Design And Development of A Jig With Multiple Drilling

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Abstract- *Mass production aims at high productivity to reduce unit cost, and interchangeability to facilitate easy assembly. It could be achieved by the use of jigs. Jigs are provided with tool guiding element such as drill bushes. Drilling jig is used whenever is necessary to drill hole to exact location. So for multiple drilling operation at different position on a same work piece, such jigs are made for accurate, precise drill operation in this project. Also jig reduces the repetitive nature required for drilling holes, because the locating, clamping and guiding of the drill bits are done by the jig itself. The basic element in this design are holding the work piece, clamping and positioning the drills with drill bushes. The scope of this paper is to design a jig for multiple drilling (i.e. Four) in a work piece in single stroke in which the four drill chuck assembly is fixed with a CNC ram. Such the design is validate and verified. The present paper entitled "Design and development of a jig with multiple drilling in single stroke" is work done for design an analysis.The modeling is done on CATIA V5.*

Keywords- Drill, Bushes, Multiple Operation, Jig, CATIA V5.

I. INTRODUCTION

The special purpose jig is a special tool for locating and firmly holding a work piece in the proper position during the drilling operation. As a general rule it is provided with devices for supporting and clamping the work piece. Jigs eliminate individual marking, positioning and frequent checking and facilitate uniform quality in manufacture. This reduces operation time and increases productivity. Because of irreplaceable feature and advantage, jigs are widely used in the factory practical production.The basic setup for drilling process via jig is illustrated below in Figure No.1.

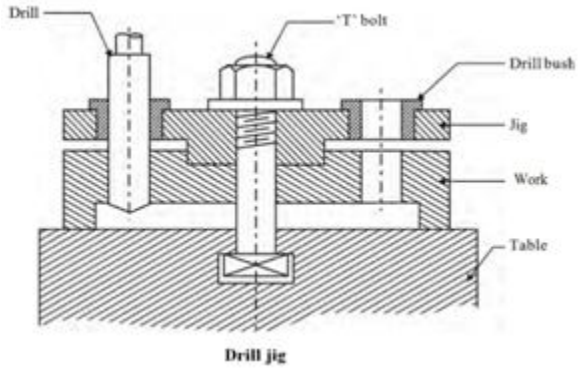


Figure No.1: A jig guiding a drill in casing of drill bush

Mass production aims at high productivity to reduce unit cost and interchangeability to facilitate easy assembly. This necessitates production devices to increase the rate of manufacture and inspection device to speed-up inspection procedure. The most common jigs are frilling and boring jigs. These jigs are almost same but differ in size, shape and placement of drill bushing. Normally, Boring jigs have larger bushes than drilling jigs. These bushings may also have internal oil grooves to keep the boring bar lubricated. Often, boring jig has more than one bushes to support the boring bar throughout the machining operation

The basic purposes of developing and using such jigs 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 inalignment 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.

II. PROBLEM IDENTIFICATION

Previously whenever there is a job in which multiple drilling operation has to be done on a works piece. After every single drill the position of the work piece or the position of the drilling spindle has to be changed and the fixing and the clamping process repeats again and again which increases the machining time as well as the labour costs. As a result of this tedious and time consuming method the production rate of the company remains slow.

TIME TAKEN WITHOUT JIG:

Serial number	Process	Number of worker required	Time required in seconds
1	MARKING + PUNCHING	1	90+60=150
2	HOLDING+CLAPMPING + DRILLING	2	30+30+40=100
3	CHANGING POSITION AND THEN AGAIN DRILLING	1	120
	TOTAL	**2**	**370**

III. PROBLEM SOLUTION

The main objective of this paper is to increase the production by reducing operations and their required time thus reduce cost which leads to enhance quality of the fabrication process methodology. The design consideration of all jigs consist of Safety, Reduction of Idle Time, Provision for Coolant, and Hardened Surfaces of components, fool proofing. Some points which leads to the objective of this paper:

- 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.

The main functions of this jig are:

• **Griping** 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.

IV. DESIGN CONSIDERATION

The design consideration of all jigs consists of safety, reduction of idle time, provision for coolant, hardened surfaces of components. Initially the component was deigned, modeled and edited to get the necessary **The Product has been drawing by using CATIA software .The design of jig is explained in Figure No.2**

S.No	COMPONENT OF JIG	DIMENTTIOS IN MM (L*B*H)	MATERIAL
1	WORK TABLE	300*220*35	MS
2	BASE PLATE	250*180*20	MS
3	BUSH HOLDIN PLATE	140*70*20	D2
4	DRILL BUSH	R5*22	EN31
5	SUPPORT BLOCK	70*30*50	MS
6	L-CHANNEL	35*35*7	MS
7	CLAMPING ARM	20*60*7	MS
8	BRACKET	14*10*7	Ms
9	FORK BLOCK	20*60 R10	MS
10	CLAMPING SCREW (HALF TURN)	R4	ALLOY STEEL
11	DRILL BITS	ϕ10	HSS

details for designed of the jig. Secondly, the individual parts such as base plate, drill bushes, bush holding plate, supporting block, work table, hinges L-channel and four drill mechanism were developed. All these parts have been designed, modeled, drafted individually. The whole Design Procedure was completed with the help of **CATIA V5 R20**software which helps for Designing,

Main components of this jig are:

The Product has been drawing by using CATIA software .The design of jig is explained in Figure No.2

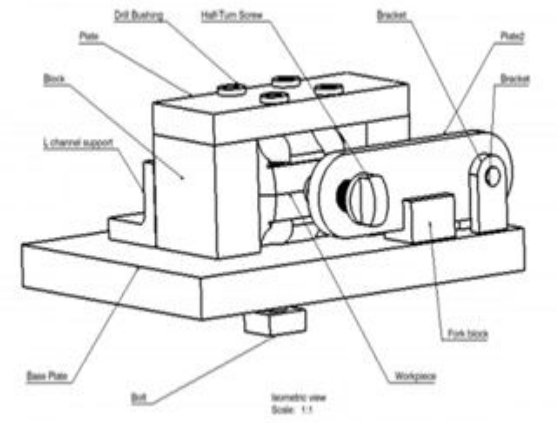


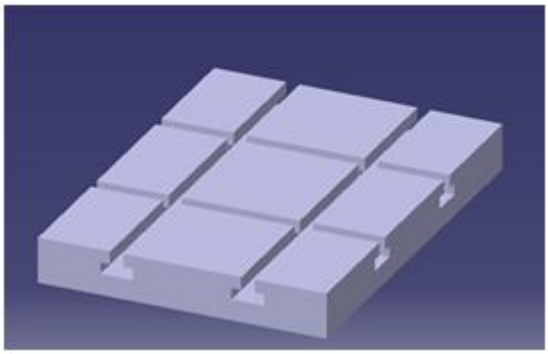
Figure No.2: Sketch view of design

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 jig and by rotate the clamping arm about horizontal axisand it is supported by arm support and it is connected by Screw and rotate the screw aboutrotate axis the work piece is fixed. The table is used to organize the motion about thecutting tool.

V. COMPONENTS OF JIG

1. WORK TABLE: it is used to control the motion of fixture and locate the actual place of drill. It is shown in figure no.3 and 3.



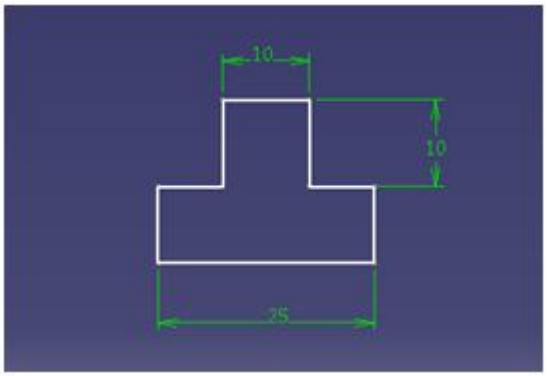


Figure No.3: 3D model of work table and sketch of slotting.

2. BASE PLATE: It is basic for building of other components and it is connected with table by link. It shown in figure no.. 4

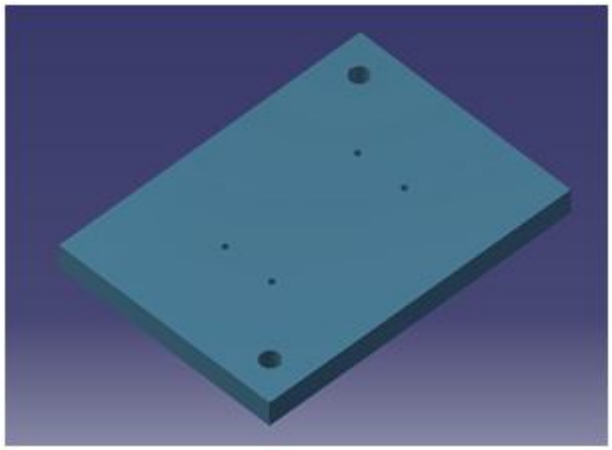


Figure no.4: 3D model of base plate

3. Bush holding plate: It used to locate the drill bits in the actual place with help of drill bushes fixed in it that required drilling. Shown in figure no.5

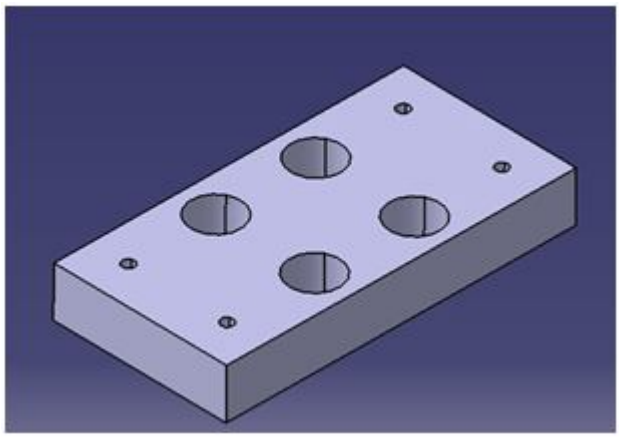


Figure no.5: 3D model of bush holding plate.

4. Drill bushing: It is used for preventing the corrosion for guide drill. It shown in figure no.6

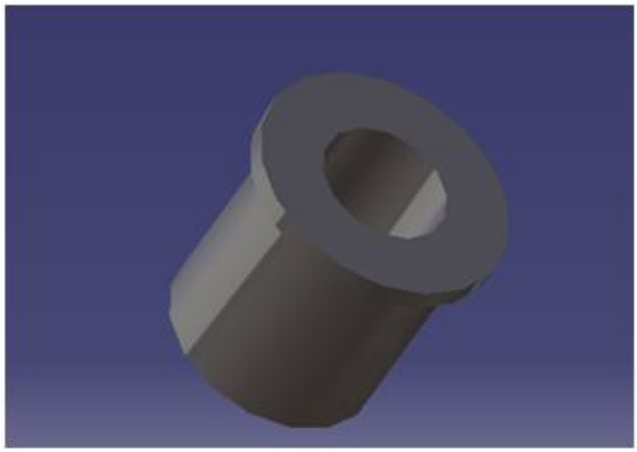


Figure no.6: 3D model of bushing

5. Support block: It is used to support bush holding plate with drill bush fixed in it from the base plate. Shown in figure no.7

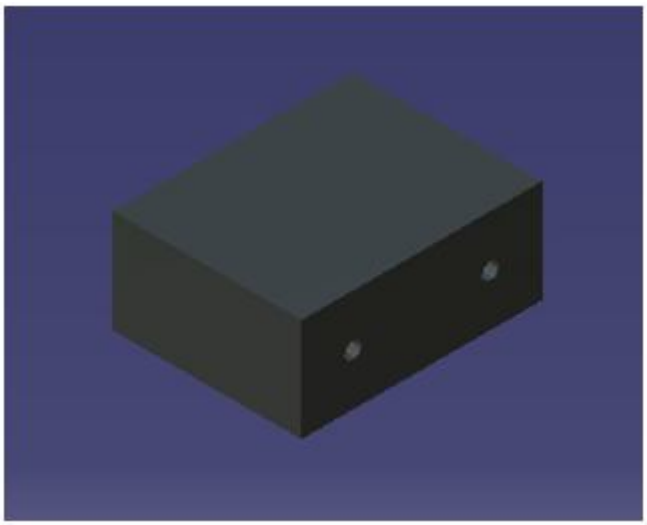


Figure no.7: 3D model of support block

6. L-channel Support: It is used to support the work piece from back and fix it at the accurate position. Shown in figure no.8

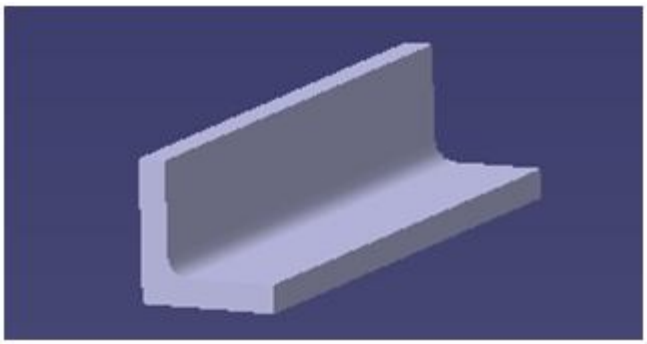


Figure no.8: 3D model of L-channel support

7. Clamping arm: It is used for fixing the work piece from the other side with tightening of a half screw fixed in this arm. This arm is very useful in easy interchangeability. It is shown in figure no.8

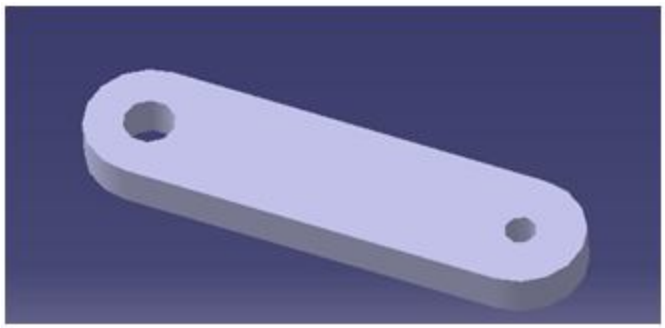


Figure no.8: 3D modeling of clamping arm

8. Bracket: It is used to fix the clamping arm with rotation motion. The arm is fixed in it by a pin. It is shown in figure no.9

Figure no.9: 3D model f bracket

9. Fork Block: it is used to locate the arm with interfacing the work piece. It is shown inFigure no.10

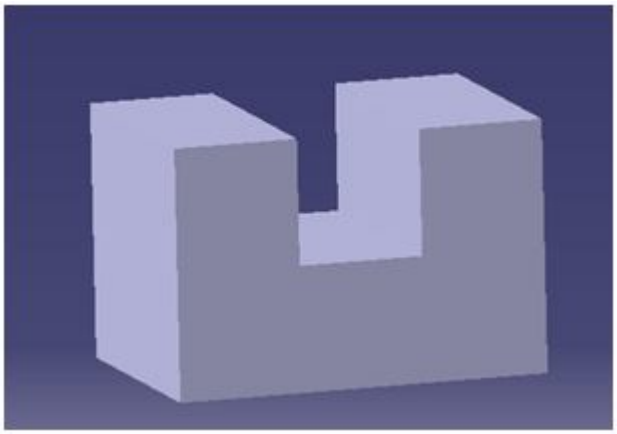


Figure no.10: 3D model of Fork Block.

10. Drill bit arrangement: this arrangement of four spindle with drill attached is connected with a CNC head used to drill four drill at a time shown in figure.11

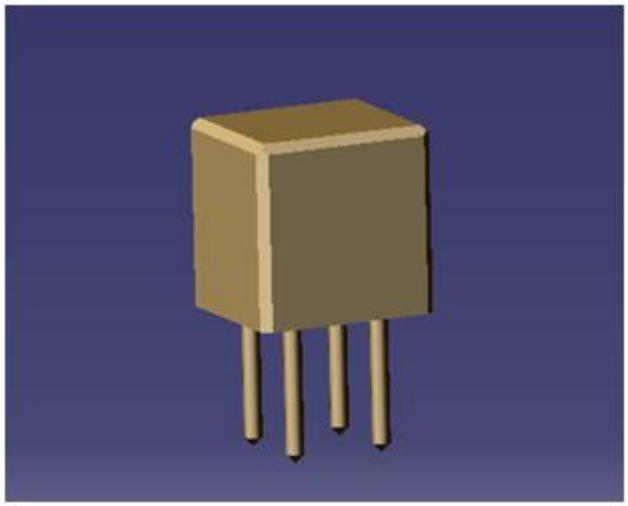


Figure no.11: 3D model of drill bit arrangement.

VI. FINAL DESIGN OF ASSEMBLY OF JIG

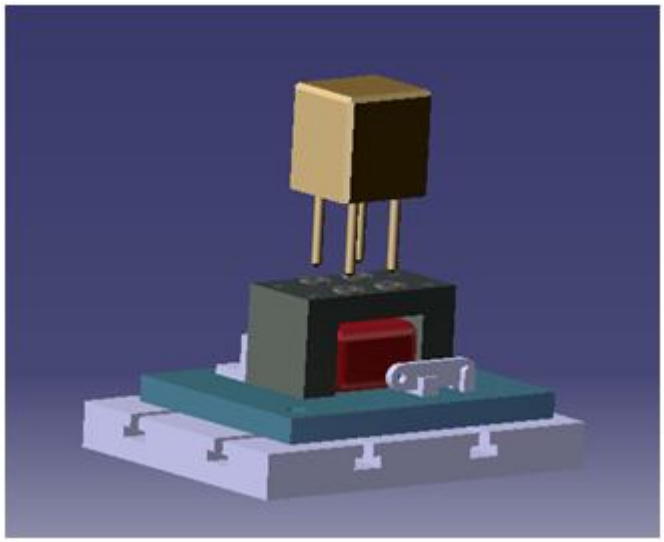


Figure No: 12 Final assembly

VII. CONCLUSION OF THIS DESIGN

In this design paper a jig has been made for machining of a job work in which four holes in a work piece can be done with a single downward stroke of the CNC machine. This design of the jig eliminate the time taken in changing the position of the work piece after every stroke of the drill. Once the work piece is fixed in this jig now all four holes can be done in the single stroke and then this process can repeat with another work piece. This design of jig leads to decreasing machining, labour cost and also increasing the productivity and accuracy of the machining process. Time taken in the drilling operation will be lesser with this jig as compare to time taken without jig.

VIII. FUTURE SCOPE

This design of jig can be used further for the various other machining operations like punching, milling etc.

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