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Design & Manufacturing of Fixture of Bearing Cap

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ABSTRACT

A fixture is designed, built to hold, support and locate every component to ensure that each is drilled or machined with accuracy and manufactured individually. A fixture can be designed for the particular job using production tools which make the standard machine tool more versatile to work as specialized machine tools. They are normally used in small scale production by semiskilled operators. This dissertation work aims at designing a fixture used for performing machining operations at certain angle (102.5 degree) on the Crank case used in commercial vehicles. The design is proposed so that the required operations are performed properly with the conventional CNC machines to obtain required dimension which includes Design & Structural analysis of fixture is carried out using known and proven methods.

Keywords*– Auto Cad, CATIA V5,*Fixtue, Bearing Cap,

1. INTRODUCTION

Fixtures are the tools used to locate and hold the work piece in position during the manufacturing process. Fixtures are used to hold the parts firmly which are to be machined, it is used to produce the duplicate parts accurately. In order to produce parts with required accuracy and dimensions the parts must be firmly and accurately fixed to the fixtures. To do this, a fixture is designed and built to hold, support and locate the work piece to ensure that each work piece is machined within the specified limits. Set blocks, feeler or thickness gauges are used in the fixture to refer the workpiece with the cutter tool. A fixture should be securely fastened to the table of the machine upon which the work is to be done. Though largely used on milling machines, fixtures are also designed to hold the work for various operations on most of the standard machine tools. Fixtures vary in design based on the use of relatively simple tools to expensive or complicated devices. Fixture helps to simplify metalworking operations performed on special equipments.

A fixture is a device for locating, holding and supporting a workpiece during a manufacturing operation. It is a production tool that locates, holds, and supports the work securely so the required machining operations can be performed. Fixtures have a much-wider scope of application than jigs. These work holders are designed for applications where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, center finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixtures, and grinding fixtures.

Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of a tool to a workpiece. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a workpiece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the workpiece in that location for the particular processing operation. There are many standard work holding devices such as jaw chucks, machine vises, drill chucks, collets, etc. which are widely used in workshops and are usually kept in stock for general applications.

Fixtures are normally designed for a definite operation to process a specific workpiece and are designed and manufactured individually. Jigs are similar to fixtures, but they not only locate and hold the part but also guide the cutting tools in drilling and boring operations. These work holding devices are collectively known as jigs and fixture. Set blocks and feeler or thickness gauges are used with fixtures to reference the cutter to the work piece. A fixture should be securely fastened to the table of the machine upon which the work is done. Though largely used on milling machines, fixtures are also designed to hold work for various operations on most of the standard machine tools. Fixtures vary in design from relatively simple tools to expensive, complicated devices. Fixtures also help to simplify metalworking operations performed on special equipment.

The following inputs are provided in the fixture plan:

− Fixture type and complexity.

− Number of work-pieces per fixture.

− Orientation of work-piece within fixture.

− Locating datum faces.

− Clamping surfaces.

− Support surfaces.

Generation of fixture layout is to represent the fixture concepts in a physical form. The following outputs are provided in the fixture layout:

− Types and Position of locators.

− Types and Position of clamps.

− Types and Positions of supports.

− Clamping forces and sequence.

Fixture element design is either to detail the design drawings committed on paper or to create the solid models in a CAD system of the practical embodiment of the conceptual locators, clamps and supports. It is possible to use standard designs or proprietary components. Fixture body design is to produce a rigid structure carrying all the individual fixture elements in their proper places.

II. BEARING CAP COMPONENT

We are going to manufacture fixture of Bearing cap. This Bearing cap is used in Automobile Industry for holding the bearing & shaft.

Photo.1.3. Bearing cap

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 (Computerised Numerical Control) machine by giving a proper program from design department.

After inspection of the CNC machined job, the job is mounted on fixture. 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.

Drawing of Bearing cap

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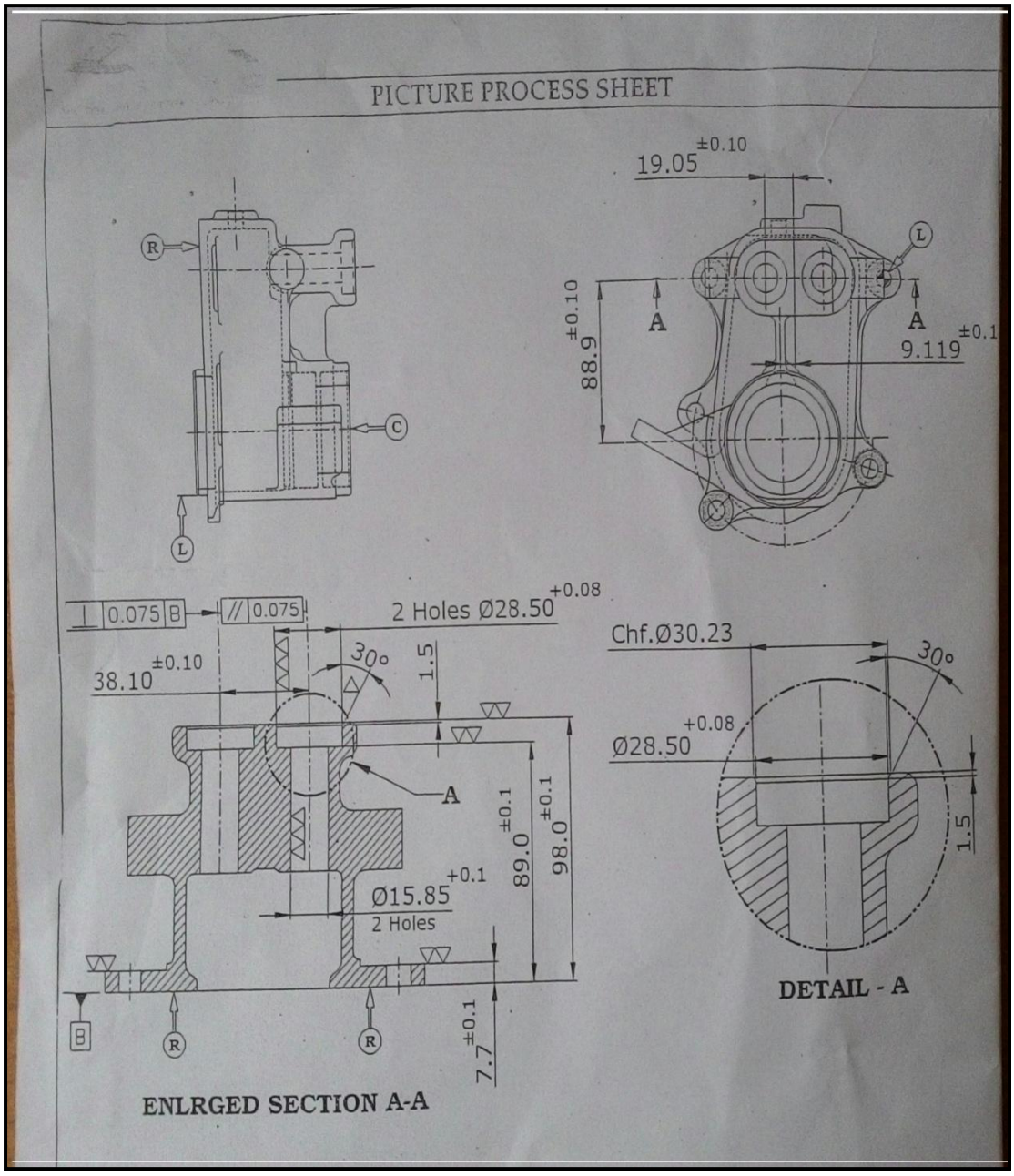

Fig.Drawing of Bearing cap

III. ELEMENTS OF FIXTURE

Locator-

A locator is usually a fixed component of a fixture. It is used to establish and maintain the position of a part in the fixture by constraining the movement of the part. For work pieces of greater variability in shapes and surface conditions, a locator can also be adjustable.

Clamp-

A clamp is a force-actuating mechanism of a fixture. The forces exerted by the clamps hold a part securely in the fixture against all other external forces.

Support-

A support is a fixed or adjustable element of a fixture. When severe part displacement/deflection is expected under the action of imposed clamping and processing forces, supports are added and placed below the work piece so as to prevent or constrain deformation. Supports in excess of what is required for the determination of the location of the part should be compatible with the locators and clamps.

Fixture Body-

Fixture body, or tool body, is the major structural element of a fixture. It maintains the spatial relationship between the fixture elements mentioned above, viz., locators, clamps, supports, and the machine tool on which the part is to be processed.

Materials used for jig and fixture

Jigs and Fixtures are made of variety of materials, some of which can be hardened to resist wear. Materials generally used are-

1. High speed Steel-

These contain 18% tungsten for toughness and cutting strength,4.3% chromium for better hardenability and wear resistance and 1% vandadium for retension of hardnesss at high temperature and impact resistance.

2. Carbon steels-

These contains 0.85-1018% carbon and can be oil hardened to RC62-63. These can be used for tools for cutting softer materials like woodwork, agriculture, etc. and also for hand tools such as files, chisels and razors.

3. Mild steel-

It is cheapest material in jigs and fixture. It contains less than 0.3% carbon. It is economical to make parts that are not subjected to much wear and are not highly stressed from mild steel.

4. Cast Iron-

Used for odd shapes to some machining and laborious fabrication. CI usage requires a pattern for casting. It contains more than 2% carbon. It has self lubricating properties and can withstand vibrations and suitable for base.

5. High tensile steel-

These can be classified into medium carbon steels with 0.45%-0.65% carbon(En8-9). The tensile strength can be increased up to 125gm/mm^2(RC40) by tempering. Medium carbon steels are used widely for fasteners and structural work while alloy steels are used for high stress applications like press ram. It has good tensile strength. It is readily machinable in any condition.

EN8 is an unalloyed medium carbon steel grade with reasonable tensile strength. It is normally supplied in the cold drawn or as rolled condition. Tensile properties can vary but are usually between 500-800 N/mm^2. EN8 is widely used for applications which require better properties than mild steel but does not justify the costs of an alloy steel. EN8 can be flame or induction hardened to produce a good surface hardness with moderate wear resistance.

IV. ASSEMBLY MODELING

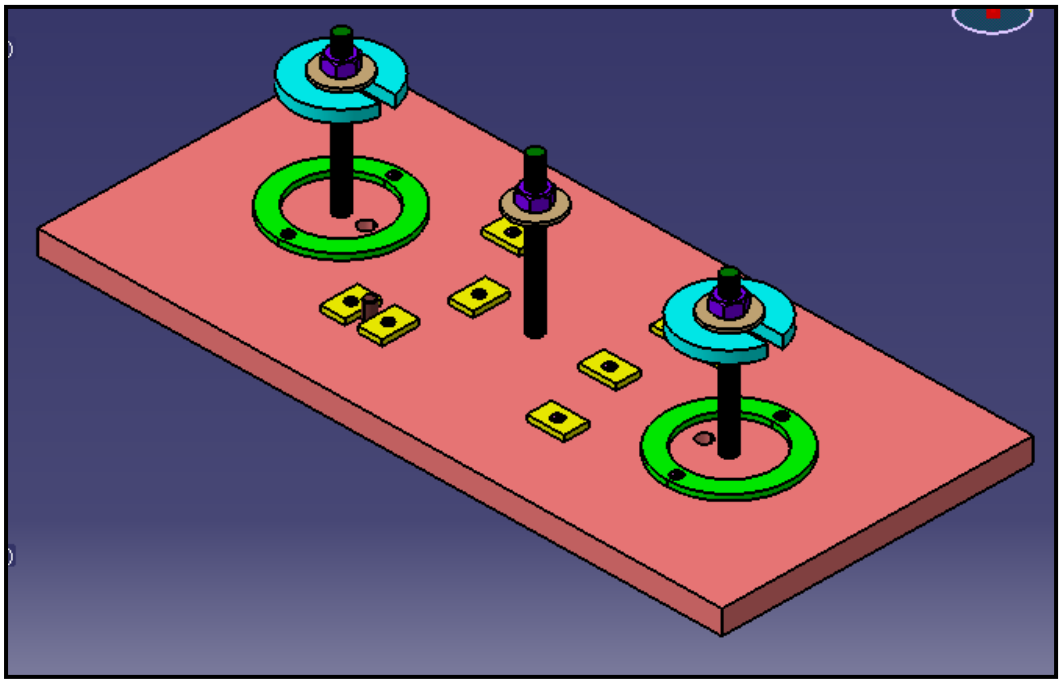

Fig.Assembly model

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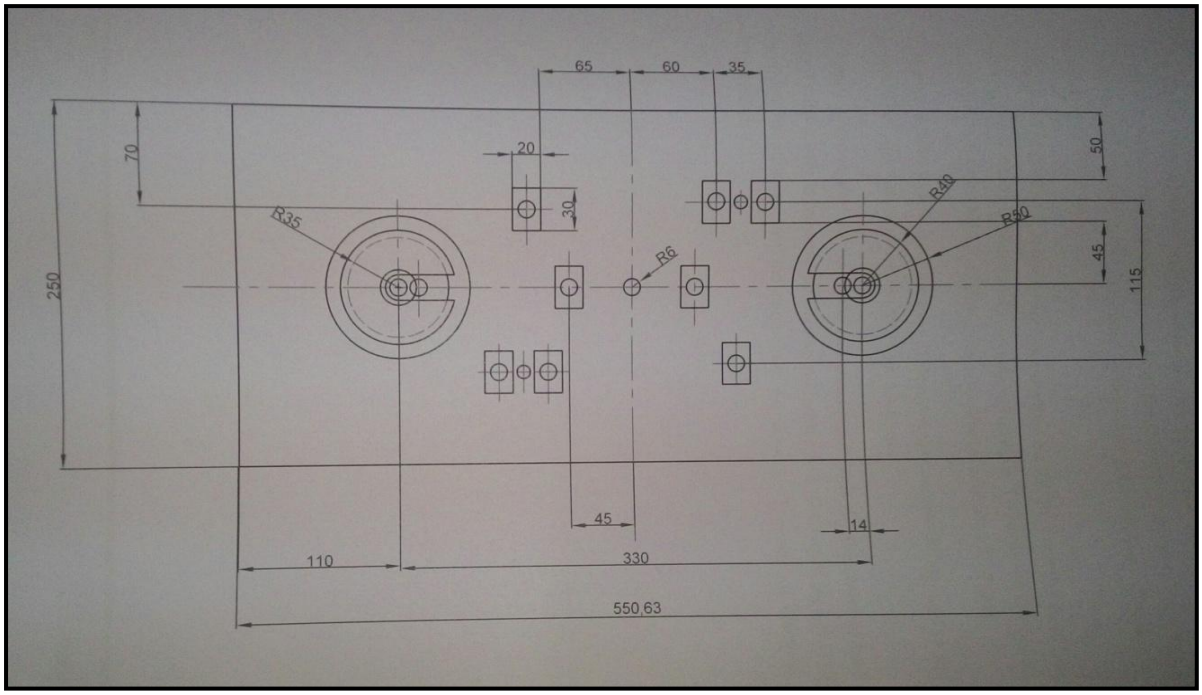

Fig. Actual fixture design

A. The size of bed 800*450 mm. This size is enough to mount two components at a time.By considering the size of job & bed we choose the size of base plate 550*250*25mm.

B. It is used for clamping purpose. The inner slot of clamp is of 18mm diameter & 50mm. This is for the easy removal because the diameter of bolt is 12mm.The size of C-Clamp is OD 80mm.

C. The external dia. of component is 70 mm which is equal to the inner dia. of locater. We select the locater with reference to the component. The bottom shape of the component is circular so that we select circular locator.

From the right and left side of the base plate 60mm distance is provided for the strap clamp which is used to fix the fixture to the bed. The center distance between the locator is 330 mm with this distance two component can be easily mount. The size of the locator is OD 100mm & ID 70mm.

D. Spacer or resting pad are used for supporting the component. The four spacer are sufficient to support each component, height of the spacer is proportional to locater. The location of this four spacer is decided by considering the job shape. The size of the spacer is 30*20*8mm.

E. The height of the bolt is 160mm which is more than the job height 98mm .The std. size of Nut & Bolt are used which is preferred from component height, C-clamp, washer height etc. The size of the bolt M12 X 160 mm. The size of nut is Size M12 X 12 mm.

F. Washer is used to distribute the load of threaded fastener prevent damage to the surface of job. The size of washer is OD 25mm ID 12mm.

G. Center clamp is used for fixing the two components. This is the center of base plate. Center clamp is mounted on the one side of the two jobs which presses it in downward direction so that the component fix properly. The size of clamp is 95*20*20mm.

V. CONCLUSION

The machining fixture is a key contributor to the manufacturability of a component, and should be designed to optimize the performance of the overall machining process. However, at the present time, due to increase in competition in many industries, they are using automated fixture for their early product launch and to increase productivity and accuracy. The present fixture model development described in this paper includes the unique aspect of designing a hydraulic fixture is novel in that it enables the user to take account of machining strategy and all key interactions between fixture, component and other system elements at an early stage. By designing above automated fixture for honing machine, cylinder liners are exactly located, supported and clamped which reduces the machine settings time, hence productivity increased by 20% and which also increase the accuracy, improved quality of machining and process control. With less than 2 % rejection rate and 20 % increase in productivity, cost to build and maintain honing fixture set up can be recovered in less than a one year.

VI.ACKNOWLEDGEMENT

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