TULSIRAMJI GAIKWAD-PATIL

COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

DEPARTMENT OF MECHANICAL ENGINEERING

TECHYUGA

TECHNICAL MAGAZINE

(2022-2023)

ABOUT THE COLLEGE

Tulsiramji Gaikwad-Patil College of Engineerinmg and Technology (TGPCET) was established in the year 2007 by Vidarbha Bahu-Uddeshiya Shikshan Sanstha (VBSS), a registed society. It is a self financed Private Engineering College, which is affiliated to Rashtrasant Tukdoji Maharaj Nagpur University (RTMNU) Nagpur and is approved by All India Council for Technical Education, New Delhi. Also college is approved by Directorate of Techical Education (DTE, Mumbai, Maharashtra State. The Institute is Accredited with A+ (3.32 CGPA) by NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL (NAAC). An Autonomous Institute affiliated to RTM Nagpur University Nagpur.

VISION OF THE INSTITUTE

To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management

MISSION OF THE INSTITUTE

- To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
- To provide facilities and services to meet the challenges of Industry and Society.
- To facilitate socially responsive research, innovation and entrepreneurship.
- To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

ABOUT THE DEPARTMENT

Department of Mechanical Engineering was established in 2011 and a B.E. degree course Mechanical Engineering started with an intake of 60 and further it increases to 120 with the objective of imparting quality education in the field of Mechanical Engineering.

The focus of the department is towards research and training activity based on advanced manufacturing processes and production, in the field of mechanical designing software, computational fluid dynamics, etc.

The Department has its own departmental Library with a rich collection of books to serve as a ready source of information. With a team of experienced & well-qualified faculty members, the department moulds its students according to the present industrial requirements in various domains such as production, material science, design, ergonomics, so as to provide better employment opportunities. The department of Mechanical Engineering in TGPCET possesses a faculty team of experienced & well-qualified professors, well acquainted with deep subject knowledge, commitment to teach.

VISION OF THE DEPARTMENT

To Emerge as a Premier Centre in the Field of Mechanical Engineering Education and Produce Competent Engineers

MISSION OF THE DEPARTMENT

- To Impart Quality Technical Education Through Effective Teaching - Learning Process.
- To Provide a Better Environment to Encourage Innovation and Entrepreneurship.
- To Strengthen Industry Institute Interaction to Meet the Challenges of Industry and Society Environment.
- To Ensure Overall Development of Students and Staff Members by Inculcating Knowledge and Professional Ethics.

HOD MESSAGE

Dr. Vijay Talodhikar

HOD, ME

It gives me immense pleasure to lead the department of ME. Our College is one of the premier institutions, unique like a prism reflecting the manifold shades of learning and co- curricular activities. The very motto of our department is to provide quality education. The process of learning is extremely important in life. What you learn, how you learn and where you learn play a crucial role in developing one's intellectual capability, besides career. Hence on behalf of ourMechanical Engineering Department, I welcome you all to ME Department, TGPCET. Along with academic knowledge Mechanical Engineering also trains its Engineers to face the challenges in life by providing many value added courses to enhance their career prospects. The excellent infrastructure, teaching faculty of the best kind ensuring quality education such as interaction among students,parents and staff, along with a Training and Placement Cell ensures a bright future to its students. Thus, we are confident that our Engineers will emerge as assets not only to thisinstitution and to the organization they belong, but also to the Society.

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CHIEF EDITOR MESSAGE

Ravindra Shende
Chief Editor

It brings me immense joy & pleasure to introduce the Third edition of the departmental newsletter 'YANTRIK' All the creative energies that came on to this platform in the form of faculty experts & students are finally presenting a replica of their enthusiastic hard work through this extravaganza that has come out so organically. Technical & Arts every section shines out differently in its true sense. All the events conducted throughout the year where perfectly planned & executed & the overwhelming response it received said it all! This piece of art would not have been complete without the sheer determination & perseverance of all the students who pushed their limits every time to bring out this artistic reality. Their efforts coupled with immense support from the faculties truly have done justice to carry on the legacy. I am grateful for all the support YANTRIK has received throughout the year in every possible way from the faculties & Students. I hope the readers of the newsletter have a wonderful reading experience & wish this year's edition too receives your love & support like it has always received till date.

EDITOR MESSAGE

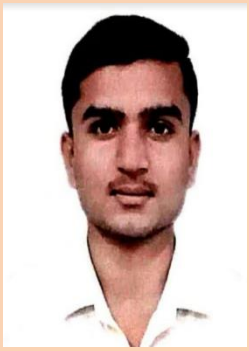
Mr. Nandadeep Dhone
Student Content Editor
Student, Final Year, ME

There is no denying that one day my memory of words will turn vague but every page of this Newsletter will open a box of memory so vivid! Filled with hard work, dedication & limitless time put in making this one book that I will always be grateful to "YANTRIK" will make you fall in love with drawings again! It gives me immense pleasure to bring to you an extraordinary & masterly collection of the events, activities, achievements, highlights at the college presented in the Seventh Annual departmental newsletter "YANTRIK 2022". The newsletter reflects the identity of TGPCET as well as gives the students & teachers a platform to explore their creativity & imagination. This work is a result of the various phases from planning to data collection to segregation to organization to proofreading to designing. I take this opportunity to express my gratitude to our HOD Dr. Prashant Kadu & Mr. R. Shende. Rode for their constant assistance & guidance.

DEPARTMENT TOPPERS

ACADEMIC YEAR (2022-23)

Mr. Kaushik Bagade
Final Year (Eight Semester)
Percentage: 75.62%



Mr. Jyotish Mohitkar
Third Year (Fifth Semester)
Percentage: 68.46%

Mr. Pratik Taywade
Third Year (Third Semester)
Percentage: 76.46%

ARTICLES

DESIGN AND DEVELOPMENT OF POWER GENERATION FROM WASTE HEAT USING THERMOELECTRIC GENERATOR.

Dr. Shubhangi Gondane

Introduction :

1) Recent trend about the best ways of using the deployable sources of energy in to useful work in order to reduce the rate of consumption of fossil fuel as well as pollution. Out of all the available sources, the internal combustion engines are the major consumer of fossil fuel around the globe. Out of the total heat supplied to the engine in the form of fuel, approximately, 30 to 40% is converted into useful mechanical work. The remaining heat is expelled to the environment through exhaust gases and engine cooling systems, resulting in to entropy rise and serious environmental pollution, so it is required to utilized waste heat into useful work.

2) The Internal Combustion Engine has been a primary power source for automobiles and automotive over the past century. Presently, high fuel costs and concerns about foreign oil dependence have resulted in increasingly complex engine designs to decrease fuel consumption

3) In this project we are generating electrical power as non-conventional method by heat energy, Non-conventional energy systems are very essential at this time to our nation. Here in this project a mechanical arrangement is made. Use of embedded technology makes this system efficient and reliable. Micro controller (AT89S52) allows dynamic and faster control.

Methodology :

1) Waste heat can also be utilized indirectly for the power generation using ranking cycle. Bryton cycle, Stirling cycle and directly used for thermoelectric generator etc., Generating power from waste heat typically involves waste heat utilization from internal combustion engine to generate mechanical energy that drives an electric generator.

2) Electricity generation is directly from heat source such as thermoelectric and piezoelectric generator. A factor that effects on power generation is thermodynamic limitations for different temperature range. The efficiency of power generation is heavily depended on the temperature of the waste heat gas and mass flow rate of exhaust gas.

3) In this project we are generating electrical power as nonconventional method by heat energy .Non-conventional energy systems very essential at this time to our nation. Non-conventional energy using is converting mechanical energy into the electrical energy. Here in this project a mechanical arrangement is made. Use of embedded technology makes this system efficient and reliable.

4) This waste heat is collected at transfer towards thermoelectric generator system. This thermoelectric generator system consists of thermoelectric generator module with aluminum heat sink and exhaust fan. When heat is applied this thermoelectric generator converts heat into electric energy.

Result :

In industrial machineries significant amount of heat is released to the environment. For example, As much as 35% of the thermal energy generated from combustion in an machine for production is lost to the environment through exhaust gas and other losses. The amount of such loss, recoverable at least partly or greatly depends on the machine load.

Among various advanced concepts, Exhaust Energy Recovery for Internal machine has been proved to not just bring measurable advantages for improving energy consumption but also increase machine power output (power density) or downsizing, further reducing CO2 and other harmful exhaust emissions correspondingly.

This was predicted that if 6% of the heat contained in the exhaust gases were converted to electric power, 10% reduction of fuel consumption can be achieved.

Conclusion :

The efficiency of the engine will not be affected because only the surface heat of the silencer is drawn out. The main objective of this paper is to recover the surface exhaust heat and to convert the heat energy into electrical by using thermoelectric generator. This objective has been successfully accomplished in this report.

The output could be increased by connecting a number of TEGs in series, so that the voltage gets added up leading to increased power. The energy produced from this system could be used to power any auxiliary devices in an automobile directly or it could be stored in a battery and then used later.

Fig: Working model of power generation from waste heat using thermoelectric generator

DEVELOPMENT OF SOLAR POWERED SHREDDER MACHINE FOR WASTE MANAGEMENT

By - Mr. ANKIT S SINGH , Mr. SACHIN V TALWEKAR, Mr. SURAJ D NAGPURE, Mr. ANIKET A SUKHADEVE, Mr. HIMANSHU A MADAI and Mr. SHUBHAM B GHOSIKAR

OBJECTIVES OF THE PROJECT :

The specific objectives of the project are listed below:

- The objective of a project is to recycle dry waste (mostly polymer) to reduce the burning solid waste and control the environmental pollution.
- To develop cost effective Solar powered shredder machine, with less labour work.
- Fabrication of Solar powered Shredder in Compact Size.

CONSTRUCTION :

1. FRAME STRUCTURE A framed structure in any material is one that is made stable by a skeleton that is able to stand by itself as a rigid structure without depending on floors or walls to resist deformation. Materials such as wood, steel, and reinforced concrete, which are strong in both tension and compression, make the best members for framing.

2. HOPPER A hopper is a large, pyramidal or cone shaped container used in industrial processes to hold particulate matter or flow-able material of any sort, like dust, gravel, nuts, seeds etc. and can then dispense these from the bottom when needed.

3. SOLAR PANEL Solar energy begins with the sun. Solar panels (also known as "PV panels") are used to convert light from the sun, which is composed of particles of energy called "photons", into electricity that can be used to power electrical loads. Solar panels can be used for a wide variety of applications including remote power systems for cabins, telecommunications equipment, remote sensing, and of course for the production of electricity by residential and commercial solar electric systems.

4. D.C. HIGH TORQUE MOTOR: A DC motor is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into mechanical energy. A high torque motor is toroid shaped, like a donut, and thus has a large diameter and short axis. These motors can directly drive the application without additional mechanics, like worm wheels, belts or pulleys. The torque of the DC series motor is proportional to the square of the armature current. That is why the DC series motor has high starting torque. The DC series motor produces the highest torque among all kinds of motors.

5. BATTERY A battery is a device that stores chemical energy and converts it to electrical energy. The chemical reactions in a battery involve the flow of electrons from one material (electrode) to another, through an external circuit. The flow of electrons provides an electric current that can be used to do work.

6. SHREDDER BLADE Shredder blade is a kind of cutter that is equipped on industrial shredder or granulator. They are machines for crushing waste materials like rubber, tires, wood, paper, polymers, plastic, textiles and so forth. As we all know, industrial waste shredders are playing a critical role in the recycling industry. For one thing, they can save a lot of storage space. Data indicates a shredder can reduce the total volume of processed industrial waste by 30%-50% on average. For another thing,

shredders optimize the value of industrial wastes by forming them into granule reaching a recyclable level.

7. BELT AND PULLEYS The device helps in power transmission using a cable or belt. In a belt and pulley system, a belt runs along a pulley's groove so that the power can be transfer either from one pulley to another or from the pulley directly to the application that requires power. The device helps in power transmission using a cable or belt. In a belt and pulley system, a belt runs along a pulley's groove so that the power can be transfer either from one pulley to another or from the pulley directly to the application that requires power. A belt drive is a loop of a flexible material that transfers movement from one rotating pulley to another. Each are held on a shaft.

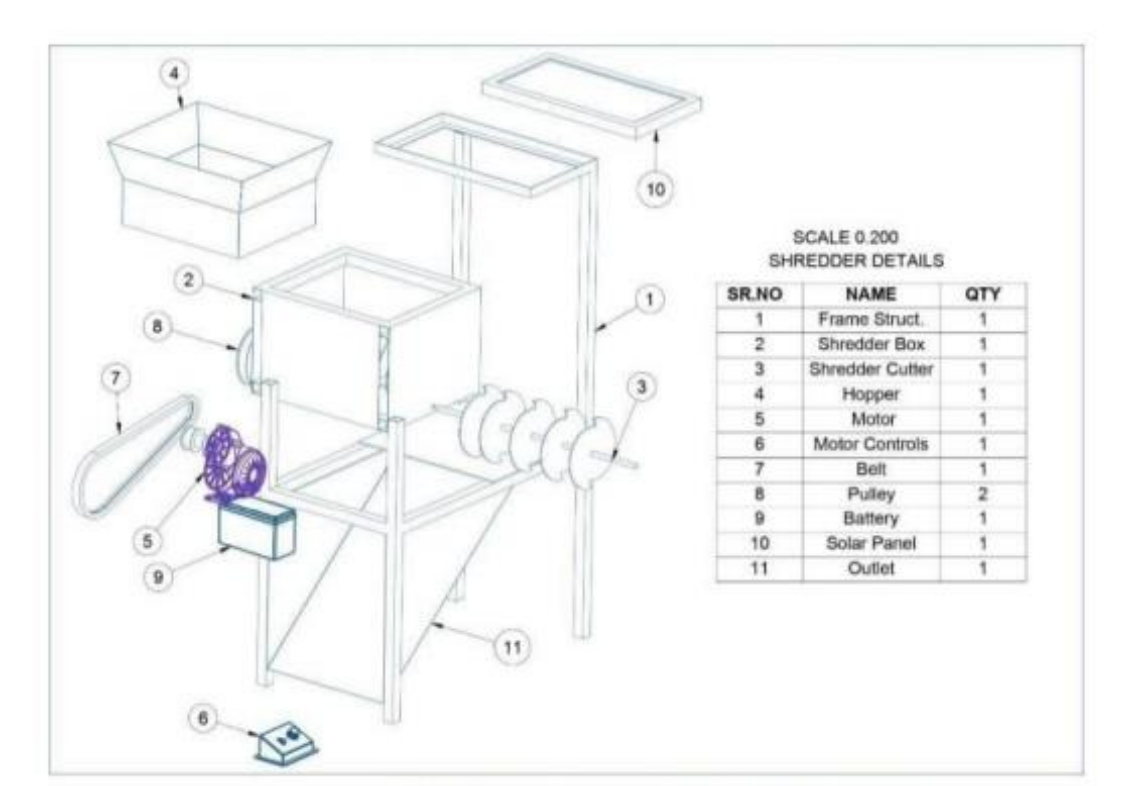


Fig: CAD Model of Shredder Machine

➢ WORKING PROCEDURE

Initially the power supply through solar panel. Solar panel absorbs the solar energy and convert into electrical energy. This electrical energy is stored in battery. Then it is supply to high torque DC motor. The motor is controlled by a switch for the forward and reverse rotation of blades. It is done by the controlling of the Double Pole Double Throw switches. The switches are made in such a way to operate in forward as well as in reverse directions of the motor. Now the motor is switched on to the forward rotation and the power is transferred to the smaller pulley by means of the shaft coupled to it.Then the smaller pulley drives the larger pulley which is connected with the belt. Again the larger pulley is coupled with another smaller pulley by means of a pillow block. The smaller pulley is then connected with the larger pulley with the help of the belt. The larger pulley is finally coupled with the main shaft in which the shredder blades are arranged. Gear arrangement is provided in between the larger pulley and the shaft for the opposite rotation of another shaft. Due to the smaller to larger pulley power transformation, the torque produced will be more from the larger pulley shaft than the smaller pulley and also the speed will be reduced for smoother operation. The larger pulley is directly

When the plastic objects came into contact with the blades, it started to get crushed and shredded due to the crushing and shear stress acted upon them by the shredder blades.

Finally, the shredded pieces of plastics will come down below the blades and it is collected in the collecting basket. The plastic which is larger in volume before the shredding process is now reduced to very small pieces. The main objective behind the plastic shredder is to reduce the volume acquired by the plastic waste during loading it connected to the blade shaft. Due to that it starts to rotate in preferred direction. Now the plastic objects are feeded manually through the hopper at the top.

Fig : Working Model of Solar Powered Shredder Machine

EVALUATION OF DESIGN AND FINITE ELEMENT ANALYSIS OF CREEP TESTING APPARATUS

Mr. Anand Ade, Apurva Dongre, Aman Tiwari, Rajat Talmale, Aman Pachare, Niraj Sahare.

ABSTRACT : The design, analysis, and construction at diagram of a tensile creep test device are covered in this study in order to determine the creep curve of quickly creeping thermoplastic polymers like Teflon and light metals like aluminum and lead FEM/ANSYS software is used for analysis purpose. The applied load mechanism, the heat transfer & monitoring, the frame, and the specimen grasp make up the apparatus's four main systems. The heating chamber's insulation is made of bison panel, and the greatest temperature it can withstand is 200°C. The maximum load capacity is of 40 Kg without tipping the machine. Every sample intended for the testing on the apparatus must be constructed with such a thickness of 1 mm to 3 mm, gauge length of 30 mm to 40 mm, and total length of 60 mm to 80 mm. Polypropylene material was used as the test specimen for creep tests, which were performed at varying loads and various different temperatures for a period of two hours. The results demonstrate that, at constant loads and varying temperatures, elongation increases over time while the creep rate decreases as temperature rises

Introduction :

High temperature progressive deformation of a material at constant stress is called creep. Normally, creep appears when vacancy in the material migrates towards grain boundaries that are oriented normal to the direction of applied stress. It is both a time and temperature dependent phenomenon. It results from the viscoelastic flow of polymer with time. Creep rate of thermoplastics is classically associated with time dependent plasticity at an elevated temperature, often in limits with 0.4 - 0.5 of its melting temperature. Creep is generally divided into three stages; i.e., primary creep, secondary creep, tertiary creep. An electromechanical creep testing machine is designed to experiment various materials to determine its creep behavior. In old creep testing machine lever arm mechanismis used to apply load. The lever arm should be kept horizontal always which is difficult for longer period of time. So, in this creep testing machine it is replaced with wire and turnbuckle arrangement to apply load.

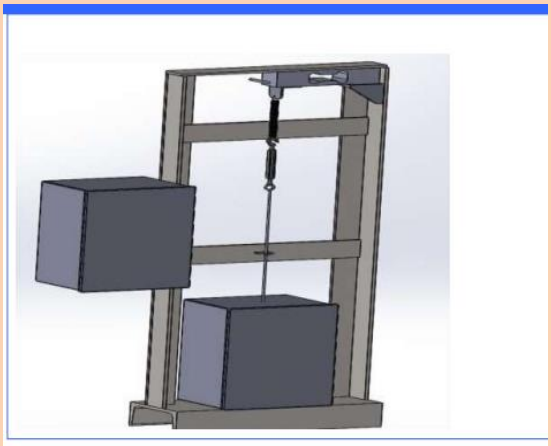
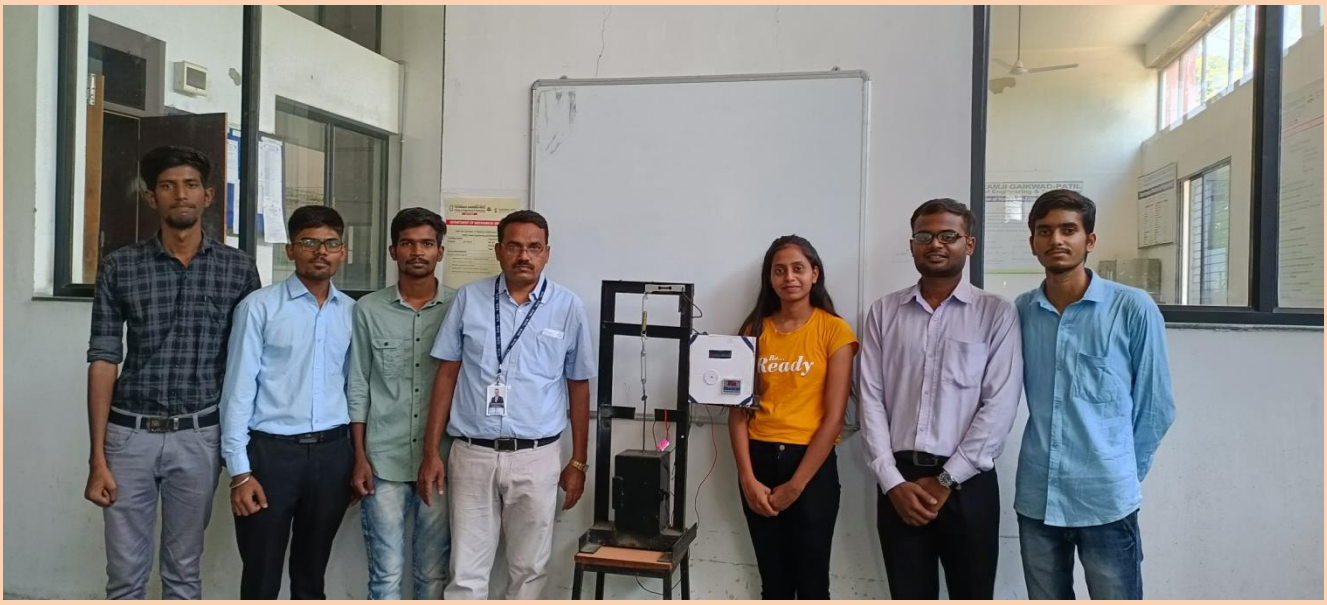


Fig : CAD Model of Creep Testing Machine

Methodology :

Specimen is held with the help of grippers inside the furnace. Load is applied with the help of turnbuckle, spring and wire arrangement. Temperature inside the furnace is controlled with the help of temperature controllingsystem. The specimen should be assembled and kept for 10 minutes inside the furnacein order to uniform the temperature. Data Acquisition System (DAS) is used to record creep rate of (PP)specimen. Thematerial of specimen selected for the tests was polypropylene. Polypropylene is mainly used in food packaging, automobile battery cases and disposable syringes. The dimensions of the specimen were shown in figure 2, with the thickness of 1.3mm. These experiments were mainly performed at a temperature range of 70 0C and 75 0C at a static load conditionof 30kg.loads are mainly applied by steel wire and turnbuckle arrangement.



Conclusion

The purpose of this work was to modify the tensile creep testing machine, which was designed and fabricated by previous batch student. Some limitations which were observed in previous machine was eliminated and the capacity of machine was improved. 2. 3. This work was carried out by applying basic engineering knowledge of mathematics, science, engineering fundamentals and engineering specialization to the solution of complex engineering problem of creep behavior regarding polymers like polypropylene and soft material like lead.

DESIGN & FABRICATION OF PNEUMATIC OPERATED STAIR CLAMBING MACHINE

By - Mr. Akash Kumbhare, Mr. Ajay Charape, Mr. Shubham Upare, Mr. Himanshu Kathiwale, Mr . Shubham Taywade, Mr . Vinayak Nagre

Introduction:

This project is based on the existed semi-automated stair-climbing machine; the advantages and disadvantages between different types of stair-climbing machines are compared and summarized, in order to make new design overcome those disadvantages. This project includes realizing how much height is negotiable to get step, controlling the gravity of object to keep the ground centre point, climbing up speed, and carrying out the load how much can support. One of most important to design mechanism in build mobile machine to climb high place is that maintain the less weight of machine and power consumption in which it is used. This project is considered the total load 60 kg to carry and the motor torque which has 120 kg. cm will be used for mechanism. This stair-climbing machine will be utilized for angle between 30 degree and below 30 degree.

Aim:

To design and fabricate "Pneumatic Operated Stair Climbing and Load Lifting Mechanism''

Objectives:

1. To reduce the human effort
2. To replace human's effort by mechanism (for farmers economical and effort point of view).
3. To make it usable for several purposes
4. To reduce the time

Construction Material:

1. AIR COMPRESSOR: The selection from the various types of compressors available is dependent upon quantity of air, pressure, quality and cleanliness and how dry the air should be. There are varying levels of these criteria depending on the type of compressor.

2. AIR RECEIVER: Receivers provide constant air pressure in a pneumatic system, regardless of varying or fluctuating consumption. This enables briefly occurring consumption peaks to be balanced out, which cannot be made up by the compressor A further function of receivers is the emergency supply to the system in cases of power failure. The reservoir can be fitted either downstream of the compressor, to act as an air chamber, or selectively at points where consumption is high. In addition, the large surface area of the receiver cools the air. thus, a portion of the moisture in the air is separated directly from the receiver as water. It is therefore important to drain the condensate regularly.

3. PNEUMATIC ACTUATORS/JACK : An actuator is an output device for the conversion of supply energy into useful work. The output signal is controlled by the system, and the actuator responds to the control signals via the final control element. Other types of output device are used to indicate the status of control system or actuator.

4. HOSE AND TUBING: Beyond the compressed air distribution system, which is composed of rigid main pipelines, feeder lines and associated fittings and accessories, a means must be provided for conducting clean, dry and lubricated compressed air to tooling and equipment. Air hose tubing are used for this purpose.

5. FLOW CONTROL VALVE: Flow control valves (Throttle valves) influence the volumetric of compressed air, in both directions.Flow control valves with constant restriction: Here, the length of the throttling section is greater than its diameter. Flow control valves with adjustable restriction Throttle valve adjustable.

WORKING

- A compressor is used to fill the tank situated in frame
- The compressor are is supplied to the double acting actuator using 4/2 D.C.V
- This 4/2 D.C.V operated by push button
- During intake at port a the air is supplied at section
- The exhaust of air from cylinder is return to the atm through DCV via muffler
- In next case, by pushing push button the direction control valve changes the port & piston moves backward & this process goes on……

RESULT :

As per calculations this machine design to lift a load of above 50 kg easily on stairs. A simple pneumatic system is used to lift a load easily. This can easily replace TRIWHEEL STAIR MECHANISM, an economical design is made to lift to load. Because there is no complex structure hence dimension of the trolley can be changed easily according to different requirement based on load capacity and stair dimension such as step-rise and tread.

CONCLUSION:

In this stair climbing cart design cost, material availability, production process availability, human factors, customer requirements, etc. all factors have been equally considered. The newly added features in this design will eliminate stress on fingers, hands, backbone & corresponding body parts. There is a direct relationship between the pulling angle and pulling force. The pulling angle varies according to user height. This design can carry a satisfactory range of load that is determined from the structural analysis. This design is unique than others in the pause- rest feature which provided the function to keep the cart standing between two stairs by keeping two backward wheels on a stair and other forward wheels on the next stair. In this design, all constraints have been satisfied & also the strength, durability & longevity of the structure have been increased which has been tested in the structural simulation. Carrying heavy loads over stairs may cause injuries to a human being such as back pain. This stair climbing cart eliminates human effort to carry goods. This research will help interested manufacturers who want to commercially produce it for mass customers. The manufacturing process and bill of material will help the manufacturers to determine the required machines, the number of operators, required space and finally the cost of the product.

COMPARISON OF MECHANICAL PROPERTIES OF RIGID FLANGED COUPLING MANUFACTURED BY PLA & ABS FILAMENTS USING FDM 3D PRINTING TECHNOLOGY.

Mr. Kaushik Bagade, Mr. Lankesh Selokar, Mr. Roshan Karokar, Mr. Nikki Lilhare,
Mr. Anuj Bhaladhare, Mr. Praful Raut

Introduction :

Coupling is a device used to connect the shafts together for the purpose of transmitting power and torque. Generally, couplings are used for connection of shafts unit that are manufactured separately. Such as motor and generator; electric motor and centrifugal pump etc. Due to the inconvenience in transportation of shaft of greater length, it becomes necessary to join two or more shafts by means of coupling. The shafts that are connected by coupling should be easy enough to assemble and dismantle for the purpose of repair and alterations. The severe failure due to shearing of bolts head, key head, nuts and other projecting parts may cause accidents. The shaft to be connected by the coupling may have collinear axes, intercepting axes or a parallel axes with a small distance in between them. The flange coupling is further classified into two types; Rigid and Flexible Coupling. Rigid flange coupling consists of two separate grey cast iron flanges. One keyed to the driving shaft and the other to the driven shaft by means of nuts and bolts arranged on a circle concentric with the axes of the shafts. There are two types of rigid flange couplings; Protected and Unprotected rigid flange coupling. In a protected rigid flange coupling, a protective circumferential rim covers the nut and bolt head. So in any case of failure of bolts during operation, broken piece of bolt will dash against this rim and eventually fall down, protecting the operator from any possible injuries.

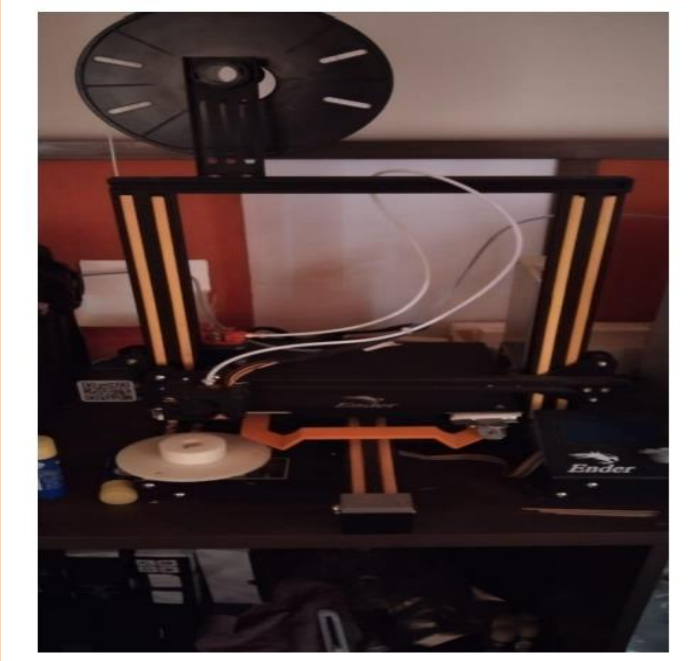


Fig : 3-D Printer

Methodology :

1. The main objective of this work is to perform the Shear stress and Crushing stress to determine the Shear and Crushing strength.
2. Firstly the model of flange coupling is designed in Auto CAD software and saved in stl. Format.
3. Selecting the Various process parameters affecting the shear and crushing strength.
4. The stl. File is then imported in PRUSA 2.4.2 software for slicing and generating G Codes.

5. Printing of the coupling is done on Mark forged mark-2 3D printer by using PLA and ABS Material.

6. Testing of Rigid Flanged coupling for Shear stress and Crushing stress is done at PARTH Metallurgy pvt. Ltd. Hingna Nagpur.

Conclusion :

1.Maximum Crushing strength for Hub of ABS Filament is 6.600 kN which is at (100% infill Density, 0.3 mm layer thickness, 65 mm/s Print speed and 900 raster angle.)
2.Maximum Crushing strength for Hub of PLA Filament is 6.060 kN which is at (100% infill Density, 0.3 mm layer thickness, 65 mm/s Print speed and 900 raster angle.)
3.Maximum Shear strength for Bolt of ABS Filament is 0.570 kN which is at (100% infill Density, 0.3 mm layer thickness, 65 mm/s Print speed and 900 raster angle.)
4.Maximum Shear strength for Bolt of PLA Filament is 0.480 kN which is at (100% infill Density, 0.3 mm layer thickness, 65 mm/s Print speed and 900 raster angle.)

Result :

Run.No	Raster Angle (0^0)	Layer Thickness(mm)	Infill Density (%)	Print Speed (mm/s)	Maximum Force(kN)
1	0°	0.1	20%	35mm/sec	0.510
2	45°	0.2	50%	50mm/sec	2.940
3	**90°**	**0.3**	**100%**	**65mm/sec**	**6.600**

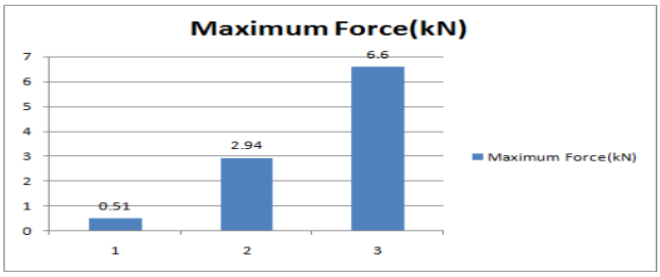


Fig : Test Results for Crushing Test of Hub (ABS)

Run.No	Raster Angle (0^0)	Layer Thickness(mm)	Infill Density (%)	Print Speed (mm/s)	Maximum Force(kN)
1	0°	0.1	20%	35mm/sec	0.330
2	45°	0.2	50%	50mm/sec	1.440
3	**90°**	**0.3**	**100%**	**65mm/sec**	**6.060**

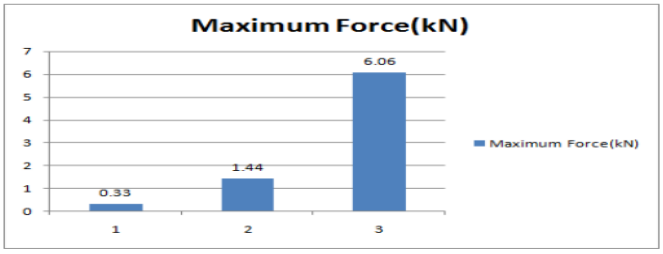


Fig. 10.2 Test Results for Crushing Test of Hub (PLA)

Fig : Test Results for Crushing Test of Hub (PLA)

Run.No	Raster Angle (0^0)	Layer Thickness(mm)	Infill Density (%)	Print Speed (mm/s)	Maximum Force(kN)
1	0°	0.1	20%	35mm/sec	0.360
2	45°	0.2	50%	50mm/sec	0.420
3	**90°**	**0.3**	**100%**	**65mm/sec**	**0.570**

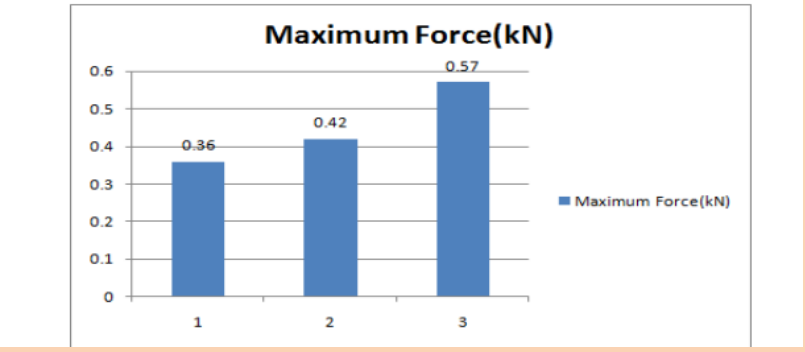


Fig : Test Results for Double Shear of Bolt (ABS)

Run.No	Raster Angle (0^0)	Layer Thickness(mm)	Infill Density (%)	Print Speed (mm/s)	Maximum Force(kN)
1	0°	0.1	20%	35mm/sec	0.360
2	45°	0.2	50%	50mm/sec	0.420
3	**90°**	**0.3**	**100%**	**65mm/sec**	**0.480**

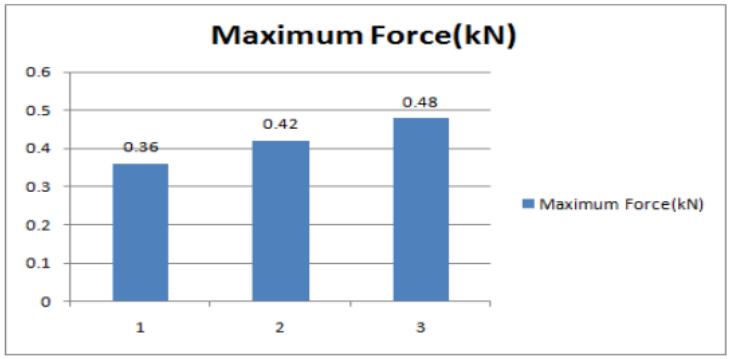


Fig : Test Results for Double Shear of Bolt (PLA)

Fig : Tested Components (ABS)

Fig : Tested Components (PLA)

Fig : Group Won first Position in Paper Presentation in GH Raisoni College of Engineering

CASE STUDY

1. Low cost, rapid deployment wireless patient monitoring system developed with additive manufacturing equipment: Case Study

Mr. Summet Gattewar is director of Pye Technologies India and he has intiated this venture as Pye Technologies India, which is a Nagpur based startup has indigenously developed a low cost wearable device to meet the patient monitoring requirements of the Covid-19 pandemic in India. COVID 19 in India is going to be a very different challenge than China, Italy, France or the US owing to its higher population density and lower healthcare infrastructure. The Government of India is taking extreme steps to control the spread of coronavirus in India. However, if the number of covid patients in India increases, there will be a need to set up temporary ICU wards and isolation zones. Efforts to establish isolation wards have already begun, but the patient monitoring needs of these wards are difficult to meet given the high cost of monitoring equipments ranging from forty thousand to two lacs of rupees per bed, and the large quantity required.

Health monitoring systems have rapidly evolved during the past two decades and have the potential to change the way health care is currently delivered. Although smart health monitoring systems automate patient monitoring tasks and, thereby improve the patient workflow management, their efficiency in clinical settings is still debatable. This case study presents a review of smart health monitoring systems and an overview of their design and modelling with 3D printing.

For the patient monitoring requirements of COVID 19 in India, a low cost device - a wrist band is designed and developed using 3D printing. This watch monitors three medical parameters viz. blood oxygen saturation, heart rate and body temperature. The band communicates wirelessly to a central station which captures and stores data. This data can be viewed and analyzed remotely with the help of cloud platform. Multiple bands can be monitored centrally on site using our dashboard which opens on any standard desktop or mobile device. Doctors can monitor patients' parameters in real time, view trends

and get notifications for cases which need attention. The complete system has also been tested for the cloud. The following hardware which has been indigenously developed at Pye Technologies India, costs around Rs. 10,000/ per patient.

The system is based on wireless communication which ensures high scalability and rapid deployment for creating temporary wards or isolation zones equipped with real time patient monitoring capability.

This prototype was developed on loc cost in-house developed CNC machines which also utilizes the various parts printed with FDM 3D Printing.

The device was tested at New Era Hospital and Research Institute, Lakadganj, Nagpur under the supervision of Dr. Anand Sancheti. The device has been found acceptable and has been recommended by doctors on the basis of the field tests carried out. Furthermore, a critical analysis of the efficiency, clinical acceptability, strategies and recommendations on improving current health monitoring systems has been tested. The main aim is to review current state of the art monitoring systems and to perform extensive and an in-depth analysis of the findings in the area of smart health monitoring systems developed through 3D printing.

Conclusion:

Finally, major advances in the system design level have been investigated, current issues facing health care providers, as well as the potential challenges to health monitoring field are identified and compared to other similar systems. The results demonstrated by Mr. Summet Gattewar, along with authors of the book suggested that the proposed system could be comparable to medical grade devices. The patent on Low cost, rapid deployment wireless patient monitoring system is filed and mass production is expected to start to sustain the effects of COVID-19 in India.

2. DESIGN AND DEVELOPMENT OF A PROSTHETIC HAND THROUGH 3D PRINTING: CASE STUDY

Mr. Mukul Pande is a Director (IT Infrastructure) at Gaikwad-Patil Group of Institution, Nagpur (MS), India. Prosthetic Robot hand is his personal project initiated with authors of this book working at Tulsiramji Gaikwad-Patil College of Engineering and Technology (TGPCET), Nagpur (MS). The objective of this case study was to create a freely-available, 3-Dimensional (3D) printable prosthetic hand. Current 3D printed prosthetic hand designs are openly available and inexpensive to produce with a 3D printer; however, these prosthetics are also prone to failure. Tolerance issues, printing errors, and poor instructions lead to a significant number of prosthetics that cannot be assembled, do not work correctly, or break with light use.

The aim was to provide a solution to these problems through the use of equation based scaling and proper instructions. Resizing available 3D printed prosthetics does not always work, as holes and joints will scale with the rest of the device by the same amount, reducing functionality when larger or smaller than the initial design.

There are two main methods of operation for these prosthetics: wrist powered and elbow powered. A decision was made to focus on wrist powered devices, as they are more common and provide another joint of movement. These devices work by the wearer bending down their wrist, allowing the tensioning cables to pull the fingers closed. Releasing the wrist allows elastics to return the fingers to a resting state. This specific prosthetic is intended for users with a moving wrist that has at least part of their palm to attach the device to. The design scales using equations to scale different features at different rates, and a provided text file allows for variable editing. It is also as reliable and easy to assemble as currently available hands.

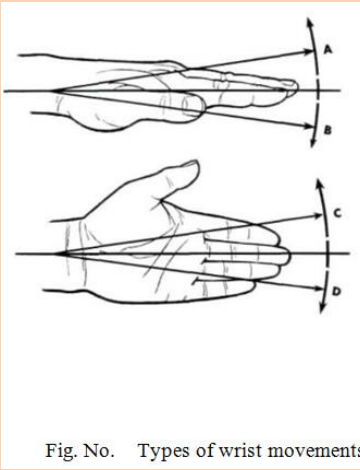


Fig. No. Types of wrist movements

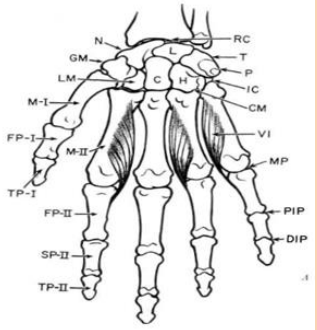
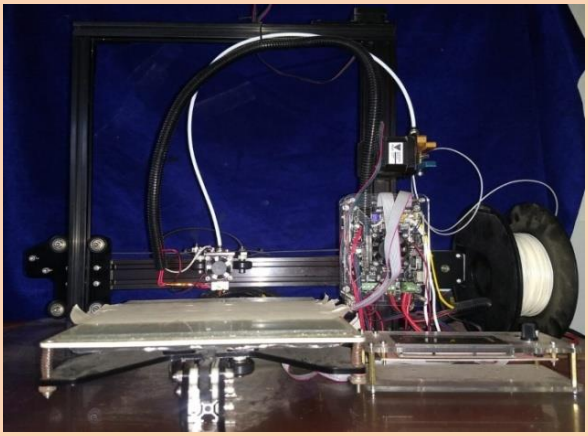


Fig. No. Bones in the hand

This project was initiated in June 2017 as the first 3D printed open Source prosthetic robotic hand and it has lead to many projects in the area of 3D Printing and its applications. This case study was done on TEVO-Tarantula I3 Aluminium 3D printer with 2 roll filament 8GB SD card, LCD and extruder supports 25 filaments. This kind of robot hand is replicable on any FDM 3D printer with a 20x20x22cm area. This idea was conceived as a development platform for Laboratory established at Tulsiramji Gaikwad-Patil college of engineering and Technology, Nagpur, which is one of the unique laboratory in central India.



This human-sized robot hand provides an appearance with five fingers and a grasping function to forearm and is entirely printed with 3D Printing and it has replaced the gripper of the Pick and Place 6 axis Articulated industrial robot (Model: ARISTO 6XT Machine NO. 147). It provides a realistic appearance that is same as the cosmetic prosthetic hand and a grasping function. A simple link mechanism with one linear actuator for grasping and 3D printed parts achieves low cost, light weight, and ease of maintenance. In this case each finger of the robot hand is activated through threads passed through it and synchronized with the drive motors of industrial robot and to perform the pick and place operation for the products with pay load capacity of 2 kg. The sketching was performed with this 3D Printed robot synchronized with articulated industrial robot.

Conclusion:

Prototype Assessment

Testing of the final prototype confirmed that the Mr. Mukul Pande, and authors of the book Dr. G. K. Awari and Mr. V. V. Ambade were successful in completing the main objectives of the case study. The prototype, shown in Figures, conforms to the previously laid out design specifications. After performing a series of tests, the prosthetic was able to carry hold a cell phone, hold and throw a tennis ball and it was operating with industrial robot available in laboratory. Through a number of design iterations, printability, ease of assembly, tolerance, and aesthetics were improved. This human-sized robot hand provides an appearance with five fingers and a grasping function to forearm and is entirely printed with 3D Printing and it has replaced the gripper of the Pick and Place 6 axis Articulated industrial robot (Model: ARISTO 6XT Machine NO. 147). It provides a realistic appearance that is same as the cosmetic prosthetic hand and a grasping function. A simple link mechanism with one linear actuator for grasping and 3D printed parts achieves low cost, light weight, and ease of maintenance.

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3. FDM 3D Printing for Zyogomatic Implant Placement Mock surgery for Prosthodontic Dentistry: A Case Study

Dr. Priya Gupta is a PG Student at VSPM Dental College, Nagpur, Dr. Saee Deshpande, VSPM Dental College, Nagpur and Mr. Abhijeet Raut, Research Fellow, VNIT, Nagpur (MS) India has done this case study of Zyogomatic Implant Placement Mock surgery for Prosthodontic Dentistry.

The quality of surgery depends on the anatomy of surgery. Three-dimensional (3D) anatomy visualization is very important for better understanding and outcome. Complex maxillofacial surgeries are usually time-consuming procedures due to the need for initial medical imaging for root complications, the determination of an appropriate course of treatment, pre-operative planning, before and after surgery. Pre-operative preparation is the most important and usually aims at executing an ideal procedure that minimizes the length of surgery and any possible problems that might occur in the future. For traditional dental procedures, the process starts by collecting the patient's impression using a powder mould until it is moved to the dental grade of alginate powder coated. These topography data are generally sufficient for the majority of cases; however, they are less acceptable for intricate cases where an implantable device may be essential.

In addition, medical imaging data offer little insight, since patient representation is a collection of two-dimensional planar images. In such situations, 3D information on the internal bone tissue structure necessary for optimal surgical planning in order to determine the precise geometry of the affected area of interest and to properly assess the size and orientation of the implant. More recently, 3D printing technology has shown tremendous potential to increase and streamline pre-operative surgery preparation and care.

Zygomatic Implant:

In recent years, edentulous patients seeking fixed recovery have increased. Yet the condition is unacceptable when maxilla is heavily resorbed and atrophic. A zygomatic implant can be an successful way to rehabilitate a badly resorbed maxilla. While zygomatic implants are responsive to the technique, they have predictable outcomes if performed correctly. The purpose of this case study was to modify the facets of the implant and to create a more patient-specific design. The idea of developing two abutment designs with an expanded base plate and modified abutment widths, lengths and angles to suit the patient's requirements has been discussed. Physicians and researchers took advantage of 3D printing technology and began a case study in 2018. The 3D printed prototype of the patient's jaw is designed using CBCT data for ease of preparation and comprehension. A mock surgery was performed in the model as shown in the figure. The proper location of the implant and the expected result of the operation were evaluated. The final optimized design was validated by a Finite Element Analysis (FEA) to analyze the force distributions that are likely to be observed after surgery. This process is vitally important to ensure that there are no structural flaws in the design, which could otherwise lead to a catastrophic failure. It was relevant in the present case, since the high force exerted on maxilla and mandible elements during eating and chewing and the ultimate goal is to ensure patient health and a good outcome of treatment.

Figure No. Shows the anatomical landmarks drawn in the model for future position Zygomatic implants.

Conclusion:

In this case study, the doctors Dr. Priya Gupta, Dr. Saee Deshpande, Mr. Abhijeet Raut, along with the writers of the book, demonstrated the synergistic use of CT medical imaging, 3D CAD and additive manufacturing in order to carry out the process of optimizing surgery planning and designing a personalized, patient-specific 3D model. And the 3D printing technology makes it a complex process simpler for doctors. The use of medical imaging to establish a representative patient model has allowed the design of the zygomatic implant to be based on the specific anatomical characteristics of the patient. Using low cost FDM 3D printing can also create medical models that allow mock surgery to be performed to test and optimize the design along with streamlining the procedure for actual surgery. Pre-surgical preparation has made the low cost model possible and reduces the difficulty and time spent on the surgical innovation. This was also instrumental in achieving superior end aesthetics and functionality. The findings of this case study provide a basis for future 3D printing implantable devices. Such methodologies can result in lower costs for healthcare providers, thus increasing surgical effectiveness and enhancing the quality of treatment provided to the patient.