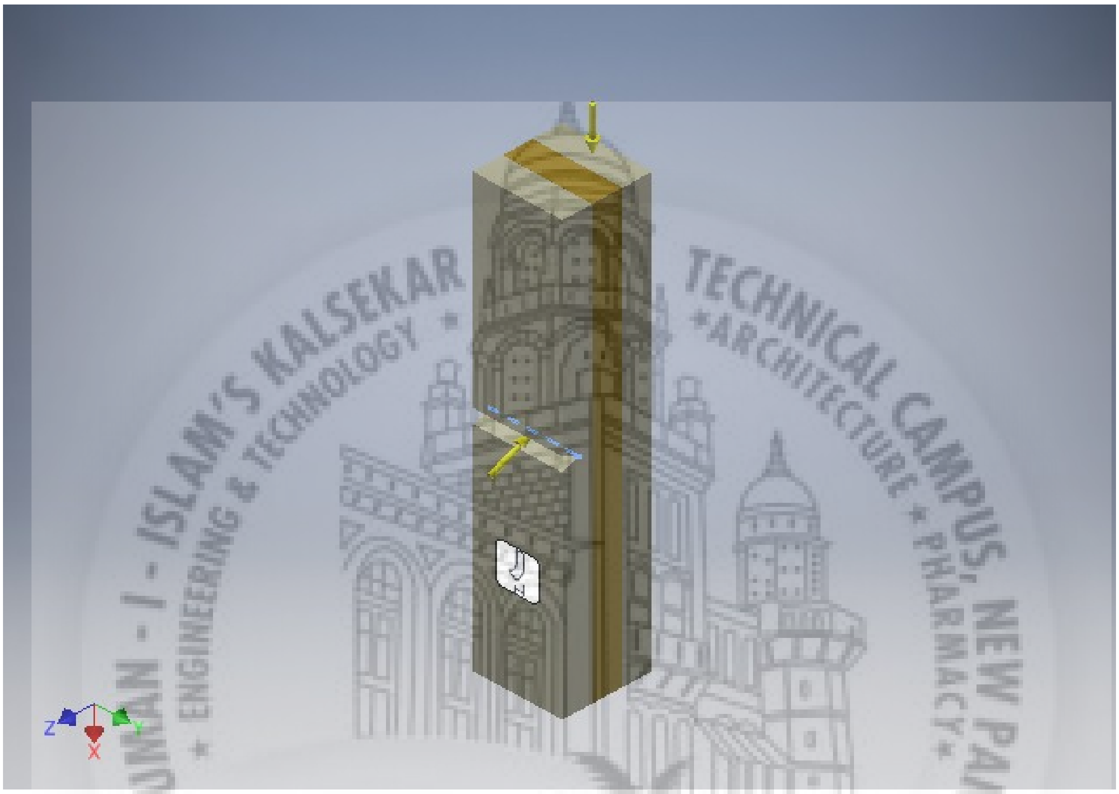
Mass	0.00728459 kg
Area	6960.81 mm^2
Volume	10449.5 mm^3

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa
Name	Wheat Straw	
General	Mass Density	0.295345 g/cm^3
	Yield Strength	14.7003 MPa
	Ultimate Tensile Strength	14.6996 MPa
Stress	Young's Modulus	4.76 GPa
	Poisson's Ratio	0.43 ul
	Shear Modulus	1.66434 GPa

Force:

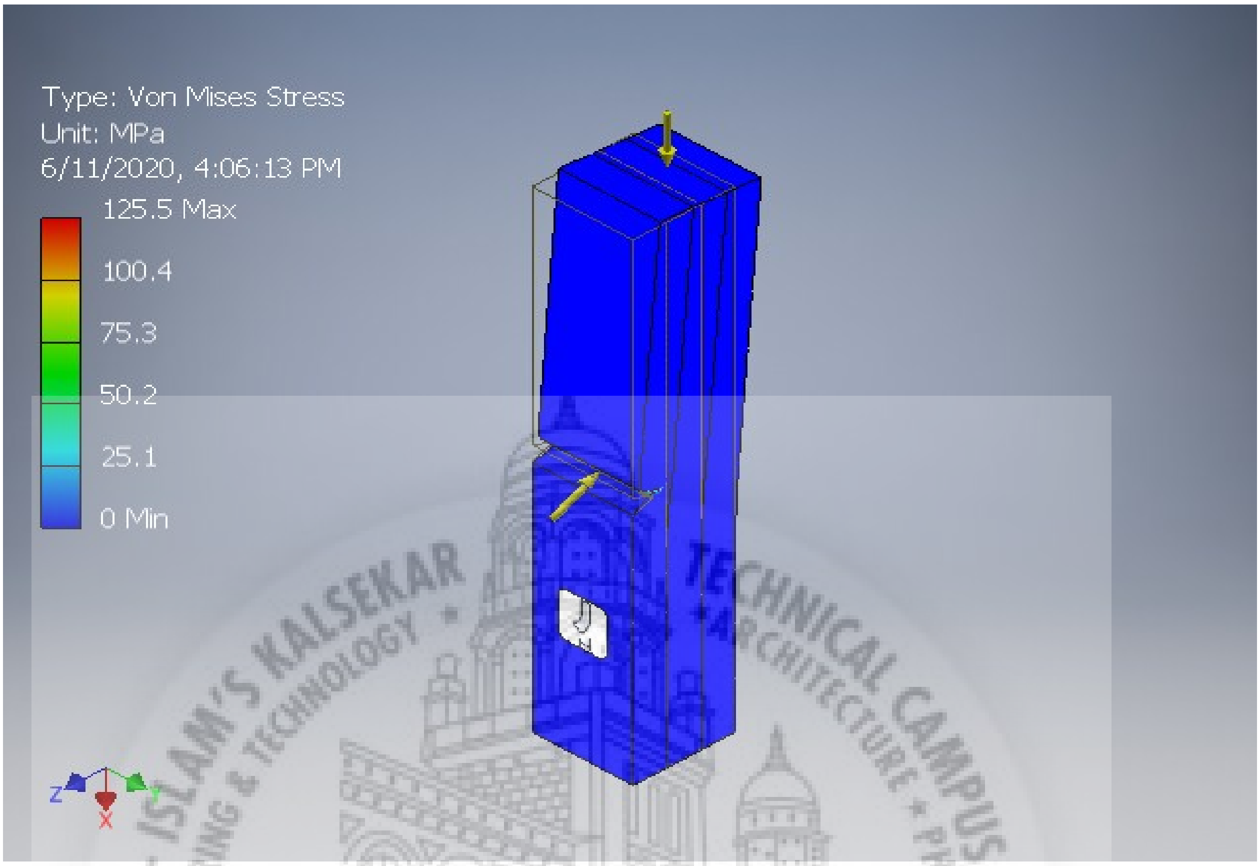
Load Type	Force
Magnitude	450.000 N
Vector X	-181.294 N
Vector Y	-0.000 N
Vector Z	-411.865 N



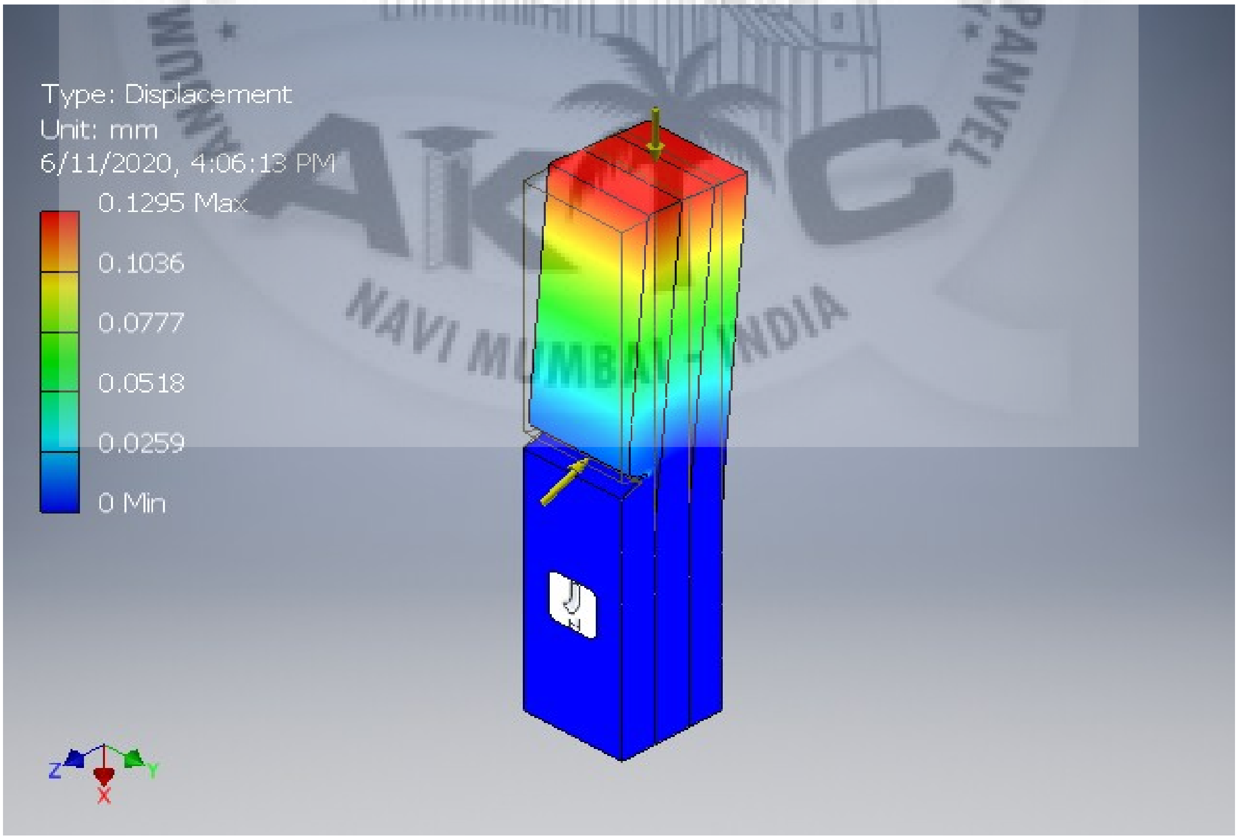
Result Summary

Name	Minimum	Maximum
Volume	10449.5 mm^3	
Mass	0.00728459 kg	
Von Mises Stress	0.0000342782 MPa	125.506 MPa
Displacement	0 mm	0.129505 mm
Safety Factor	0.241423 ul	15 ul

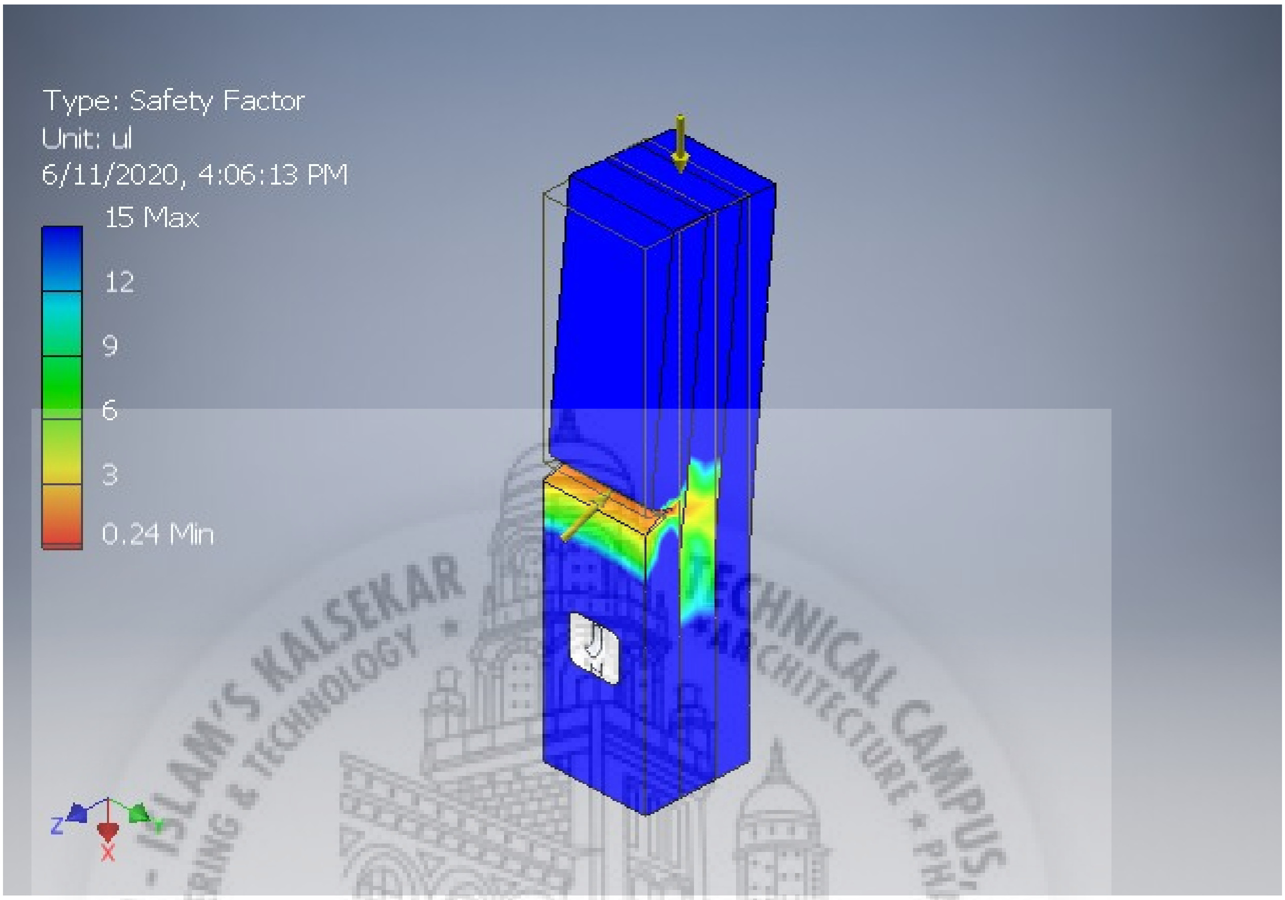
Von Mises Stress



Displacement



Safety Factor



Stress Analysis Report of PP-Glass Composite

Physical

Mass	0.0138707 kg
Area	6960.81 mm^2
Volume	10449.5 mm^3

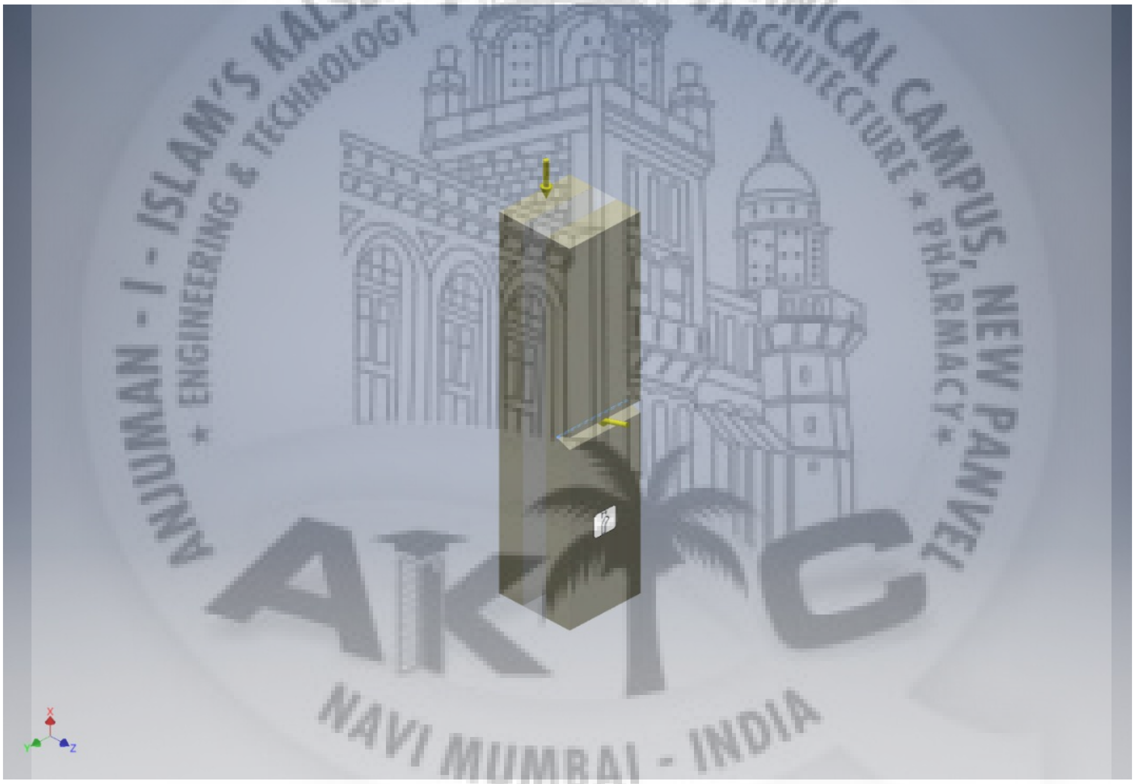
Material(s)

Name	Glass	
General	Mass Density	2.18 g/cm^3
	Yield Strength	33 MPa
	Ultimate Tensile Strength	33 MPa
Stress	Young's Modulus	68 GPa
	Poisson's Ratio	0.19 ul
	Shear Modulus	28.5714 GPa
Name	Polypropylene	
General	Mass Density	0.899 g/cm^3

	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Force:

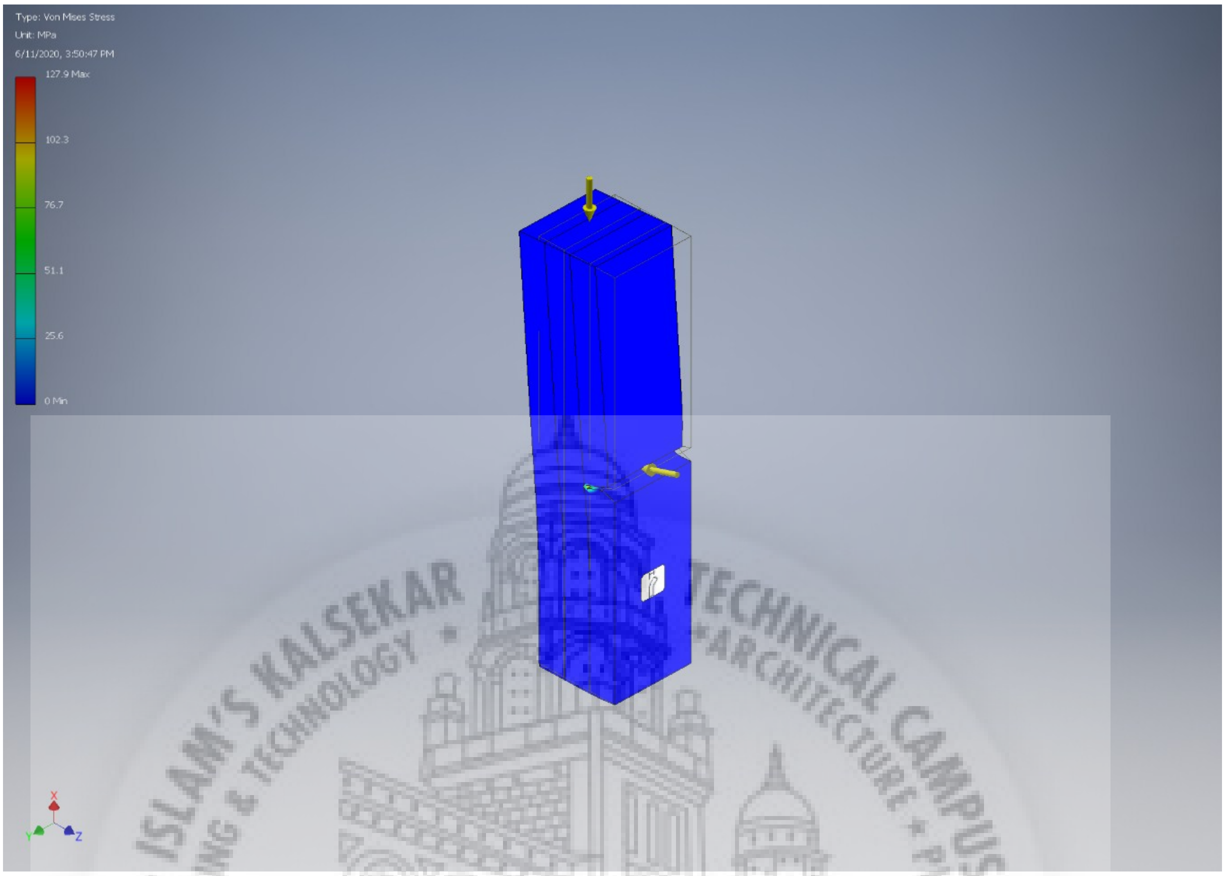
Load Type	Force
Magnitude	640.000 N
Vector X	-197.295 N
Vector Y	-0.000 N
Vector Z	-608.830 N



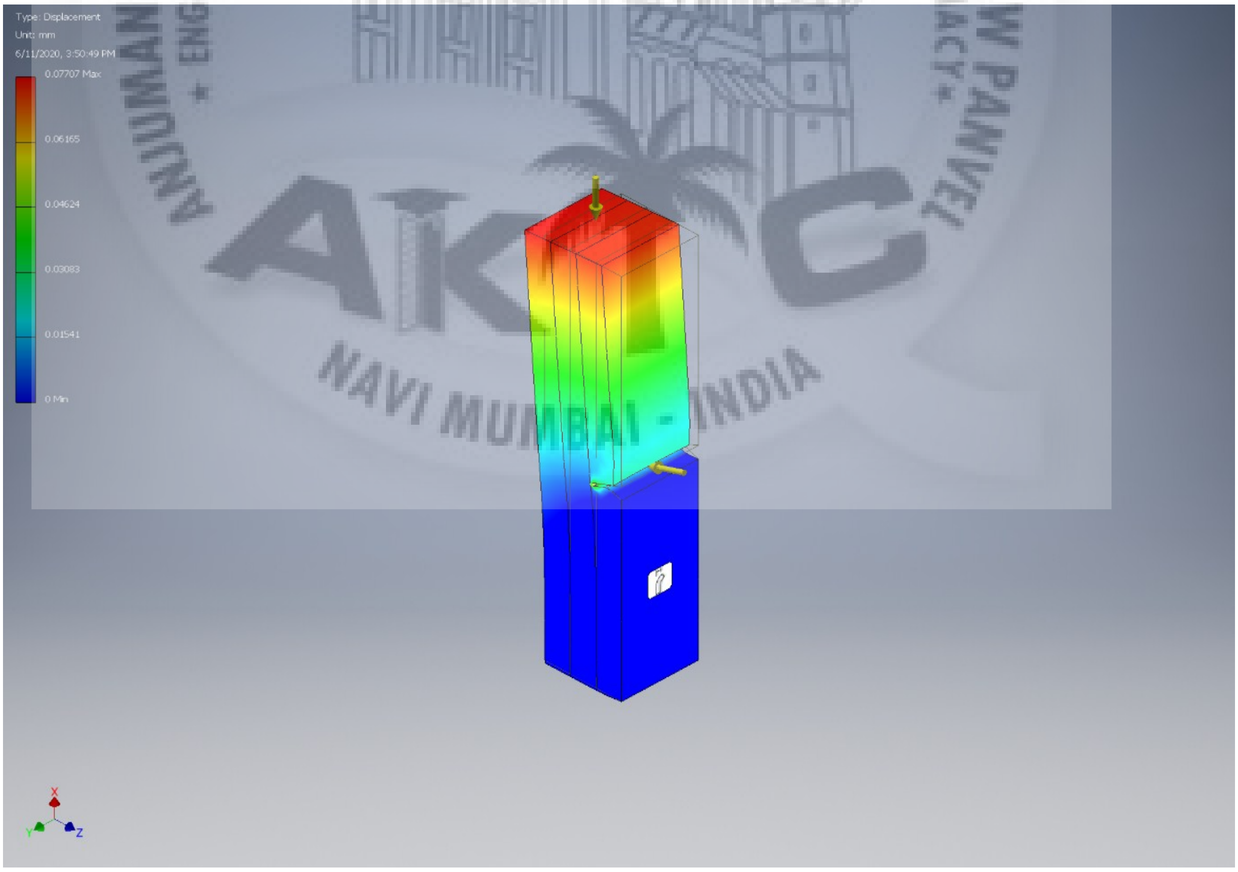
Result Summary

Name	**Minimum**	**Maximum**
Volume	10449.5 mm^3	
Mass	0.0138707 kg	
Von Mises Stress	0.00051214 MPa	127.86 MPa
1st Principal Stress	-109.744 MPa	134.048 MPa
3rd Principal Stress	-210.297 MPa	25.1541 MPa
Displacement	0 mm	0.0770672 mm
Safety Factor	0.236978 ul	15 ul

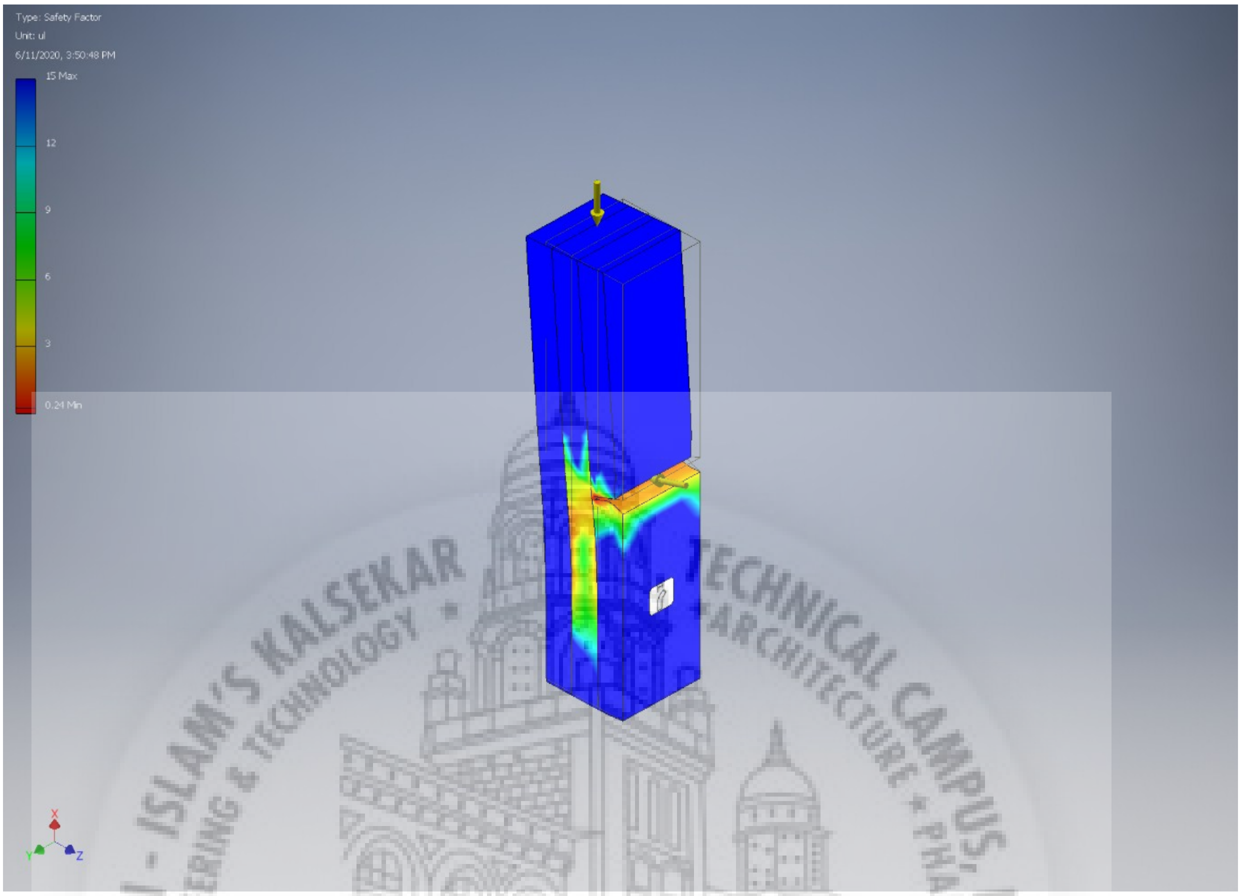
Von Mises Stress



Displacement



Safety Factor



5.3 Flexure Test

<u>Stress Analysis Report of Polypropylene</u>

Physical

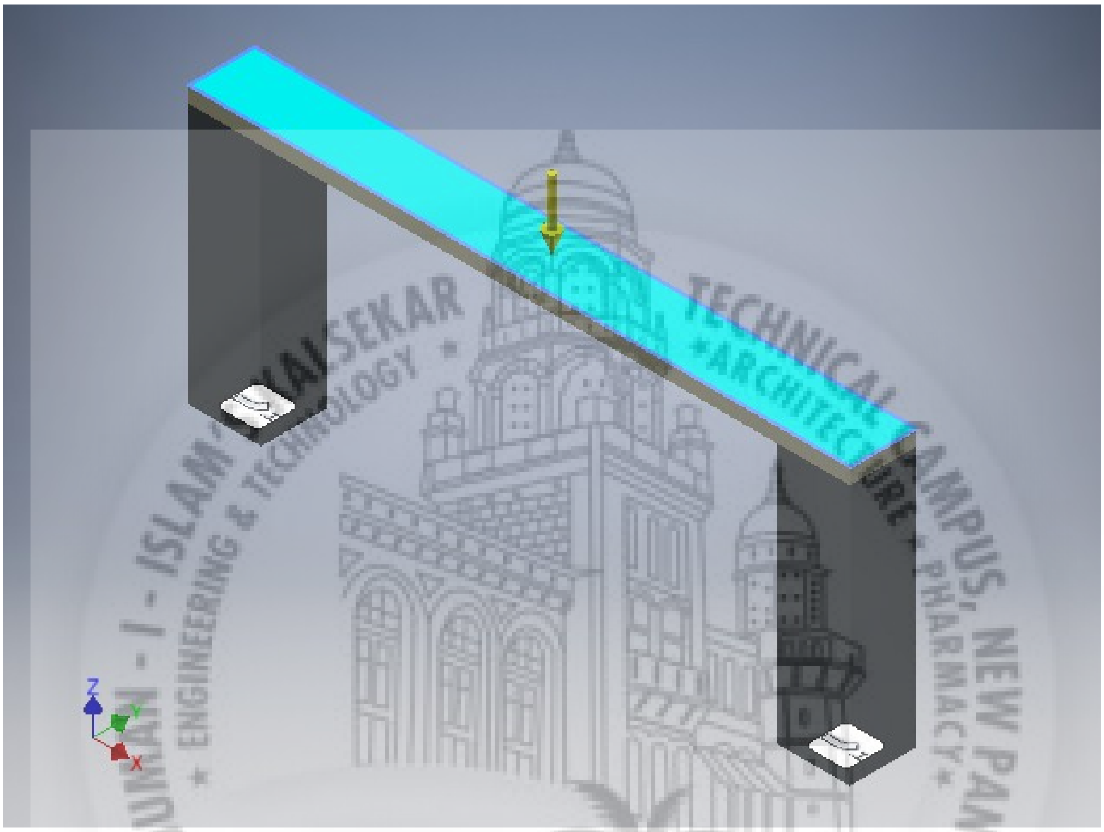
Mass	0.131767 kg
Area	10171.1 mm^2
Volume	22941.3 mm^3
Center of Gravity	x=34.3395 mm y=2.83623 mm z=-25.6633 mm

Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Force:

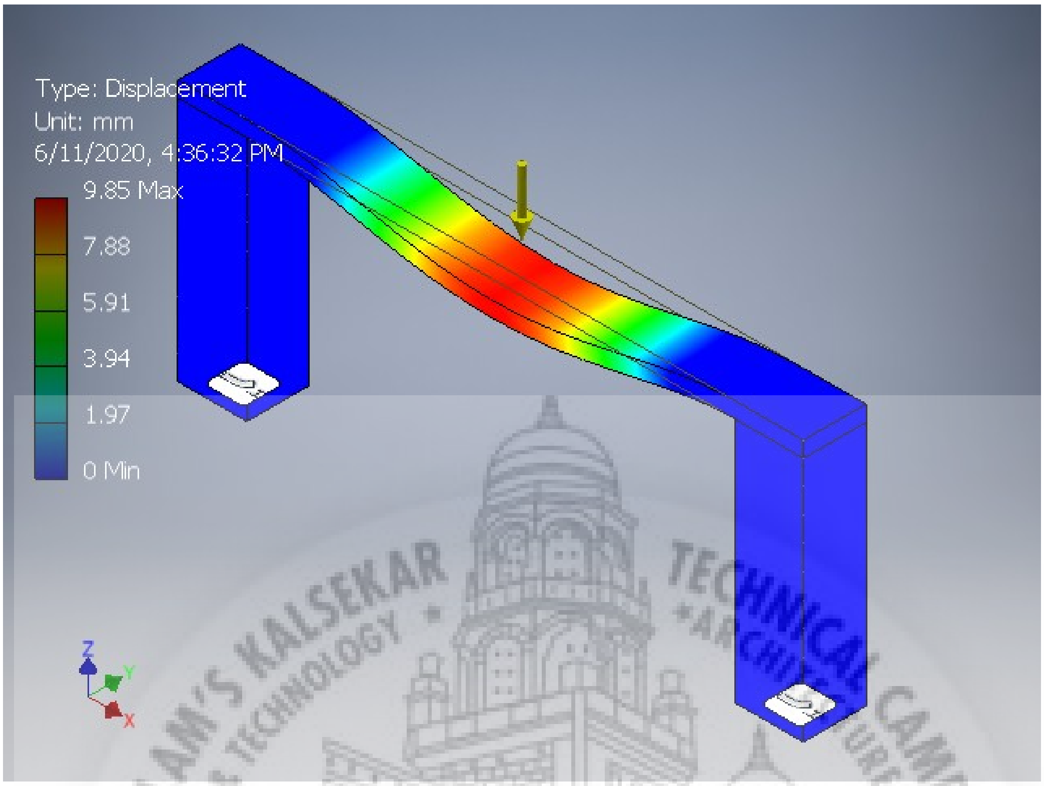
Load Type	Force
Magnitude	300.000 N
Vector X	0.000 N
Vector Y	0.000 N
Vector Z	-300.000 N



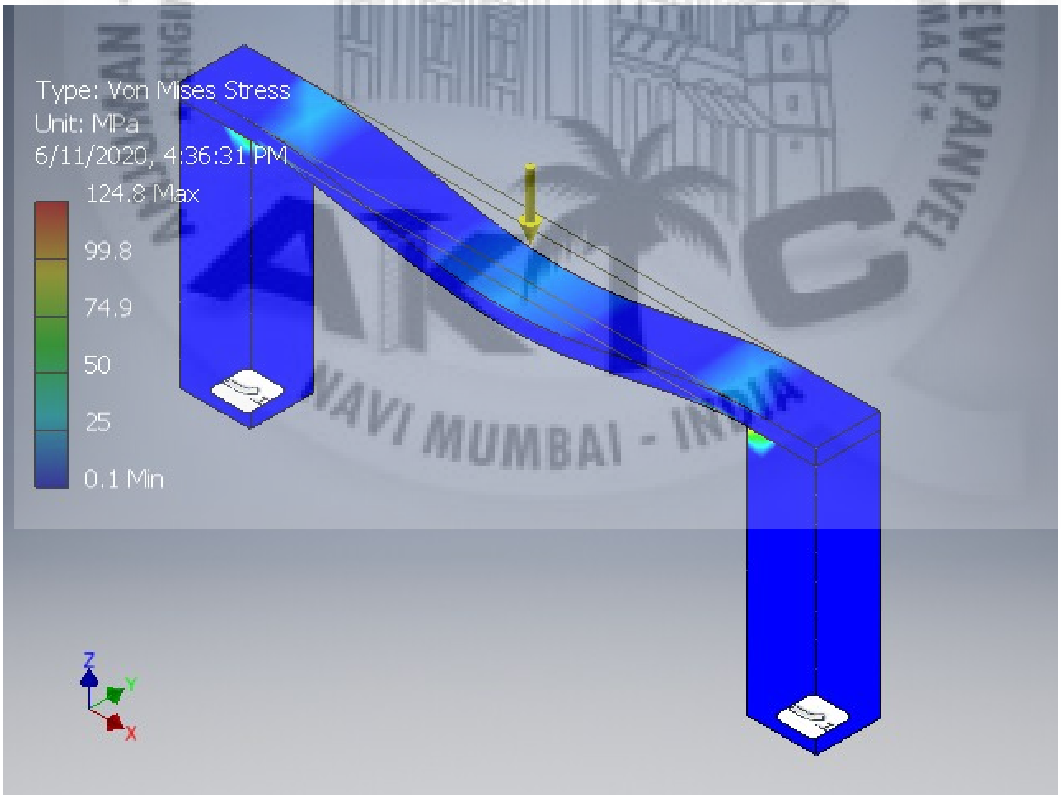
Result Summary

Name	**Minimum**	**Maximum**
Volume	22941.3 mm^3	
Mass	0.131767 kg	
Von Mises Stress	0.065815 MPa	124.779 MPa
Displacement	0 mm	9.8504 mm
Safety Factor	0.622396 ul	15 ul

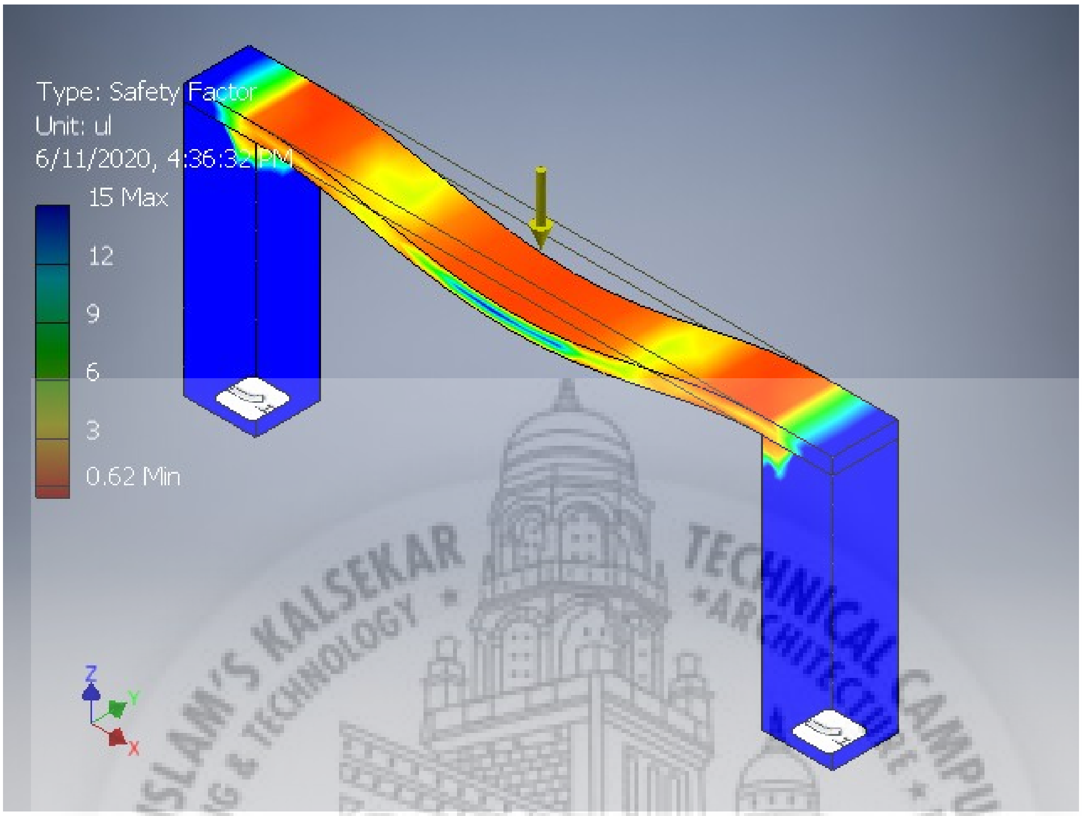
Von Mises Stress



Displacement



Safety Factor



Stress Analysis Report of PP-Wheat straw composite

Physical

Mass	0.130728 kg
Area	16622.7 mm^2
Volume	22941.3 mm^3

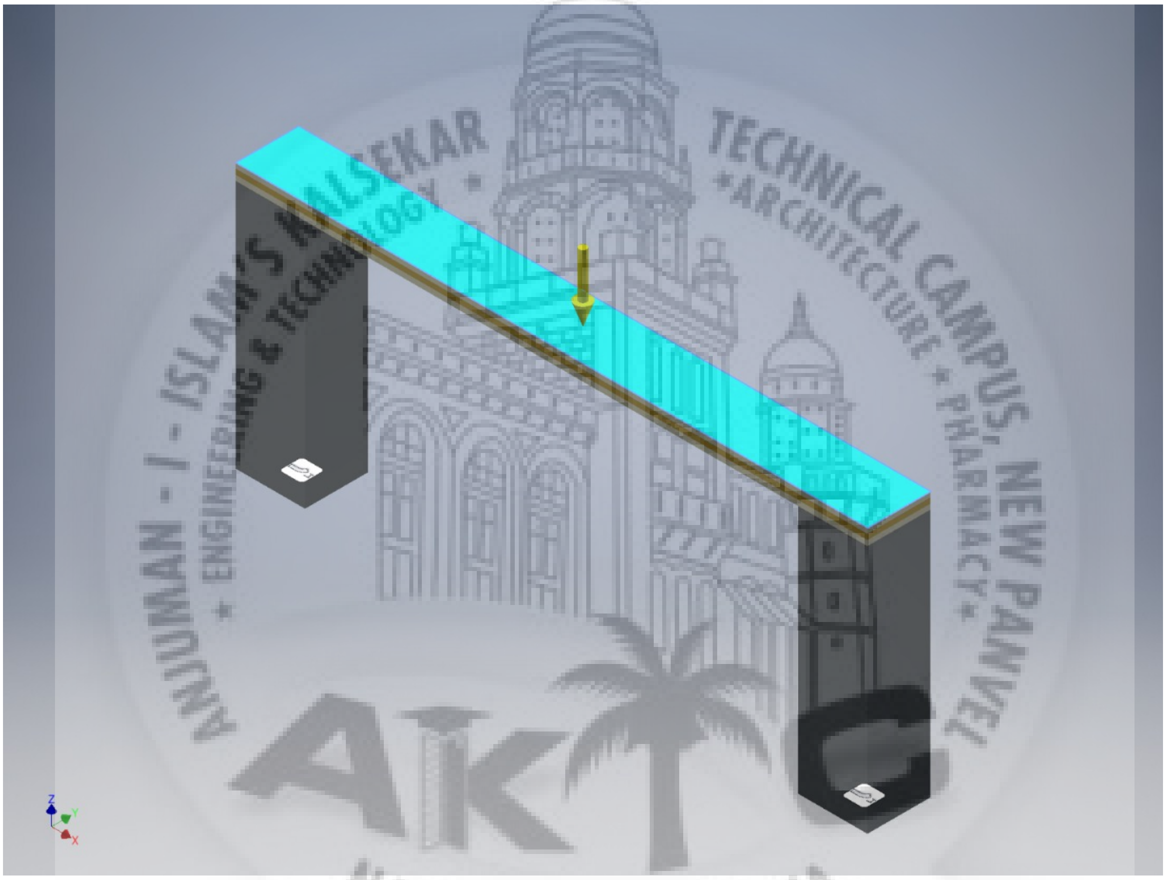
Material(s)

Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa
	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa
Name	Wheat Straw	
General	Mass Density	0.295345 g/cm^3
	Yield Strength	14.7003 MPa
	Ultimate Tensile Strength	14.6996 MPa
Stress	Young's Modulus	4.76 GPa

	Poisson's Ratio	0.43 ul
	Shear Modulus	1.66434 GPa

Force:

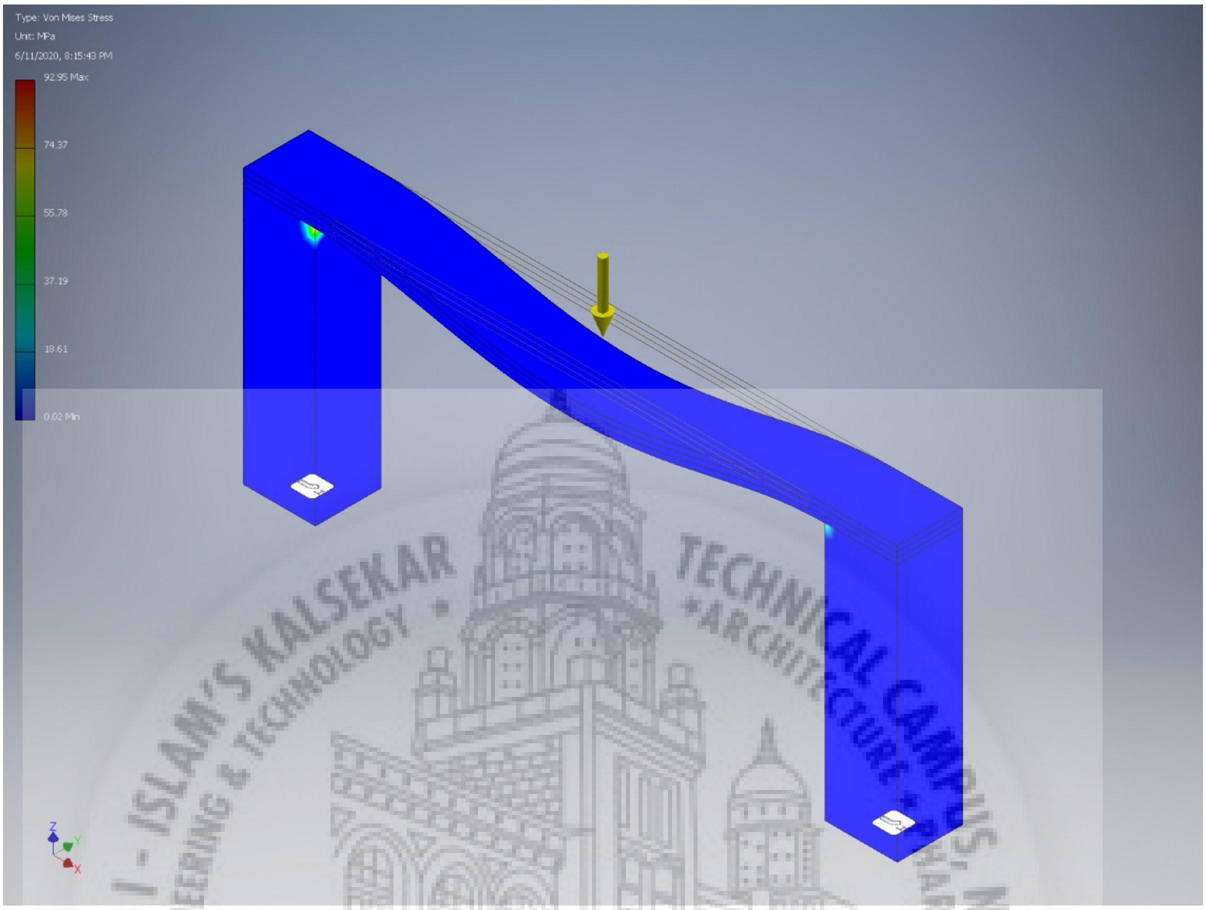
Load Type	Force
Magnitude	100.000 N
Vector X	0.000 N
Vector Y	-0.000 N
Vector Z	-100.000 N



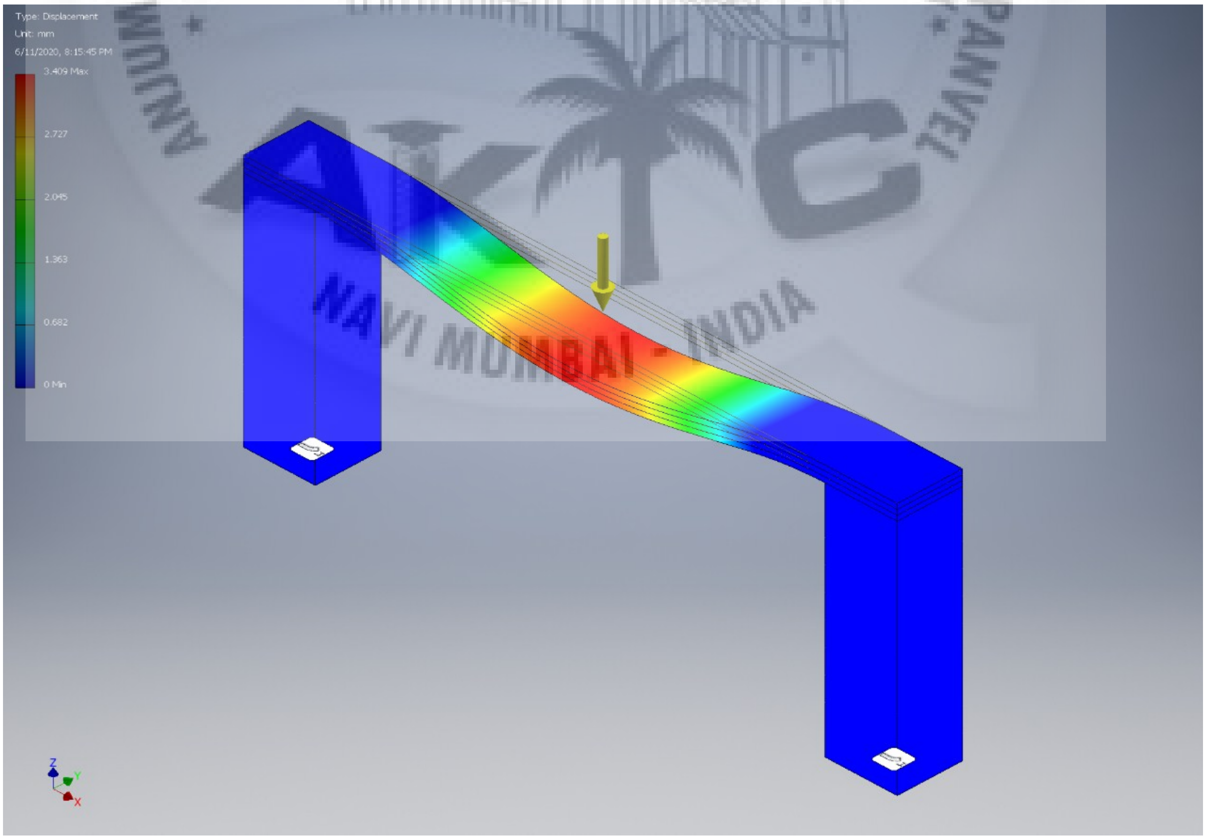
Result Summary

Name	**Minimum**	**Maximum**
Volume	22941.3 mm^3	
Mass	0.130728 kg	
Von Mises Stress	0.0197278 MPa	92.9537 MPa
1st Principal Stress	-36.1576 MPa	44.432 MPa
3rd Principal Stress	-127.346 MPa	12.9415 MPa
Displacement	0 mm	3.40868 mm
Safety Factor	0.614629 ul	15 ul

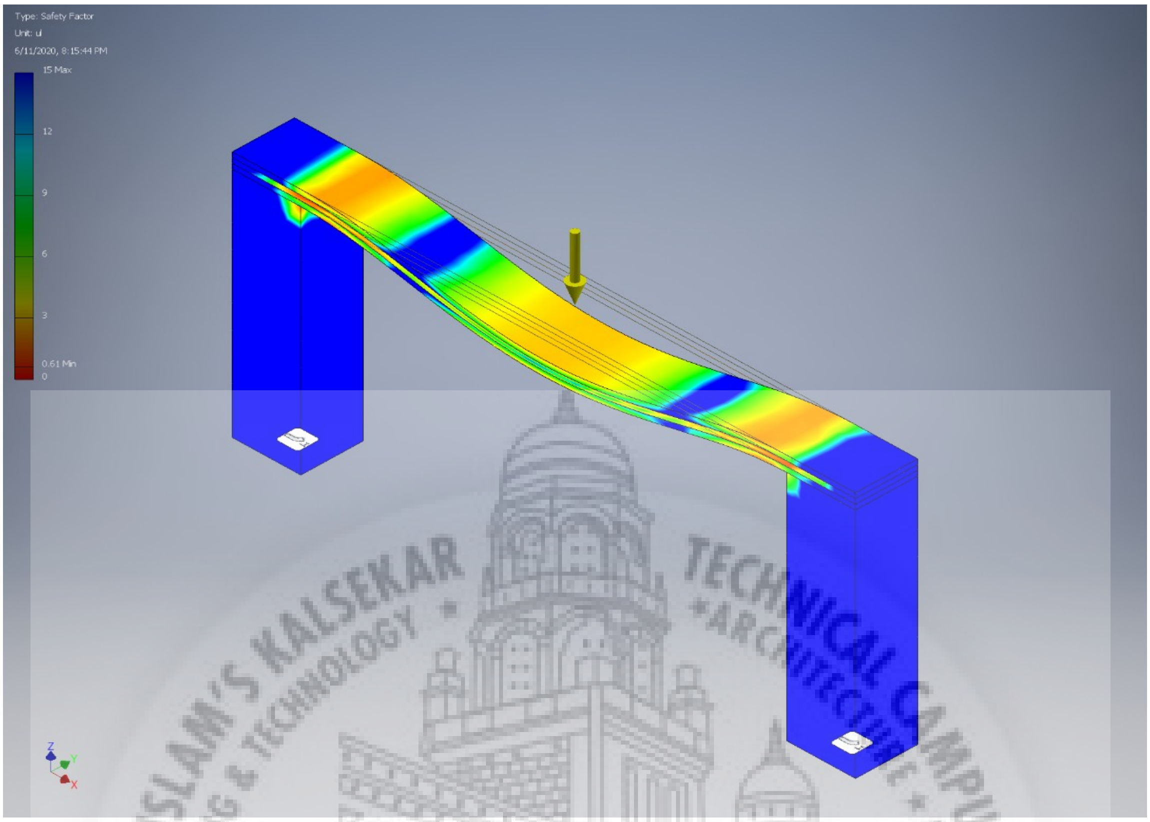
Von Mises Stress



Displacement



Safety Factor



Stress Analysis Report of PP-Glass composite

Physical

Mass	0.133971 kg
Area	16622.7 mm^2
Volume	22941.3 mm^3

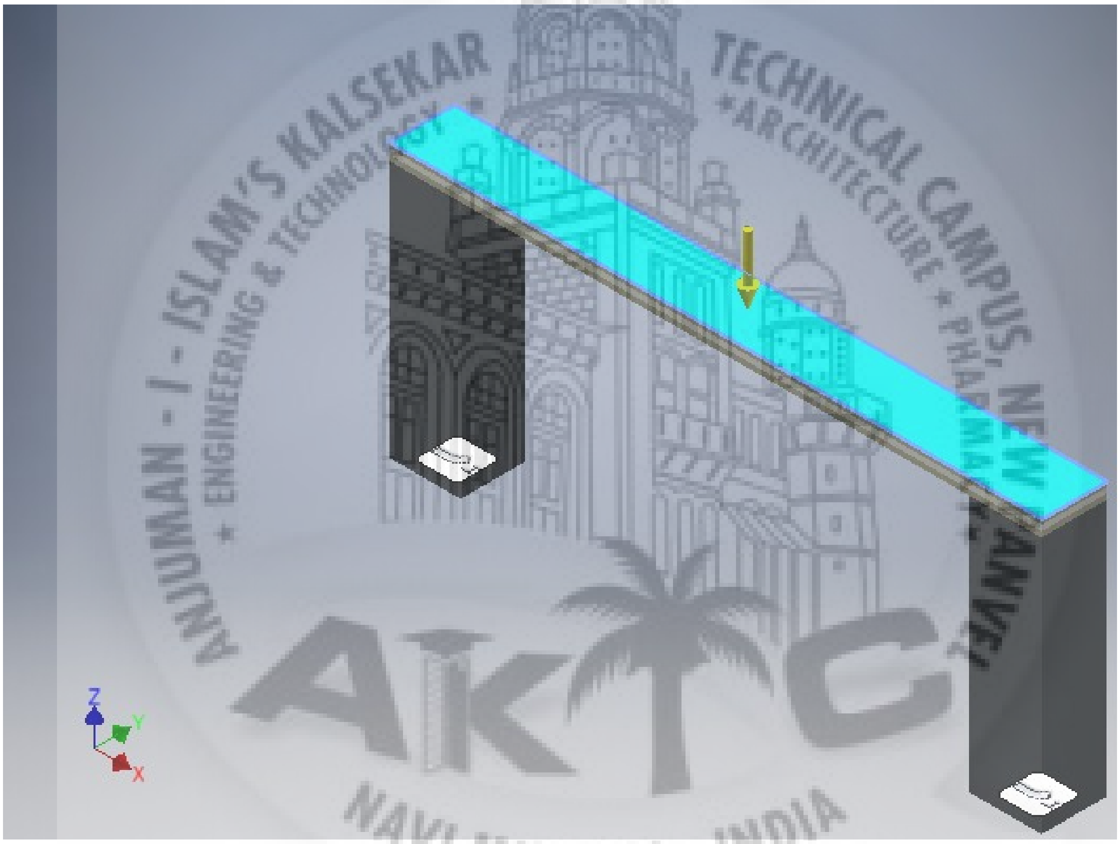
Material(s)

Name	Glass	
General	Mass Density	2.18 g/cm^3
	Yield Strength	33 MPa
	Ultimate Tensile Strength	33 MPa
Stress	Young's Modulus	68 GPa
	Poisson's Ratio	0.19 ul
	Shear Modulus	28.5714 GPa
Name	Polypropylene	
General	Mass Density	0.899 g/cm^3
	Yield Strength	30.3 MPa

	Ultimate Tensile Strength	36.5 MPa
Stress	Young's Modulus	1.34 GPa
	Poisson's Ratio	0.392 ul
	Shear Modulus	0.481322 GPa

Force:

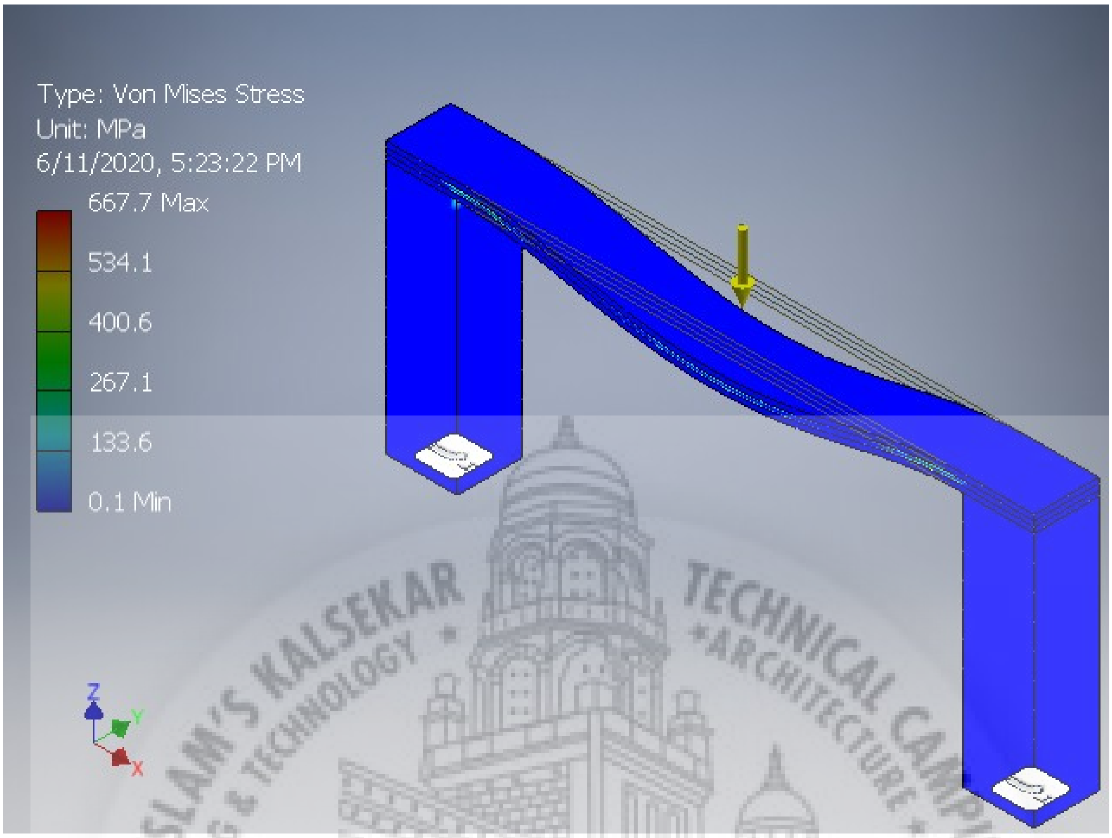
Load Type	Force
Magnitude	550.000 N
Vector X	0.000 N
Vector Y	-0.000 N
Vector Z	-550.000 N



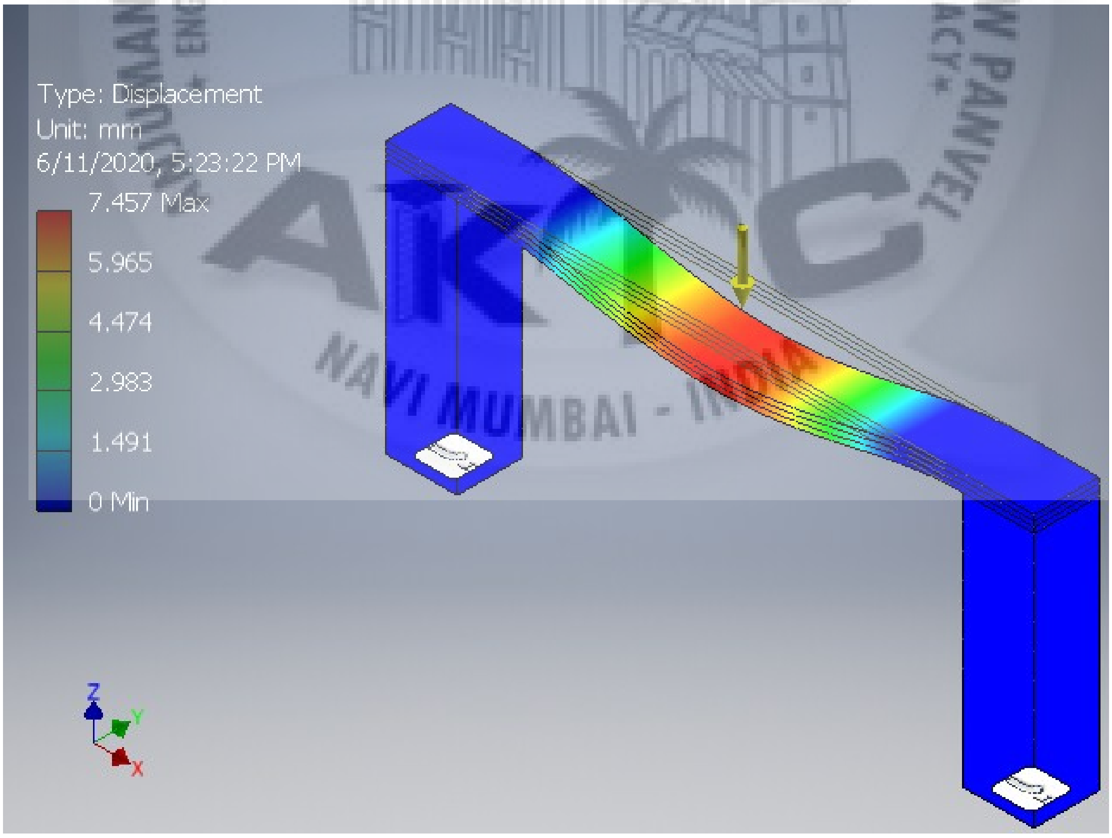
Result Summary

Name	Minimum	Maximum
Volume	22941.3 mm^3	
Mass	0.133971 kg	
Von Mises Stress	0.104515 MPa	667.659 MPa
Displacement	0 mm	7.4566 mm
Safety Factor	0.0494264 ul	15 ul

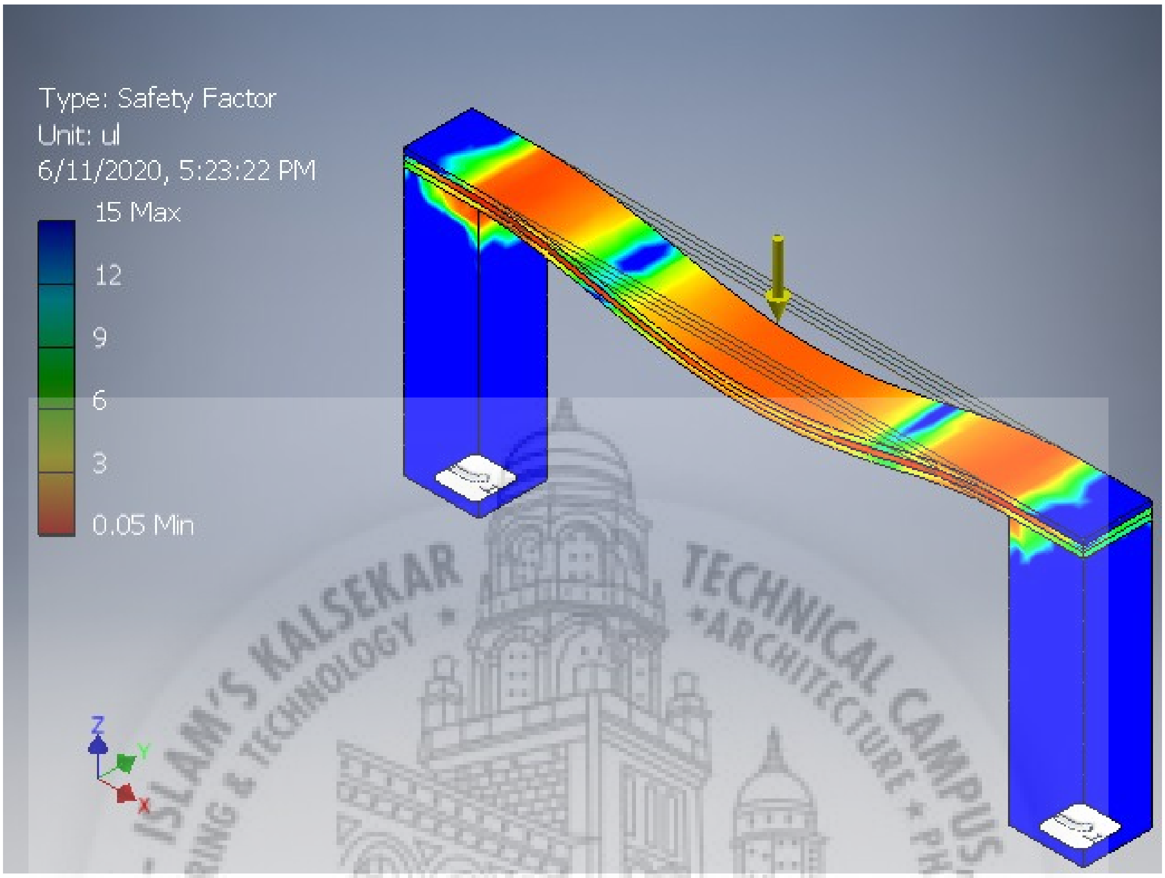
Von Mises Stress



Displacement



Safety Factor



5.4 Results and Discussion

The orientation of fibres of wheat straw and glass are arranged in such a way that the layers of both are in between the PP polymer matrix i.e layer by layer orientation of fibres are fabricated between the matrix of PP and weight percentage are taken as 30% of fibres and 70% of polymer matrix.

Sample	**Color/ material**
Neat Polypropylene	Off-white
PP-Glass fibre	White/ 70%PP 30%GF
PP-Wheat straw fibre	Brownish yellow/ 70%PP 30%WS

Table No. 2: Samples of matrix

Tensile Test

In this test, the above samples are tested and found that PP-WS sample is more effective in tensile properties but PP and PP-GF are not that effective or poor in tensile properties.

Impact test

In this test, the above samples are tested and found that PP-GF sample is more effective in impact properties but PP and PP-WS are not that effective or poor in impact properties.

Flexure test

In this test, the above samples are tested and found that PP sample is more effective in flexure properties but PP and PP-WS are not that effective or poor in flexure properties.

5.5 Estimation cost

Sr No.	***Name***	***Cost in rupees***
1	Polypropylene	2000
2	HDPE	2000
3	Wooden mold	550
4	Metal mold	1050
TOTAL		5600

Table No. 3: Cost estimation

CHAPTER 6

CONCLUSION

6.1 Conclusion

As due to corona virus or COVID-19, tests are not possible practically, so in order to conclude this study with complete report. We had done testing or analysis in software such as ANSYS and INVENTOR to get the idea of the composite samples that were produced in compression molding machine with a proper fabrication as shown in figure no.12.

The matrix that were produced in compression molding machine is shown in table no. 1 and the matrix which were analyzed or tested in software are as follows: -

Polymer matrix	Fibre composition	Weight percentage
Polypropylene	No composition	100% PP
Polypropylene	Wheat straw	90% PP- 10% WS
Polypropylene	Glass fibre	90% PP- 10% GF

Table No. 4: Order Of Composite Samples In ANSYS

There were three types of testing or analysis was done in software which are impact test, tensile test and flexure test. According to this study water absorption test was also included, but as testing was not practical this test is not possible or available in software like ANSYS. It was observed from the results that, PP-WS composite samples gave the best tensile properties while PP-GF composite samples gave the best flexural and impact properties.