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# DESIGN AND FABRICATION OF TURNING FIXTURE FOR CNC LATHE MACHINE

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## ABSTRACT

*Manufacturing industries have brought lot of revolution in manufacturing technology, as a consequence of which several development like CNC lathe, CNC machine centre, flexible manufacturing system, fabrication centre, transfer machines, robotics etc. took place. Even with these advancements in the manufacturing industries, there is a continued use of jigs and fixture in some form or the other either independently or in combination with other systems.*

*This paper proposed integrated approach of design for manufacturing. The paper contains 3D assembled view of fixture using Pro/Engineer Wildfire 4.0. Fixture mass balanced using Pro/Mechanism. Different component are safely design by calculations and components are not only design but also manufactured.*

***Keywords****: Turning fixture, CNC (computerized numerical control), dynamic balancing etc.*

## I. INTRODUCTION

The machine tool industry has undergone sufficient changes as the required of user engineering systems changed; first it started with the manufacture of basic general purpose machine tools. These machines though offered higher flexibility were not suitable for mass production owing to longer set up times and the tedious adjustment of machine and tools besides requiring highly skilled operators.

With growing need of fast production to meet the requirement of industry, mass production machine are conceived. Hydraulic, tracer control machine tool, special purpose automatic and semi-automatic machines were introduced with the advancement of technology. These machines were highly specialised but inflexible. The use of these machines was with a success for mass production and they have considerably reduced the production costs by way of reduced machining times and labour costs. Because of inflexibility these machine tools could not however be adopted by unit involved in small lot and piece production.

Mass production aims at high productivity to reduce unit cost and interchange ability facilitate easy assembly. This necessitates production devices to increase rate of manufacture and inspection device to speed up

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inspection procedure. Fixture orients and stabilizes a work piece during machining processes such as turning, drilling and milling. A typical fixture contains a base plate, locators, and clamps. The goal of fixture is to provide the constraint work piece with quasi equilibrium environment throughout an entire machining operation which includes setup and material removal. In piping industry regulators, connectors, reducers in piping network some of our axis symmetrical and they made of aluminium and steel. The industry is heavily dependent on machining processes to make this product. These products have very tight tolerances and unique features which impose great challenges upon the fixture - work piece environment.

### 1.1 Problem Statement

Holding cylindrical part to be drilled is one of the major problems faced by the manufacturing company, especially small medium company. Sometimes they need expensive equipment to hold the parts to be drilled. Today, customers request in industries is increasing so the company must find new method to improve productivity. Fixture is important part using in any industry. Before this, fixtures always have limited function like just one part can be support for one process. This makes production slow and can't fulfil customer demand. Nowadays there are several methods available to improve design to increase productivity. Fixture are simply locating and clamping of work piece. Tool guiding elements to ensure correct positioning of tools with respect to work piece. Fixture with easy to setting and can hold more than one items should be design to reduce cost and time for productivity. Above problem is faced by VANAZ ENGINEERS LTD, Devrukh, regarding fixture of regulator body in tapping and drilling operation that it taking much more time for loading locating and unloading.

### 1.2 Objectives

The objectives of this project are to:

1) Design a fixture that hold small cylindrical parts to be used by small medium company
2) Evaluate the design in terms of force applied to fixture
3) Fabricate the evaluated design

## II. LITERATURE REVIEW

Erik studied general considerations of fixture design like loading and unloading of parts, locating parts of fixture for ready access to tools ,Clamping the part, supporting the part, positioning cutting tool relative To loaded fixture, coolant supply and return and chips. Nirav et al explained dynamic balancing can be done by dividing the model or design of fixture into two parts that is two quadrants one and two. After determining the centre of gravity of each quadrant, the moment of inertia and resultant R is determined. With the help of these of parameters we can balance the model dynamically by adding specific mass at specific distance into consideration their properties and machining conditions, Study of manufacturing consideration in design. Riken

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seiki operation manual for power chuck History of chuck: voe type oil hydraulic power chucks have been developed designed and manufactured by combining oil hydraulic technology of super high pressures and production technology of precision collet chucks which our company is proud of. A collet chuck system has been adopted for chucking of work and the chuck body has a hollow-hole construction, resulting in being able to work long objects. Furthermore, mounting to the machine to be operated is very easy. Setting and removing operations of work are carried out by opening or closing of valves and high speed and high precision cutting is assured. Therefore, a beginner can operate it easily and safely.

## III.. DESIGN DETAILS

### 3.1 Material selection:

It is important step to select proper material for each component for its proper working and safety.

**Frame-**It should be light in weight, high strength, Corrosion resistant, Wear resistant. Above properties are satisfied by aluminium alloy 6061 tempered at $707^0$c [ASM handbooks]

**Base plate-**It should have high strength, Corrosion resistant**,** Wear resistant

Above properties are satisfied by alloy steel EN 24 normalised [ASM handbooks]

**Power screw –** It should have high power transmission**,** Anti slipping property**,** Self-locking property**,** and High strength.

Above properties are satisfied by alloy steel G92550 normalised [ASM handbooks]

**Nut-** It should have high heat dissipation property**,** Self-lubricating property**,** High strength

Above properties are satisfied by G1800 cast iron [ASM handbooks] other components are standard, having standard material. E.g. nut bolts, etc.

**Table 1 Material selection for each component**

| *Sr. No.* | *Name of Component* | *Material* | *Yield strength ($N/mm^2$)* | *Heat treatment* | *Density ($Kg/m^3$)* |
|---|---|---|---|---|---|
| 1 | Frame | Aluminium alloy 6061 | 125-400 | Tempered at $707^0$c | 2750 |
| 2 | Base Plate | Alloy steel EN 24 | 850-1000 | Normalised | 7840 |
| 3 | Power Screw | Alloy steel G92550 | 500-2000 | Tempered at $207^0$c | 7700 |
| 4 | Nut | Cast iron G1800 | 290-550 | - | 7859 |

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**Table 2 Design Details**

| *Sr. No.* | *Name of Parts* | *Dimensions* | *Allowable* | *Induced* | *Remark* |
|---|---|---|---|---|---|
| 1 | Screw | | $\sigma c = 144.8$ N/mm$^2$ | $\sigma c = 50.92$ N/mm$^2$ | Safe |
| 2 | Nut | | $\sigma c = 800$ N/mm$^2$ | $\sigma c = 400$ N/mm$^2$ | Safe |
| 3 | Stud M16 | | Syt = 380 N/mm$^2$ | $\tau = 76$ N/mm$^2$ | Safe |

### 3.2 Dynamic balancing of fixture

It is needed to model should be balanced dynamically. For simplicity Pro/MECHANICA is used for finding CG, weight. As fixture is asymmetrical, it has to be mass balanced. The fixture rotates around one axis; hence it has to be balanced about other two perpendicular axes. Here x –axis is the axis of rotation. The innovative approach of use of pro/engineer wild fire 4.0 is used to solve the balancing problem.

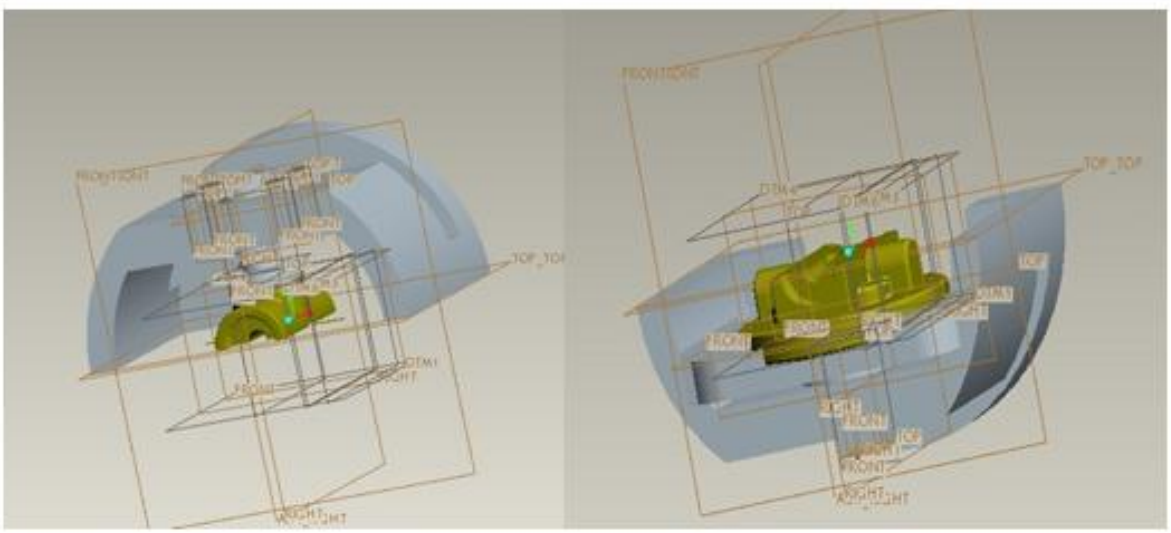

**Figure 1 - Quadrant 1 and Quadrant 2**

Thus the unbalanced mass is found to be 2.07 kg and CG is situated at an angle of $270^0$ with X axis at a distance of 97.91 mm. Hence the fixture can be balance by placing the counterweight equal in magnitude and opposite in direction as that of unbalanced mass

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### 3.3 Working

**Figure 2 – Actual Fixture**

The working of fixture is very simple and totally mechanical. Fixture is manually operated and operated by using hands only. Fixture is attached to spindle coupling with the help of three studs. Fixture is of turning type so it should be tighten accurately. After assembling fixture the following steps should be followed

### 3.4 Steps for operating fixture

1) First position the fixture in right manner, power screw head on upside and base plate end and bottom side.
2) Pick the job and load it from front opening of fixture, by loosening power screw.
3) Place it over base plate with matching hole with locating pins on base plate
4) Tight the power screw with the help of chuck key or hand.
5) Do the required operation on working job.
6) After operation completion remove a job by losing power screw by chuck key. And load the next job by repeating above procedure.

## IV. RESULTS

| Specification | Existing Fixture | Fabricated Fixture |
|---|---|---|
| Material | Alloy steel | Aluminium |
| No of components | 5 | 2 |
| weight | 12 kg | 8 kg |

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| | | |
|---|---|---|
| Speed | 250 rpm | 500 rpm |
| Clamping force | 10 KN | 16 KN |
| Production rate | 14 units/hr | 20 units/hr |
| No of rotation for clamping | 10 | 6 |
| Ejector | Not available | Available |
| Operation | One sided | Both sided |
| Sharp edges | Present | Not present |
| External clamping device | Needed | Occasional |
| Cost | 12000 /- | 8000 /- |
| Vibrations | More | Less |
| Clamping accuracy | 5 microns | 3 microns |

## V. CONCLUSION & FUTURE SCOPE

By having trial on our project we came to following conclusions:

After implementing our fixture model on the place of existing model of company the time for material handling that is loading and unloading of work piece became less.

Lesser time for material handling cause the reduction in overall completion time of the work piece which ultimately reduce the production cost of work piece and increase profit of company. The loading and unloading with new model is easy and user-friendly and reduce the chances of any accidental injury.

The new model is the assembly type so can be dissembled and removed in case of any problem or emergency.

The new model is lesser in weight than existing requires less power so efficiency is increased.

Following modification that can be implemented in future:

1. Use of pneumatic or hydraulic actuation systems to operate the opening and closing of fixture
2. Use of automation for loading and unloading of work piece.
3. Design the fixture to reduce all possible degrees of freedom.
4. Minimize the surface contact of fixture and work piece.
5. Use different materials for decreasing thickness of wall of frame

## REFERENCES

[1] Erik K. Henriken, “jig and fixture design manual”, *Industrial Press INC*

[2] Nirav P. Maniar, D. P. Vakharia, Chetan M. Patel “ design & manufacturing with modelling, dynamic balancing & finite element analysis of rotary fixture for cnc turning centre to function as hmc”, *ASME*

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*Early Career Technical Journal 2009 ASME Early Career Technical Conference, ASME ECTC October 2-3, 2009, Tuscaloosa, Alabama, USA*

[3] Riken seiki operation manual for power chuck

[4] S.K. Hajara Choudhury, S.K Bose, A.K. Hajara Choudhury ,Inrjhar Roy , "Elements of workshop technology vol.2 machine tools", *media promoters and publishers pvt.ltd, page no.178,505* 1964.

[5] HMT Banglore, "Production technology", *Tata Mc-Graw-Hill publishing company, page no71* 1980.

[6] P.N. Rao , "Manufacturing technology",*Tata Mc-Graw-Hill, page no* 82 2001.

[7] Roy A. Lindberg, "Process and materials of manufacture", *eastern economy edition, page no 240* 1990.

[8] Arthur H. Burr, John B. Cheatham, "Mechanical Analysis And design second edition", *Prentice- Hall of India , page no 256 ,290* 2001

[9] William Orthwein, "Machine Component Design", *JAICO publishing house, page no 321* 1999.

[10] V.B. Bhandari, "Design of machine elements third edition", *Tata McGraw Hill Eduction Private Limited, page no 184* 2010.

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