

Jig and Fixture Design

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Definition of jig and fixture

(i) **Jigs and fixtures:** it is Components of machine-tool installations, specially designed in each case to position the work piece, hold it firmly in place, and guide the motion of the power tool (e.g., a punch press).

(ii) Definition of jig

Jig can be defined as follows

- a) A fixture with an additional feature of tool guidance.
- b) A portable device that guides the cutting tool.
- c) A device which positions two or more objects to a location in space such that degrees of freedom of movement of the objects relative positions are limited to movement along, or rotation about, a single axis [1].

A jig is usually made of metal which locates and holds the work-piece(s) in a positive manner and also guides the cutting tool(s) such that it is in the correct relationship to the work when machining commences. It is usually necessary for the work to be held in the jig by clamping. The jig is not fixed to the machine table by clamping but is held by hand. Jigs are use for quantity drilling, reaming and tapping for example.

Jigs can also be guides for tools or templates, as in the furniture industry. Special cramping jigs that ensure squareness are set up so that, for example, a wardrobe can be glued up in one operation by power-driven rams.

(iii) Definition of fixture

The fixture can be defined as:

- a) It is strong and rigid mechanical devices which attaches to a machine and allows the stock to slide while being held firmly enabling easy, quick and consistently accurate locating, supporting and clamping, blanks against cutting tool(s) and result faster and accurate machining with consistent quality, functional ability and interchangeability [2].

- b) A device which secures a single object to a location in space relative to a specific reference plane and/or point by limiting at least four of its possible six degrees of movement in space (along the x, y and z axis and rotation about said axis) [1].

The fixture is a device similar to a jig but as the name implies is fixed to the machine bed clamping in such a position that the work is in the correct relationship to the cutter. A further difference is that the cutter is not guided into position ready for machining to commence. A setting gauge is often provided to enable the initial setting of work to the cutter to be quickly and easily accomplished before production begins.

1.1 The purpose of jig and fixture

The basic purposes of developing and using suitable jigs and fixtures for batch production in machine shops are:

- To eliminate marking, punching, positioning, alignments etc.
- Easy, quick and consistently accurate locating, supporting and clamping the blank in alignment of the cutting tool
- Guidance to the cutting tool like drill, reamer etc.
- increase in productivity and maintain product quality consistently
- To reduce operator's labour and skill – requirement
- To reduce measurement and its cost
- Enhancing technological capacity of the machine tools
- Reduction of overall machining cost and also increases in interchangeability.

Hence, provision of Jigs and fixtures as production tools provides the following:

- Manufacture accurately duplicate and interchangeable parts. Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components.
- Facilitate economical production of engineering components.
- **Make** operation of parts fairly simple which otherwise would require a lot of skill and time.

1.2 The advantages of using jig and fixture

The main functions of a jig or fixture are:

- **Gripping** a work piece in the predetermined manner of firmness and location.
- **Holding** components rigid and prevent movement during working in order to impart greater productivity and part accuracy.
- **Supporting and locating** every component (part) to ensure that each is drilled or machined within the specified limits.
- **Positioning** components accurately and maintain relationship and alignment between the tool and the work piece correctly to perform on the work piece a manufacturing operation.

Example of Jig and Fixture Redesigning

6.1 Old Design

The Product has been drawing by using CATIA software. The old design of jig and fixture is explained in figures (6.1) & (6.2)

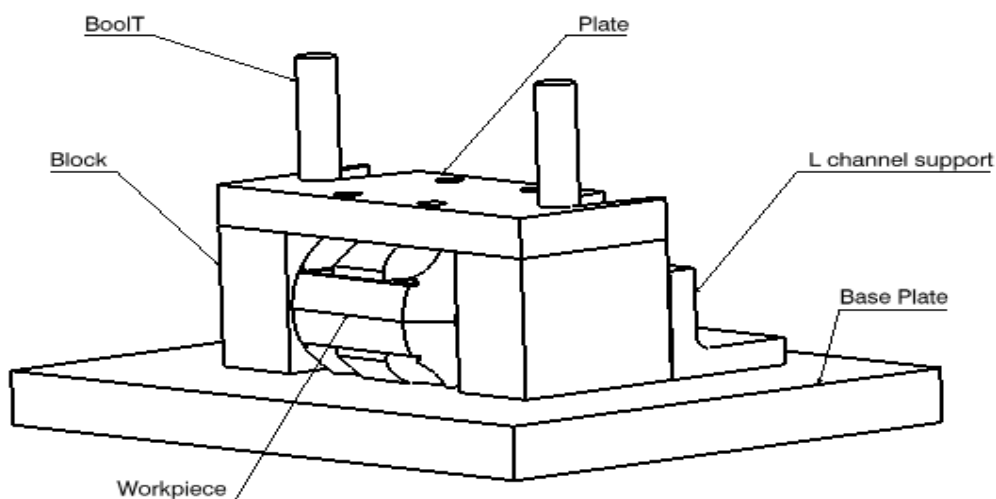


Figure (6.1)

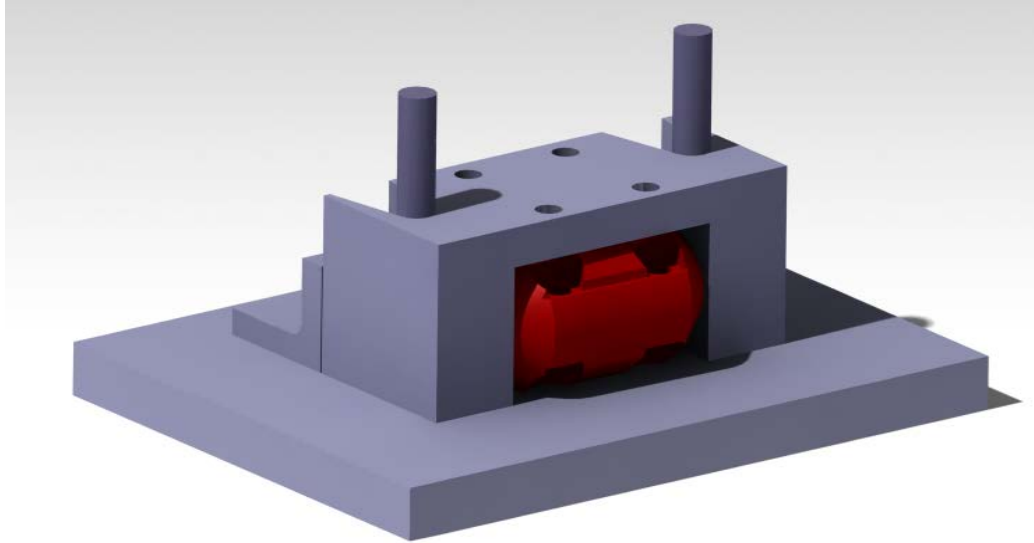


Figure (6.2)

Disadvantages

- The direction of motion for drilling operation is random.
- The binding process for fix guide drill is difficult & it takes a long time.
- The guide drill fixes the work piece that may causes bending in the bottom surface.
- The work piece is compound from two parts which may result in slipping in the parts of work piece.
- It is required high skill and high performance that causes fatigue for operator.

The main disadvantages which needed to be improved or eliminated are the directions of motion for drilling and the binding process for fix guide drill.

New design

The Product has been drawing by using CATIA software .The new design of jig and fixture is explained in figure (6.2.1) & (6.2.2)

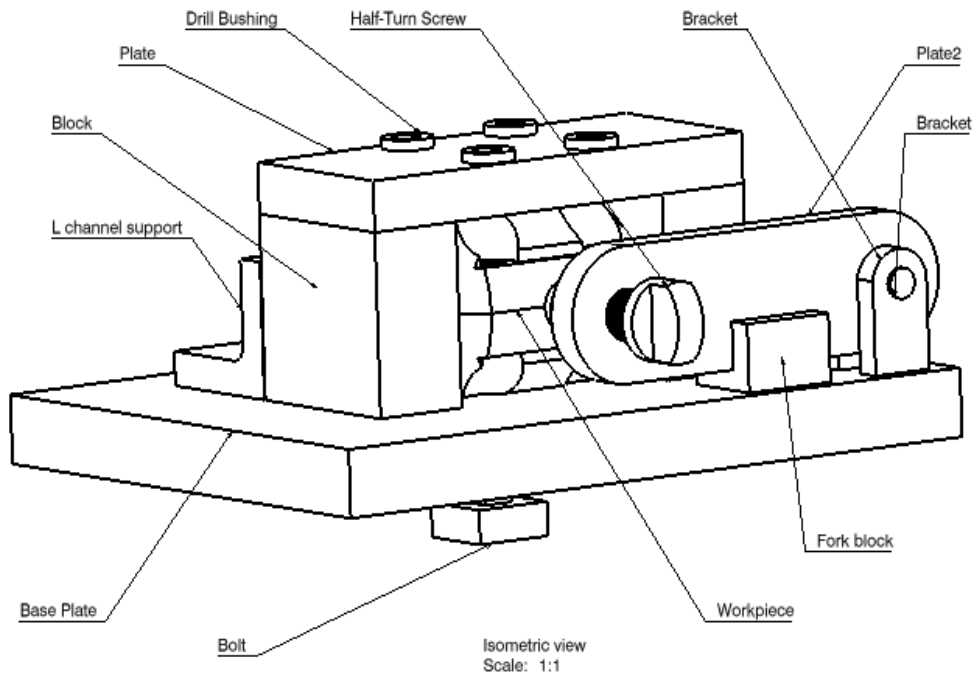
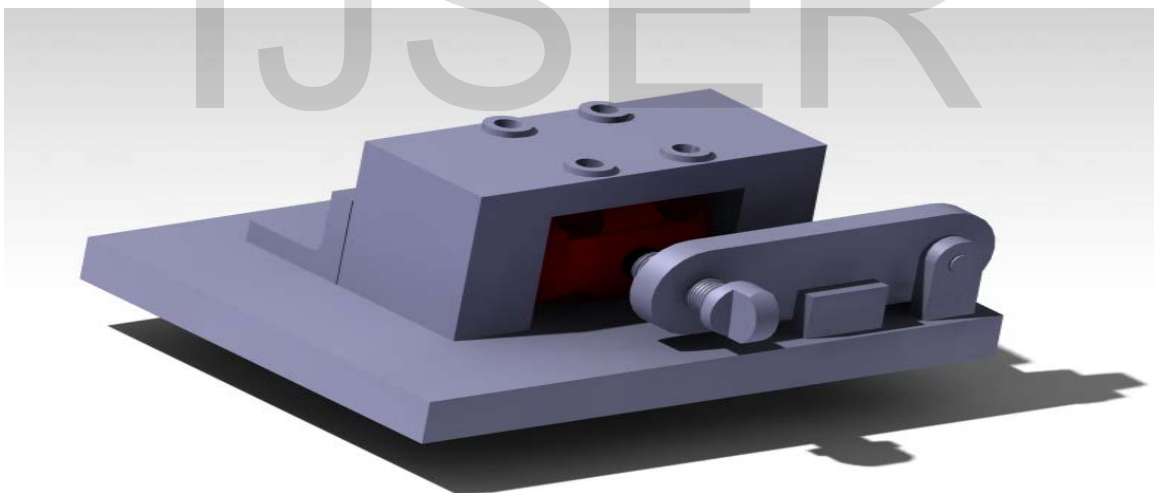


Figure (6.2.1)



Scientific Idea

The work piece is fixed by generating lateral force as result of rotating the screw that makes pressing on the work piece and back support generates reaction for this force. The force is central on work piece. Therefore, it prevents sliding of the parts of the work piece.

Technology Idea

After insertion the work piece into the fixture and by rotate the arm about horizontal axis and it is supported by arm support and it is connected by Screw and rotate the screw about rotate axis the work piece is fixed. The table is used to organize the motion about the cutting tool.

Components of New Design

- **Base Plate:** it is basic for building of other components and it is connected with table by link. It shown in figure(6.2.3.0)

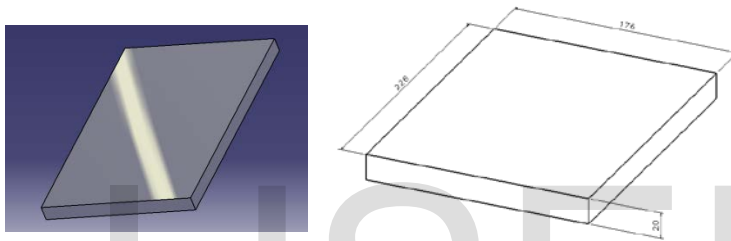


Figure (6.2.3.0)

- **Block:** it is used to support the guide drill. It shown in figure (6.2.3.1)



➤ Figure (6.2.3.1)

- **Plate:** it used to locate the drill tool in the actual place that required drilling. Shown in figure (6.2.3.2)

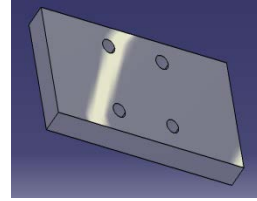
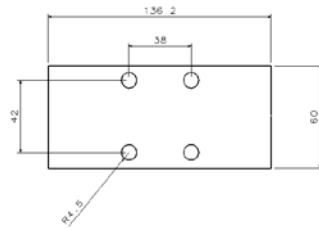


Figure (6.2.3.2)

- **Plate2:** it is used to include the screw and change the location it by organize motion. It shown in figure (6.2.3.3)

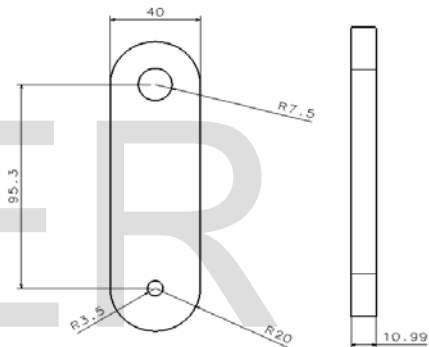
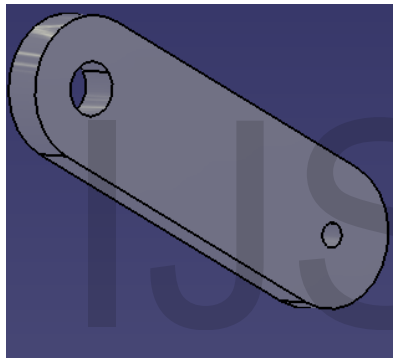


Figure (6.2.3.3)

- **Fork block:** it is used to locate the arm with interfacing the work piece. It is shown in figure (6.2.3.4)

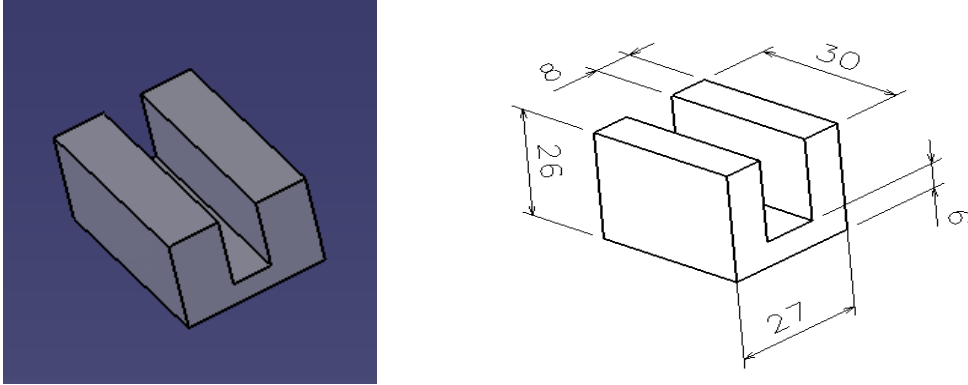


Figure (6.2.3.4)

- **L channel support:** it is used to support the work piece from back. It shown in figure (6.2.3.5)

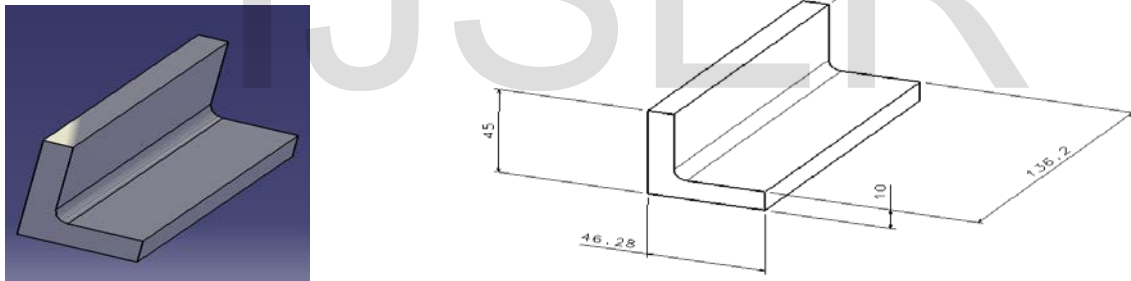
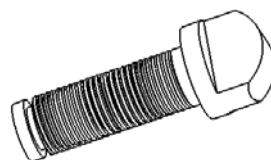


Figure (6.2.3.5)

- **Bolt:** it is used to hold the work piece. it shown in figure (6.2.3.6)



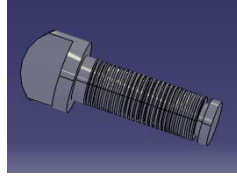


Figure (6.2.3.6)

- **Bracket:** it is used for help the arm to rotate by joint. It shown in figure (6.2.3.7)

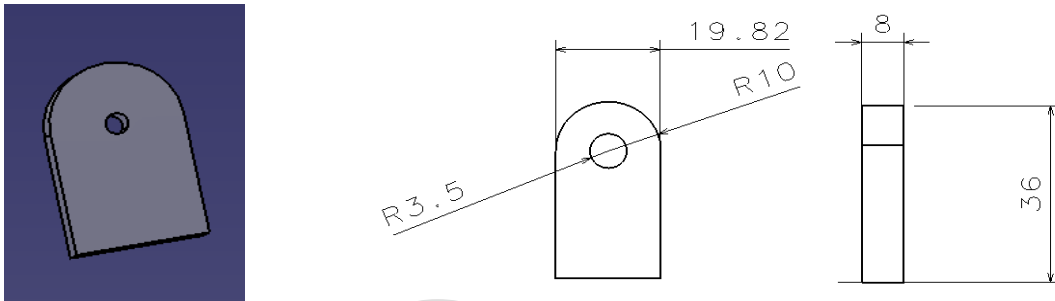


Figure (6.2.3.7)

- **Bolt:** it is used to connect with table. It shown in figure (6.2.3.8)

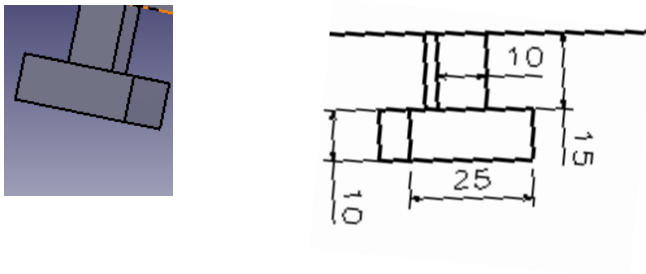


Figure (6.2.3.8)

- **Joint:** it is used for rotate the arm about horizontal axis. It shown in figure (6.2.3.9)

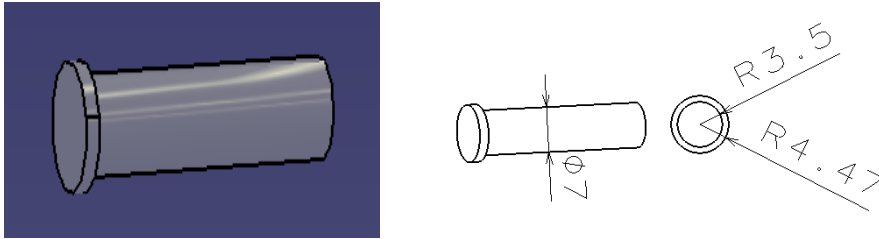


Figure (6.2.3.9)

- **Drill Bushing:** it is used for preventing the corrosion for guide drill. It shown in figure (6.2.3.10)



Figure (6.2.3.10)

- **Table:** it is used to control the motion of fixture and locate the actual place of drill. It shown in figure (6.2.3.11)

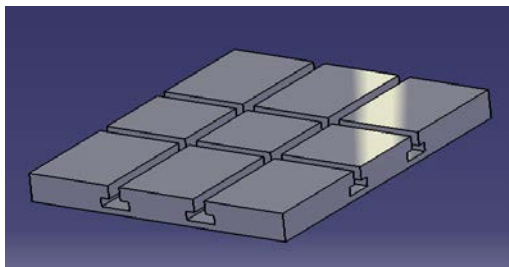


Table: it is used to control the motion of fixture and locate the

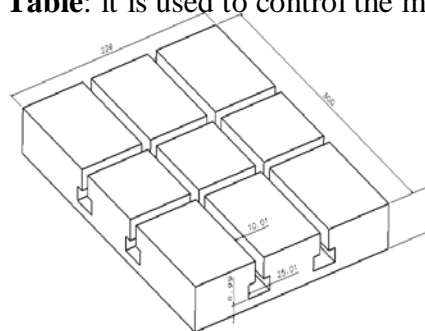


Figure (6.2.3.11)

Advantage of New Design

- The blinding process for fix the work piece is very easy because the screw is included in Arm.
- The direction of motion for make drill is organized and deterministic.
- The total time for make fix work piece and release is short.
- The entering work piece and pulling is very easy.
- The new design is not required high skill and high performance.
- The new design is included drill bushing that makes preventive for guide drill from corrosion.
- By use the lateral screw that generates lateral force on the center of work piece and then it preventives the deviation for part of work piece from another.

Final Design

The final design is included the new design and table. The final design eliminates all disadvantages in the old design and will enhance the production because the time is reduced. The details and dimensions are shown in figure below.

