IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

Design & Manufacturing Of Fixture For Bearing Casing Cap

Mr.Vinayak Yadav[1], Mr.Aniruddha Mahadik[2] ,Mr.Atharv Keluskar[3], Mr.Amar Matekar[4], Mr.Akshay Nalawade[5], Mr. Sagar Nalawade[6]

Mechanical Engineering, DACOE. [1-6]

Abstract: The jigs and fixtures are the economical ways to produce a component in mass. So jigs and fixtures one of the most important facility of mass production system. These are special work holding and tool guiding device. Quality of the performance of a process largely influenced by the quality of jigs and fixtures used for this purpose. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a jig &fixture is to locate and in the cases hold a work piece during an operation. In this have designed and manufactured jig & fixture for bearing cap .Intially we studied problem faced in earlier jig & fixture .after that we done modelling of new jig & fixture.after modelling manufacturing of new jig & fixture done to optimize time.

Keywords: Jig,Fixture,Design,Manufacturing etc.

I. INTRODUCTION

Engineering is first and foremost the application of knowledge. However, the application must be carried out with judgment, to ensure that the resultant system is effective and efficient, and that it is of benefit. The fixture is a special tool for holding a work piece in proper position during manufacturing operation. For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process are eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a work piece, whereas clamps exert clamping forces so that the work piece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts. Jigs and fixtures are used and serve as one of the most important facility of mass production system. These are special work holding and tool guiding device. Quality of the performance of a process largely influenced by the quality of jigs and fixtures used for this purpose. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in the cases hold a work piece during an operation. A jig differs from a fixture in the sense that it guides the tool to its correct position or towards its correct movement during an operation in addition to locating and supporting the work piece.

II. LITRATURE REVIEW

Y. Zheng et.al. [1] in their paper, a finite element analysis for stiffness of fixture units, proposed a systematic finite element model to predict the fixture unit stiffness by introducing nonlinear contact elements on the contact surface between fixture components.

J. Cecil [2] proposed an innovative clamping design approach is described in the context of fixture design activities. The clamping design approach involves identification of clamping surfaces and clamp points on a given work piece. This approach can be applied in conjunction with a locator design approach to hold and support the work piece during machining and to position the work piece correctly with respect to the cutting tool. Detailed steps are given for automated clamp design. Geometric reasoning techniques are used to determine feasible clamp faces and positions. The required inputs include CAD model specifications, features identified on the finished work piece, locator points and Elements.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

Michael Stampers [3] presented a paper which deals with the problem of setup and fixture planning for the machining of box-shaped parts on the horizontal machining centers. The central topic of this research is the automation of the conceptual design of fixtures. This topic is deal with the setup planning.

Shrikant [4] discussed various design and analysis methods in the context of to improve the life of fixture; different fixture geometries are compared experimentally and are selected. The proposed eccentric shaft fixture will fulfilled researcher Production target and enhanced the efficiency, fixture reduces operation time and increases productivity, high quality of operation.

Weifang Chen [5] developed a multi-objective model was established to increase the distributing uniformity of deformation and to reduce the degree of deformation. The deformation is analyzed by optimizing the finite element method. To solve the optimizations model a genetic algorithm was developed. A satisfactory result was obtained by illustrating an example, which is superior to the experiential one.

Chen Luo et.al. [6] in his paper Two-Sided Quadratic Model for Work piece Fix Turing Analysis, 2011proposed that presents a novel model for work piece positioning analysis. Existing fix Turing models may underestimate the positioning error due to neglect of the curvature of one or both contacting bodies.

S. Kashyap et.al.[7] in their paper Finite element analysis and optimization in fixture, proposed with minimizing deformation of the work piece due to machining loads about fix Turing support positions, especially in thin castings.

M. Y. Dakhole et.al.[8] , in their paper, Design And Analysis Of Dedicated Fixture With Chain Conveyor, gives a feasible solution on conventional roller chain conveyorised arrangement with dedicated moving fixture with conveyor for the tractor components like rear axle career, bull gear and shaft of a tractor model.

III. SYSTEM DEVELOPMENT

3.1 Introduction

Fixtures are used for large number of operations. Different of principles applied fixtures are described below.

A) Locating Points

Good facilities should be provided for locating the work. The article to be machined must be easily inserted and quickly taken out from the jig so that no time is wasted in placing the work piece in position to perform operations. The position of work piece should be accurate with respect to tool guiding in the jig or setting elements in fixture.

B) Fool Proof

The design of jigs and fixtures should be such that it would not permit the work piece or the tool to insert in any position other than the correct one.

C) Reduction of Idle Time

Design of Jigs and Fixtures should be such that the process, loading, clamping and unloading time of the work piece takes minimum as far as possible.

D) Weight of Jigs and Fixtures

It should be easy to handle, smaller in size and low cost in regard to amount of material used without sacrificing rigidity and stiffness.

E) Jigs Provided With Feet

Jigs sometimes are provided with feet so that it can be placed on the table of the machine.

F) Materials for Jigs and Fixtures

Usually made of hardened materials to avoid frequent damage and to resist wear. Example-MS, Cast iron, Die steel, HSS.

G) Clamping Device

It should be as simple as possible without sacrificing effectiveness. The strength of clamp should be such that not only to hold the work piece firmly in place but also to take the strain of the cutting tool without springing when designing the jigs and fixtures.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

3.2 Component Details

This research work is for manufacture fixture of bearing cap. This Bearing cap is used in Automobile Industry for holding the bearing & shaft. The introduction is based upon the current production system & working in industry.

At the start of process of fixture designing, raw material is first of all taken and then it is inspected with demands of desired product with respect to design of product . This design is acquired from design department of industry.

The design of fixture has very close dimensional tolerances and clearances, to get a very significant final output to reduce the further machining costs.After the inspection, the raw material is machined with the CNC (computerized numerical control) machine by giving a proper program from design department.

After inspection of the cnc machined job, the job is mounted upon the component. The holes are drilled as per drawing. After this entire if there is any need of any other machining like grinding, boring, finishing etc. are performed inside the machine shop.

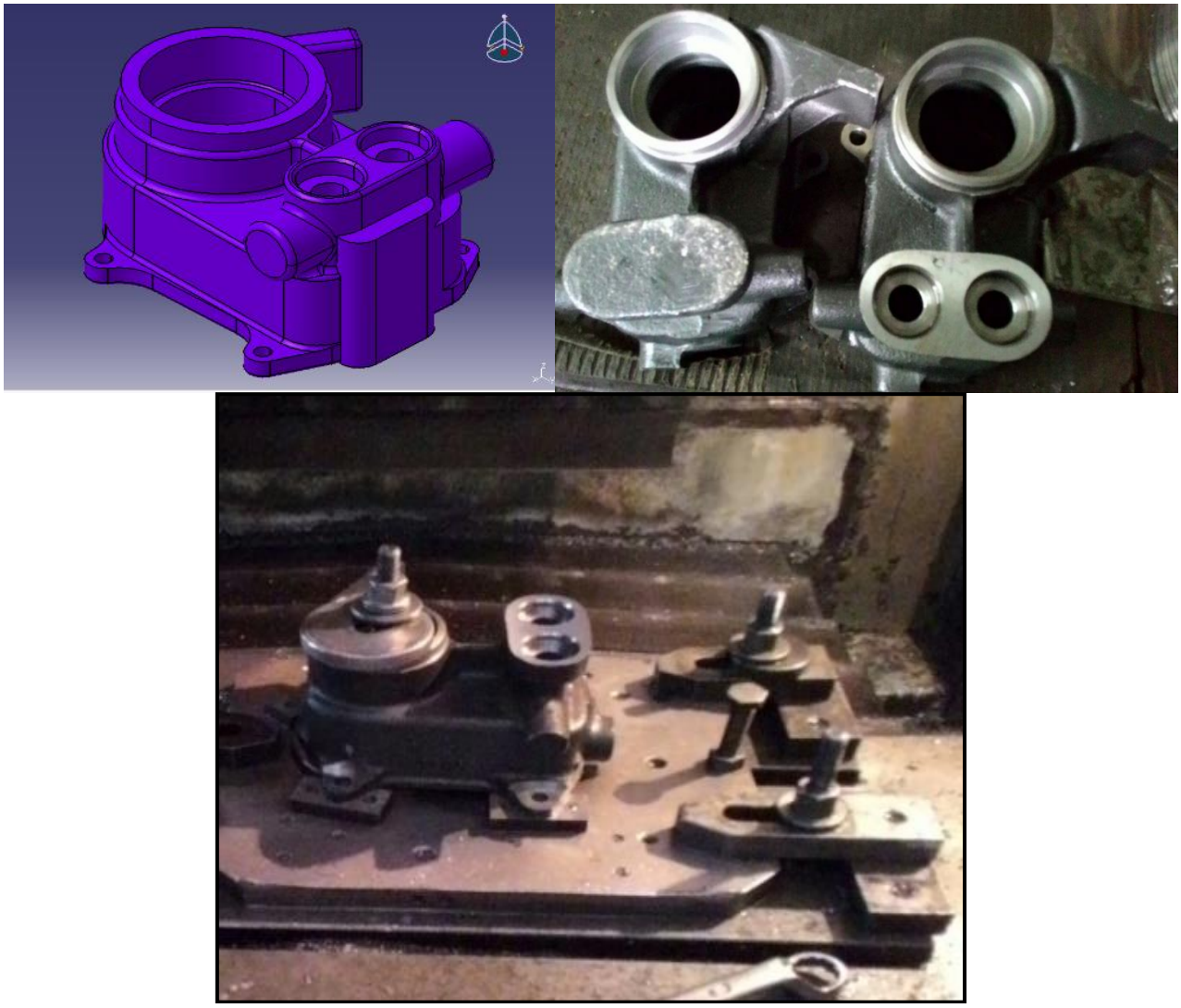


Fig 3.1Actual bearing cap component & existing fixture

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

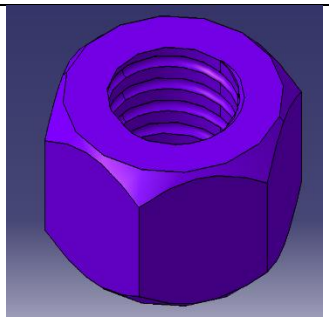
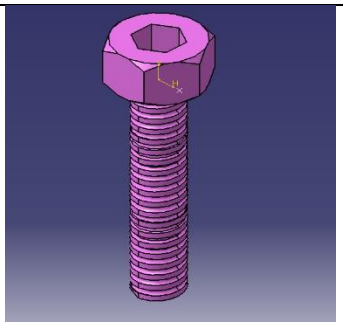
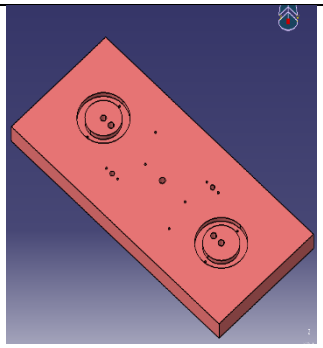
International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

IV. DESIGN & MANUFACTURING OF FIXTURE

Operation	Dimensions	Cutting tool	Tolerance (mm)
Facing	98 mm	T' max face cutter	± 0.1
Drilling	Φ 10.2 mm Φ15.5 mm Φ28.0 mm	10.2 drill 15.5 drill 28.0 cutter	
Reaming	ϕ15.85 mm ϕ28.5 mm	15.85 reamer 28.5 reamer	± 0.1 ± 0.08
Chamfering	1.5mm*30°	Chamfer cutter 30°	-

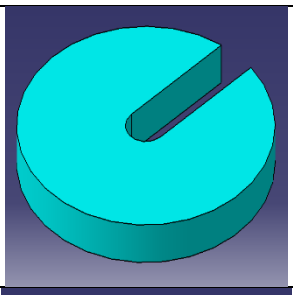
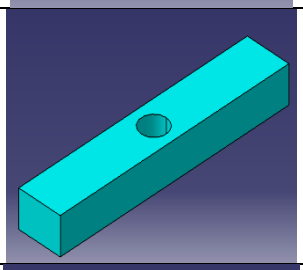
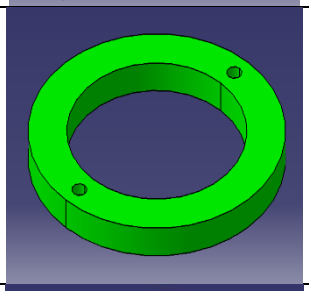
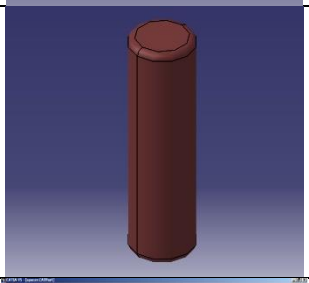
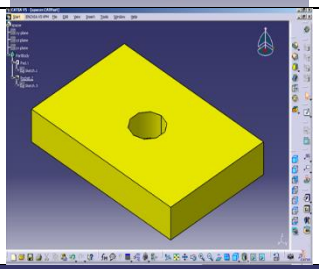
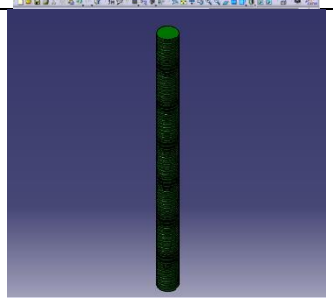
Sr. No.	Component	Details	Image
1	Nut	Height of nut = T =D =10 mm Width across flats, W = 1.5D + 3 mm =18 mm Angle of chamfer = 30° Radius of chamfer = R = 1.4D =14mm	
2	Bolt	Length of bolt = 5D =50mm Width across flats, W = 1.5D + 3 mm =18 mm Angle of chamfer = 30° Radius of chamfer = R = 1.4D =14mm	
3	Base plate	Material : - En8 Size : - 550 X 250 X 25 mm Operations : - Roughing, Facing, Grinding & Drilling Machines : - Lathe m/c, Grinding m/c & VMC	

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

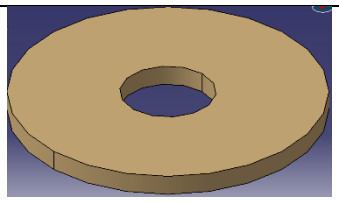
4	C Clamp	Material : - En8 Size : - Ø75 X 10 mm Operations : - Roughing, Facing, Grinding & Slotting Machines : - Lathe m/c, Grinding m/c & VMC	
5	Clamp	Material : - En8 Size : - 110 X 20 X15 mm Operations : - Roughing, Facing, & Drilling Machines : - Lathe m/c, & Drilling m/c	
6	Locater	Material : - En8 Size : - Ø70 X Ø100 X 10 mm Operations : - Roughing, Facing, Grinding, Drilling & Milling Machines : - Lathe m/c, Grinding m/c & VMC	
7	Pin	Material : - En8 Size : - Ø9.5 X 30 mm Operations : - Roughing, Facing, Grinding Machines : - Lathe m/c & Grinding m/c	
8	Spacer	Material : - En8 Size : - 30 X 20 X 5 mm Operations : - Roughing, Facing, Grinding & Drilling Machines : - Lathe m/c, Grinding m/c & VMC	
9	Stud	Material : - En8 Size : - M12 X 150 mm Operations : - Standard Part Machines : - Lathe m/c & Threading m/c	

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

10	washer	Material : - En8 Size : - Ø 40 X Ø 12 X 3 mm Operations : - Roughing, Facing, Grinding & Drilling Machines : - Lathe m/c, Grinding m/c & Drilling m/c	

4.2 Assembly Modeling

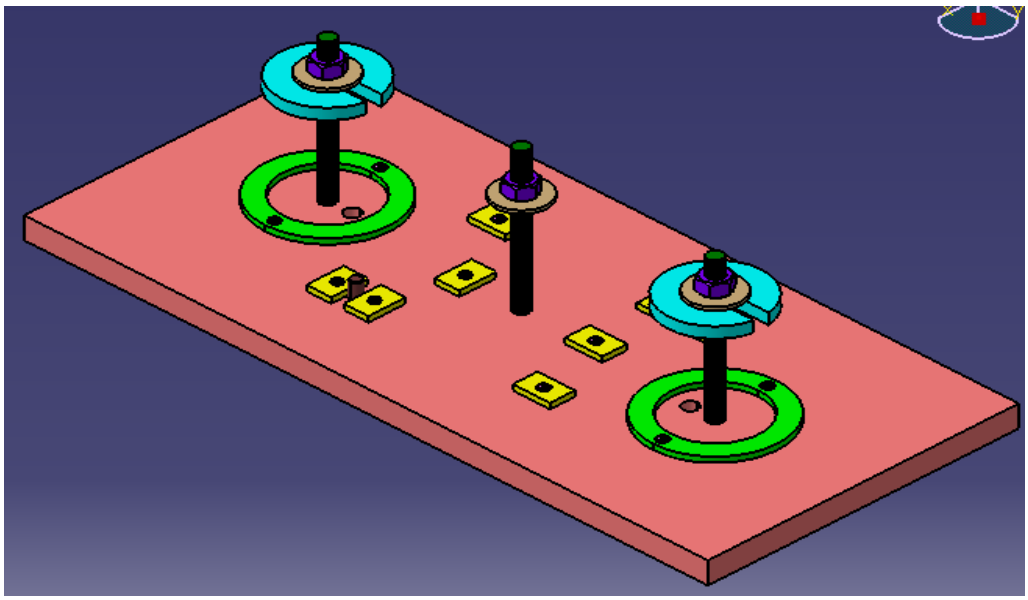


Fig 4.13 assembly modelling

V. PERFORMANCE ANALYSIS

5.1 Component Machining (Old Fixture)

The old fixture provided by the manufacturer of machine is not having the arrangement for machining frames of different diameters on the same fixture. It is having spigot plate with only one spigot. Thus, we need to change the spigot plate and all other components on the spigot plate for every new frame. Assembling and disassembling of fixtures becomes a time consuming process, thus there is a loss of productivity.

The old fixture is not having the arrangement for avoiding misalignment while mounting the frame on fixture. Operator has to do the trial and error method for proper alignment. This is also a time consuming process and possibility of misalignment is more.

5.2 During Time Study

1. Personal allowance-

It is intended to compensate the operator for the time necessary to leave, the workplace to attend to personal needs like drinking water, washing hands, lunch.

Here, Personal allowance is **45 min**.

2. Contingency allowance-

Contingency allowances are-

- Tool breakage involving removal of tool from holder and all other activities to insert new tool into the tool holder.
- Power failures of small duration.
- Obtaining the necessary tools and gauges from central tool store.
- Contingency allowance should not exceed 5%.

Here, Contingency allowance is **3%.**

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

5.3 Cycle Time Calculations

T = D X 60 / F

Where,

T = Cycle Time in Second
D = Tool Travel in mm
F = Tool Feed in mm / min

- Operation No.-1 (N1- Facing Program)
  T 1 = 300 X 60 / 100
  T 1 = 180 Sec
- Operation No.-2 (N2- Peck Drilling Programme)
  T 2 = 60 X 2 X 60 / 120
  T 2 = 60 Sec
- Operation No.-3 (N3- Drilling Programme)
  T 3 = 9 X 2 X 60 / 40
  T 3 = 27 Sec
- Operation No.-4 (N4- Chamfering Programme)
  T 4 = 5 X 2 X 60 / 50
  T 4 = 12 Sec
- Operation No.-5 (N5- Combination Reaming Programme)
  T 5 = 60 X 2 X 60 / 50
  T 5 = 144 Sec

Total Cycle Time = T1+T2+T3+T4+T5 +Tool change Time clamp/unclamp Time
Total Cycle Time = 180+60+27+12+144+ 40+120
Total Cycle Time = 583 Sec
Total Time in shift = 8X3600 =28800 sec
Allowance Time= 1 Hr =3600 Sec
Total Time in shift = 28800 -3600 =25200 sec
Total Jobs in shift = 25200 / 583
Total Jobs in shift = 44
Total Jobs in Day = 3 X Jobs in Shift
Total Jobs in Day = 3 X 44
Total Jobs in Day = 132 Nos.
Total Jobs in Month = 132 Nos. * 22 Days =2904

5.4 Component Machining (New Fixture)

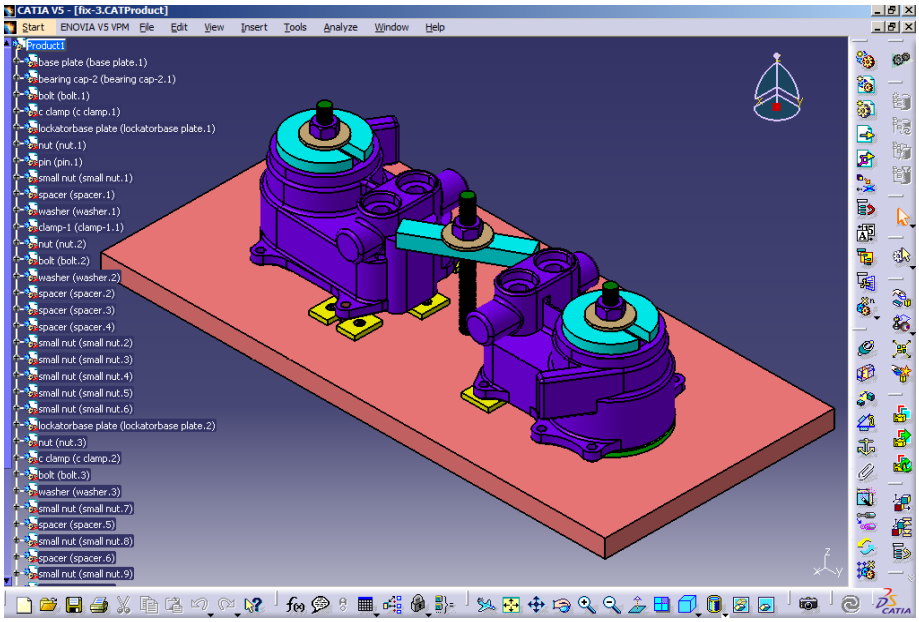


Fig 5.1- component machining

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

5.5 Cycle Time Calculations

we used new fixture for manufacturing.opration performed on fixture are given in detail below.The production rate is increased 9.09% monthly due to new fixture.

T = D X 60 / F

Where,

T = Cycle Time in Second
D = Tool Travel in mm
F = Tool Feed in mm / min

- Operation No.-1 (N1- Facing Program)
  T 1 = 600 X 60 / 100
  T 1 = 360 Sec
- Operation No.-2 (N2- Peck Drilling Programme)
  T 2 = 120 X 2 X 60 / 120
  T 2 = 120 Sec
- Operation No.-3 (N3- Drilling Programme)
  T 3 = 18 X 2 X 60 / 40
  T 3 = 54 Sec
- Operation No.-4 (N4- Chamfering Programme)
  T 4 = 10 X 2 X 60 / 50
  T 4 = 24 Sec
- Operation No.-5 (N5- Combination Reaming Programme)
  T 5 = 120 X 2 X 60 / 50
  T 5 = 288 Sec

Total Cycle Time (2comp.) = T1+T2+T3+T4+T5 +Tool change Time + clamp/unclamp Time
Total Cycle Time (2comp.) = 360+120+54+24+288+ 40+180
Total Cycle Time (2comp.) = 1066 Sec
Total Cycle Time (1comp.) = 533 Sec
Total Time in shift = 8X3600 =28800 sec
Allowance Time= 1 Hr =3600 Sec
Total Time in shift = 28800 -3600 =25200 sec
Total Jobs in shift = 25200 / 533
Total Jobs in shift = 48
Total Jobs in Day = 3 X Jobs in Shift
Total Jobs in Day = 3 X 48
Total Jobs in Day = 144 Nos.
Total Jobs in Month= 144*22 Days=3168
Total increase in Production Jobs in Month = 3168-2904
Total increase in Production Jobs in Month = 264

Total Percentage increase in Production Jobs in Month = 9.09%

Fig.5.2- New Fixture

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.11450

Table 5.1-Performeance Parameters

Sr No.	Parameter	Old Fixture	New Fixture	Improvement
1	Total Cycle Time (sec)	583	533	9.38%
2	Total Jobs in Day (No.s)	44	48	9.09%
3	Production Jobs in Month (Qty)	132	144	9.09%

VI. CONCLUSION

In this experimentation we designed fixture for bearing cap. For this study initially we studied operation performed on the component & machine used for machining. The fixture was designed on catia software & manufacturing was done in workshop as per design. The designed fixture will reduce the time required for different operations performed on component. Fixture gives good result as well as easy handling.

The project made by us fulfils the requirements of industry & results are as follows:

- By using New fixture cycle time reduced from 583 sec to 533 sec which gives 9.38% reduction in cycle time.
- By using New fixture job production increases 44 jobs to 48 jobs per day which gives 9.09 % increase in job production rate per day.
- By using New fixture job production increases 132 jobs to 144 jobs per month which gives 9.09 % increase in job production rate per month.

Sr No.	Parameter	Old Fixture	New Fixture	Improvement
1	Total Cycle Time	583	533	9.38
2	Total Jobs in Day	132	144	9.09
3	Production Jobs in Month	132	144	9.09

REFERENCES

[1]. Zhang Min Wan Guohua Qin, Weihong, “Analysis and Optimal Design of Fixture Clamping Sequence ASME for publication in the journal of manufacturing science and engineering, 2006.
[2]. J. Cecil “A Clamping Design Approach for Automated Fixture Design” Int J Adv Manuf Technol 18:784–789,2008
[3]. Michael Stampfer “Automated setup and fixture planning system for box-shaped Parts” International Journal of Advance Manufacturing Technology 45:540–552 DOI 10.1007/s00170-009-1983-1, 2008
[4]. Shrikant. V. Peshatwar, L.P Raut “Design and development of Fixture for eccentric shaft: A Review” International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 3, Issue 1, February 2013
[5]. Weifang Chen ,Lijun Ni & Jianbin Xue “Deformation control through fixture layout design and clamping force optimization” Int J Adv Manuf Technol 38:860–867 DOI 10.1007/s00170-007-1153-2,2008
[6]. Djordje Vukelic, Uros Zuperl & Janko Hodolic “Complex system for fixture selection, modification, and design” Int J Adv Manuf Technol 45:731–748 DOI 10.1007/s00170-009-2014-y, 2009
[7]. Robert A. Malloy (1994), Plastic Part Design for Injection Moulding: an Introduction, Hanser Gardner Publications, Inc, Cincinati. ISBN : 1-56990-129-5
[8]. Kumara b., m. mohan ram “design and fabrication of lathe fixture for brake drum machining” International Journal of Advance Manufacturing Technology, volume 4, issue 7, July 2014.

