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Following students have carried out their Project work/ Internship/ Field Project/Industrial Training for the academic session 2022-23

<b>S.No.</b>	<b>Name of Student</b>	<b>Page No.</b>
1	Abhishek Singh Dhurvey	3-8
2	Abhishek Pal	3-8
3	Diksha Gupta	3-8
4	Manik Raghuwanshi	3-8
5	Ashish Bhagat	9-13
6	Hero Lal Tandan	9-13
7	Rahul Chandra	9-13
8	Sanjay Chandra	9-13
9	Puneet Kumar Gond	14-18
10	Dheeraj Kumar Rajak	14-18
11	Nitesh Singh	14-18
12	Deepanshu Sahu	14-18
13	Rittik Kumar	19-24
14	Ayush Kumar	19-24
15	Saurabh Kumar	19-24
16	Aakashdeep Srivastav	19-24
17	Saurabh Kumar	25-29
18	Pawan Mahawar	25-29
19	Preethavi Singh	25-29
20	U Chandrahaas	30-34
21	V Rahul	30-34
22	G Chinna Babu	30-34
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38	Ganesh Ram	65-70
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40	Shubhrant Lahrey	76-82
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A  
Project Report  
On  
**Tensile Strength and Failure Analysis of Natural (Jute) and Glass  
Fibre Composite With circular Drill Using Scanning Electron  
Microscopy For Failure Mechanism.**



Submitted to  
**Department Of Mechanical Engineering**  
**Guru Ghasidas Vishwavidyalaya**  
(A Central University)  
Bilaspur (C.G.)

Submitted as Major Project Work for 8<sup>th</sup>  
Semester  
Of  
**Bachelor of Technology**  
In  
**Mechanical Engineering**

Submitted By  
  
Abhishek Pal  
Abhishek Singh Dhurvey  
Diksha Gupta  
Manik Raghuwanshi



### CERTIFICATE BY THE EXAMINERS

This is to certify that project work entitled:

**Tensile Strength and Failure Analysis of Natural (Jute) and Glass  
Fibre Composite With circular Drill Using Scanning Electron  
Microscopy For Failure Mechanism.**

Submitted by:

Name	Roll No.	Enrollment No.
Mr. Abhishek Pal	Roll No: 19104406	Enrolment No: GGV/19/1010
Mr. Abhishek Singh Dhurvey	Roll No: 19104407	Enrolment No: GGV/19/1011
Ms. Diksha Gupta	Roll No: 19104425	Enrolment No: GGV/19/1094
Mr. Manik Raghuwanshi	Roll No: 19104438	Enrolment No: GGV/19/1158

Has been examined by the undersigned as a part of examination of B. Tech (Mechanical) 8<sup>th</sup> semester project at Department of Mechanical Engineering, School of Studies of Engineering & Technology, Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur, and (CG) India.

Internal Examiner

Date:

External Examiner

Date:

Head of Department / Head  
Department of Mechanical Engineering  
School of Studies of Engineering & Technology,  
Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh

[vi]





## ABSTRACT

In this experiment, Comparative study of tensile strength is done on hybrid composite laminates having jute and glass with and without circular hole on transverse loading. Moreover, the failure mechanism is observed with a Scanning Electron Microscope. The hand-layup method is used to fabricate the samples of dimensions 160mm\*160mm with different stacking sequences.

Four layers (JJJJ,JGGJ,GJJG,GGGG) are fabricated under uniform pressure and room temperature. Use of rollers are done to avoid air gaps and resin pockets. Bi-directional Jute and unidirectional glass fibres are used for the experiment. L-12 EPOXY and K-6 HARDENER are used in a 10:1 ratio. The specimen of dimension 150mm\*36mm\*3.2 mm is taken with and without a circular hole for testing.

The hole diameter is kept 6 mm as mentioned in the ASTM standard having hole to width ratio as 1:6. After the tensile test of the specimen on transverse loading, the laminates having hole have lesser tensile strength than without hole. This is due to stress concentration on the circumference of the hole due to sudden area change. It is also seen that laminates having synthetic fibres as core have higher tensile strength than on face. JGGJ has 17.25% higher tensile strength than GJJG.

For the failure mechanism, a Scanning Electron Microscope is used for the microscopic view. The edges of the circular hole are observed under it. Fibre pullout, matrix failure, Crack propagation are the phenomena which are observed.



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A  
Project  
On

“Study of solar air heater performance with evacuated tube involving a phase change material as a thermal storage enhancer.”



Submitted to  
**Department Of Mechanical Engineering**  
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A Central University  
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Submitted by  
Ashish Bhagat  
Sanjay Chandra  
Hero Lal Tandan  
Rahul Chandra

Department of Mechanical Engineering  
School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (C.G.)  
**Session 2022-2023**



### CERTIFICATE BY THE EXAMINERS

This is to certify that the project work entitled:

**“Study of solar air heater performance with evacuated tube involving a phase change material as a thermal storage enhancer”**

Submitted by:

Name	Roll no.	Enrollment no.
Mr. Ashish Bhagat	19104413	GGV/19/1052
Mr. Sanjay Chandra	19104459	GGV/19/1259
Mr. Hero Lal Tandan	19104431	GGV/19/1116
Mr. Rahul Chandra	19104453	GGV/19/1226

Has been examined by the undersigned as a part of the examination of the B.Tech (Mechanical) 8<sup>th</sup>-semester project at the Department of Mechanical Engineering, School of Studies of Engineering & Technology, Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur, and (CG) India.

.....  
10.05.2023

**Internal Examiner**

Date:

.....  
10.05.2023

**External Examiner**

Date:

.....  
10.05.2023

**Head Of Department**

Department of Mechanical Engineering  
School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya (C.G.)  
Bilaspur, Chhattisgarh





## **ABSTRACT**

The investment of solar energy in life applications has become mandatory to maintain a clean environment and reduce the use of fossil fuels. This work aimed to improve the performance of solar air heaters (SAH) by using evacuated tube solar collectors ETSC integrated with phase change material (PCM).

To achieve this purpose, a system consisting of a solar evacuated tube with co-axial pipes containing paraffin wax was designed, fabricated, and experimentally investigated.

A panel included a glass-evacuated tube with two concentric iron pipes installed inside. PCM was placed between the inlet and outlet air paths inside the evacuated tube to enhance the heat transfer rate. As well known, the hot air is used for a variety of purposes including space heating, food processing, drying of fruit, vegetables, dairy, and solar cooking.



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A  
Project Report  
On  
Pedal Press Pneumatic Lifting Jack



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In  
**Mechanical Engineering**

Submitted By  
Deepanshu Sahu  
Dheeraj Kumar Rajak  
Punit Kumar Gond  
Nitesh Singh  
**Department of Mechanical Engineering**  
School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (Chhattisgarh)  
**Session 2019-2023**



### CERTIFICATE BY THE EXAMINERS

This is to certify that project work entitled:

**Pedal Press Pneumatic Lifting Jack**

Submitted by:

Name	Roll No.	Enrollment No.
Mr. Deepanshu Sahu	Roll No: 19104423	Enrolment No: GGV/19/1092
Mr. Dheeraj Kumar Rajak	Roll No: 19104424	Enrolment No: GGV/19/1092
Mr. Puneet Kumar Gond	Roll No: 19104452	Enrolment No: GGV/19/1222
Mr. Nitesh Singh	Roll No: 19104446	Enrolment No: GGV/19/1193

Has been examined by the undersigned as a part of examination of B. Tech (Mechanical) 8<sup>th</sup> semester project at Department of Mechanical Engineering, School of Studies of Engineering & Technology, Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur, and (CG) India.

.....  
Internal Examiner

Date:

.....  
External Examiner

Date:

.....  
Head of Department / Head  
Department of Mechanical Engineering / Mechanical Engg. Dept  
School of Studies of Engineering & Technology, Institute of Technology  
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)  
Koni, Bilaspur, Chhattisgarh





## **ABSTRACT**

The principal focus of the work we performed was basically focused on providing comfort and ease to the driver of an automobile especially women and old aged people at the time of changing the tire in case of puncture by replacing the screw and hydraulic jack with pneumatic jack. The pneumatic jack works basically on the principle of Pascals Law and Second law of Thermodynamics. The pneumatic lifting jack incorporates a pneumatic cylinder mechanism that converts compressed air into linear force, providing a reliable and consistent lifting capability. By eliminating the need for manual pumping or complex hydraulic systems, this innovative device reduces operator fatigue and increases productivity. Furthermore, the pneumatic lifting jack offers a safe and stable lifting experience. The main challenge we faced was getting a pneumatic piston-cylinder which could fit inside a car and lift the weight of 450kg. The device's lightweight design and portability make it an ideal solution for on-site lifting operations.





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# MAJOR PROJECT REPORT

## Design, Analysis, and Simulation of V-frame Octocopter

# V-FRAME OCTOCOPTER



SESSION 2019-2023

Submitted in the fulfillment of the requirement in  
8th semester for the degree of

BACHELORS OF TECHNOLOGY  
IN  
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Approved by  
Department of Mechanical Engineering  
Guru Ghasidas Vishwavidyalaya, Bilaspur, CG  
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Under supervision of  
**Dr. Anoop Kumar Sahu**

Prepared by

Aakashdeep Srivastava	19104401
Ayush Kumar	19104415
Rittik Kumar	19104457
Saurabh Kumar	19104461



### CERTIFICATE BY THE EXAMINER

This is to certify that project work entitled: "Design, Analysis & Simulation of V-Frame Octocopter"

Name	Roll No.	Enrollment No.
Aakashdeep Srivastava	19104401	GGV/19/1003
Ayush Kumar	19104415	GGV/19/1060
Rittik Kumar	19104457	GGV/19/1246
Saurabh Kumar	19104461	GGV/19/1265

are examined by the undersigned as a part of an examination of the B. Tech (Mechanical) 8th semester project at, the Department of Mechanical engineering, Institute of Technology Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur (C.G.).

INTERNAL EXAMINER

DATE:

EXTERNAL EXAMINER

10/5/2023 :DATE

विभागाध्यक्ष / Head  
वाणिज्यिक अभियांत्रिकी विभाग / Mechanical Engg. Dept.  
ग्रोव्हाउस / Institute of Technology  
गुरु घासीदास विश्वविद्यालय / Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)  
Guru Ghasidas Vishwavidyalaya, Bilaspur, CG  
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## ABSTRACT

Octocopters, a type of multirotor vehicle with more than two rotors, have recently garnered significant attention in both scientific and commercial applications due to their high maneuverability and robustness. Multi-copters have played a crucial role in the technological revolution in several fields, including military, industry, transportation, mapping, and particularly agriculture. With the advent of advanced technology in sensors, electronics, 3D printing, and high-performance batteries, multi-copters can now be manufactured at a lower cost. This has resulted in the new technological application in the agricultural field, such as precision agriculture, mapping, and surveillance.

This study aimed to design, simulate, and manufacture a new model of an octocopter V-frame using 3D printing technology. The primary objective was to achieve a simple manufacturing process. Furthermore, the octocopter's PID controller was simulated on the Simulink environment to obtain optimum performance in roll and pitch angle control.

The V-frame octocopter was chosen for this research due to its superior performance, including high redundancy rotors, high payload capability, and affordable cost when compared to other multi-copter family. Additionally, the V-frame octocopter allowed for an increased field of view of the camera by placing it in the front of the drone.



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## NOMENCLATURE

$FOV$ = field of view	$\dot{m}$ = mass flow
$F_{Thrust}$ = thrust force of each motor	$v$ = velocity of octocopter
$E$ = Young's modulus	$S$ = propeller surface area
$\sigma_u$ = ultimate tensile strength	$P$ = power
$K_M$ = torque constant	$K_F$ = thrust constant
$\omega_i$ = rotation rate of rotor number $i$	$C$ = drag coefficient
$U_T$ = thrust control input of propeller's velocity	$s_i$ = sine of angle $i$
$K_p$ = proportional gain, a turning parameter	$c_i$ = cosine of angle $i$
$K_i$ = integral gain, a turning parameter	$A$ = crossing area
$K_D$ = derivative gain, a turning parameter	$\rho$ = air density
$R_\psi$ = rotation about z-axis	$R_\theta$ = rotation about y-axis
$R_\phi$ = rotation about x-axis	$\tau_\phi$ = roll moment of octocopter
$\tau_\phi$ = pitch moment of octocopter	$\tau_\psi$ = yaw moment of octocopter



**Project Report**

**On**

***“TO STUDY THE EFFECT OF OPERATING PARAMETERS ON  
THE THERMAL PERFORMANCE OF ETSC IN BOTH INDOOR  
AND OUTDOOR CONDITIONS”***



**Submitted to**  
**Department of Mechanical Engineering**  
**Guru Ghasidas Vishwavidyalaya**  
(A Central University)  
Bilaspur (C.G.)

**Submitted as Major Project Work for 8<sup>th</sup> Semester**  
**of**  
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**in**  
**Mechanical Engineering**

**Submitted by**  
Preethavi Singh (19104451)  
Pawan Mahawar (19104448)  
Saurabh Kumar (19104460)

Department of Mechanical Engineering  
School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya (A Central University)  
Bilaspur (Chhattisgarh)  
**Session 2022-23**





**Certificate by the Examiner**

This is to certify that project work entitled: ***“TO STUDY THE EFFECT OF OPERATING PARAMETERS ON THE THERMAL PERFORMANCE OF ETSC IN BOTH INDOOR AND OUTDOOR CONDITIONS”***

Submitted By	Roll Number	Enrollment No.
Preethavi Singh	19104451	GGV/19/1218
Pawan Mahawar	19104448	GGV/19/1205
Saurabh Kumar	19104460	GGV/19/1264

Are examined by the undersigned as a part of an examination of the B. Tech, **Mechanical**, 8<sup>th</sup> semester project at, the Department of Mechanical Engineering, School of Studies of Engineering and Technology **Guru Ghasidas Vishwavidyalaya (A Central University)**, Koni, Bilaspur, Chhattisgarh.

.....  
**Internal Examiner Date:**

.....  
**External Examiner Date**

.....  
विभागाध्यक्ष / Head  
गणित की अभियांत्रिकी विभाग / Mechanical Engineering  
Head of Department (Mechanical Engineering)  
गुरु घासीदास विश्वविद्यालय / Koni, Bilaspur, Chhattisgarh  
School of Studies of Engineering and Technology,  
Guru Ghasidas Vishwavidyalaya (A Central University), Koni, Bilaspur, Chhattisgarh



## Abstract

Solar air heater (SAH) is the leading component of the solar thermal conversion system. Solar air heaters, which are a primary component of solar thermal conversion systems. These heaters absorb solar radiation and convert it into thermal energy. The heaters are widely used in various applications, such as space heating, timber seasoning, and agriculture drying, Industrial purpose. The performance was experimentally examined simultaneously with simple ETC solar air heater at different mass flow rates ranging 0.002–0.007 kg/s. The effect of Plane GI Tube and Copper Mesh GI evacuated tube on the outlet temperature, heat gain and thermal efficiency, has been studied under the normal operation. The maximum air temperature at the outlet for ETC was observed to be 80.8°C, whereas average air temperature of 65.7°C was recorded corresponding to the mass flow rate of 0.002 kg/s for plane steel tube. The maximum thermal efficiency value of 85.25 % was achieved for ETC solar air heater with copper mesh tube at a mass flow rate of 0.0057 kg/s, whereas, the thermal efficiency for simple steel tube ETC solar air heater was 82.11% for indoor conditions. The maximum thermal efficiency value of 87.65% was achieved for ETC solar air heater at a mass flow rate of 0.0057 kg/s, whereas, the thermal efficiency for simple steel tube ETC solar air heater was 82.40% for outdoor conditions. The thermal efficiency of ETC with copper mesh tube was superior as compared to simple steel tube ETC without any economic downside. Copper tubes heat up quickly as compared to steel tubes because copper has a higher thermal conductivity than steel. Thermal conductivity is the ability of a material to conduct heat. Copper has a thermal conductivity of about 400 W/mK, while steel has a thermal conductivity of about 50 W/mK. This means that copper can transfer heat more efficiently than steel. On the grounds of improved thermal efficiency, output temperature and heat gain ETC with copper tube solar air heater has been observed to be better and yield higher air temperatures as compared to the simple ETC with plane tube solar air heater.

*Keywords: Thermal Efficiency, Copper Tube, Plane Tube, Thermal conductivity.*



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**A**

**Project Report**

**On**

***“DESIGN AND FABRICATHION OF 360 DEGREE AIR COOLER CUM  
ROOM HEATER”***



**Submitted to**

**Department of Mechanical Engineering  
Guru Ghasidas Vishwavidyalaya  
(A Central University)  
Bilaspur (C.G)**

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Bachelor of  
Technology in  
Mechanical Engineering**

**Submitted by**

1. U CHANDRAHAAS
2. V RAHUL
3. G CHINNA BABU
4. S SRAVAN KUMAR

**Department of Mechanical Engineering  
School of Studies of Engineering &  
Technology  
Guru Ghasidas Vishwavidyalaya (A Central  
University)  
Bilaspur (Chhattisgarh)**



CERTIFICATION BY THE EXAMINERS

This is to certify that project work entitled:

***"DESIGN AND FABRICATION OF 360 DEGREE AIR COOLER CUM ROOM HEATER"***

NAME	ROLL NO.	ENROLLMENT NO.
Mr. U Chandrahaas	19104469	GGV/19/1292
Mr. V Rahul	19104472	GGV/19/1296
Mr. G Chinna Babu	19104426	GGV/19/1100
Mr. S Sravan Kumar	19104463	GGV/19/1267

Has been examined by the undersigned as a part of examination of B. Tech (Mechanical) 8th semester project at Department of Mechanical Engineering, School of Studies of Engineering & Technology, Guru Ghasidas Vishwavidyalaya (Central University) Bilaspur, and (CG) India.

Internal Examiner  
Date:

External Examiner  
Date: 10.05.2023

Head of Department / Head  
Department of Mechanical Engineering / Mechanical Engg. Dept  
School of Studies of Engineering & Technology / Institute of Technology  
Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh (C.G.)



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### ABSTRACT

This project aims to design and fabricate a 360-degree air cooler cum heater, which can provide both cooling and heating functionality for a room. The main objective is to develop the energy efficient, environment friendly direct evaporative air conditioning and forced heating system having low operating cost suitable that can provide year-round comfort for the people living in hot and dry regions and climates. 360-degree design air cooler & heater will allow a person to sit in any direction during winter for heater and cooler for summer. Simple 360-degree evaporative cooling is achieved by direct contact of water particles & a moving air stream. When hot, dry air is allowed to flow through a wet cooling pad, the temperature of the incoming air is lowered and the specific humidity rises because some of the water from the cooling pad evaporates, absorbing heat from the incoming air to vaporise. A forced convective heater that rotates 360 degrees features an electric fan to quicken the airflow.

In order to achieve the best thermal conductivity and structural integrity, the various components are assembled and integrated throughout the fabrication process. Experimental testing and analysis are conducted to evaluate the performance and efficiency of the system under different operating conditions. The results demonstrate the effectiveness of the air cooler cum heater in providing rapid and precise temperature regulation. Overall, this research helps to meet the rising demand for flexible temperature control solutions by advancing the field of air conditioning technology.





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A  
Project Report  
On  
**“ELECTRICITY GENERATION BY USING  
FOOTSTEPS”**



**Submitted to**  
**DEPARTMENT OF MECHANICAL ENGINEERING**  
**GURU GHASIDAS VISHWAVIDYALAYA**  
(A Central University)  
Bilaspur (C.G.)  
**Submitted as MAJOR PROJECT Report for 8<sup>th</sup> Semester**  
**Of**  
**Bachelor of Technology**  
**In**  
**Mechanical Engineering(2022-2023)**

**Submitted By**  
**VENNA ANJANEYA REDDY**  
**VEERMALLA CHARAN KUMAR**  
**N BHEEMARAO RAMJI**  
**M UMA MAHESWARA RAO**

**Submitted to**  
**Dr. BIPLAB DAS**  
**(ASSISTANT PROFESSOR)**

Department Of Mechanical Engineering  
School Of Studies Of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya, Bilaspur (Chhattisgarh)



### CERTIFICATION BY THE EXAMINERS

This is to certify that project work entitled:

Project name

Submitted by:

Name	Roll No	Enrollment No
Mr. V. Charan Kumar	18104054	GGV/18/1333
Mr. V. Anjaneya Reddy	18104055	GGV/18/1334
Mr. N. Bheemaroo Ramji	18104024	GGV/19/1176
Mr. M. Uma Maheswara Rao	18104022	GGV/18/1166

Has been examined by the undersigned as a part of examination of B. Tech (Mechanical) 8<sup>th</sup> semester project at Department of Mechanical Engineering, School of Studies of Engineering & Technology, Guru Ghasidas Vishwavidyalaya (Central University) Bilaspur, (CG) India.

.....  
Internal Examiner

Date: 10/5/2023.

.....  
External Examiner

Date:

.....  
Head of Department / Head  
यांत्रिकी अभियांत्रिकी विभाग / Mechanical Engg. Dept  
प्रौद्योगिकी संस्थान / School of Engineering & Technology  
गुरु घासीदास विश्वविद्यालय / Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)  
School of Studies of Engineering & Technology,

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh





## ABSTRACT

In this project we are generating electrical energy by means of a non- conventional method just by walking on the footsteps. Non-conventional system for energies are very much required at this time. Energy generation using footsteps requires no any fuel input to generate electricity. In this project we are generating electricity just with the help of rack and pinion arrangement along with alternator and chain drive mechanism. For its proper functioning such that it converts Force into electrical energy, the mechanism consists of rack & pinion, chain drives, alternator and battery. We have discussed its various alternate applications with extension also. The power generation is much worthy but it has little initial cost. Man has needed and used energy at an increasing rate for the substance and well- being since time immemorial. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India where the railway stations, temples, etc, are overcrowded all round the clock.

Nowadays energy and power are the one of the basic need in this modern world. Energy demand is increasing day by day. On the other hand, the many energy resources are getting exhausted and wasted .Millions of people move around. This whole energy is wasted. If this energy made possible for utilization then it will be a great invention. In this project we are converting non-conventional from just walking foot step into electrical energy. This project uses simple drive mechanism such as rack and pinion assembly. The control mechanism carries the rack & pinion; D.C generator, gears, shafts, plates and multimeter to show output. We have discussed the various applications and further extension.

Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step needs no fuel input power to generate the electrical power. In this project the simple drive mechanism such as rack and pinion assembly mechanism is used for generating power by utilization of force which is obtained during the walking on steps is converted in to electric

Nowadays energy and power are the one of the basic need in this modern world. Energy demand is increasing day by day. On the other hand, the many energy resources are getting exhausted and wasted .Millions of people move around. This whole energy is



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**Project Report**

**On**

**“DEVELOP A WORKABLE MODEL OF AN AUTOMATIC SPICE  
CRUSHING MACHINE THAT PRESERVES THE FLAVOUR AND  
NUTRITIONAL CONTENT OF SPICES”**



**Submitted to**

**Department of Mechanical Engineering  
Guru Ghasidas Vishwavidyalaya  
(A Central University)  
Bilaspur (C.G.)**

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**Of**

**Bachelor Of Technology**

**In**

**Mechanical Engineering**

**Submitted by**

Arjun Singh

Banoth Vennela

Gaurav Saket

Vikash Kumar Shrivastva

School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (Chhattisgarh)  
(A Central University)

**SESSION- 2022-2023**





### Certificate by the Examiner

This is to certify that project work entitled: “Develop a Workable Model of an Automatic Spice Crushing Machine that Preserves the Flavor and Nutritional Content of Spices”

Submitted By	Roll Number	Enrollment Number
Arjun Singh	18104006	GGV/18/1098
Banoth Vennela	18104009	GGV/18/1076
Gaurav Saket	18104014	GGV/18/1110
Vikash Kumar Shrivastva	18104057	GGV/18/1338

are examined by the undersigned as a part of an examination of the B.Tech (Mechanical) 8<sup>th</sup>-semester project at, the Department of Mechanical Engineering, Institute of Technology Guru Ghasidas Vishwavidyalaya (A Central University), Koni, Bilaspur, Chhattisgarh.

  
10/05/23


Internal Examiner

Date: 10/05/23

  
10/05/23

External Examiner

Date: 10/05/23

  
10/05/23  
विभागाध्यक्ष / Head  
विभागाध्यक्ष / Mechanical Engg. Dept  
Institute of Technology  
Guru Ghasidas V.V.  
School of Engineering & Technology,  
Koni, Bilaspur (C.G.)  
Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur, Chhattisgarh



## ABSTRACT

Develop a workable model of an automatic spice crushing machine that preserves the flavour and nutritional content of spices is a pounding machine used to crush different types of spices into a fine powder for commercial use. Traditionally, spices were pounded with a mortar and pestle, but as technology advanced, large-scale spice mills replaced manual pounding methods. The Spice Crusher Machine is a motor-driven device designed to efficiently pound and crush spices. This machine is used for crushing the spices such as cinnamon, pepper, coriander, and cloves, among others. It offers the convenience of simultaneously processing two different spices without requiring manual stirring, making it a time-saving and labour-efficient tool. The machine is equipped with a detachable stirrer, buckets and strainer, strainer allowing for easy separation of the pounded spices. Additionally, different spices need different weights to pound, extra weight can be added at the tip of the hammers according to the spice that need to be pounded. The Spice Crusher Machine operates on a cam follower mechanism, eliminating the need for skilled personnel to operate it. we are aiming for a user-friendly feature that makes it accessible to a wide range of users. The machine's mass production rate and efficiency are commendable, making it suitable for various applications. One notable advantage of using the Spice Crusher Machine is that it ensures a more hygienic process compared to grinding. Moreover, pounding helps preserve the nutritional content and freshness of spices, making it an ideal method for spice preparation.

When choosing a spices crusher machine, it is important to consider factors such as the size and capacity of the machine, the type of spices you will be crushing, and the level of precision required for your application. Additionally, you should consider the durability and maintenance requirements of the machine to ensure that it will provide reliable service for years.

Overall, the Spice Crusher Machine offers a practical solution for efficient spice pounding, ensuring hygiene, freshness, and nutritional preservation.



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A

Project Report

on

**“Automatic Paddy Refresher Machine”**



Submitted to

**Department of Mechanical Engineering**  
**Guru Ghasidas Vishwavidyalaya**  
(A Central University)  
Bilaspur (C.G.)

**In partial fulfilment of requirement for the award of Degree**

**Of**

**Bachelor of Technology**

**in**

**Mechanical Engineering**

**Submitted By :-**

**Abhishek Yadav**  
**Aman Ratre**  
**Prince Kumar**

Department of Mechanical Engineering  
School of Studies of Engineering & Technology  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (Chhattisgarh)  
8<sup>th</sup> Sem.



**Certificate by the Examiners**

This is to certify that project work entitled:

**“Automatic Paddy Refresher Machine”**

Submitted by

Mr. Abhishek Yadav

Roll No: 17104234

Enrolment No: GGV/17/1011

Mr. Aman Ratre

Roll No: 17104238

Enrolment No: GGV/17/1024

Mr. Prince Kumar


Roll No: 18104034

Enrolment No: GGV/18/1227


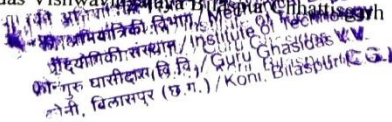
Has been examined by the undersigned as a part of examination of B.Tech (Mechanical) 8<sup>th</sup> semester, Major project at Department of mechanical engineering, Institute of Technology Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur (C.G.) India.

  
Internal Examiner

Date:

  
External Examiner

Date:

  
Head of Department  
Department of Mechanical Engineering  
School of Studies of Engineering & Technology, Dept  
Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur (C.G.) India  




### Abstract

The conventional process of manually stimulating the plants of paddy was done by farmers with the help of pulling a long wooden block which was known as PATA at that time. This process helps in increasing tiller in crop which later enhances the overall production yield. Manual stimulation has been shown to increase the production of growth hormones, such as gibberellins, in rice plants (paddy crops). Gibberellins are naturally occurring plant hormones that play a crucial role in regulating plant growth and development, including stem elongation and seed germination. However, the process was manual and requires man-power for pulling in the muddy field and used to be time consuming. This method has been obsoleted with the increase in labour costs and induction of chemicals fertilizers and drugs. As organic farming is in growing trend in India, farmers are reaching back to these methods. Although it is not very cost effective due to increased labour costs.

Farmers use chemical products in large amounts in the farming process to increase crop production, in the form of chemical fertilizers such as Urea, Phosphate. Also, chemical growth hormones are induced in plant to improve production. Not only this, many types of pesticides and drugs are used in the crop for killing the insects which damages the crop in the field, and also for damaging the unwanted plants that come into the field. However, these chemicals used in our crops badly affect our ecosystem as well as our health. This is because these chemicals are poisonous and they affect our health and have become the reason for increasing so many diseases today.

In an effort to decrease reliance on chemical treatments, we have devised a specialized device intended for paddy crops. This device is powered by GPS and compass technology, and operates using battery power. Its propulsion system is comprised of two motors: one which propels the wheels forward and another which control steering and rotation. The machine is entirely automated and requires minimal direct human interaction during its operation.

*This project was submitted by a group in 2022 batch of students, but in their project, they were failed to steer the machine however this year we have solved that problem of steering the machine and we have a made a model that is automatic based on GPS based automatic mechanism. The machine scans the path and then follows the scanned path on its own with little to no human intervention.*



**MECHANICAL BEHAVIOR OF CONVENTIONALLY  
DRILLED SiO<sub>2</sub> DISPERSED CARBON, GLASS, AND  
KEVLAR FIBER REINFORCED EPOXY COMPOSITES**

A dissertation interim evaluation submitted in partial fulfillment of the requirement for  
the degree.

Of

**MASTER OF TECHNOLOGY  
(Machine Design)**

Submitted by

**ABHISHEK TANDEY**

Under the supervision of

**Dr. Samarjit Singh**

**Assistant Professor**



Department of Mechanical Engineering  
School of Studies of Engineering and Technology  
Guru Ghasidas Vishwavidyalaya (A Central University)  
Koni, Bilaspur, Chhattisgarh, INDIA  
Pin- 495009

October 2023





## CERTIFICATE

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Signature of the student

**ABHISHEK TANDEY**

Signature of supervisor

**Dr. SAMARJIT SINGH**

(Assistant professor)

Head विभागाध्यक्ष/Head

यांत्रिकी अभियान्तरी विभाग / Mechanical Engg. Dept.  
प्रौद्योगिकी संस्थान / Institute of Technology

गुरु घासीदास विश्वविद्यालय / Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)

CERTIFICATE BY EXAMINERS



## CERTIFICATE BY EXAMINERS


This is to certify that the "Thesis" entitled "**MECHANICAL BEHAVIOR OF CONVENTIONALLY DRILLED SiO<sub>2</sub> DISPERSED CARBON, GLASS, AND KEVLAR FIBER REINFORCED EPOXY COMPOSITES**"

Submitted by  
**Mr. ABHISHEK TANDEY**  
Roll no. – 21040101  
Enrolment No. – GGV/21/01601

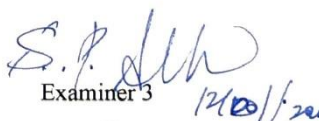
Has been examined by the undersigned as a part of an examination of Master of Technology (Machine Design) at the Department of Mechanical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur, and Chhattisgarh, INDIA. The dissertation is found to be satisfactory.

  
Examiner 1

Date:

  
Examiner 2

Date:

  
Examiner 3

Date:



## ABSTRACT

Research and development of synthetic fiber-reinforced composites have been on the rise over the past few decades owing to the advancement in technology and the effects of synthetic fibers on the environment. Researchers are searching for alternatives while keeping in mind the advancement of mechanical properties. Due to their exceptional mechanical properties, synthetic fibers as reinforcement in composites are inevitable in today's composite industry. The objective of this thesis is to investigate the performance of continuous carbon, glass, and kevlar unidirectional (0/90) reinforced composites manufactured using the hand layup method. These fibers are combined with epoxy resin, which acts as a binding agent to form composites. A filler material silica ( $\text{SiO}_2$ ) is also used with different weight percentages to further enhance the material's properties. A hole is drilled in the specimen, and its tensile behavior is compared to the material without drilling, which often results in damage around the drilled hole. The tensile and flexural tests are conducted to identify the composite specimen with the better mechanical characteristics. A predictive approach based on artificial neural networks (ANN) modeling analysis has been developed to predict the ultimate tensile strength of the ( $\text{SiO}_2$ ) dispersed carbon, glass, and kevlar fiber-reinforced epoxy composite. The results of the predictive model are in close agreement with the training and testing data.



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**INFLUENCE OF SAWDUST AND ADHESIVE TYPE ON THE  
MECHANICAL PROPERTIES OF RICE HUSKS PARTICLE BOARD**

**A dissertation-interim evaluation submitted in partial fulfillment of the  
requirement for the degree**

**Of**

**MASTER OF TECHNOLOGY**

**(Machine Design)**

**Submitted By**

**Devendra Kumar**

**Under the supervision of**

**Dr. Biplab Das**



**Department of Mechanical Engineering School of Studies of Engineering and  
Technology Guru Ghasidas Vishwavidyalaya (A Central University)**

**Koni, Bilaspur, Chhattisgarh, INDIA**

**Pin- 495009**

**October 2023**



## CERTIFICATE

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Signature of the student

Devendra Kumar

Signature of supervisor

**Dr. Biplab Das**

(Assistant professor)

विभागाध्यक्ष / Head  
यांत्रिकी अभियांत्रिकी विभाग / Mechanical Engg. Dept.  
प्रौद्योगिकी संस्थान / Institute of Technology  
गुरु घासीदास वि.वि. / Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)





## ABSTRACT

Utilizing agricultural waste materials like rice husks has shown promise as a replacement for conventional wood-based components. However, rice husks particle board's mechanical qualities might not be sufficient for some applications. In this context Influence of sawdust and adhesive type on the mechanical properties of rice husks particle board is examined in this study. This study investigates the effects of various adhesive types NEROFIX, SUPERCOL plus and RADCOL royal and Sawdust ratios on the properties of composite particle boards. Specimens of 20 x 20 x 2.4 cm were made with different proportions of rice husks, Sawdust and with each adhesive type. Three commercial synthetic adhesives were used. The particle adhesive mixtures were molded and were subsequently cold pressed and left to dry on air. Modulus of elasticity, density, water absorption and thickness swelling tests were performed. As the sawdust ratio rises, the internal bond strength falls, indicating the importance of the adhesive in preserving the board's structural integrity. The study also emphasizes how the type of adhesive might affect the mechanical properties of the board. This study offers important information about the effects of sawdust and adhesive type on the mechanical properties of rice husks particle board, which can help with the production of the board and aid in the creation of high-quality, sustainable wood-based substitute.



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## INVESTIGATION OF MECHANICAL BEHAVIOR OF INDUSTRIAL AND AGRICULTURAL WASTE BASED EPOXY COMPOSITES

A dissertation-evaluation submitted in partial fulfillment of the  
requirement for the degree

Of  
MASTER OF TECHNOLOGY  
(Machine Design)

Submitted

By

**DUSHYANT KUMAR DEWANGAN**

Under the supervision of

### SUPERVISOR

MRS. SHWETA SINGH  
ASST. PROFESSOR,  
DEPT. OF MECH.  
ENGINEERING GGV,  
BILASPUR

### Co-SUPERVISOR

DR. SAMARJIT SINGH  
ASST. PROFESSOR,  
DEPT. OF MECH.  
ENGINEERING GGV,  
BILASPUR



Department of Mechanical Engineering  
School of Studies of Engineering and Technology  
Guru Ghasidas Vishwavidyalaya (A Central University)  
Koni, Bilaspur, Chhattisgarh, INDIA  
Pin- 495009  
October-2023





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Signature of Student

**DUSHYANT KUMAR DEWANGAN**

Signature of the Supervisor

**MRS. SHWETA SINGH**

**ASST. PROFESSOR**

Signature of Co-Supervisor

**DR. SAMARJIT SINGH**

**ASST. PROFESSOR**

विभागाध्यक्ष/Head  
कार्मिकी अभियांत्रिकी विभाग/Mechanical Engg. Dep:  
प्रौद्योगिकी संस्थान/Institute of Technology  
गुरु घासीदास वि.वि./Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.)/Koni, Bilaspur (C.G.)



## ABSTRACT

In this work presents an investigation of mechanical behavior of industrial and agricultural waste-based epoxy composites. Specifically, rice husk ash (agriculture waste) and fly ash (industrial waste) are used as filler materials in the epoxy (matrix). This study aims to optimize mechanical properties of the composite material through the implementation of Design of Experiments (DOE) and Artificial Neural Network (ANN) techniques. The composites were prepared by varying weight percentages i.e., 7%, 10% & 13% of the filler content. Here we also check the improvement of mechanical properties with the aid of increases the homogeneity of mixture via mixing criteria i.e., hand stirred, 900rpm & 2400 rpm, after that behavior of the composites, were evaluated. The results show that the filler group, filler loading and mixing criteria have a significant effect on the mechanical properties of the composites. The optimum combination of these parameters was determined using the DOE method. Furthermore, an ANN model was developed to predict mechanical properties of the composites based on the input variables. The ANN model was trained and tested using a dataset of experimental results. The results show that the ANN model is capable of accurately predicting the mechanical of the composites with high precision. Overall, the study demonstrates that the use of waste-based filler materials can significantly enhance the mechanical properties of the epoxy composites. Moreover, the DOE and ANN techniques can be effectively used to optimize the process parameters and predict the properties of the composites. The findings of this study have implications for the development of sustainable composite materials and can contribute to reducing the environmental impact of industrial and agricultural waste.



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**INVESTIGATION OF MECHANICAL & DYNAMIC PROPERTIES OF  
CHEMICALLY AND MICROWAVE TREATED CALOTROPIS  
GIGANTEA REINFORCED NELUMBO NUCIFERA FILLED  
HYBRID POLYMER COMPOSITE.**

**A dissertation-evaluation submitted in partial fulfillment of the  
requirement for the degree**

**Of  
MASTER OF TECHNOLOGY  
(Machine Design)**

**Submitted**

**By**

**GANESH RAM**  
**Under the supervision of**

**SUPERVISOR  
PROF. T.V. ARJUNAN  
HoD,  
DEPT. OF MECH. ENGINEERING  
GGV, BILASPUR**

**CO-SUPERVISOR  
DR. K. VINOTH KUMAR,  
ASST. PROFESSOR,  
DEPT. OF MECH. ENGINEERING,  
R.M.K COLLEGE OF ENGG. &  
TECHNOLOGY, CHENNAI**



**Department of Mechanical Engineering  
School of Studies of Engineering and Technology  
Guru Ghasidas Vishwavidyalaya (A Central University)  
Koni, Bilaspur, Chhattisgarh, INDIA**

**Pin- 495009**

**October-2023**



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Signature of the student

GANESH RAM

Signature of supervisor

PROF. T.V. ARJUNAN,

विभागाध्यक्ष / Head  
यांत्रिकी अभियंत्रिकी विभाग / Mechanical Engg. Dept.  
प्रौद्योगिकी संस्थान / Institute of Technology  
गुरु घासीदास वि.वि. / Guru Ghasidas V.V.  
कोनी बिलासपुर (छ.ग.) / Koni Bilaspur (C.G.)



## ABSTRACT

In recent times, there has been an increasing inclination towards the use of natural fibers as reinforcements in polymer composites owing to their environmentally sustainable and renewable characteristics. In this context, the present study used Calotropis Gigantea fiber, which has minuscule significance in vegetation value, and waste Nelumbo Nucifera filler for the production of polymer composites. This work aims to examine the mechanical and dynamic properties of a hybrid composite material consisting of a Chemically and Microwave Treated Calotropis Gigantea (CMTCG) fiber combined with Nelumbo nucifera (NN) infills. The assessment of the mechanical properties of several combinations of CMTCG with NN infills was conducted utilizing established testing methodologies, including tensile, flexural, impact, and Dynamic Mechanical Analysis (DMA) to assess the viscoelastic nature of the composites. In addition to this, a Cole-Cole curve is plotted by utilizing the findings of the DMA to analyze the effect of particle impregnation and the anticipation of the heterogeneity of the composite material at different loadings of fillers. The investigation of dynamic mechanical characteristics, such as storage modulus, loss modulus, and damping factor, involves the analysis of how composites react to dynamic loads across various loading circumstances. The current investigation revealed that a fiber loading of 10 wt% represented the optimal threshold since any loading above this value resulted in a noticeable decline in all characteristics. Moreover, with the inclusion of greater weight percentages of the NN filler into the CMTCG epoxy system, it seems that the epoxy resin is inadequate in terms of effectively diffusing throughout the CMTCG fiber Mat and NN filler. Consequently, this leads to a loss in mechanical characteristics.



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**COMPUTATIONAL ANALYSIS OF SELF-EXCITED ACOUSTIC RESONANCE IN  
CO-AXIAL SIDE BRANCHES DUE TO FLOW**

A dissertation interim evaluation submitted in partial fulfillment of the requirement for  
the degree.

Of

**MASTER OF TECHNOLOGY**

**(Machine Design)**

Submitted by

**HITESH SHRIWAS**

Under the supervision of

**Mr. BHUSHAN SINGH GAUTAM**

**(Assistant Professor)**



**Department of Mechanical Engineering**

School of Studies of Engineering and Technology

**Guru Ghasidas Vishwavidyalaya (A Central University)**

Koni, Bilaspur, Chhattisgarh, INDIA

Pin- 495009

**October 2023**



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Signature of the student

HITESH SHRIWAS

Signature of supervisor

Mr. BHUSHAN SINGH GAUTAM

(Assistant professor)

विभागाध्यक्ष/Head

यांत्रिकी विभाग / Mechanical Engg. Dept.  
प्रौद्योगिकी संस्थान / Institute of Technology  
गुरु घासीदास विश्वविद्यालय  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)

Guru Ghasidas Vishwavidyalaya, Bilaspur





### CERTIFICATE BY EXAMINERS

This is to certify that the "Thesis" entitled, "COMPUTATIONAL ANALYSIS OF SELF-EXCITED ACOUSTIC RESONANCE IN CO-AXIAL SIDE BRANCHES DUE TO FLOW"

Submitted by

Mr. HITESH SHRIWAS

Roll no. - 21040106

Enrolment No. - GGV/21/01606

Has been examined by the undersigned as a part of an examination of Master of Technology (Machine Design) at the Department of Mechanical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur, and Chhattisgarh, INDIA. The dissertation is found to be satisfactory.

Examiner 1

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**CFD ANALYSIS AND ASSESSMENT OF  
PERFORMANCE PARAMETERS OF A CO-AXIAL  
PIPE EVACUATED TUBE SOLAR AIR HEATER**

**THESIS**

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE  
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**MASTER OF TECHNOLOGY**

**(Machine Design)**

Submitted by

**SUBHRANT LAHREY**

(Roll Number- 21040109)

Under the supervision of

**PROF. T.V. ARJUNAN**

and

**MR. PRASHANT KUMAR JANGDE**



**DEPARTMENT OF MECHANICAL ENGINEERING**

School of Studies of Engineering and Technology

Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur,

Chhattisgarh, India

OCTOBER 2023





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Signature of the student

Subhrant Lahrey

Signature of supervisors

  
Prof. T. V. Arjunan

  
Mr. Prashant Kumar Jangde

  
Signature

Head

Department of Mechanical Engineering

Guru Ghasidas Vishwavidyalaya, Bilaspur



### CERTIFICATE BY EXAMINERS

This is to certify that the "Dissertation-Interim Evaluation" entitled "**CFD ANALYSIS AND ASSESSMENT OF PERFORMANCE PARAMETERS OF A CO-AXIAL PIPE EVACUATED TUBE SOLAR AIR HEATER**"

Submitted by

Name - Subhrant Lahrey Roll no. - 21040109 Enrollment No. - GGV/21/01609


Has been examined by undersigned as a part of an examination of Master of Technology (Machine Design) at Department of Mechanical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur, Chhattisgarh, INDIA. The dissertation is found to be satisfactory.

  
Examiner 1

Date: 10/1/2024

  
Examiner 2

Date: 10/01/2024

  
Examiner 3

Date: 10/1/24



## ABSTRACT

The increasing exponential demand for energy today is straining our resources, particularly traditional energy sources that are depleting rapidly. In response, there's a growing emphasis on utilizing non-conventional energy sources across various applications. Solar energy stands out as a vast and environmentally friendly energy source, and India benefits from abundant sunshine year-round. Over time, various solar collectors have been developed to capture the Sun's thermal energy. One such innovation is the Evacuated Tube Solar Collector (ETSC), designed to harness solar energy for heating water or air. The energy collected by ETSC can serve a wide range of purposes, both in domestic and industrial settings.

This research involves a computational fluid dynamics (CFD) analysis of a co-axial Evacuated Tube Solar Collector (ETSC) used for air heating applications. The primary goal is to evaluate how the ETSC performs thermally under various mass flow rates and heat flux conditions. The validity of our computational model is established by comparing it to an existing experimental study. Our findings indicate that the highest air outlet temperature 356.708 K and 37.3 °C whereas the inlet temperature 319.4 K from the solar collector manifold are achieved when using a configuration with a mass flow rate of 9.36 kg/h and a constant heat flux of 888 W/m<sup>2</sup> and the maximum thermal efficiency 63.45% achieved at a mass flow rate of 18.36 kg/h and a constant heat flux of 822 W/m<sup>2</sup>. This particular configuration outperforms all other configurations considered. Furthermore, we explore potential design enhancements that could further boost the overall thermal efficiency of the system.



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## NOMENCLATURES

CFD	Computational fluid dynamics
ETSC	Evacuated tube solar collector
ETC	Evacuated tube collector
C	Specific heat (J/kg-k)
T	Temperature (°C)
I	Constant heat flux (W/m <sup>2</sup> )
$\eta$	Thermal efficiency
$\rho$	Density (g/mm <sup>3</sup> )
$m_a$	Mass flow rate of fluid
SC	Solar collector
K	Thermal conductivity (W/m-k)
V	Velocity of the fluid
$\nu$	Poisson's ratio
E	Elastic modulus
$\rho_0$	Density of fluid
A	Area of tube
p	Pressure of the fluid
g	Acceleration due to gravity
G	Shear modulus



**FINITE ELEMENT ANALYSIS AND EXPERIMENTAL  
STUDIES OF BANANA BRISTLE COIR HYBRID  
COMPOSITE**

of

**MASTER OF TECHNOLOGY  
(Machine Design)**

Submitted

By

**Sonam Goutam**

Under the supervision of

**Prof. Mukesh Kumar Singh**  
And

Co-supervision of

**Mrs. Shweta Singh**



**Department of Mechanical Engineering  
School of Studies of Engineering and Technology  
Guru Ghasidas Vishwavidyalaya (Central University)  
Koni, Bilaspur, Chhattisgarh, INDIA  
Pin- 495009**

October 2023



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(SONAM GOUTAM)

Signature of supervisor

(PROF. MUKESH KUMAR SINGH)

Signature of Co-supervisor

(MRS. SHWETA SINGH)

Signature

Head

Department of Mechanical Engineering

Guru Ghasidas Vishwavidyalaya (Central University),

Bilaspur (Chhattisgarh)-495009.

12/10/2023  
प्रमुख/Head  
विभाग/Department / Institute of Technology  
गुरु घासीदास विश्वविद्यालय / Guru Ghasidas V.V.  
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)





**CERTIFICATE BY EXAMINERS**


This is to certify that the "Dissertation-Interim Evaluation" entitled "Finite Element Analysis and Experimental Studies of Banana Bristle Coir Hybrid Composite"


Submitted by

Ku. Sonam Goutam Roll no. - 21040108 Enrolment No. -GGV/21/01608

Has been examined by undersigned as a part of an examination of Master of Technology (Machine Design) at Department of Mechanical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya (Central University), Bilaspur, Chhattisgarh, INDIA. The dissertation is found to be satisfactory.

  
Examiner 1  
Date: 12/01/24

  
Examiner 2  
Date: 12/01/24

  
Examiner 3  
Date: 12/01/24



#### ABSTRACT

This research report is related with design and development of Banana and Bristol Coir natural hybrid composite. The natural hybrid composite plays an important role to design light weight with good strength smart composite. A lot of research is going on to design smart material now a days, but the design of smart material is still needs to be improved in order to have light weight, fire proof and smart material. The natural hybrid composite materials consisting of Banana and Bristol Coir fibres are easily available in the environment which have a good mechanical property to design a composite material with light weight and accommodable strength. The Banana and Bristol coir composite has a wide range of potential applications due to its unique combination of properties, making it an attractive material for various industries seeking sustainable and durable alternatives to traditional materials such as aerospace and automotive industries, textile and agriculture industries, packages, building materials etc.

In this research work, a hybrid layered natural composite using banana and Bristol coir is fabricated using hand layup technique and analysed the mechanical properties using numerical analysis, Finite Element Analysis (FEM) and experimental analysis. In the first part the numerical analysis carried out to obtained the mechanical properties of the proposed hybrid natural composite using PYTHON 3.2 and after getting the results on the basis of ASTM standard the tensile and flexural strength results obtained by FEM analysis using ANSYS software Finally, the experimental tests are conducted of fabricated three samples *i.e.*, banana-coir-banana, coir-banana-coir and banana-banana-coir natural composite to verify the mechanical strength. The tensile, flexural, water absorption and flammability test are performed and obtained the experimental results. The results obtained from numerical analysis are compared with the results obtained from experimental test, shows that the deviation of both results is between 4 to 5%, in all three fabricated laminates. The results obtained from theoretical, numerical and experimental analysis having very good agreement and shows the effectiveness of the proposed research carried out in this thesis.



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