RAMAIAH Institute of Technology

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

MINI PROJECT (IMP67)

"Smart Fixture Solutions for Operational Excellence"

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CERTIFICATE

This is to certify that the following students who are working under my guidance have satisfactorily completed the project work titled **"Smart Fixture Solutions for Operational Excellence"**. To the best of my understanding, the work submitted in the report does not contain any work, which had been carried out previously by others and submitted by the candidates for themselves for the award of any degree elsewhere.

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DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted by any other student/person or at any other institution or for any other purpose.

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ACKNOWLEDGEMENT

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We would also like to extend our gratitude towards our beloved principal **Dr. N.V.R. Naidu** for his support in the completion of this project. Our heartfelt gratitude to our guide **Dr. Hemavathy S Assistant professor** in Department of **Industrial Engineering & Management** for her constant support and motivation throughout and for being an unending source of inspiration in providing the most valuable information and help in implementation of our project. We would also like to express our sincere gratitude to **Dr. G.S. Prakash**, Professor and Head of Department, IEM, for his guidance and continuous motivation throughout our project completion.

ABSTRACT

Our study focuses on a production line at CAMTRONIX, a leading aerospace and defense equipment manufacturer. CAMTRONIX is a dynamic engineering team that specializes in manufacturing aerospace and defense projects, precision CNC machine components, and undertaking job work for precision CNC milling, press tools, jigs, and fixtures. Founded in 2013 by Mr. Shivakumar S, CAMTRONIX aims to establish one of the best CNC job shops through cutting-edge machines and skilled manpower. As an AS9001D and ISO 9001:2015 certified company. CAMTRONIX is committed to delivering quality products on time and in a cost-effective manner for aerospace and defense applications.

Their services include CNC milling, in-house wire cutting, sheet metal fabrications, and more We employ direct observation and stopwatch-based measurements to analyze the assembly process for aerospace and defense components. The rotary assembling table is a pivotal component in modern manufacturing, offering enhanced efficiency and precision in assembly operations. This study presents the design and engineering of a robust rotary index table, which serves as the heart of automated processes.

The rotary assembling table is an innovative solution designed to enhance the efficiency and precision of assembly operations in various industries. This study introduces a novel rotary assembling platform that integrates advanced features such as a workbench, lifting cylinders, clamping cylinders, and locking mechanisms to facilitate the assembly of complex products. The platform's design allows for the simultaneous clamping and assembly of different surfaces of a compressor, significantly reducing manual labor and increasing the production efficiency. The research also explores the reliability and the necessities of the rotary table.

We can conclude from this research that rotary table if efficient for small scale manufacturing firms that have a tight deadline and less labor. Although, the training is necessary for the laborers, but in the long run we find out that the efficiency gets improved, and the factories can easily meet deadlines.

CHAPTER 1

INTRODUCTION

INTRODUCTION

In the manufacturing sector the integrity of threaded connections is very important. HELICOIL inserts, renowned for their ability to repair damaged threads and enhance the strength of new threads, are important in ensuring the longevity and reliability of various mechanical assemblies. Despite their advantages, the manual insertion of HELICOIL inserts often presents challenges such as misalignment, cross-threading, and inconsistent torque application. These issues can lead to compromised thread quality, increased rework, and higher production costs. The adoption of HELICOIL insertion guns has emerged as a transformative solution. These specialized tools are designed to streamline the insertion process, offering precision, speed, and repeatability. This report aims to explore the optimization of HELICOIL insertion processes through the utilization of HELICOIL insertion guns. By examining the benefits of these tools and the techniques employed to maximize their effectiveness, this report will provide insights into how the manufacturer can improve their production efficiency and product quality. We can conclude from this research that rotary table if efficient for small scale manufacturing firms that have a tight deadline and less labor. Although, the training is necessary for the laborers, but in the long run we find out that the efficiency gets improved and the factories can easily meet deadlines. cost. Rotary is a special tool used for locating and firmly holding work piece in the proper position during the manufacturing or assembly operation. It also guides the tool or work piece during the operation. Jig is designed to increase the productivity of operation assisting worker to do job easier, faster and more comfortable. Meanwhile, applying principles of ergonomics in the job environments such as improving working posture and workstation design as part of ergonomics efforts on enhance productivity and safe working condition have been extensively discussed by many authors The studies discussed ergonomics intervention may improve productivity, quality, operators' working condition,), and even cost effectiveness. This research studied several parameters afore mentioned: i.e. design of workstation, design of assembly process, design of jig, their effects to productivity in the assembly line of plugs.

1.1 TIME STUDY AND METHOD STUDY

Time study and method is a fundamental technique used in manufacturing to analyze and optimize work processes. By measuring the time required for specific tasks, factories can

enhance efficiency, reduce costs, and improve overall productivity. In this abstract, we explore the practical application of time studies within a factory setting, using a real-life example.

To measure how long it takes to complete a task or activity. It is a valuable tool for businesses to identify inefficiencies, optimize processes, and improve productivity. Time study involves two main types of operations:

1. **Manual Time**: This includes the use of handing tools, materials and machines
2. **Machining Time**: This represents the time taken by the machines to perform their share of work

The rotary table project uses the help of sensors and motors to improve the efficiency of the

HELICOIL installing process. The idea behind "rotary table" is to build an assembly process that inserts HELICOIL faster and more accurately compared to manual labor which causes a lot of delays and is not that fast in assembling.

As the demand increases, there is a lot of backlogs in the inventory that causes the production to stop daily so that the inventory gets cleared. Manual labor is time taking as the worker has to insert the HELICOIL with a lot of care and precision. As the manufacturing advances daily, the demand increases which causes neck to neck deadlines for small scaled factories.

Jigs and Fixtures

In manufacture sector jig and fixture are devices that used to facilitate production work in industry especially that involve in machine. The perfect jigs and fixtures can work repeatability and interchangeability to produce the same parts in production. In manufacturing industry, jigs and fixtures are most important device that can assist the workers in their production process become easier. Jig and fixture are important tool using in industry. Tool that are carries the main forces will form the final shape of the workpiece.

The difference between jig and fixture is in the way of the tool is guided with the work part. Fixture are essential element in production operation as it always important in industry such as automated manufacturing, inspection, and assembly operation.

The future prediction for components manufacturing in India that require HELICOIL is closely tied to the country's growing electronics manufacturing sector.

With initiatives like Make-in-India, AMANIRBHAR BHARAT, and Vocal for Local, India is rapidly expanding its electronics and semiconductor ecosystem. The government has set ambitious

targets for the electronics system design and manufacturing (ESDM) sector, aiming for a total production value of $300-$400 billion by 2026.

The Production Linked Incentive Scheme (PLI) and other government initiatives are expected to attract investments and boost the production of electronic components, including those that require HELICOIL. As India positions itself as a global hub for ESDM and semiconductor manufacturing, the need for high-quality components like HELICOIL will become more pronounced. The country's focus on developing automation and digitization will further drive the demand for such specialized components.

Overall, the future looks promising for the manufacturing of components requiring HELICOIL in India, with significant growth anticipated in the coming years.

1.2 COMPONENT ANALYSIS:

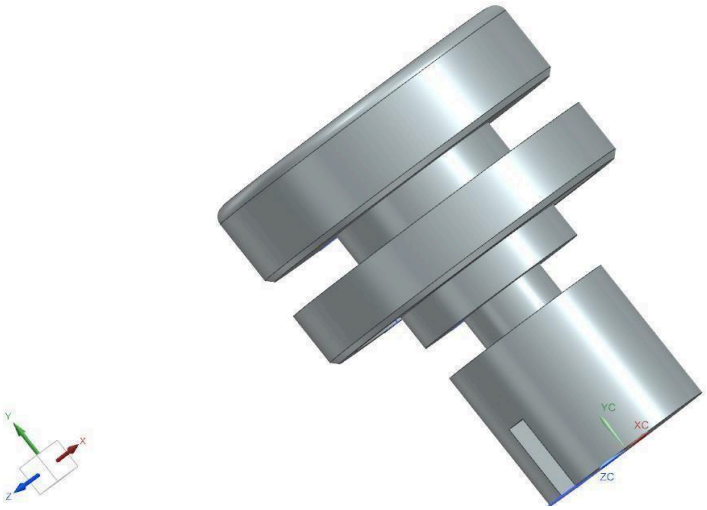


Fig.1.1. component

In Fig1.1 is the component was manufacturing in the CAMTRONIX, the component first process in CNC machine by turning after the turning it will move to deburr section after complete deburr it will move to the Heli-coil installation in the assemble section can manually install the Heli-coil

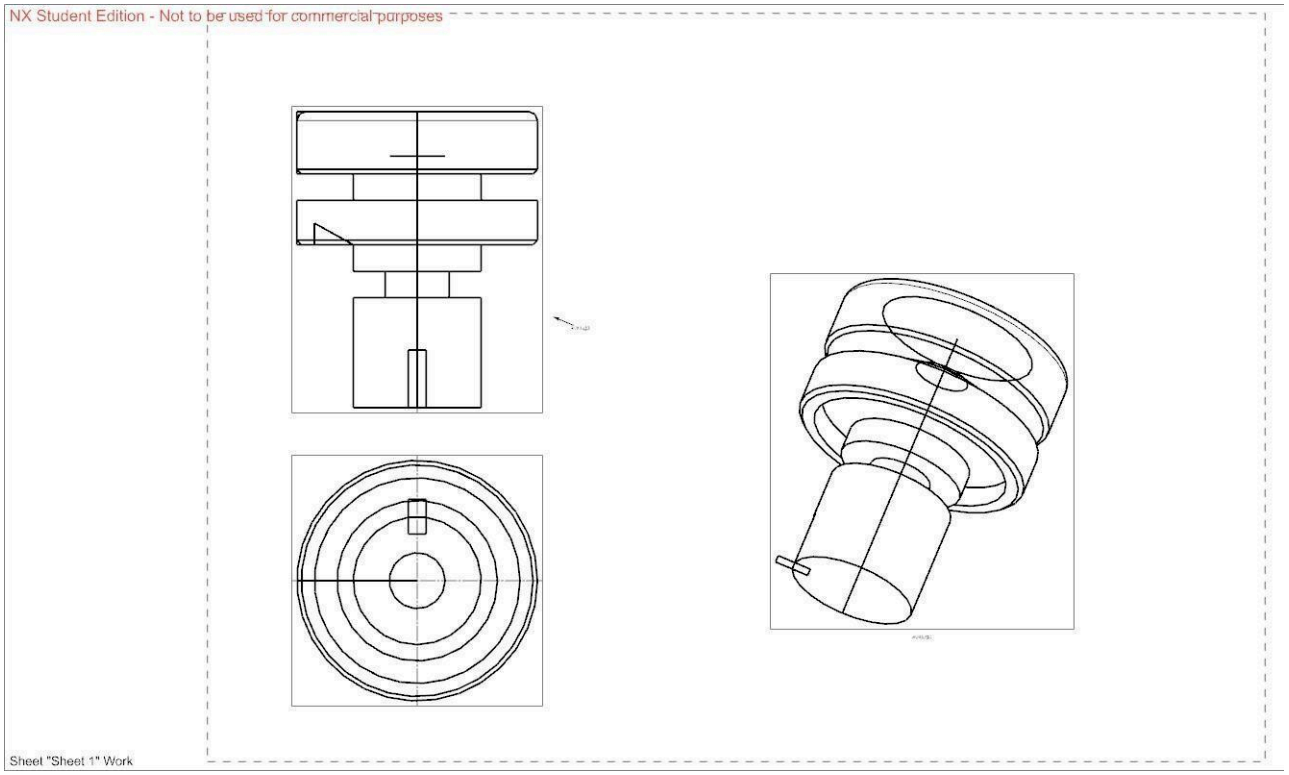


Fig.1.2. Drawing Datasheet

Product Details

- Thickness:5 mm
- Material: Stainless Steel Metal
- Country of Origin Made in India
- Hardness:50 HRC
- Surface Finish Chrome Finish
- Tensile Strength:350 MPa

1.3FIXTURE ANALYSIS:

The reason why Rotary table is preferred over manual HELICOIL insertion are due to:

➢ **Consistency:** The rotary table ensures that there is consistency in the insertion process which takes a lot of time and experience for a human labor.

- **Quality control:** The rotary table is coded to rotate with the help of sensors that eventually reduces bad quality inserts.

- **Efficiency:** In this study, we have proved that the rotary table can increase the amount of HELICOIL being inserted which eventually reduces the lead time.

- **Precision:** Rotary table offers precise positioning, which is important for the accurate placement of HELICOIL inserts.

In this research we have used Process study and time study to prove the fact that the rotary table is far more efficient and more reliable compared to the manual insertion which was being done.

Process study: A process study is an investigation undertaken to assess the mechanisms and variables that contribute to and influence the outcome of a particular activity.
It involves a systematic inquiry into the processes involved in a specific task or operation, with the aim of understanding how different factors interact and affect the final result.

Time study: A time study is a methodical process used to determine the time required for a qualified worker to complete a specific task at a defined level of performance. It involves observing and recording the time taken to perform each detailed element of an industrial operation, including manual, mental, and machining operations.
The goal is to establish standard times for tasks, which can be used for various purposes such as setting wages, estimating costs, and improving production efficiency

1.4. Advantages:

1. **Increased Precision**: They ensure parts are consistently positioned and aligned correctly, leading to high precision in machining.
2. **Enhanced Productivity:** By streamlining operations, they allow for faster production rates and reduce the need for highly skilled labor.
3. **Cost Reduction:** Speeding up tasks and reducing variability helps lower overall manufacturing costs.

4. **Improved Quality:** They minimize dimensional variability, ensuring consistent quality of manufactured products.
5. **Versatility:** Custom-designed for specific tasks, they can be adapted to various manufacturing needs.

6. **Safety:** Providing a secure way to hold and position parts, they reduce the risk of accidents and improve workplace safety.

Disadvantages:

1. **High Initial Cost:** Designing and manufacturing jigs and fixtures can be expensive, especially for custom solutions.
3. **Limited Flexibility:** They are often designed for specific tasks, making them less adaptable to changes in the manufacturing process.
4. **Maintenance:** Regular maintenance is required to ensure they remain accurate and functional.

5. **Storage Space:** They can take up significant storage space, especially in a facility with many different jigs and fixtures.

Overall, while jigs and fixtures are invaluable for improving efficiency and precision in manufacturing, they do come with some trade-offs. Do you have a specific application or project in mind where you're considering using jigs and fixtures?

CHAPTER 2

LITERATURE REVIEW

LITERATURE REVIEW

1. Performance Analysis and Reliability Optimization of Internal Feedback Hydrostatic Rotary Table

Support Authors: Jinfeng Xie, Congbin Yang, Honglie Ma, Ying Li, Zhifeng Liu, Jun Yan Publication Year: 2024 Journal: J. Tribol.Volume: 146 Issue: 6 Pages: 064101

Paper No: TRIB-23-1327 DOI: 10.1115/1.4064400. The internal feedback hydrostatic rotary table is a precision support device, and its performance relies heavily on the oil pad. However, uncertainties in the manufacturing process are often overlooked during the stiffness optimization, affecting the reliability of the optimized results. Accordingly, this paper aims to analyze the influence of structural parameters on the stiffness performance of the internal feedback hydrostatic rotary table and to perform reliability optimization considering the uncertainties. Initially, a theoretical computational model of internal feedback hydrostatic rotary table, accounting for the oil leakage effect, is proposed. The model's accuracy is validated through comparative simulation calculations, and based on this model, the load-bearing performance of the table is further analyzed. Subsequently, focusing on the structural characteristics of the oil pad, a reliability optimization model that considers manufacturing uncertainties is proposed. To improve the optimization efficiency, a Levenberg–Marquardt Backpropagation (LM-BP) neural network is introduced as a surrogate model for theoretical calculations

2. Reliability Analysis of Rotary Table Over the Lifetime Authors: Aleš Richter, Pavel Fišer VÚTS, a, s., Svarovska 619, Liberec XI, 460 01 Liberec, Czech Republic Publication Year: 2022 Journal: Springer Volume: MMS 85 Pages: 269–277

DOI: 10.1007/978-3-030-83594-1_28. This paper deals with the evaluation of the reliability of a high-precision and fast carousel for its expected service life. The total service life is given by the weakest link of the transmission mechanism. In our case, these are the rotating moving parts of the gearbox, or their contact surfaces. With the help of specially developed test equipment, it is possible to approximately simulate the degree of load to which the components of the carousel will be exposed under normal operating conditions. The results collected from the tests performed will allow us to modify future carousel designs to achieve the specified values of positioning cycles.Another integral part of increasing the competitiveness of a product is its accuracy. This is given by the construction of the rotary table, production and subsequent professional assembly. The accuracy of the carousel should not change significantly during operation.

3. Trends in the Development of Rotary Tables with Different …Authors: Various

Publication Year: 2017 Journal: Springer Volume: MMS 85 37–48 DOI: 10.1007/978-3-319-68619- 6_37. The paper presents the special solutions of rotary table drive with hybrid spiroid gear drive. The construction solutions of rotary tables were reviewed and the various construction solutions, most frequently encountered on the market, were described. Rotary table solutions are discussed for the application in numerical control machines that are the fifth axis or can be used as an independent positioning device. Many different types of rotary table solutions are available on the market where direct drive or mechanical gear transmissions of different types are

used, i.e.: worm gear drive or spiroid gear drive. One of the directions for the development of the rotary table drive are the new hybrid solutions, in which different types of mechanical gear transmissions are used

4. Rotary Table Accuracy Improvement Authors: Various Publication Year: 2018 Journal: AIP Conference Proceedings | AIP Publishing Volume: AIP Conf. Proc.

   Pages: 020065 DOI: 10.1063/1.5066527. his paper deals with improving the accuracy of a specially designed rotary table. The made carousel mechanism achieves a high precision given by production procedures, but still insufficient. With a series of unique measurements, there were found deviations from the theoretical exact position. These data served as references for adjusting the input data for the servo drive.

5. Gameros A, Lowth S, Axinte D, Nagy-Sochacki A, Craig O, Siller HR. State-of-the-art in fixture systems for the manufacture and assembly of rigid components: A review. International Journal of Machine Tools and Manufacture. 2017 Dec 1; 123:1-21. Basic work holding devices (e.g. vices), fixtures and jigs are used to construct a critical interface between a workpiece and an end-effector. This interface performs two main functions: location of the workpiece in the Euclidean space and preservation of the workpiece position against any loads. Despite the critical nature of the part- machine interface, limited attention has been given to work holding systems in the academic community. In this respect, the main objective of this paper is to systematically review the field of fixture design, thus allowing the classification of fixturing systems to identify research trends and niches.

6. Teegavarapu, Sudhakar, Joshua D. Summers, and Gregory M. Mocko. "Case study method for design research: A justification." International design engineering technical conferences and computers and information in engineering conference. Vol. 43284. 2008. Case studies are used in design research to analyze a phenomenon, to generate hypotheses, and to validate a method. Though they are used extensively, there appears to be no accepted systematic case study method used by design researchers. Considering its nature and objectives, the case study method could be considered as a suitable method for conducting design research. Many times, design researchers have to confront questions about the validity of using case studies and their results. The objective of this paper is to present a brief overview of case study method, compare it with other qualitative and quantitative research methods, and study the merits and limitations of using the same in design research.

7. Mintzberg, Henry. "Structured observation as a method to study managerial work." Journal of management studies 7.1 (1970): 87-104IN the May 1965 issue of The Jumano Management Studies, Rosemary Stewart published an article entitled ‘The Use of Diaries to Study Managers’ Jobs’. In she discussed the diary method, whereby managers describe the nature of their activities on preceded pads, and she contrasted this method with observation. Miss Stewart claimed that she required a method that would be simple for the manager to use, and that would enable her to compare adequately the differences between Weren’t types of managers’ jobs. She chose the diary, she claimed, because it allowed her to study more managers for greater periods of time, and because only the manager has the understanding of and the access to

   the events to be recorded. Then, in the October 1967 issue of the Journal, David Marples suggested, in his article ‘Studies of Managers - A Fresh Start?’,

8. Burns, Alan, and Andrew J. Wellings. "HRT-HOOD: A structured design method for hard real-time systems." Real-time systems 6.1 (1994): 73-114.Several physical stressors, including repetitive, sustained, and forceful exertions, awkward postures, localized mechanical stress, highly dynamic movements, exposures to low temperatures, and vibration have been linked to increased risk of work- related musculoskeletal disorders. This method uses a series of 10-cm visual-analog scales with verbal anchors and benchmark examples. Ratings for repetition reflect both the dynamic aspect of hand movements and the amount of recovery or idle hand time. Trained job analysis experts rate the jobs individually and then agree on ratings. For a group of 33 jobs, repetition ratings using this system were compared to measurements of recovery time within the cycle, exertion counts, and cycle time. Amount of recovery time within the job cycle was found to be significantly correlated with the analysis ratings (r2=0.58), as were the number of exertions per second (r2=0.53). Cycle time was not related to the analyst ratings. Repeated analyses using the new method were performed 1½ to 2 years apart on the same jobs with the same group of raters

9. Messick, Samuel, and Ann Jungeblut. "Time and method in coaching for the SAT." Psychological Bulletin 89.2 (1981): 191. A review of studies of coaching for the Scholastic Aptitude Test (SAT) indicates that, although there are methodological flaws, some definite regularities emerge relating the size of score effects associated with coaching to the amount of student contact time entailed in the coaching programs. Rank-order correlations between these 2 variables were upwards of .7 for both SAT-Verbal (SAT-V) and SAT-Mathematics (SAT-M) scales. The relationship was nonlinear with arithmetically increasing amounts of score effect associated with geometrically increasing amounts of student contact time. the student contact time required to achieve average score increases of more than 20–30 points (on a 200–800-point scale) for both SAT-V and SAT-M rapidly approaches that of full-time schooling. (24 ref) (PsycINFO Database Record (c) 2016 APA, all rights reserved)

10. Womack, in 1992, on the book “The machine that changed the world”, used for the first time the expression Lean Manufacturing, doing a retake of the history of automobile production combined the Japanese, American and European production lines. Lean Manufacturing (LM) consists of producing, by maximizing the economy of resources, to represent the products developed in Toyota Lately, Lean Thinking concept is described as being a philosophy that imposes less time since the order placement (Lead time), obtaining products and services with high quality and low cost, through improvement of production fluxes, by reducing wastes on the flux chain, that we can see through Value Stream Mapping (VSM) or Waste Identification Diagram (WID).Applying this tool brings real advantages, as proved by [5]. The authors stated that it could reduce 2,5 days the Production Lead-Time (PLT), and, the value added-time lowered from 68 minutes to 37 minutes.

CHAPTER 3

PROBLEM DEFINITION

PROBLEM DEFINITION

In this assembly are have more backlog because of manually installing the Heli-coil. Achieving higher productivity and precision requires a reduction in downtime of job in manufacturing. One of the options to accomplish this is by the use of correct fixture that helps in minimizing setup time during manufacturing. because of using rough way of installing the Heli-coil and not proper position for install the Heli-coil into the threaded hole of the product and also less experience will also affect to install the Heli-coil this all the problem facing in the assemble in the company, this all the major problem facing in below

- Human error
- Tool usage
- Thread damage
- Heli-coil damage

3.1COMPONENT DELAY:

Typically made out of Stainless-steel wire, Heli-Coils are threaded inserts with diamond-shaped cross-sections that screw into receiving threads. Heli-coils inserts reinforce screw threads and transfer forces, especially in soft materials. Assembly and Disassembly: They are ideal for applications where frequent assembly and disassembly occur. Installing each Heli-coils takes about more than 2/3 minutes, which can impact lead times in production manufacturing

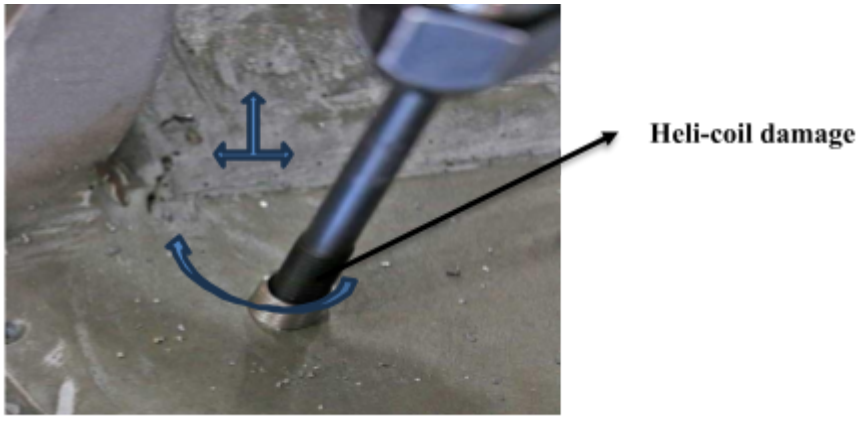


Fig. 3.1 Install the Heli-coil

is because the wrong instan of a tool cannot remove enough material fast enough, causing excessive friction, leading to work handling in both the tools and the workpiece.

With dull tools, more rubbing between the tool and workpiece occurs. What results is heating generation in both the tool and the workpiece that can cause both deformation and hardening in the workpiece. If the workpiece is too hard, tool wear and eventually breakage will occur. Therefore, manufacturers need to check that the taps, dies, and roller edges are sharp and that the hardness of the threading tool is higher than the workpiece, typically around 60 HRC, to prevent stripped or damaged threads.

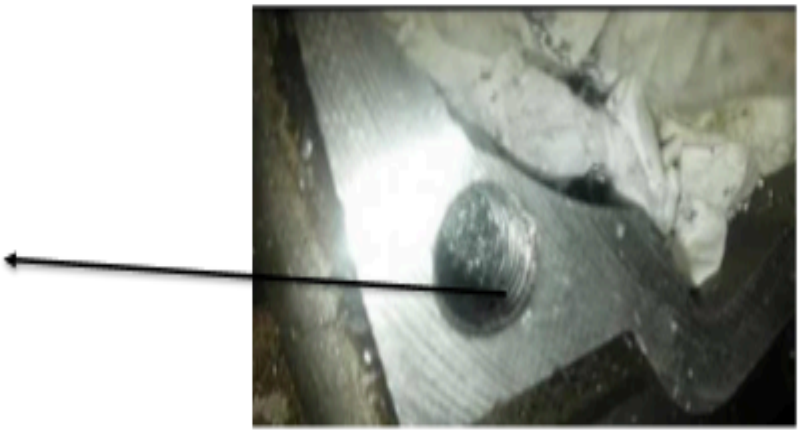


Fig. 3.2 Thread damage

Thread damage:

Thread damage

Human error:

if you're having issues with stripped or chipped threads, it's most likely that your tap and hole are not properly aligned. Even a slight misalignment can increase pressure and friction greatly. Check your tap holder and machine are right for the job, and possibly look into chamfering the hole before you try to use a tap on it. Also, make sure to check the tap alignment from several perspectives before you go ahead and start machining

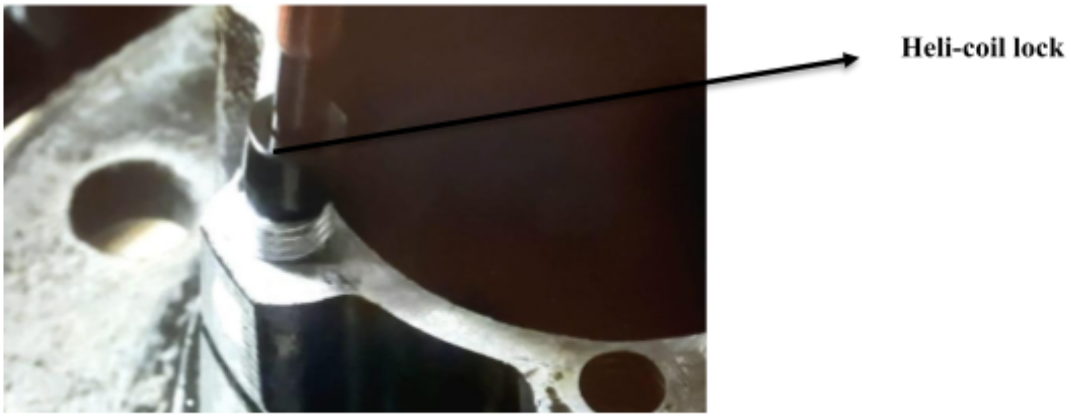


Fig. 3.3 Heli-coil lock

If the Heli-coil is not sitting at the correct depth, it may not hold the screw firmly, Heli-coils that have been in use for a long period may retract, causing thread instability Heli-coils typically fail when there are problems with the parent material they are installed in

CHAPTER 4

EXPERIMENTATION AND DATA ANALYSIS

4.1 TIME STUDY AND METHOD STUDY:

Time study is a work measurement technique for recording the times and rates of working for the elements of specified job carried out under specified conditions and for analyzing the data so as to obtain the time necessary for carrying out the job at a defined level of performance.

Method study enables industrial engineer to subject each operation to systematic analysis. The main purpose of method a study is to eliminate the unnecessary operations and to achieve the best method of performing

Fig. 4.3 Time study equipment

Method Study Procedure:

This procedure involves seven basic steps as follows:

SELECT: The work to be studied/job to be analyzed

RECORD: all the relevant facts about the present method

EXAMINE: The facts critically and in ordered sequences, using the techniques best suited to the purpose.

DEVELOP: The most practical, economic and effective method which meets the required

processes to be done sequentially

DEFINE: the new method so that it can always be identified

INSTALL: The method as standard practice

MAINTAIN: The method by regular routine checks and by standardization

4.2 HELI-COIL:

A Heli-Coil is a **coiled-wire type of thread repair insert** used to create internal screw threads to accommodate standard-sized fasteners

Types of Inserts:

There are two designs of Heli-Coil inserts. STANDARD, which provides a smooth running for thread; and, SCREW-LOCK which provides self-locking torque on the male member by series of "chords" on one or more of the insert coils.

They are available in inch series coarse and fine and metric series, coarse and fine. Inch series Screw Lock inserts are dyed red for identification

Fig. 4.3 HELICOIL

Size Range:

• UNC #2 through 1-1/2

• Metric Coarse M2 through M39

• Metric Fine M8 through M39 Inserts are also available in UNEF, UNS, 8UN, 12UN, 16UN, Spark Plug and Pipe Thread

Fig. 4.3 HELICOIL

Fig. 4.4 Heli-coil installer

Manually Heli-coil installing process

- Thread the Heli-Coil insert onto the end of the installation tool.
- Set the end of the insert into the hole and continue rotating the installation tool
- clockwise to wind the insert until it is flush with the top of the threaded hole
- Rotate the installation tool to drive the insert through the pre-coil body and into
- the tapped hole in the housing.
- After you seat the insert to the proper depth, unthread the installation tool.

4.3 TIME RECORD OF MANUALLY INSTALL THE HELICOIL PROCESS:

TIME STUDY SHEET									
		HELICOIL	INSTALL	CYCLE	TIME				
OPERATION NAME	OPERATOR	H1	H2	H3	H4	H5	H6	TOTAL SEC	TIME IN (MIN)
Manual install	1	85	68	70	55	68	55	401	6.68
Manual install	2	88	75	92	88	74	58	475	7.92
Manual install	3	75	45	94	82	88	70	454	7.57
Manual install	4	55	48	95	86	98	80	462	7.7
Manual install	5	78	88	98	75	68	86	493	8.225
Manual install	6	95	45	67	95	48	45	395	6.58
Manual install	7	48	56	68	45	75	95	387	6.45
Manual install	8	58	88	65	85	45	98	439	7.32
AVERAGE TIME									7.305625

Fig.4.5 TIME STUDY SHEET

The pace of work values must be assigned by engineers and technicians. The correct calculation depends on these calculations. Standard time is calculated by considering correct work speed of Heli-coil install process. The calculation below shows how the data must be analyzed. The table shows the given time

PRESENT AVERAGE TIME = 7.305MIN

4.4 PROCESS PLANNING

Process planning can be defined as the systematic determination of the method by which a product is to be manufactured economically and competitively. It consists of devising, and selecting and also specifying process, machine tools and other equipment to convert raw material into finished & assembled product.

FLOW CHART FOR METHODICAL FIXTURE MAKING PLANNING:

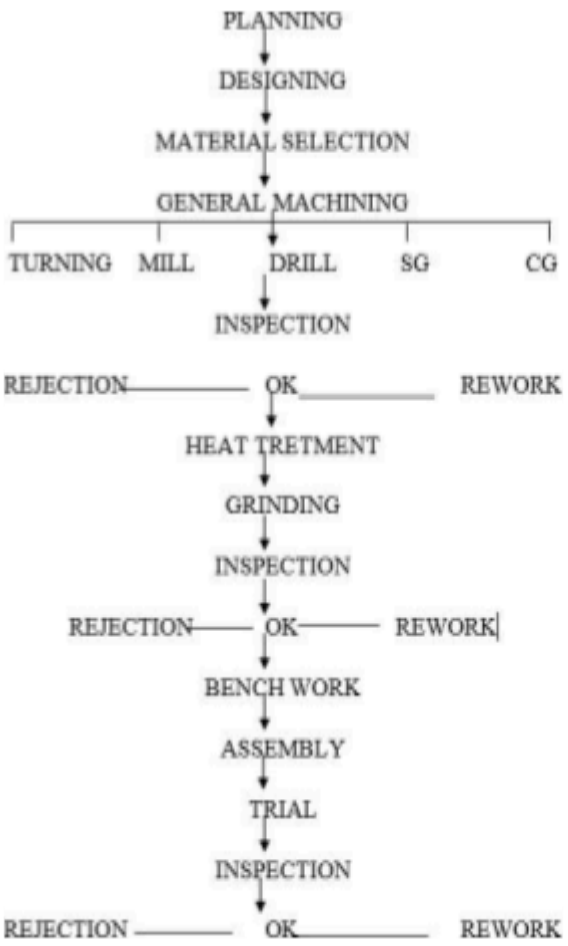


Fig.4.6 Flow chat

4.5 FIXTURE DESIGN AND ANALYSIS

A fixture is a **manufacturing tool that holds, supports, and locates a workpiece on machine at the required location**. It reduces workpiece set-up time and improves part quality. Therefore, fixtures precisely locate the part on the machine to reduce machine idle time & operator efforts and increase productivity.

Tool	-	fixture.
Type of fixture	-	Assembly
Operating mode	-	PLC board
Type of location	-	Hole location
Type of clamping	-	Location
Loading and unloading	-	manual.
Number of components Load	-	4 components

Fig.4.7 Fixture description

Fixtures have become a necessary part of modern manufacturing process. Fixtures are the economical means to produce respective type of work by incorporating special work holding devices.

Employing fixtures in mass production work eliminates the marking out, measuring and other setting methods before machining.

Fixtures increase the machining accuracy and reduce the overall cost of machining by fully or partly automatizing the process.

Principles of fixture design:

The successful designing of fixture depends on the analysis of several factors, which must be carefully studied before the actual work is taken in hand. The following are the essential factors, which must be considered in design of fixtures:

1. Study of the component.
2. Study of the type and capacity of the machine.
3. Study of the clearance required between the fixture and the component.
4. Study of the indexing device.
5. Study of rigidity and vibratory problems.
6. Study of safety devices.

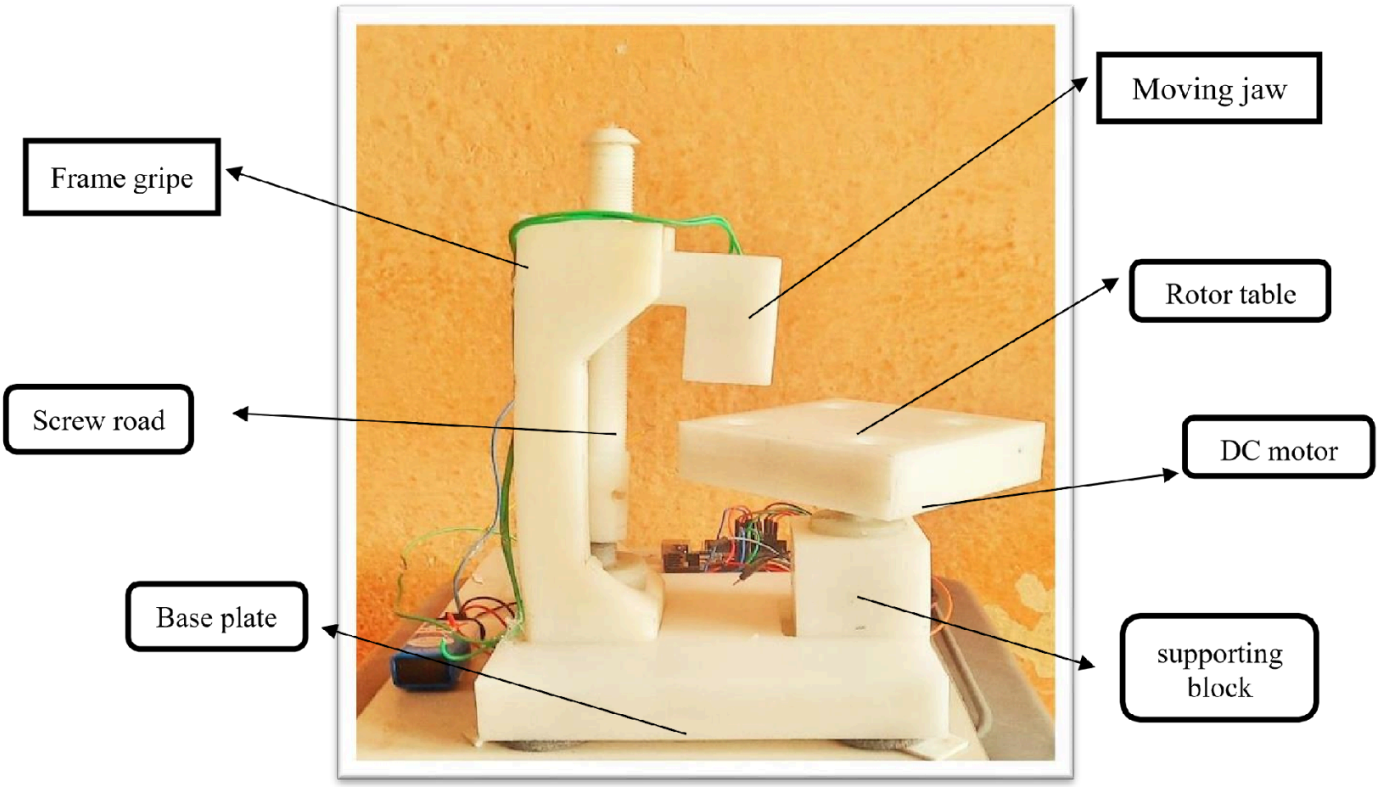


Fig. 4.5 Prototype Rotary Table

- **LOCATING:**
  - Locating refers to the dimensional and positional relationship between the work piece and the Heli-coil tool.

- **LOADING AND UNLOADING:**
  - The design of the fixture should be such so as to enable the operator to fix up and remove the components with ease, before and after machining without exerting unnecessary effort and spending undue idle me for these purposes.
  - The manner of loading and unloading should be quick, simple and positive. Here in this fixture loading and unloading is carried out by manually and
  - this concept is simple and convenient to regular production.

- **CLAMPING:**
  - Once a work piece is located, it is necessary to press it against the locating the surfaces and hold it there against the force acting upon it.

➢ **LEAD SCREW:**

- A lead screw, also known as an energy screw or translation screw, functions as a linkage in a system to convert rotary movement into linear movement. One sort of motion, rotary, can be transformed into linear movement via a lead screw. This mechanism combines a screw and a nut, in which the screw thread without delay contacts the nut thread. However, inside the case of curler screws

➢ Controller:

- An **L298 Motor Driver IC** is a monolithic chip, used in motor driver modules to control the speed of a DC motor. At present, the most frequently used motor driver ICs as compared to L298 is; L293D & L2938N. This IC is frequently used in RC cars & autonomous robots.

➢ Arduino:

- Arduino is an open-source platform that helps circuit developers build electronic projects. It consists of both hardware and software. Arduino hardware is a programmable circuit board called a microcontroller. Arduino software is an IDE through which developers write and upload the code to the microcontroller.

➢ DC motor / pneumatic cylinder:

- Pneumatic cylinders also called air cylinders are the final component of the pneumatic or compressed air control mechanical device. Air or pneumatic cylinders are devices that transform compressed air power into mechanical energy.
- A DC motor is an electrical motor that uses direct current (DC) to produce mechanical force. The most common types rely on magnetic forces produced by currents in the coils. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

CHAPTER 5:

COMPONENT ANALYSIS

COMPONENT ANALYSES

5.1 FRAME

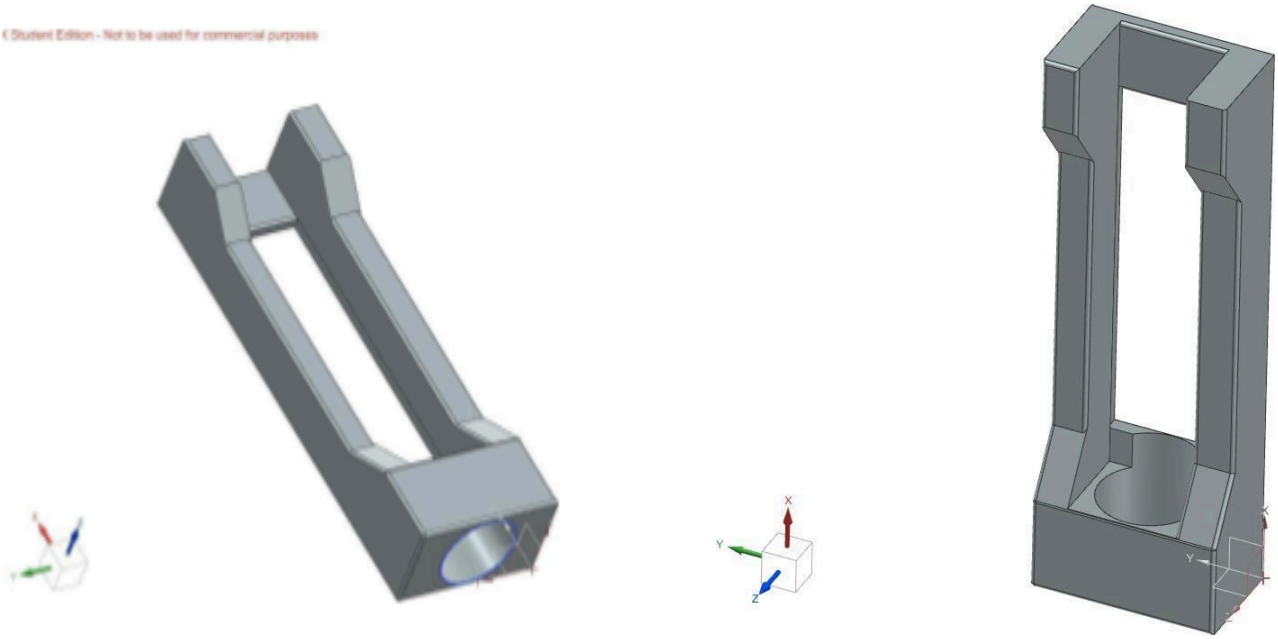


Fig.5.1 FRAME

Fixture Frame Body Description

In this Fig 5.1, the frame body will take the main role because the body will hold the screw rod. The install part also connects to the rod, which is why the frame rod needs to have high strength and stability. The fixture body serves as the robust foundation, providing stability and precise alignment for workpieces during machining or assembly processes.

Additionally, a DC motor will be installed in the centre, and it will be positioned near the fixture in

the body.

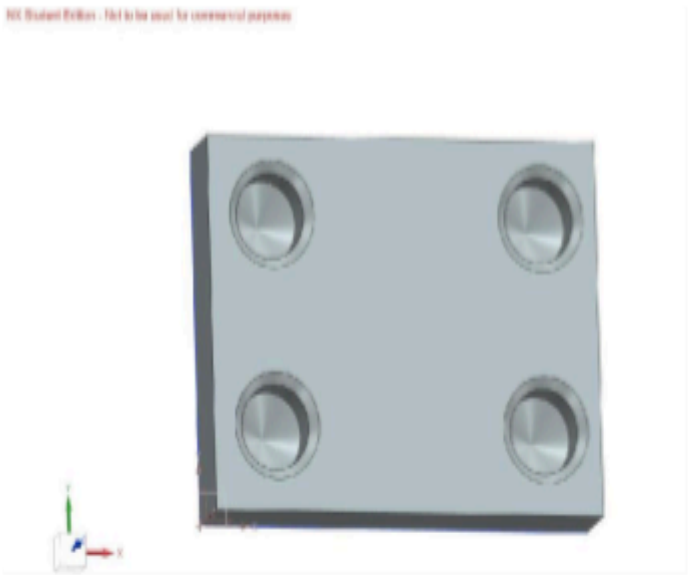
Material

Mild Steel:

- Contains carbon (<0.3%).
- in jigs and fixtures.

Most suitable for most jig applications as it is the most economical and widely used material

5.2 ROTARY PLATE



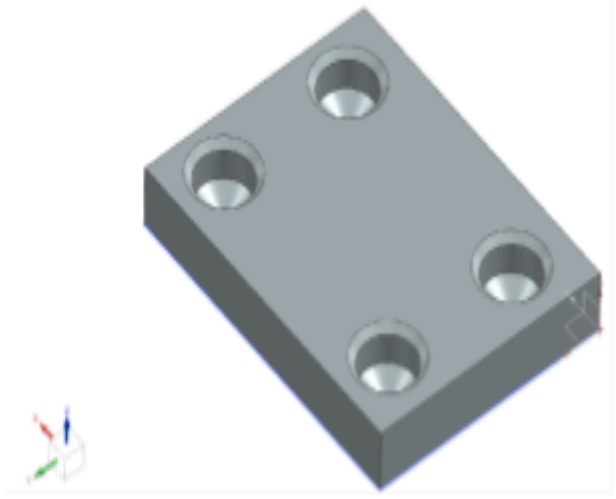


Fig. 5.2 ROTARY PLATE

Rotary plate is one of the main parts in the fixture it can hold 4 parts at a time and also in the plate can attached to the DC motor and also in the plate, and the plate will rotate each time to the center of the locator and also the plate will have 4 holes in each corner and also have the slot have same as the component. The material used is Aluminum Alloy Suitable for locating fixtures and jigs. Valued for its ease of machining and light weight. Can experience excessive wear when in contact with harder materials

5.3 MOVING L BLOCK

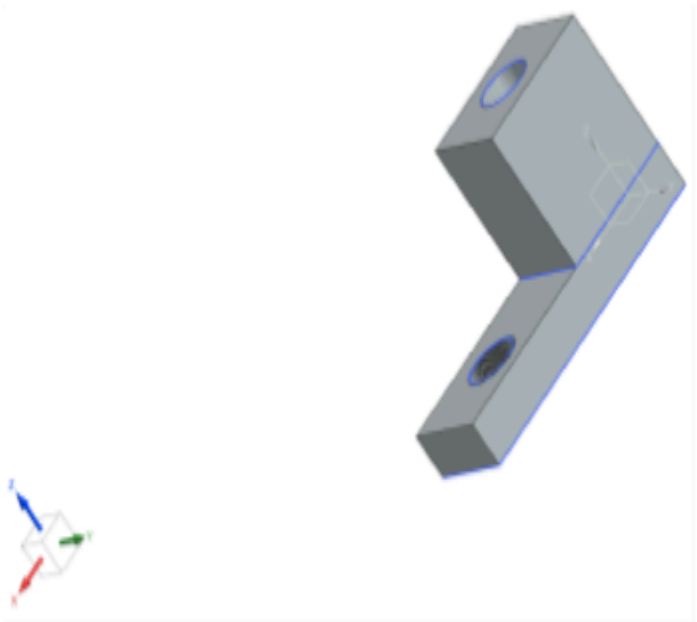


Fig 5.3 Moving L block

Moving L block is mainly attached to the screw road it will move forward and backward on the screw road and in the block have 2 hole one for the screw connected for motion and it will be a M16 tap inside the hole and also in the 2nd hole have a to install moto to install the Heli-coil to the component. And mainly

5.4 SUPPORTING BLOCK

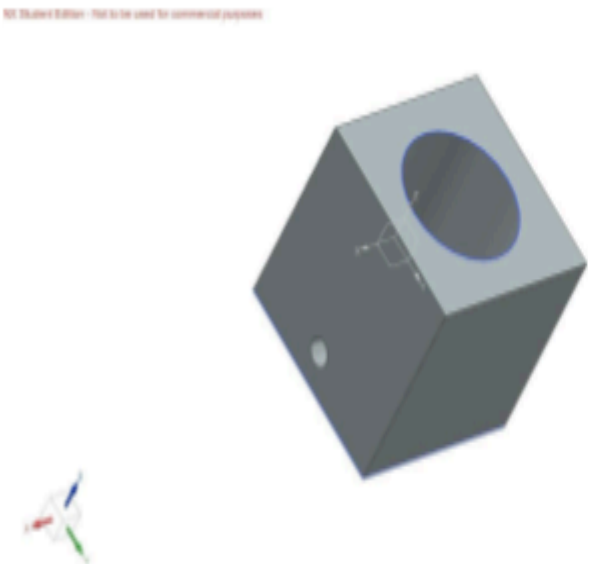


Fig 5.4 supporting block

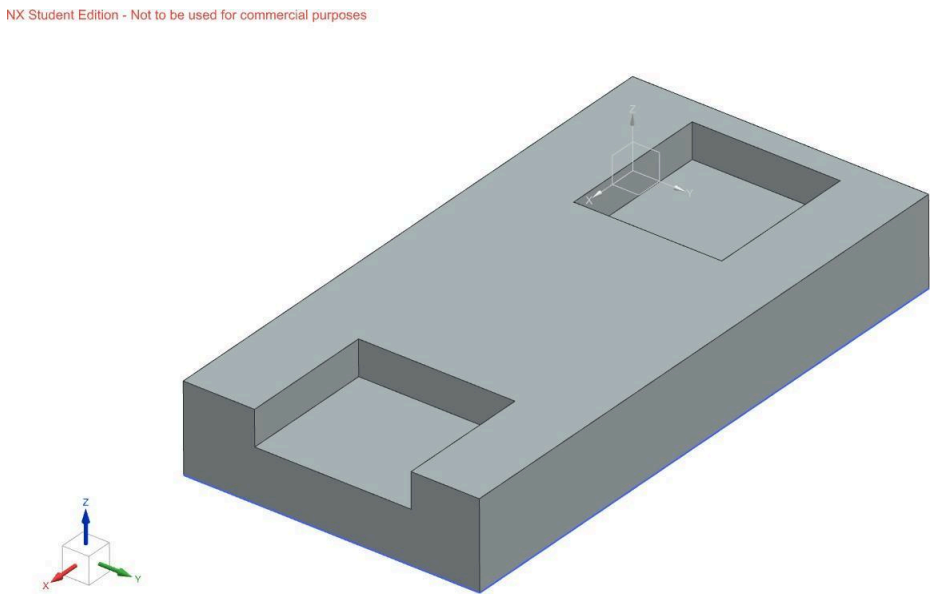
The supporting block is the of the holding device in the fixture and also it has 32DIA free hole to insert the DC motor and the motor will be attached to fixture plate this block L50W50H50 and it attached to base plate and the depth of the hole is 35 the motor will be placed the hole and it rotate frequently.

5.5 SCREW ROD

Fig. 5.5 Screw Rod

A screw is a type of fastener used to join two or more moving or stationary parts to provide a tight fit between those parts. The part below the screw's head is called the body of the screw. It is that part that gets penetrated into the object. The body consists of helical structures called threads of the screw. And also, in the screw road different types in this M16 thread and also length of the thread is 100MM length and it used for the rotate clock wise and anti-clockwise direction.

5.6.BASE PLATE



Fig, 5.6 Base plat

In fixture this is the base plate, it connects to frame and the support block and also the three have a

2 slot in this plate it will be slid fit to this part and also in this part. The part is made up of alloy steel

Volume, V = L*W*H
V = 150*250*50 V = 4.73*10-3 m3
Material: aluminum
Density of aluminum = 2700 kg/m3

5.7 CONTROL SYSTEM

Controller is the main role in the fixture because in each component need to rotate by this controller so we use this component. There are 3 types of controllers used in this fixture and one push button and also a 2 DC motor and this component can control the process of the fixture and also au dino can supply the required electric for the DC motor and also in the switch can control the complete process and also one

more battery added to the supper install motor.

Fig. 5.7 ARDUINO

Fig. 5.9 DC motor

➢ **Arduino Uno** is a circuit board that can be programmed and used for a variety of applications12345. Some of the applications of Arduino Uno include:

- Do-it-Yourself projects prototyping
- Developing projects based on code-based control
- Development of Automation System
- Designing of basic circuit designs

➢ The **motor driver IC** is an integrated circuit chip used as a motor controlling device in autonomous robots and embedded circuits. L293D and ULN2003 are the most commonly used motor Driver IC that is used in simple robots and RC cars. A motor driver is undoubtedly something that makes the motor move as per the given instructions or the inputs (high and low).

- Microcontrollers operate at lower voltages than motors. They cannot directly power motors.
- Motor drivers step up the current from the microcontroller to match the higher current needed by the motor.
- Essentially, motor drivers act as power amplifiers, regulating the power flowing to the motor for speed and torque control

➢ Mainly **DC motor** and the push button are mainly used in fixture, Push button switches or push switches are small lever-like devices used to create or break an electronic circuit. A DC motor or direct current motor is an electrical machine that transforms electrical energy into mechanical energy by creating a magnetic field that is powered by direct current

○ A DC motor converts electrical energy into mechanical energy using direct current ○ The main components of a DC motor include the stator (stationary part), rotor (rotating part), commutator, brushes, and windings. ○ DC motors are widely used in various applications due to their ability to provide high starting torque and precise speed control.

➢ **Push button** is switches (also referred to as pushbutton switches) are electrical actuators that, when pressed, either close or open the electrical circuits to which they are attached. They are capable of controlling a wide range of electronic gadgets. Push button switches, like all other types of electrical switches, are used to reconfigure the electrical circuits to which they are attached.

CHAPTER:6

FIXTURE MANUFACTURING PROCESS

Manufacturing process

Machining is a subtractive manufacturing process that involves the use of cutting tools, discs, abrasive wheels, and more to remove excess material from a workpiece. Furthermore, this process is used to remove unwanted materials to achieve the desired product shape.

6.1 Raw Material Selection for fixture:

Material selection is a matter of quality and cost. The properties of the material must be adequate to meet design requirements and service conditions. While manufacturing any machinery parts, Molds, press tools, equipment, gauges, jigs & fixtures etc. Raw material selection plays vital role. Selection of raw material depends upon the function of manufacturing parts.

MATERIALS USED IN THIS FIXTURE ARE AS FOLLOWS:

Mild steel : St -42

Carbon steel : C 45

Fig. 6.1 RAW MATERIAL

MILD STEEL (St-42):

This is a low carbon steel with no precise control over the composition or mechanical properties. The cost is low in comparison with other steels and it is used for covers, sheet metal work, tanks, fabricated items, etc.

CARBON STEELS (C45):

These steels are medium carbon steels with a carbon percentage varying between 0.35% and 0.6%. C45 is the preferred steel of this category and is suitable for applications such as shafts, gears, keys footed clutch, threaded fasteners requiring high strength, pins, etc. C45 can be induction hardened

6.2 Raw Material Selection for prototype

Fig. 6.2 NYLON 66

Nylon 66 is frequently used when high mechanical strength, rigidity, good stability under heat and/or chemical resistance are required.

It is used in fibers for textiles and carpets and molded parts. For textiles, fibers are sold under various brands, we used this material for prototype and also cheaper compare to steel material so that's why we use this material for prototype and mainly it light wight can handle easily.

Category	Thermoplastic
Density	1140 kg/m3

Water Absorption	2.3 % wt/day
Density	1.140 g/ml (Zytel)
Melting point	264 °C (507 °F)

6.3 Turning:

In the turning process, the cutting tool remains stationary while the workpiece rotates. Furthermore, it is a lathe operation and involves the removal of excess material from a workpiece with the aid of a cutting tool. Besides, the cutting tool works along two axes of motion.

Dia: 20MM
Length: 100MM

Fig. 6.3 NYLON ROD

Thread size: M18

Thread cutting on the lathe is a process that produces a helical ridge of uniform section on the workpiece. This is performed by taking successive cuts with a threading tool bit the same shape as the thread form required.

- For this practice exercise for threading, you will need a piece of round material, turned to an outside tread Diameter.
- Using either a parting tool or a specially ground tool, make an undercut for the tread equal to its single depth plus .005 inch.
- The formula below will give you the single depth for undertaking unified threads:

$$d = P \times 0.750$$

Where d = Single Depth

P = Pitch

n = Number of threads per inch (TPI)

- Infeed Depth = .75 / n

6.4 Thread Calculations:

To cut a correct thread on the lathe, it is necessary first to make calculations so that the thread will have proper dimensions. The following diagrams and formulas will be helpful when calculating thread dimensions.

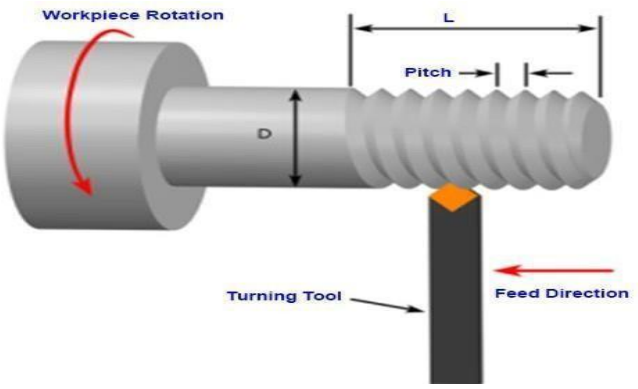
Example: Calculate the pitch, depth, minor diameter, and width of flat for a ¾-10 NC thread.

P = 1 / n = 1 / 10 = 0.100 in.

Depth = .7500 x Pitch = .7500 x .100 = .0750 in.

Minor Diameter = Major Diameter – (D + D) = .750 – (.075 + .075) = 0.600 in.

Width of Flat = P / 8 = (1 / 8) x (1/10) = .0125 in.



After the threading operation need to check the pitch of the thread and also need to check the thread by using the thread gauge if any need to remove the material give the cut before remove the part after remove the work piece from the machine

Finishing product

Fig. 6.4 Turning process

Fig. 6.7 Threaded rod

6.5 Milling operation:

Milling is a machining process that involves the use of rotating cutters to remove material from a workpiece. Furthermore, there are two main types of milling operations; face milling and slab milling. It is the most important machine in the tool room as nearly all the operations can be performed on it with high accuracy. Many types of operation can be done in the milling machine they are

- Rough milling ○ Sizing ○ Slotting ○ Countersink ○ Plan milling
- Drilling

Here are the steps involved in a milling operation:

1. Identify Requirements:

Understand the milling needs, including the material, finish requirements, and tolerances. The project's specifications will guide the subsequent steps.

2. Selection of Tools:

Choose the appropriate face milling cutter based on the material and desired finish. Common tools include end mills, shell mills, and fly cutters.

3. Machining Parameters Definition:

Determine the feed rate and spindle speed using a face milling speeds and feeds chart. These parameters are crucial for achieving the desired surface finish and material removal rate.

4. Mount and Secure Workpiece:

Fasten the workpiece to the machine table using a vice or other clamping methods. Ensure it is securely attached to prevent movement during milling.

5. Position the Milling Machine:

Adjust the milling machine so that the cutting head is perpendicular to the workpiece. This ensures that the top of the cutter works on the material.

6. Inspection and Finishing:

After milling, inspect the workpiece to ensure it meets the required specifications. Perform any necessary finishing operations to achieve the desired surface quality.

7. Cleanup:

Clean the machine and work area to remove any debris or chips generated during the milling process.

Face milling is a versatile operation used to create flat surfaces with a fine surface finish on a workpiece. If you have any specific questions about any of these steps, feel free to ask

Operation 1:

Face milling is a machining manufacturing process used for smoothening or flattening the surface of workpieces. Conversely, slab milling is ideal for machining a wide flat surface. And mainly used cutter is Dia 8 END MILL, Dia 30CUTTER, it also involves making planar cuts across a workpiece's surface using the mill cutter's peripheral edges.

Fig. 6.8 Face milling

Calculation

Given Data:

Cutter Diameter (D): 50 mm

Cutting Speed (Vc): 1000 m/min

Feed per Tooth (fz): 0.1 mm/tooth

Number of Teeth (z): 4

Spindle Speed (n): The spindle speed can be calculated using the formula:

$$n = \frac{Vc \times 1000}{\pi \times D}$$

Spindle Speed: 636 RPM

Feed Rate (Vf): The feed rate can be calculated using the formula

$$vf = n \times z \times fz$$

Feed Rate: 254.4 mm/min

Operation 2:

In milling, the sizing operation involves precisely shaping and dimensioning a workpiece to meet specific requirements. This is typically achieved through various milling processes, each designed to produce different shapes and finishes. Here are some common milling operations. These operations are essential for achieving the desired dimensions and surface finishes in various manufacturing processes

Fig. 6.9 Sizing

Operation 3:

Slot milling, also known as groove milling, is a machining process used to create slots or grooves in a workpiece. This process involves using a rotating tool with multiple cutting edges to remove material and form precise slots, keyways, or channels.

Fig. 6.10 Slotting

Tool Movement: The tool moves along its own axis to cut into the workpiece, creating the desired slot or groove

Applications: Slot milling is commonly used to produce components like gears, pulleys, and other mechanical parts that require precise slots for assembly or functionality.

Types of Slots: Slots can vary in length, depth, and width, and can be open or closed, straight or non-straight.

Tool Selection: The choice of tool depends on the slot's dimensions and the material of the workpiece. Common tools include end mills, side and face milling cutters, and long-edge cutters.

Advantages: Slot milling allows for the creation of dimensionally accurate geometries that would be difficult to achieve by other means.

6.6 Drilling:

Drilling involves using drill bits (multi-point cutting tools) to produce cylindrical holes in solid materials. Furthermore, drill bits used for this procedure feature two spiral channels. These

channels, also known as flutes, evacuate the swarf or chips out of the hole as the drill bit progresses into the material.

DRILL DIA: 10MM and 20MM

Fig. 6.11 DRILLING

Drilling on a turning machine, such as a lathe, involves creating holes in a workpiece by removing material from its interior. This process is commonly used for creating holes for assembly purposes, such as accommodating bolts or screws.

Chamfering is a common process performed after drilling to remove sharp edges and burrs, creating a beveled edge around the hole. This process is essential for several reasons

Here's a brief overview of how it's done:

- **Setup:** The workpiece is securely held in the chuck or between centers on the lathe.
- **Tool Positioning**: A drill bit is mounted either in the tailstock or in a tool holder on the lathe.
- **Operation:** The lathe rotates the workpiece while the drill bit is fed into it, creating a hole with a diameter equal to the drill bit size1.
- **Safety:** It eliminates sharp edges that could cause injuries.
- **Assembly:** Chamfered holes make it easier to insert screws, pins, or other components.

6.7 Hardware and software:

In the centerer is nothing but a makes the component run by using this controller and also in this system can in put the value of by using the coding software's

And this the command of the coding, write a code for drilling, 4 components pleased on plate one by one using 3 dc motor. one for drilling, second for moving up and down of drilling motor and third on is for rotating plate that hold component using Arduino and L298N

```
                // Define motor pins
      const int drillingMotorPin1 = 2;
      const int drillingMotorPin2 = 3;
      const int drillingMotorSpeed = 9;

                const                int
      verticalMotorPin1  =  4;  const  int
      verticalMotorPin2  =  5;  const  int
      verticalMotorSpeed = 10;

                const                int
      rotatingMotorPin1  =  6;  const  int
      rotatingMotorPin2  =  7;  const  int
      rotatingMotorSpeed = 11;

                void setup() {
                  //   Set   motor   pins   as
        outputs    pinMode(drillingMotorPin1,
        OUTPUT);   pinMode(drillingMotorPin2,
        OUTPUT);  pinMode(drillingMotorSpeed,
        OUTPUT);

                   pinMode(verticalMotorPin1,
        OUTPUT);   pinMode(verticalMotorPin2,
        OUTPUT);  pinMode(verticalMotorSpeed,
        OUTPUT);
    pinMode(rotatingMotorPin1,         OUTPUT);
          pinMode(rotatingMotorPin2,   OUTPUT);
          pinMode(rotatingMotorSpeed, OUTPUT);
                }
        void loop() {
          for (int i = 0; i < 4; i++) { // Rotate
plate to position component rotatePlate();
                        // Lower drilling motor
            moveVerticalMotor(true);
                   delay(1000); // Adjust delay as needed
```

```
                // Start drilling
    startDrilling();
                delay(2000); // Adjust delay as needed

                // Stop drilling
    stopDrilling();

                // Raise drilling motor
    moveVerticalMotor(false); delay(1000);
    // Adjust delay as needed
  } void
rotatePlate() {
            digitalWrite(rotatingMotorPin1, HIGH);
  digitalWrite(rotatingMotorPin2, LOW);
  analogWrite(rotatingMotorSpeed, 255); // Full speed delay(1000);
  // Adjust delay for rotation analogWrite(rotatingMotorSpeed, 0);
  // Stop motor
         } void
moveVerticalMotor(bool down) {
            if (down) {
              digitalWrite(verticalMotorPin1, HIGH);
    digitalWrite(verticalMotorPin2, LOW);
  } else { digitalWrite(verticalMotorPin1,
    LOW);   digitalWrite(verticalMotorPin2,
    HIGH);
            } analogWrite(verticalMotorSpeed, 255); // Full speed
  delay(1000); // Adjust delay for movement
  analogWrite(verticalMotorSpeed, 0); // Stop motor
        } void startDrilling() {
digitalWrite(drillingMotorPin1, HIGH);
digitalWrite(drillingMotorPin2, LOW);
            analogWrite(drillingMotorSpeed, 255); // Full speed
```

6.8 Deburring and Surface Finish:

Deburring is the one of the main processes and also helps to measure the dimension non-conventional machining produces parts with a better surface finish than conventional machining.

This is due to the high accuracy and precision of the machining process. On the other hand, conventional machining leads to the manufacturing of products that are less accurate and precise than that produced by unconventional methods.

Several tool will used in deburring and surface finishing they are

Fig. 6.12 Deburring tool

Fig. 6.13 Removing the burr

Here are the general steps involved in the deburring process

Pre-deburring Preparation:

- **Tool Selection:** Choose the appropriate deburring tool based on the material, size, and shape of the part.
- **Setup and Calibration:** Ensure the deburring machine or tool is properly set up and calibrated for the specific task.

Deburring Process:

- **Apply the Tool:** Use the deburring tool to remove burrs by applying light, consistent pressure along the burr edge.
- **Tool Path Planning:** Plan the path the tool will take to ensure all burrs are effectively removed.
- **Workpiece Securing:** Secure the workpiece to prevent movement during the deburring process.
- **Depth Control:** Control the depth of the tool to avoid removing too much material.

Inspection: ○ **Visual and Tactile Inspection**: Inspect the part visually and by touch to ensure all burrs have been removed. ○ **Repeat if Necessary:** If any burrs remain, repeat the deburring process as needed.

Post-deburring Procedure ○ **Cleaning:** Clean the part to remove any debris or residue from the deburring process. ○ Final Inspection: Perform a final inspection to ensure the part meets quality standards

CHAPTER:7

INSPECTION

INSPECTION

Inspection is the most common method of attaining standardization, uniformity, and quality of workmanship. It is the cost art of controlling the product quality after comparison with the established standards and specifications.

7.1 Stages of Inspection

- Inspection of incoming materials
- Inspection of the production process
- Inspection of finished goods

1. Inspection of Incoming Materials

Purpose: Ensure that the raw materials and components meet the required quality standards before they enter the production process.

Steps:

- **Material Verification:** Check the materials against purchase orders and specifications.
- **Quality Testing:** Conduct tests for physical properties, chemical composition, and other relevant parameters.
- **Visual Inspection:** Look for visible defects, damage, or inconsistencies.
- **Documentation:** Verify accompanying documentation for compliance with standards and traceability requirements.
- **Supplier Performance Review:** Track and evaluate supplier performance over time.

2. Inspection of the Production Process

Purpose: Monitor and control the production process to detect and correct defects in real-time.

Steps:

- **In-Process Testing:** Perform tests at various stages of production to ensure consistency and adherence to specifications.
- **Statistical Process Control (SPC):** Use statistical methods to monitor and control the production process.
- **Visual Inspection:** Regularly inspect the production line for defects, malfunctions, and deviations from standards.
- **Process Audits:** Conduct audits to ensure that processes are being followed correctly and efficiently.
- **Corrective Actions:** Implement immediate corrective actions when deviations or defects are identified.

3. Inspection of Finished Goods

Purpose: Ensure that the final products meet the quality standards and are ready for delivery to customers.

Steps:

- **Final Testing:** Conduct comprehensive tests to verify the functionality, performance, and durability of the finished products.
- **Visual Inspection:** Check for any visible defects, inconsistencies, or damages.
- **Dimensional Inspection:** Measure the dimensions of the finished products to ensure they meet specifications.
- **Packaging Inspection:** Ensure that the packaging is appropriate and meets the required standards.
- **Documentation:** Verify that all required documentation, such as certificates of conformity, is complete and accurate.
- **Random Sampling:** Use random sampling techniques to inspect a subset of finished goods for quality assurance.

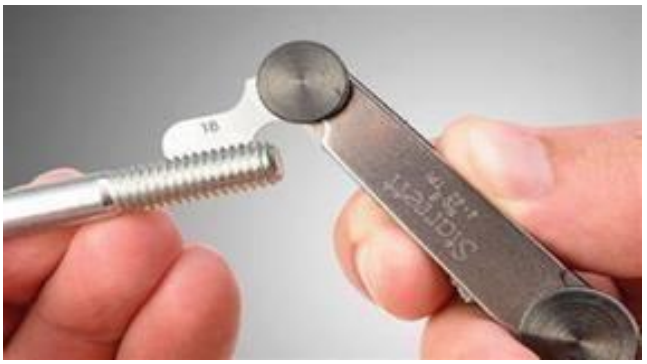
In the fixture is the main thing is precision because of the assemble and also in the fixture need make the operation for the component that's why need to make the fixture more accurate and achieve the tolerance in the Machine process have several error it will be milling and turning or other convention machine and also in the nylon material also have heating process have in the material it can vary the dimension.

7.2 Measuring Instruments

Steel rule

Vernier caliper

vernier height gauge



Thread gauge

CHAPTER:8

ASSEMBLY

ASSEMBLY

We have now come to the final stage of manufacturing of this tool. Assembly is a high skilled operation; The skill of the toolmaker is required in fitting in each part into the right place as per design to produce successful tool.

The two important things to be kept in mind while assembling it is given care and cleanliness.

If the care is not taken while handling the parts it leads to damages which in turn leads to loss of time and increases the cost. Assembly means seating the parts of the tool in their respective position to get the required work from them.

8.1 STAGE 1

- First make the hole to each part for install the screw ○ After install the DC motor to the square block ○ Also insert one more DC motor into the frame ○ After the install that put the screw road on the motor head ○ Finaly check the assemble process

Fig. 8.1 Assembly

TRY OUT-1

Try out is the process where the manufactured tool is exposed to actual working condition on a specified machine, to know whether the manufactured tool is fit for production and is it infilled with required functioning aspects as specified.

- Check the motor
- Check the assemble
- Check the screw assemble

STAGE 2

In second part install the moving jaw process to insert the jaw in clock wise direction it will move upward back downward and check the variation of the jaw

- install the moving block
- Insert the moving jaw into the screw road
- And check the movement of the jaw

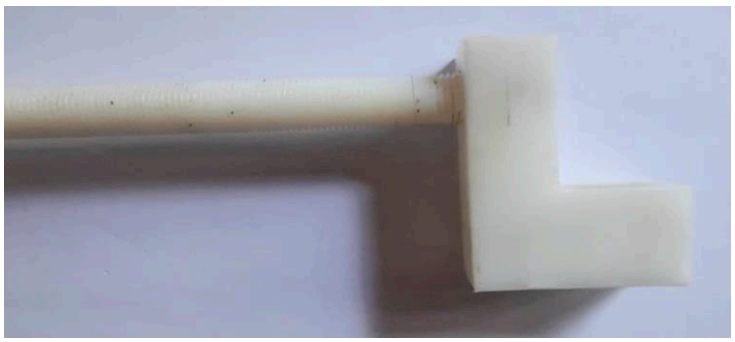


Fig. 8.2 Assembly

TRY OUT

To know whether the manufactured tool is fit for production and is it infilled with required functioning aspects as specified.

- Check the motion of the jaw
- Check the distance of motion of the jaw

STAGE 3

In the third assemble we need to install the DC motor and check the rotation of the threaded rod, also need to install the screw

- First make the hole on the center
- Install the DC motor head into the DIA16
- After the insert head on that and put the locking nut

Fig. 8.3 Assembly

TRY OUT

Try out is the process where the manufactured tool is exposed to actual working condition on a specified machine, in the third part need to check the DC motor by running the motor and check the threaded rod for any variation.

- Check the moto speed
- Check the threaded road
- Check the vibration
- Also check the wobbling

Fourth part

In the fourth part is nothing but a make the assemble of the square block assemble to the base plate after the install checking the assembly and the motion ○ First assemble the square block to the base plate ○ After check the mounting part ○ Then check the slot gap between the of block ○ After the attached the body to anther slot ○ Put the screw on both parts

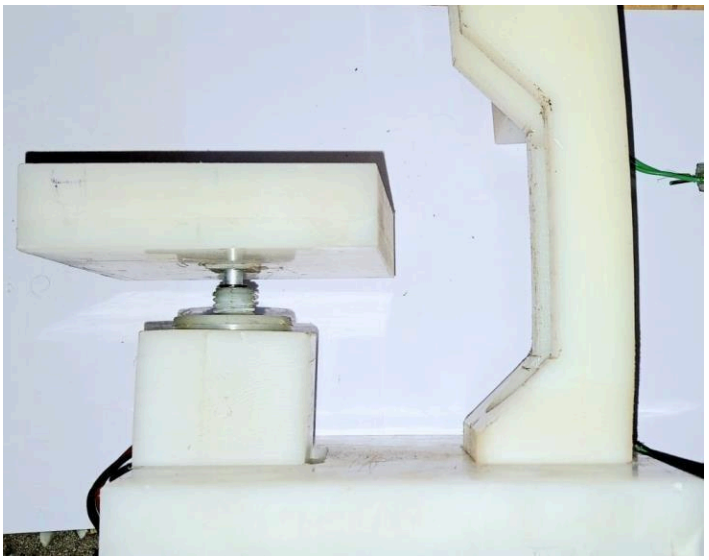


Fig. 8.2 Assemble

TRY OUT

Try out is the process where the manufactured tool is exposed to actual working condition on a specified machine, in this try out need to check the assemble.

○ Run the DC motor to check the variation ○ Check the supporting the guard ○ Check the screw assemble

Fifth part

In the last part need to assemble the controller on side to control the all mechanism and the components and try out the process

○ First install the Arduino and connect the positive and negative things ○ After the install the moto driver ○ Then install the push button ○ Lastly connect the DC motor ○ Install the program

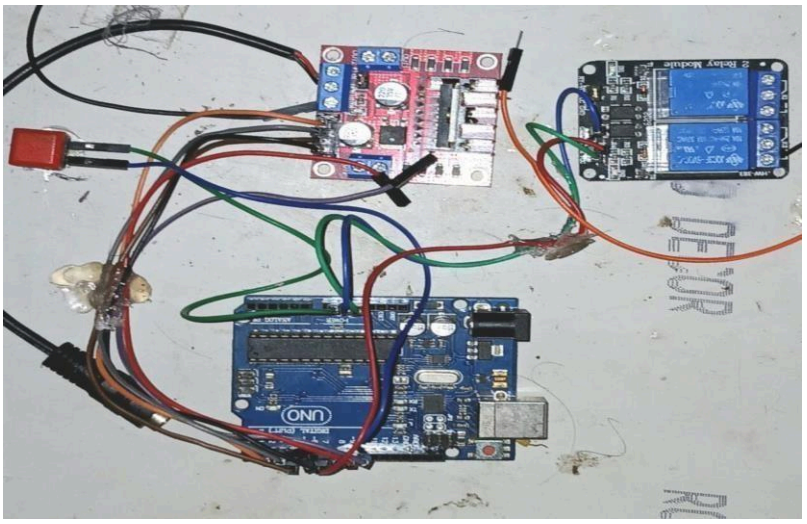


Fig.8.3 Assembly

TRY OUT

Try out is the process where the manufactured tool is exposed to actual working condition on a specified machine, in this try out need to check the assemble. In the final part check the connectivity and check the problem

○ Check the program ○ Check the motor rotation ○ After check the moving jaw

CHECK LIST BEFORE TRYOUT

- Ensure all the specified parts are positioned in the proper location.

- Ensure all the assembled parts are fastened properly.
- Ensure that the assembly of the tool is done as per design.
- Ensure location of the component is correct.
- Ensure that the air pressure is sufficient.
- Ensure that press pressure is set according to the specification.
- Ensure properly that rotary table is indexing properly.
- Ensure the machining sequence is in order.

Final assembles

In fixture manufacturing, final assembly refers to the stage where all individual components of a fixture are brought together to form the complete, functional unit. This process is crucial as it ensures that the fixture is ready for its intended use in manufacturing operations. Here are the key steps involved

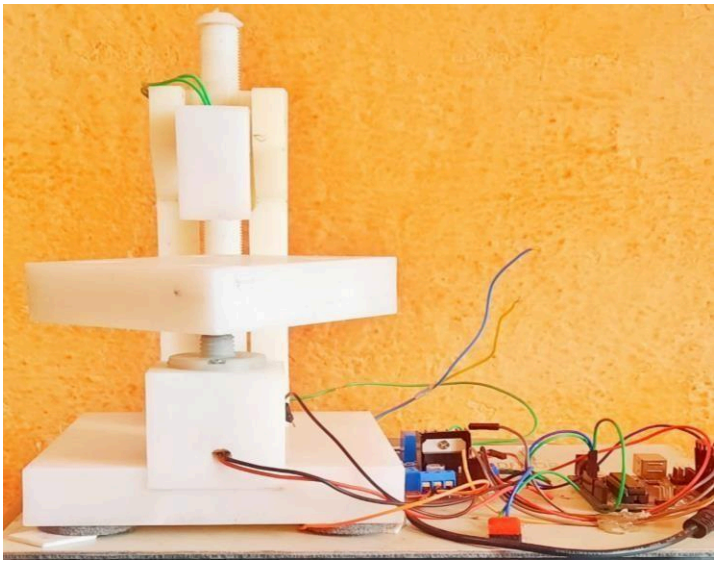


Fig. 8.3 Front view

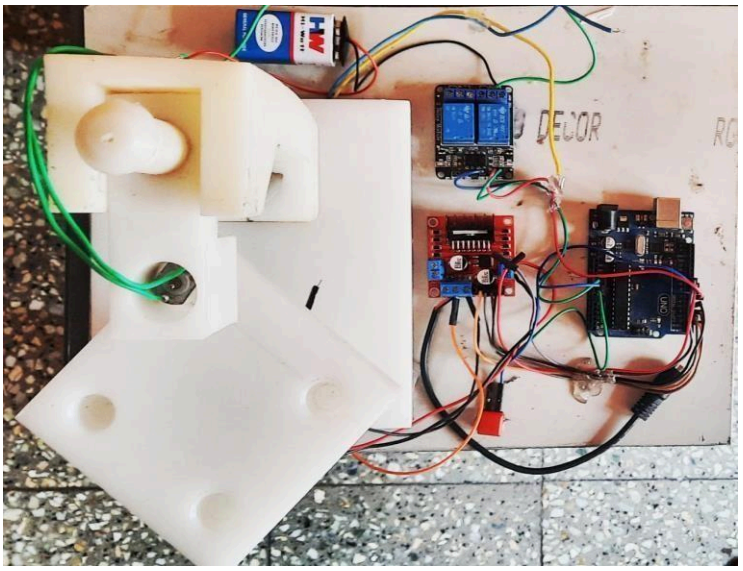


Fig. 8.4 Top view

8.2 Steps to Check Runout

1. **Prepare the Fixture**: ○ Ensure the fixture and the part to be measured are clean and free from debris.
    - Secure the part in the fixture properly to avoid any movement during measurement.
2. **Set Up the Dial Indicator**: ○ Mount a dial indicator on a stable base or a magnetic stand.
    - Position the dial indicator's probe against the surface to be measured, ensuring it is perpendicular to the surface.
3. **Measure Radial Runout**:
    - Rotate the part slowly by hand or using a motorized setup. ○ Observe the dial indicator reading as the part rotates.
    - Record the maximum and minimum readings to determine the total radial runout.
4. **Measure Axial Runout**:
    - Position the dial indicator's probe against the end face of the part. ○ Rotate the part and observe the dial indicator reading.
    - Record the maximum and minimum readings to determine the total axial runout.
5. **Analyse the Results**:
    - Compare the measured runout values with the specified tolerances.
    - If the runout exceeds the acceptable limits, adjustments may be needed in the fixture or the part.

Fig, 8.5 left side view

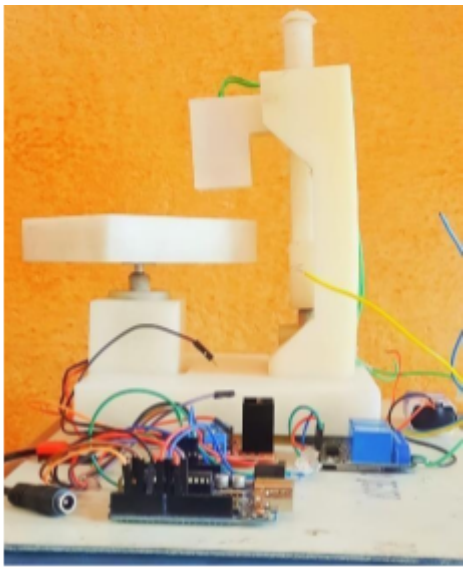


Fig. 8.6 Right side view

CHAPTER:9

ESTIMATION AND PROPOSED METHOD ESTIMATION

This also includes predetermination of the quantity & quality of material and labor required etc. this is essential in order to have a rough picture of the machining time, tool cost etc. it requires a complete knowledge of manufacturing method & operation.

- **Material Costs:** The type of materials used for the fixture will impact the cost. Common materials include steel, aluminum, and various alloys, each with different price points.
- **Manufacturing Costs:** This includes the cost of machining, welding, assembling, and finishing the fixture. Traditional methods may be more cost-effective if the fixture can be produced in-house.
- **Modification and Maintenance Costs:** If the fixture needs to be modified due to design changes or wear and tear, these costs can be significant. Sometimes, the cost of modifying a fixture can be as high as manufacturing a new one.
- **Overhead Costs:** These are indirect costs such as utilities, factory overhead, and administrative expenses that contribute to the total cost of manufacturing the fixture.

MATERIALS:

A) Direct Material. B) Indirect Material.

LABOUR:

A) Direct Labor. B) Indirect Labor.

EXPENSES:

A) Direct Expenses. B) Indirect Expenses.

MATERIAL WEIGHT: -

To calculate the weight of each part, the following formula has been used.

$$\text{WEIGHT} = \frac{\text{VOLUME} \times \text{DENSITY}}{106}$$

DENSITY OF THE TOOL MATERIALS:

MATERIAL DENSITY

- STEEL7.85 gm/cc.
- GRAY CAST IRON 7.5 gm/cc.

9.1 RAW MATERIAL COST FOR FIXTURE

Mainly need a different type of material to manufacture process also need a several components to build the fixture it will have a high cost compare to manufacture prototype.

9.2 ESTIMATED COST AS FOLLOWS:

TABLE	IN RUPEES
• Raw material charges.	₹3,228
• Machining charges.	₹7,380
• Standard items charges.	₹1,000
• Designing charges.	₹2,500
• Overhead charges.	₹3,300
• Risk factor.	₹1,950
• Inspection charges.	₹1,500
Total estimated cost	= ₹21,060/-
Pneumatic items	- 1,15,200/-

= ₹1, 36,260/-

Therefore, estimated cost is Rs. 1, 36,260/-

9.3 Proposed method:

TIME STUDY SHEET							
CYCLE TIME OF HELI-COIL INSTALATION							
H1	H2	H3	H4	H5	H6	TOTAL (SEC)	TOTAL (MIN)
22	20	19	14	18	17	110	1.83
14	15	16	15	14	12	86	1.43
16	14	15	13	17	18	93	1.55
20	21	19	17	13	12	102	1.7

19	23	22	14	14	11	103	1.72
17	18	21	18	16	14	104	1.73
18	15	20	19	12	11	95	1.58
11	13	23	20	13	13	93	1.55
AVERAGE		TIME				786	1.63625

Fig.9.1 TIME STUDY SHEET

In the Fig.9.1 showing the time calculation analysis of the proposed method of the installing the Heli-coil in the rotary table the plate can hold the 3 component it will install component in one rotation and also after the installation automatically the moveable jaw will go upward direction another component will placed near the installer it reduces time up to 5/6 minutes after the implementing this fixture

PROPOSED AVERAGE TIME = 1.63632MIN

CHAPTER 10
DEFECTS AND REMEDIES

DEFECTS AND REMEDIES

THREAD DAMAGE:

Since all the functioning aspects of the tool are cannot be achieved in a single setup (trail), some modifications are to be made in the tool to achieve the expected requirements.

➢ **Defect** – The threaded rod will be stacked by thread depth not achieve by the given dimension

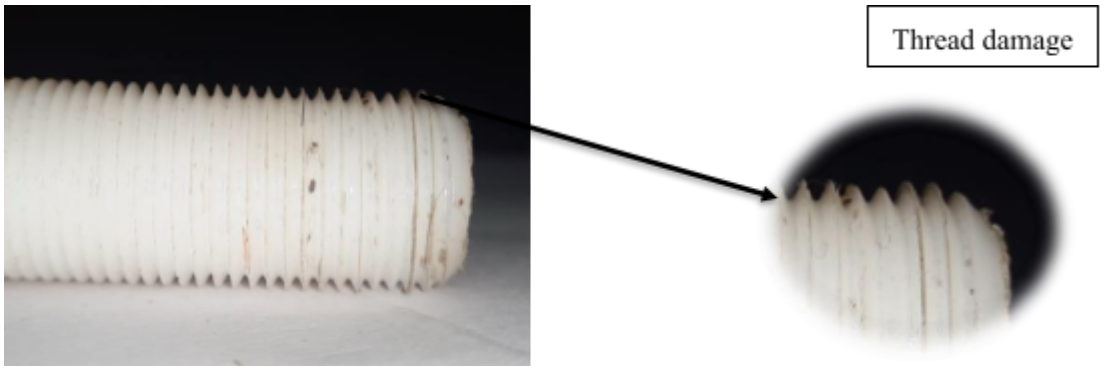


Fig. 10.1 Thread damage

Remedy – Should check the OD of the ROD. If is it within the specification of the drawing then should check the diameter of the component.

Dimension:

➢ **Defect** – The fixture may not be aligned properly to the base plate so it will be got dislocated and gap in between the block and base plate.

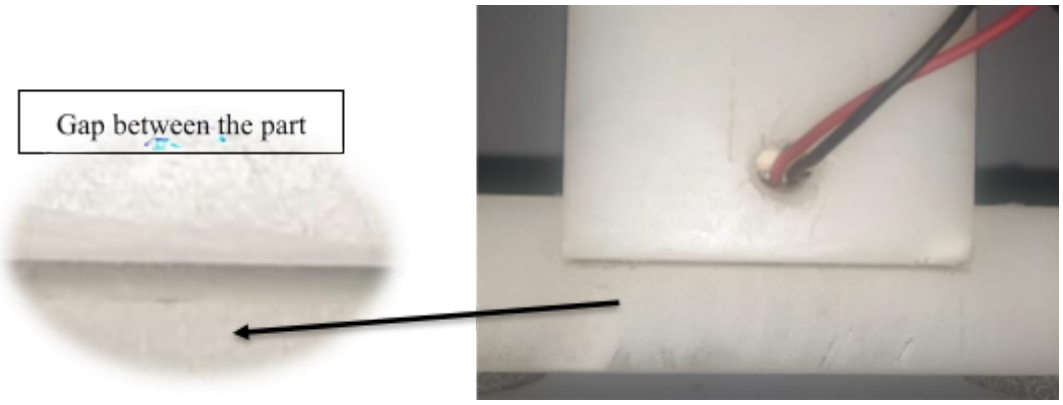


Fig. 10.2 Assemble

Remedy – Remove the whole unit and realigned and check weather if peening is proper.

PROFILE BEND:

➢ **Defect** – The moving jaw is not moving properly by the bend of the body

will machining

Profile bend

Fig. 10.2 Profile bend

➢ **Remedy** – just remove the road and replaced the rod with new threading by achieved dimension

Plate rotation anticlockwise:

➢ **Defect** – In the main defect comes from fixture is coding. The code will get error will running the part because of the rotary table does not allocate in the near the installer

```
            void rotatePlate() {
              digitalWrite(rotatingMotorPin1, HIGH);
      digitalWrite(rotatingMotorPin2, LOW);
      analogWrite(rotatingMotorSpeed, 255); // Full speed delay(1000);
      // Adjust delay for rotation analogWrite(rotatingMotorSpeed, 0);
      // Stop motor
            }
```

➢ **Remedy** – By changing the code giving the right command the tool wail comes near the installer to install the HELICOIL

CHAPTER-11

RESULTS AND CONCLUSION

RESULTS

From the above result it can be concluded that the process can be improved based on method study, work procedure and proper utilization of machine and material. It will improve the current process by reducing the cycle time of the Heli-coil installation process by inventing the fixture. Is the line chat given below showing the no of operator installing by manually and after the fixture design it reduce the time of the up to 40% of time.

PRESENT AVERAGE TIME = 7.305MIN

PROPOSE AVERAGE TIME = 1.63MIN

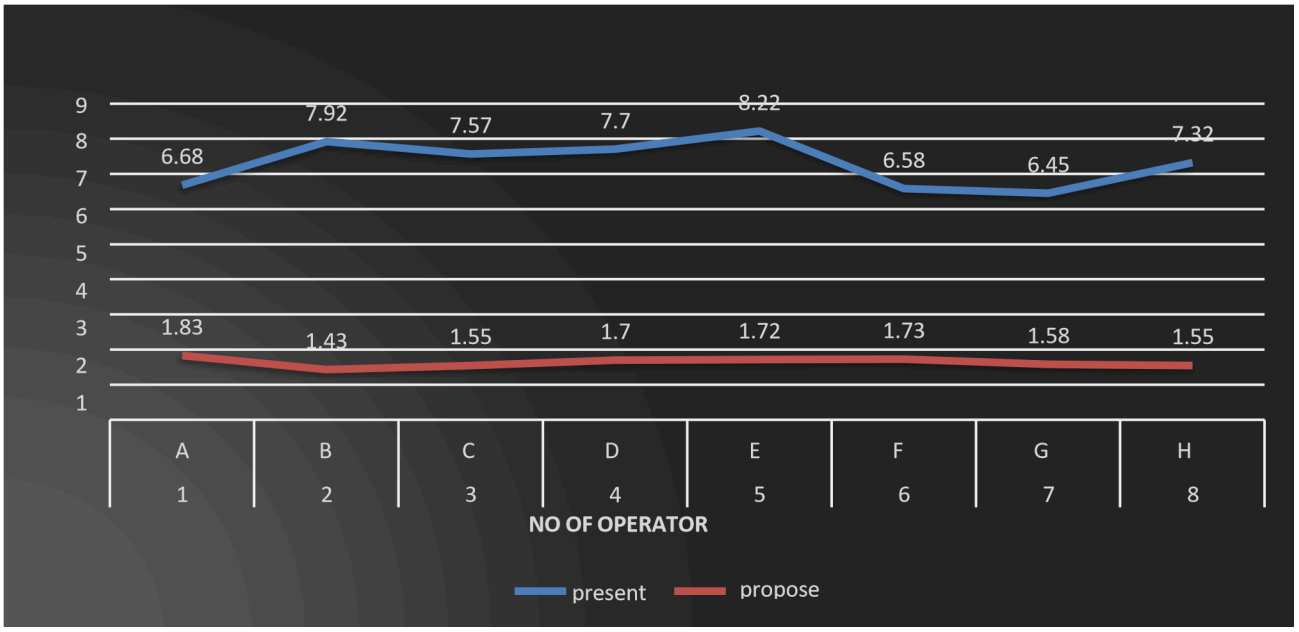


Fig.11.1 Flow chat

CONCLUSION

From the above result it can be concluded that the process can be improved based on method study, work procedure and proper utilization of machine and material. We can improve the current process

by reducing the wasting time on installing the HELICOIL, and reducing the worker fatigue by 22% and also reduce 8.93 minutes. In the manufacturing of Assembly fixture, we have gained practical experience regarding Fixture manufacturing after completion of this project, our conclusion is that the training imparted for us was one of the best as it is the place where we can develop our career Finally, I would like to thank all others who are directly or indirectly involved in completion of the project, I have gained practical experience regarding Fixture manufacturing. The immense training programmers and lot of practical work during various semesters helped me to do the Fixture easily. After completion of this project, my conclusion is that the training imparted to me was one of the best because it is the place where I developed my career. Finally, I would like to thank all others who are directly or indirectly involved in completion of the project

- **Accuracy and Consistency**:
  - Rotary table ensure precise positioning of workpieces during machining.
  - This accuracy leads to consistent results across multiple parts.
- **Reduced Setup Time**: ○ Using jigs and fixtures streamlines the setup process.
  - Operators can quickly load workpieces, saving valuable production time.
- **Improved product Safety**:
  - Properly designed fixtures enhance safety by preventing workpiece movement.
  - Operators can focus on quality without compromising their well-being.
- **Cost Efficiency**:
  - fixtures optimize tool usage and Heli-coil and reduce scrap.
  - They contribute to cost savings by minimizing errors and rework.
- **Increased Productivity**:
  - Batch processing and simultaneous machining are possible with jigs and fixtures.
  - This boosts overall productivity in manufacturing.

REFERENCES

1. Aaron EA, Seow KC, Johnson BD, Dempsey JA (1992) Oxygen cost of exercise hyperpnea:

implications for performance. J Appl Physiol 72:1818–1825

2. Anton-Kuchly B, Roger P, Varene P (1984) Determinants of increased energy cost of submaximal exercise in obese subjects. J Appl Physiol 56:18–23

3. Bell HJ, Ramsaroop DM, Duffin J (2003) The respiratory effects of two modes of passive exercise. Eur J Appl Physiol 88:544–552. doi:10.1007/s00421-002-0771-5

4. Atkinson, S. E., and C. E. Halabi (2005), "Economic Efficiency and Productivity Growth in the Post-Privatization Chilean Hydroelectric Industry," Journal of Productivity Analysis 23:2 (March), 245-73.

5. Berger, A. N., and T. H. Hannan (1998), "The Efficiency Cost of Market Power in the Banking Industry: A Test of the 'Quiet Life' and Related Hypotheses," Review of Economics and Statistics 80:3 (August), 454-65.

6. Jain KC, Aggarwal LN (2014) Production planning, control and industrial management. (6thedn) Aggarwal, India, p: 1596.

7. Biswas S, Chakraborty A, Bhowmik N(2016) Improving Productivity Using Work Study Technique. International Journal of Research in Engineering and Applied Sciences. 6: 49-55

8. Singh MD, Saurabh KS, Sachin BP, Rahul BP, Ankit PP (1992) To Improve Productivity by Using Work Study & Design A Fixture In Small Scale Industry. International Journal on Theoretical and Applied Research in Mechanical Engineering 1: 75-81.

9. Macleod MR, Michie S, Roberts I, Dirnagl U, Chalmers I, Ioannidis JPA, et al. Biomedical research: increasing value, reducing waste [Editorial]. Lancet. 2014;383(9912):101–4.

10. Ioannidis JPA, Greenland S, Hlatky MA, Khoury MJ, Macleod MR, Moher D, et al. Increasing value and reducing waste in research design, conduct, and analysis. Lancet. 2014;383(9912):166–75

11. Salman RA-S, Beller E, Kagan J, Hemminki E, Phillips RS, Savulescu J, et al. Increasing value and reducing waste in biomedical research regulation and management. Lancet. 2014;383(9912):176–85.

12. Chan A-W, Song F, Vickers A, Jefferson T, Dickersin K, Gøtzsche PC, et al. Increasing value and reducing waste: addressing inaccessible research. Lancet. 2014;383(9913):257–66.

13. Glasziou P, Altman DG, Bossuyt P, Boutron I, Clarke M, Julious S, et al. Reducing waste from incomplete or unusable reports of biomedical research. Lancet. 2014;383(9913):267–76.

14. Ioannidis JPA, Fanelli D, Dunne DD, Goodman SN. Meta-research: evaluation and improvement of research methods and practices. PLoS Biol. 2015;13(10):e1002264.

15. Macfarlane F, Gantley M, Murray E. The CeMENT project: a case study in change management. Med Teach. 2002;24(3):320–6

16. McKinley RK, Fraser RC, Baker RH, Riley RD. The relationship between measures of patient satisfaction and enablement and professional assessments of consultation competence. Med Teach. 2004;26(3):223–8.

17. DeToro, I., & McCabe, T. (1997). How to stay flexible and elude fads. Quality Progress, 30(3), 55-60. Fisher, E. (2011). What practitioners consider to be the skills and behaviours of an effective people project manager. International Journal of Project Management, 29(8), 994-1002.

18. Project Management Institute. (2008b). Organizational project management maturity model (OPM3) (2nd ed.). Pennsylvania, US Rose, K. H. (2005). Project quality management: Why, what and how. Boca Raton, FL, USA: J. Ross Publishing, Incorporated.

19. Sarshar, M., Haigh, R., & Amaratunga, D. (2004). Improving project processes: Best practice case study. Construction Innovation: Information Process Management, 4(2), 69-82.

20. ISO. (2005). Quality management systems - fundamentals and vocabulary (ISO 9000:2005). (p. 7) International Organization for Standardization.