



Design & Fabrication of a CNC Lathe Machine Fixture for a Square Block

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Abstract:

Fixture is a device for locating, holding, and supporting a component or work piece securely in definite position for a specific operation but it does not guide the cutting tool. Fixture is required in various applications. The various methodology used for clamping operation use in different application by author revived in this paper. This paper present design and development of fixture for real industrial square block components. The operation to be performs are front facing and boring. Actually four jaw chuck is best solution for performing required operation but four jaw chuck cost around 60 thousand rupees, whereas CNC fixture cost about 3000 rupees. Fixture reduces operation time and increase productivity and high quality of operation is possible. Fixtures are specially designed so that large number of component can be machined or assembled identically, to ensure interchangeability of component. Fixture hold or grip a work piece in the predetermined manner of firmness and location, to perform a manufacturing operation on the work piece.

Keywords:-Fixture, square block, facing and boring, CNC-machine, four jaw chuck.

1. INTRODUCTION

If a component is to be produce in a small numbers, then procedure adopted is marking out, setting on machine, clamping to machine table. But it would not be suitable for producing same component in large quantities because of economic reasons. A faster and more profitable method called for a device (fixture) on which component can be quickly positioned in the correct relationship to the cutting tool and quickly clamped before machining. Alignment between the tool and work must be maintained. Fixture is design to hold, support, and locate every part to ensure that part is machined within the specific limits. Principle of fixture design is to reduction in ideal time, cleanness, location and clamping, full proofing, size of work piece, strength and rigidity, weight, handling, economic consideration, ejecting devices. The fixture designing and manufacturing is considered as complex process that demands the knowledge of different areas, such as geometry, tolerances, dimensions, procedures and manufacturing processes. While designing this work, a good Number of literature and titles written on the subject by renowned author are referred. All finding the conclusions obtained from the literature review and the interaction with fixture designers is used as guide to develop the present research work. As stated by Koji Termite, Masahiko Ana Soto and Kazuaki Iwata [1], Fixture Plan (FP) and Machining Plan (MP) are mutually dependent. Implicit to this conclusion, paper coordinator MP and FP by coupling a fixture design with manufacturing consideration and mass balancing.

2. LITERATURE REVIEW:

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November 2013 entitled design optimization for slant-bed CNC lathe (SBCNC 80/2000) describes. The objective of this project is to find an optimum design for a multi-purpose fixture for lathe bed (SBCNC 80/2000). Suitable clamping mechanism is also to be designed. The (SBCNC 80/2000) lathe bed and its angle distribution. Publish in international journal of recent trends in engineering volume 1 NO.5 "Design of 28 operations 4 axis 360 indexing milling fixture for CNC" describes the present volume of this paper includes the unique aspect of designing of 4 axis-360 indexing milling fixture for CNC. This fixture provides locating and clamping provisions for as large as 28 numbers of operations to performed on support plate, one of the component of color mixing machine. The real time application of the research reflects from the fact that a real industrial component is taken for fixture designing. The designed fixture has the important characteristic of allowing all 28 operations to be performed on component in a single set up. Publish in International journal of Engineering Science Invention Volume 1 Issue 1 December 2012 Design & Development of Rotary Fixture for CNC Mechanical Engineering Department, Dharmsinh Desai University, India Mechanical Engineering Department, Sardar Vallabhbhai National Institute Of Technology, India describe This paper presents design and development of rotary fixture for real industrial component. The component is Flow TEE body of petroleum refinery. The operation to be performed are front facing, Actually HMC is the best solution for performing the required operations, but HMC costs around 12.5 million rupees whereas CNC turning centers costs only about 2.5 million rupees.

2.1 Purpose and Advantages of Fixtures: It reduces or sometimes eliminates the effort of marketing, measuring and

setting of work piece on a machine and maintains accuracy of performance.

- The work piece and tool relatively located at their exact position before the operation automatically within negligible time. So it reduces product cycle time.
- Variability of dimension in mass production is very low so manufacturing processes supported by use of jigs and fixture maintains a consistence quality.
- Due to low variability of dimensions assembly operation becomes easy, low rejection due to less defective production is observed.
- It reduces the production cycle time so increases production capacity. Simultaneously working by more than one tool on the same work piece is possible.
- The operating condition like speed feed rate and depth of cut can be set to higher values due to rigidity of clamping of work piece by jigs and fixtures.
- Operators working become comfortable as his efforts in setting the work piece can be eliminated.
- Semi-skilled operators can be assigned the work so it saves the cost of man power also.
- There is no need to examined the quality of produced provided that quality of employed jigs and fixtures is ensured.

2.2 Consideration While Designing Jigs and Fixture

- Study of work piece and finish component size and geometry.
- Type and capacity of the machine, it extent of automation.
- Provision of locating devices in machines.
- Available clamping arrangement in the machine.
- Available indexing devices, their accuracy.
- Evaluation of variability in the performance results of the machine.
- Rigidity of machine tool under consideration.
- Study of ejecting devices, safety devices etc.
- Require level of accuracy in the work and quality to be produced.

2.3 Meaning of Location

It is very important to understand to meaning of location before understanding about the jigs and fixtures. The location refers to the establishment of desired relationship between the work piece and the jigs or fixtures correctness of location directly influences the accuracy of the finish product. The jigs and fixtures are desired so that all undesirable movements of the work piece can be restricted. Determination of the locating points and clamping of the work piece serve to restrict movements of the component in any direction, while setting it in particular pre-decided position relative to the jigs. Before deciding the locating points it is advisable to find out the all possible degree of freedom of work piece then some of the degree of freedom or all of them are restrained by making suitable arrangements. These arrangements are called locater.

2.4 Principles of Locations

The principle of location is being discussed here with the help of most popular example which is available in any of the book covering jigs and fixtures. It is important that one should understand the problem first. Any rectangular body many have three axis along x-axis, y-axis and z-axis. It can more along any

of this axis or any of its movement can be released to three axes. At the same time the body can be rotates about this axis too. So total degree of freedom of the body along which it can move is six. For processing the body it is required to restrain all degree of freedom (DOF) by arranging suitable locating points and then clamping it in fixed required position. The basic principle used to locate the points is described below.

2.5 Location of a Cylinder on a Vee Block

The analysis of the principle of location of the cylinder on a Vee Block is indicated in figure 1. All the degree of freedom of the cylindrical object is restrained. It is only fixed to move along axis AB. It can rotate about the axis AB. These free movements are also indicated in the figure. If the operation to be done on the cylindrical object requires restriction of the above mentioned free movements also the same more locating provisions must also be incorporated in addition to use of the Vee block.



Figure.1. Location of a Cylinder on a Vee Block

2.6 Six Point Location of a Rectangular Block

Considering the six degree of freedom of a rectangular block as shown in Fig 2, it is made to rest on several points on jigs body. Provide a rest to work piece on three points on the bottom x-y surface. This will stop the movement along z-axis, rotation with respect to x-axis and y-axis supporting it on the three points is considered as better support then on point or two points. Rest the work piece on two points of side surface x-z; this will fix the movement of the work piece along y-axis and rotation with respect to z-axis. Provide a support at one point of the adjacent surface y-z that will fix other remaining free movements. This principle of location of fixing points on the work piece is also named as 3-2-1 principle of the fixture design as number of points selected at different faces of the work piece is 3, 2 and 1 respectively.

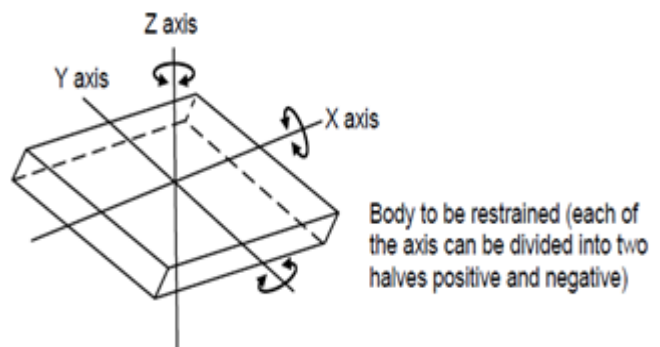


Figure.2. Six Point Location of a Rectangular Block

3. CONSTRUCTION

We are providing a supporting plate mounting on the base plate and drill hole of supporting plate pass through bolt. And connecting to the work piece is mounted on the cylindrical locator. Supporting plate is connecting to screw at 8 mm diameter with the help of base plate.

It consist of following parts

- 1) Base plate
- 2) Supporting plate
- 3) Allen bolt

3.1 Base Plate:

1. Base plate is device which are use to mount the fixture assembly.
2. This is made up of mild steel $\phi 260\text{mm}$ and thick 46mm.
3. This is connected to the machine spindle and rotates its own axis.

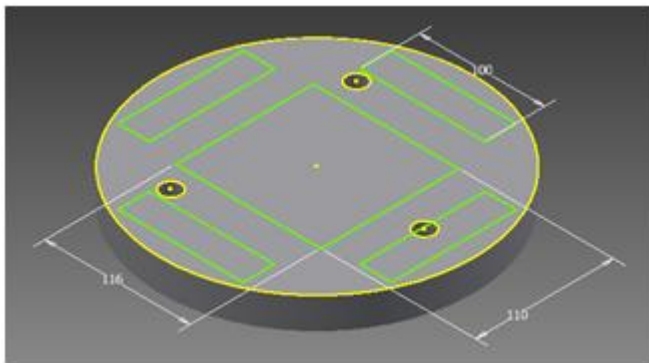


Figure.3. Base Plate

3.2 Supporting Plates

It is used to securely locate (position in a specific location or orientation) and support the work. A primary purpose is to create a secure mounting point for a work piece.

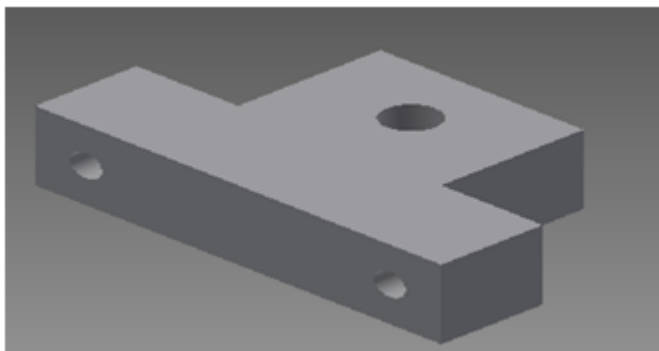


Figure.4. Supporting Plates

3.3 Allen Bolt

- 1) Material of bolt made of steel.
- 2) Bolt use for clamping which supporting plate.
- 3) Size of bolt (M8), (M16) and (M6).

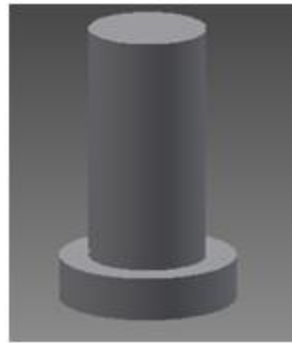


Figure .5. Allen Bolt

3.4 Cylindrical Locator

- 1) Locator is pin which is inserted separately in the body jig or fixtures again which the work piece forced.
- 2) They are made from harden steel and accurately ground to size.
- 3) To locate means to establish a proper relationship between the work piece and jig and fixture.
- 4) A locator has its ends chamfered to ensure good seating in the work piece and jig and fixture body.
- 5) A cylindrical locator is a pin with shoulder which prevents push into fixtures or jig body.
- 6) The portion of this pin is given a sufficient chamfer to facilitate loading of work piece.



Figure .6. Support Location Pins

Table.1. Component of fixture

| SR.NO | PART NAME | MATERIAL | SIZE |
|-------|-------------|-----------------|---------------------------|
| 1 | Base plate | MS plate | $\phi 260$ thick 46 |
| 2 | Jaw | MS Flat | 300*65 |
| 3 | Hex bolt | HT bolt | M16*30 |
| 4 | Button | MS round bar | 55*15 |
| 5 | Allen bolt | Stainless steel | 5*20 |
| 6 | Socket bolt | MS | M8*30 |
| 7 | Face plate | M.S Plate | 30*30 |

4. CONCLUSION

From the present analysis, it can be concluded that process change could result in great improvements in quality and productivity. Fixture forms an important factor since fixture design directly affect manufacturing quality and productivity. Traditionally fixtures were designed by trial and error, which was expensive and time consuming. But now, research in flexible fixture and Computer-Aided-Fixture-Design (CAFD) has significantly reduce manufacturing lead time and cost.

5. REFERENCES

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