

# **Design and Fabrication of Drill Jig for Cooling Tower Hub**

Swapnil Salunkhe<sup>1</sup> Prof: Vijay Dhadke<sup>2</sup>

<sup>1</sup>Final year PG student, Department of Mechanical Engineering, Pillai HOC College of Engineering and Technology, Rasayani, Mumbai, India<sup>1</sup>

<sup>2</sup>Asst. Professor, Department of Automobile Engineering, Pillai HOC College of Engineering and Technology, Rasayani, Mumbai, India<sup>2</sup>

**ABSTRACT:** The manufacturing industry mainly small scale and medium scale provides wide range of products to fulfill the market needs. To face the many challenges of market these industries should increase their production rate with good quality and accuracy. As the company's present requirement they need such a technique for drilling operation which can be efficiently used to reduce the cost of production, improve the quality of product, increase the production rate and reduce the operation time. Therefore, this project aims to design and Fabrication of drill jig. The main purpose of making this drill jig is to perform drilling operation without any need of shifting the job regularly and these creative approaches have necessitated the need for a reliable and cheaper tools and work holding devices. Firstly we will draw 2D drawing of jig by drafting Further we make 3D model by using Solid works software the objective of this project work is to design a drill jig for cooling tower hub. According to the dimension, all parts are manufactured and assembled together.

**KEYWORDS:** Work holding devices, clamping system, Interchangeable part concept, Mass production, Manufacturing, Model

## **I. INTRODUCTION**

Over the past century, manufacturing has made considerable progress. New machine tools, high-performance cutting tools, and modern manufacturing processes enable today's industries to make parts faster and better than ever before. Although work holding methods have also advanced considerably, the basic principles of clamping and locating are still the same. The first manufactured products were made one at a time. Early artisans started with little more than raw materials and a rough idea of the finished product. They produced each product piece by piece, making each part individually and fitting the parts into the finished product. This process took time. Moreover, the quality and consistency of products varied from one artisan to the next. As they worked, early manufacturing pioneers realized the need for better methods and developed new ideas. Eventually, they found the secret of mass production target is to increase the productivity and increase the accuracy by reducing the setup time, labour cost and manual operations These standard parts were the key to enabling less-skilled workers to replicate the skill of the craftsman on a repetitive basis. The original method of achieving consistent part configuration was the template. Templates for layout, sawing, and filing permitted each worker to make parts to a standard design. While early templates were crude, they at least gave skilled workers a standard form to follow for the part. Building on the template idea, workers constructed other guides and work holders to make their jobs easier and the results more predictable. These guides and work holders were the ancestors of today's jigs and fixtures. A jig minimizes the repetitive nature of work required for drilling a hole, as the locating, d guiding are done by jig itself.

## International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 7, April 2017

5<sup>th</sup> National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2017)

30<sup>th</sup> & 31<sup>st</sup> March 2017

Organized by

Sri Krishna College of Engineering & Technology, Kuniyathur, Coimbatore-641008, Tamilnadu, India

### II. PROBLEM STATEMENT

As per the companies present requirement they need such a technique for drilling operation which can be efficiently used to reduce the cost of production, improve the quality of the product, increase the production rate and reduce the operation time. These following part are having drilling operation which is currently done with manual mode of drilling comprising various processes such as marking, punching, setting of components and drilling.

These will semi automated the process and provide better way to increase the production. The below mentioned part is having drilling operations at various positions, which require tedious method of operation. For that total drilling operations require 90 minutes in manual condition.



It time consuming, so we have decided to Design the Jigs & Fixtures for it. After detailed study of these components we have come to the conclusion that the providing drilling jig is the best way to increase the production rate.

### III.OBJECTIVES

1. Mass production methods demand a fast & easy method of positioning work for accurate operations on it.
2. Analyze the part data to determine suitable jig type to perform Specified tasks.
3. Specify the locating, clamping, supporting methods and details to suit sample parts.
4. Design drill jig to suit the specified sample parts and construct the required drawings.
5. Used to drill holes to an exact location in many identical parts - Used to save layout time. - Produces holes accurately and economically.

### IV. SOLIDWORK MODEL

Solid Works (stylized as SOLIDWORKS) is a solid Modeling computer-aided design(CAD) and computer-aided engineering(CAE)computer program that runs on Microsoft Windows. Solid Works is published byDassaultSystems.

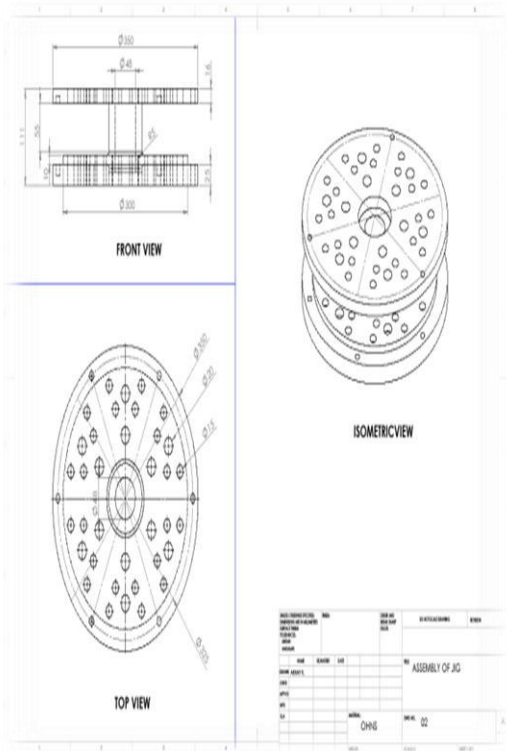


Fig.1

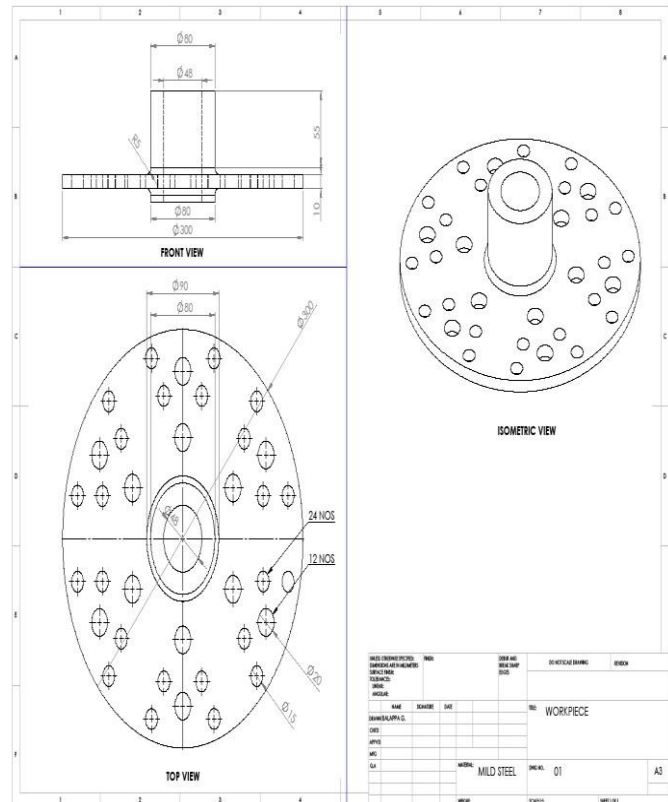


Fig.2

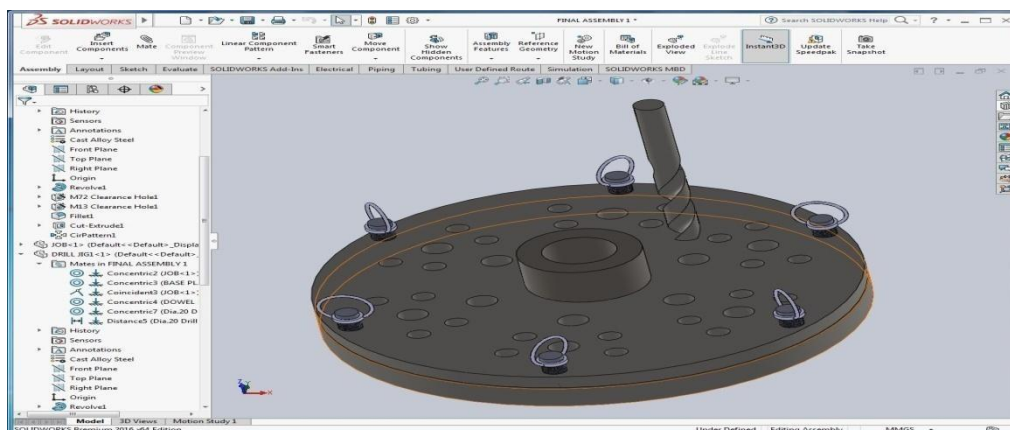


Fig 3 shows that full assembly of drill jig

Fig.1 Shows arrangement of whole model according to dimensions first base plate then drill jig plate and In between this two plates having workpiece & shows clamping, locating positions.

Fig.2 shows that standard dimension of workpiece as per requirement. and also shows position of different holes in different sizes.

## International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 7, April 2017

5<sup>th</sup> National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2017)

30<sup>th</sup> & 31<sup>st</sup> March 2017

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

In fig.3 Detailed study about this diagram I will make solid model of drill jig for each part by using solidworks software and assemble it.

### V. SELECTION OF MATERIAL

To prepare any machine part, the type of material should be properly selected, considering design, safety and following points:-

The selection of material for engineering application is given by the following

factors:-

- Availability of materials.

- Suitability of the material for the required components.

- Suitability of the material for the desired working conditions.
- Cost of the materials.

We have selected the Mild steel material for Base plate & Workpiece considering the above factors.

#### 1. BASE PLATE & WORKPIECE

**Material:** MILD STEEL

**Composition:** Carbon → 0.20 % - 0.30%

Manganese → 0.30% - 0.60%

**Reason for using mild steel:**

Is readily available in the market.

It is economical in use.

It is available in standard size and dimensions.

It has good mechanical properties i.e. easily machinable.

It has moderate factor of safety.

It has high tensile strength and low coefficient of thermal expansion.

**Properties:** Tensile strength 44.54 kgf/mm<sup>2</sup>

Yield stress 28 kgf/mm<sup>2</sup>

Hardness 170 BHN

**Application:** General purpose steels for low stressed components.

#### 2) JIG PLATE

**JIG MATERIALS:**

Jigs are made from variety of materials, they should be harden to resist wear. It is sometimes necessary to use nonferrous metal like phosphor bronze to reduce wear of the mating parts or nylons to prevent damage to the workpiece. Given below are the materials often used in design of jig.

#### 1. HIGH SPEED STEEL (HSS):

These contain 18% tungsten for toughness and cutting strength, 4.3% chromium for better harden ability and wear resistance and 1% vanadium for retention of hardness at high temperature and impact resistance. HSS can be air or oil hardened to RC 64-65 and are suitable for cutting tools such as drills, reamers and cutters.

**International Journal of Innovative Research in Science, Engineering and Technology**

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 7, April 2017

5<sup>th</sup> National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2017)

30<sup>th</sup> & 31<sup>st</sup> March 2017

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

**2. OIL HARDENING NON – SHRINKING TOOLS STEELS:**

These contain 0.9 – 1.1 % carbon, 0.5 – 2 % tungsten and 0.4 – 1 % carbon. These are used for fine parts such as taps, hand reamers too, milling cutters, engraving tools, and intricate press tools which cannot be ground after hardening.

**3. MILD STEEL:**

It is the cheapest and the most widely used material in jigs and fixtures. It contains less than 0.3 % carbon. It is economical to make parts which are not subjected to muck wear and not highly stressed from mild steel.

➤ We have selected the OHNS material for Jig plate considering the above factors and as per suitable condition

**Material:** OHNS/WPS

**Composition:**

Steel Type	Quality	AISI	TYPICAL ANALYSIS IN %								
			C	Si	Mn	Cr	W	V	Co	Mo	Ni
OHNS Die Steel	OHNS	01	0.95	...	1.00	0.50	0.5	0.10	...	...	...
	"	02	0.90	0.20	1.90	0.30	...	0.10	...	...	...
	"	EO300	1.00	0.40	1.00	1.00	...	0.10	...	0.10	...

**Reason for using OHNS material:**

An Ideal type oil-hardened steel which is economical and dependable for gauging, cutting and blanking tools as well as can be relied for hardness and good cutting performance

**Properties:** Hardness 60-70hrc

**Application:** Blanking and stamping dies, Punches, Rotary shear blades, Thread cutting tools, Milling cutters, Reamers, Measuring tools, Gauging tools, Wood working tools, Broaches, Chasers.

**3) DOWEL PINS & BOLTS**

**Material:** silver steel & mild steel

**Application:** use in various machining operation to restrict the motion of workpiece.

**VII.MANUFACTURING PROCESS AND PROCEDURE:**

1.The first step in the design is to draw the outline of workpiece in the required position for the machining and to draw the location system and the clamping system.





Fig.4

2. Turning of jig plate and base plate and maintaining the diameter of 350mm on the lathe machine. Grooving or step turning or drawing the base plate of inner diameter of 80mm.
3. Drilling the 36 deep holes at six equidistance on the base plate and jig plate for workpiece and the 3 deep holes on jig plate with threading done at the three alternate holes to bolts for accurate position and location of workpiece and three alternate groove holes on jig plate and base plate to dowel pins for restriction. the motion they are programming on C.N.C. machine as per drawing in the product design and C.N.C. drilling are carried in drilling operation.



Fig.5



Fig.6

4. Boring of inner diameter of 80 mm on the lathe machine and then all the materials are heat treated up to 58 rc to make jig durable, hard and increasing the life then, all assembly of parts is done **Manufactured jig:**

**International Journal of Innovative Research in Science, Engineering and Technology**

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 7, April 2017

5<sup>th</sup> National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2017)

30<sup>th</sup> & 31<sup>st</sup> March 2017

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India



**VII.COST ESTIMATION**

The importance of cost estimation is well known as any manufacturing concern. Estimates are basis on which any factory fills up leaders & start production work after accepting that the manufacture of any particular component will be a profitable business. Both over estimating & under estimating is dangerous to concern. Overestimation leads to heavy financial losses. Hence greater care has to be taken while preparing estimate. An estimate has defined as a guess for calculating of cost which is likely to be incurred in the production of component. Before it is actual manufacture base of all known facts. In addition it also determines the quality of materials, tools used & type of labour etc.

**NEED OF COST ESTIMATION:**

- (1) The selling price of product that ensures reasonable profit to the company is economical to be manufactured in the company.
- (2) Decides whether the part or assembly is to be purchased.
- (3) Initial means of cost reduction.
- (4) Determine the most economical process or material in manufactured product.

The costs accounted in this project are material cost, machining cost & cost of Standard parts & cost of indirect expenses.

**A) RAW MATERIAL:**

SR NO.	NAME	DIMENSIONS (all in mm)	QUANTITY	COST (Rs)
1.	M.S. BASE PLATE	350 DIA. 25 THK	1.Nos	1500/-
2.	OHNS JIG PLATE	350 DIA. 16 THK	1 Nos.	5600/-
3.	DOWEL PINS & NUT, BOLTS	M18	6 Nos	400/-
	<b>TOTAL COST</b>			<b>7500/-</b>

**B) MACHINIG COST:-**

Here we have to work on the different machines for having different Operations. So the machine is being hired for that much period of time. Considering the depreciation and the electric light bill along with the rent of The work shop or the initial investment, the machining cost is calculated as the cost in Rs/hour.

**International Journal of Innovative Research in Science, Engineering and Technology**

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 7, April 2017

5<sup>th</sup> National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2017)

30<sup>th</sup> & 31<sup>st</sup> March 2017

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

Sr.No.	Machine	Time In hours	Rate In Rs.	Operation	Rupees
1	Lathe	2	250	Turning and boring	500/-
2	Milling M/C	1	250	Key slot	250/-
3	CNC M/C	3	2000	Fixing the linkages	6000/-
4	Grinding M/C	1	80	Finishing the comp.	80/-
5	Cutting M/C	1	80	Parting off Objects	80/-
	Total				6910/-

(C) HEAT TREATMENT COST:- 42 Rs. per kg  
C=1650/-

(D) LABOUR COST :-The labor cost consists of the amount incurred on the wages paid to the Operators. The cost is calculated based on the calculation of the hourly wages paid to the operator. Here the operator is considered as the skilled operator.

Hence the total manufacturing cost = A + B +C=7500+6910+1650  
= 16060/-

**IF LABOUR COST ADDED**

**Labours Required:**

The number of labours required for various operations such as welding, grinding, fitting, cutting and for helping. The following table represents the total labours required for making the whole fixture

SR NO.	DESIGNATION	NO. OF LABOUR
1.	LATHE M/C OPERATOR	1
2.	CNC M/C OPERATOR	1
3.	GRINDER	1
4.	HELPER	1

**labours cost:**

Sr. no	Operation	Hours	Rate/hours	Amount paid
1	Turning	2	160	320/-
2	Milling	2	160	320/-
3	CNC m/c	3	1000	1000/-
6	Grinding	2	100	200/-

Hence the total manufacturing cost =A+B+ C+D=7500+6910+1650+1940=18000/-



**VIII.RESULT & CONCLUSION**

**8.1 RESULT:**

**Cycle Time:**

Cycle time is defined as time required to complete the process on workpiece. It includes the time from when an operator starts a process until the work is ready to be passed.

The purpose of knowing cycle time is to planning and provide the basis for continuous improvement

SR NO.	OPERATION	TIME REQUIRED BEFORE JIG (MIN)	TIME REQUIRED AFTER JIG (MIN)
1.	MARKING TIME	21	0
2.	DRILLING OPERATION		
	A)SMALL DRILL	13.5	18
	B)MEDIUM DRILL	16.5	
	C)LARGE DRILL	18	
	D)CHAMFERING	3	0
3.	TOTAL TOOL CHANGE TIME	3	0
4.	TOTAL SETTLING TIME	15	30
	TOTAL PROCESSING TIME	90	48

Saving labour hrs= 42 min

**“Saving labour hrs ultimately saved the labour cost.”**

**IX. CONCLUSION**

In this project work the drill jig is successfully Design & fabricated for cooling tower hub. The drill jig modeled by using Solidworks software.then fabricate. By using this jig to eliminate the need for a special set up for every workpiece thereby facilitating production and also ensuring that every workpiece is manufactured within a predetermined tolerance.and drill jig are made of Oil hardening non shrinking steel. Saving labour hrs= 42 min  
“Saving labour hrs ultimately saved the labour cost.”

The mechanical advantage of jig is much more useful for mass production in industrial field.

1. Because of use of jig Accuracy, quality, mass production increases and error decreases.
2. We can handle batch production with less time and more efficiency.
3. Mechanical advantages of mechanism eliminate the massive human efforts.
4. Testing trial was done on machine the performance of machine and efficiency of machine, satisfactory.
5. The items manufactured are in proper sequence.
6. We could understand different mechanical processes, materials, and working media.

**REFERENCES**

- 1) M.H.A Kempster, Intoduction to Jig & tool Design S. Chand & Company Ltd, 3<sup>rd</sup> Edition
  - 2) Mohson Ali, Ganesh Mahale. Design & analysis of drill jig for weight lever jig, IJPRET 2013
  - 3) Shivanand vathare, Shrinivas l Gombi,Darshan M.Katgeri. Design and analysis of Drill jig for head and cover part of the Actuator
  - 4) NBV Lakshmi Kumari, G.Prasanna Kumar Design and Analysis of Indexing Type of Drill Jig
- BOOKS: 1.Production Process-II by Ingole S.B. 2.Workshop Technology by Hajra Choudhary  
3.Production engineering by P.C.Sharma