Design, Modification and Manufacturing of CB Ring Fixture

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ABSTRACT

CB Rings with the help of Vertical Machining Centres (VMCs) have greatly improved the process of manufacturing different complicated products by increasing accuracy, reducing machining times and transferring the heavy lifting to the machines and computers. But increasing demands by customers are forcing companies to devise new methods of furthering this objective. The two VMCs currently active in Antech Industries are in need of newer methods to optimise their usability. The most direct way to do this is to design a fixture for every type of component machined. Fixtures are used to securely locate and support the workpiece to ensure uniformity and accuracy in all numbers of the part. Another general method would be to optimise the VMC itself for better holding. This is the first part of the project; to design an attachment for the VMC table to allow for Single Minute Exchange of Dies (SMED).

Parato Analysis is process of observing every second of the process cycle from the beginning to the end and plotting the various times for every part of the process on a chart/table. Such micromanagement of the cycle time yields a better idea of the percentage of time occupied by each part of the process. This can be used to identify various opportunities for time saving after a Pareto analysis of the process. This technique helps to identify the top portion of causes that need to be addressed to resolve the majority of problems. Once the predominant causes are identified, then tools like the Ishikawa diagram or Fish-bone Analysis can be used to identify the root causes of the problems.

Keywords*: SMED, PARETO ANALISYS, PULSE MAPPING*

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1. Designof Jigs and Fixture

The design of jigs and fixtures is dependent on numerous factors which are analyzed to achieve an optimum output. Jigs should be made of rigid light materials to facilitate easy handling, as it has to be rotated severally to enable holes to be drilled from different angles. It is recommended that four feet should be provided for jigs that are not bolted on the machine tool, to enable the jig to wobble if not well positioned on the table and thereby alert the operator. Drill jigs provide procedures for proper location of the work-piece with respect to the cutting tool, tightly clamp and rigidly support the work-piece during machining, and also guide the tool position and/or fasten the jig on the machine tool. To achieve their expected objectives, jigs and fixtures consist of many elements: Frame or body and base which has features for clamping;

- The accuracy and availability of indexing systems or plates;
- The extent of automation, capacity and type of the machine tool where jigs and fixtures will be employed;
- Bushes and tool guiding frames for jigs;
- The availability of locating devices in the machine for blank orientation, and suitable positioning.

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JIGS:

It is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation. Jigs are usually fitted with hardened steel bushings for guiding or other cutting tools. a jig is a type of tool used to control the location and/or motion of another tool. A jig's primary purpose is to provide repeatability, accuracy, and interchangeability in the manufacturing of products. A device that does both functions (holding the work and guiding a tool) is called a jig. An example of a jig is when a key is duplicated, the original is used as a jig so the new key can have the same path as the old one.

FIXTURE:

It is a work holding device that holds, supports and locates the workpiece for a specific operation but does not guide the cutting tool. It provides only a reference surface or a device. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in some cases hold a workpiece during either a machining operation or some other industrial process. A jig differs from a fixture in that a it guides the tool to its correct position in addition to locating and supporting the workpiece.in the machine for blank orientation, and suitable positioning.

2.Selection of component for Manufacturing of Jigs and fixture

Pareto analysis is a means used to signify and prioritize the reasons leading to problems specified in quality improvement process (Gitlow et al., 2005). The technique developed by Italian economist Vilfredo Pareto has been started to be commonly used in management area especially in consequence of the studies of Joseph M. Juran, the founder of total quality management. Vilfredo Pareto examined how the revenue of Italy is shared by public and stated that about 20% of the population had the 80% of the revenue generated in the country and the remaining 80% of the population only had 20% of such revenue. This detection took place in literature as 80-20 Pareto rule (Bozkurt, 2003). According to Pareto rule, generally 80% of the faults in a system stems from 20% of the reasons constituting the faults (Cravaner et al.,1993). Deming also adopted Pareto analysis following Juran and started to use it intensively. As a result of the transfer of Pareto analysis to Japans in the seminars of Deming conducted in Tokyo, such technique has been started to be commonly used by quality improvement groups. Pareto principle is also called as "80-20".
Pareto analysis is a technique which is used to separate significant causes from less significant ones. Such technique can also be used in many areas other than economy since it helps to specify priorities thereby stating the problem with the help of graphic.

SR NO	PART NAME/NO	SR NO	DEFECT DESCIPTION	REJECTED QTY	% REJECTION	CUMULATIVE %
1	2205	1	BROACHING DENT	24	43.63636364	43.63636364
		2	TOTAL LENGTH	10	18.18181818	61.81818182
		3	ID Rej	4	7.272727273	69.09090909
		4	DIP Higher	3	5.454545455	74.54545455
		5	Face unclean	3	5.454545455	80
		6	Cone DIA Rej	2	3.636363636	83.63636364
		7	Parallity Rej	2	3.636363636	87.27272727
		8	Double Broaching	2	3.636363636	90.90909091
		9	Job Sleeped jaw ID Mark	1	1.818181818	92.72727273
		10	O D Rej	1	1.818181818	94.54545455
		11	Power off	1	1.818181818	96.36363636
		12	Power off	1	1.818181818	98.18181818
		13	Tool mark	1	1.818181818	100
			TOTAL	55		

Table -1: Defect description for C.B Ring

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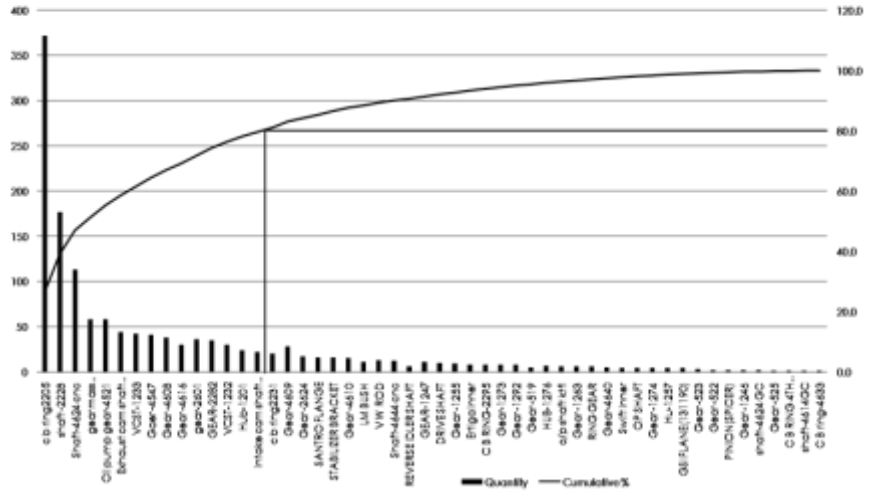

Fig-1: Pareto chart for C.B Ring

Part-wise Rejection data

C.B Ring manufacturing travels through a sequence of manufacturing and machining processes to become end product. Quality control at every workstation is important. Controlling measures for preventing the defect parts being accepted and sent through next stations need to be avoided to reduce the defect rate in the processing itself.

step 1 •Set the objectives for the study

step 2 •Review the existing opeation process and quality system in the piston machine shop

step 3 •Identification of nature defects in the piston unit by collecting data and categorization of defect

step 4 •Implementation of check sheet in order to capture number of defects occurance

step 5 •Analysis of data collected in order to identify the major occuring defects

step 6 •Identify the frequently rejected parts by the help of pareto chart

step 7 •To determine the reason for rejection using cause and effect diagram

step 8 •To collect samples using subgroup method and plotting control charts

step 9 •To provide suggestion to solve the problem

Rejection data was collected for all the parts processed in the company.

Using the 80-20 (Pareto) principle, some parts were shortlisted to be considered for analysis. Pareto analysis helps to identify and classify the defect according to percentage significant. Cause and effect diagram is a useful tool in identifying the major causes. This diagram helps to build a relationship. Brainstorming is done with utilising these quality tools to provide an effective solution. Thus quality management tools are effective and significant in reducing the rework and rejection rate.

Generation of Model

The model is generated using Creo Parametric 3.0. It is made of two parts, the base plate and the resting plate, designed separately and then assembled together. The fixture is designed for the Broaching process, used to machine the central sprocketed bore.

Attachment for VMC

Design of a simple attachment for VMC table, to reduce changeover times. This is an application of SMED principle.

Base Plate:

The base plate represents the old fixture, which was in use by the company prior to the project.The recess provided in the base plate provides room for the Resting plate, which can be changed according to the component .

Resting Plate:

The Resting Plate sits atop the Base Plate, and provides a ground for the main component. It also houses 15 bolts, fitted with bushes, on its circumference. These are used to serve the purpose of cleaning the Broach tool.

Fig-2: Assembly model

Analysis using FEA

Finite Element Method (abbreviated as FEM) is a numerical technique to obtain an approximate solution to a class of problems governed by elliptic partial differential equations. Such problems are called as boundary value problems as they consist of a partial differential equation and the boundary conditions. The finite element method converts the elliptic partial differential equation into a set of algebraic equations which are easy to solve.

The software used to implement this technique was ANSYS 16.0. The resting plate, modelled in Creo Paramteric, was imported to ANSYS and then meshed to obtain a solution.

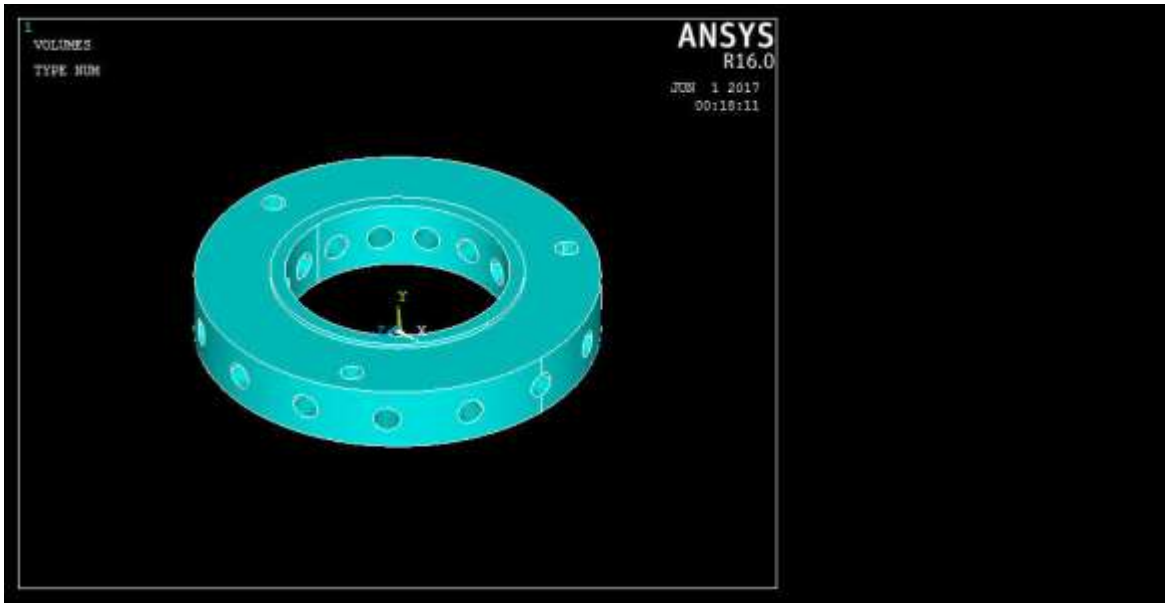

Fig-3: Base Plate ANSYS

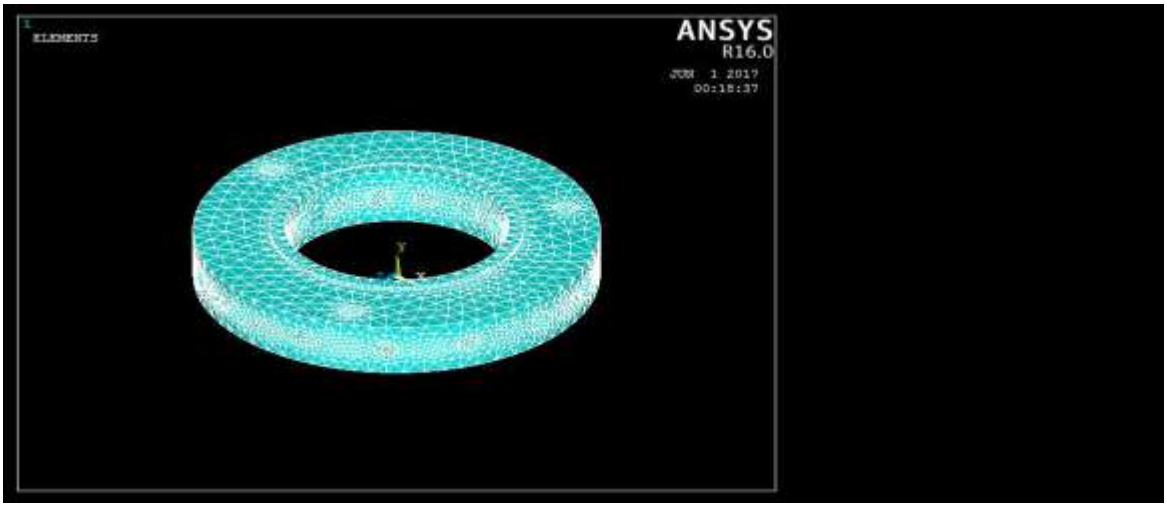

Fig-4: Elemental representation

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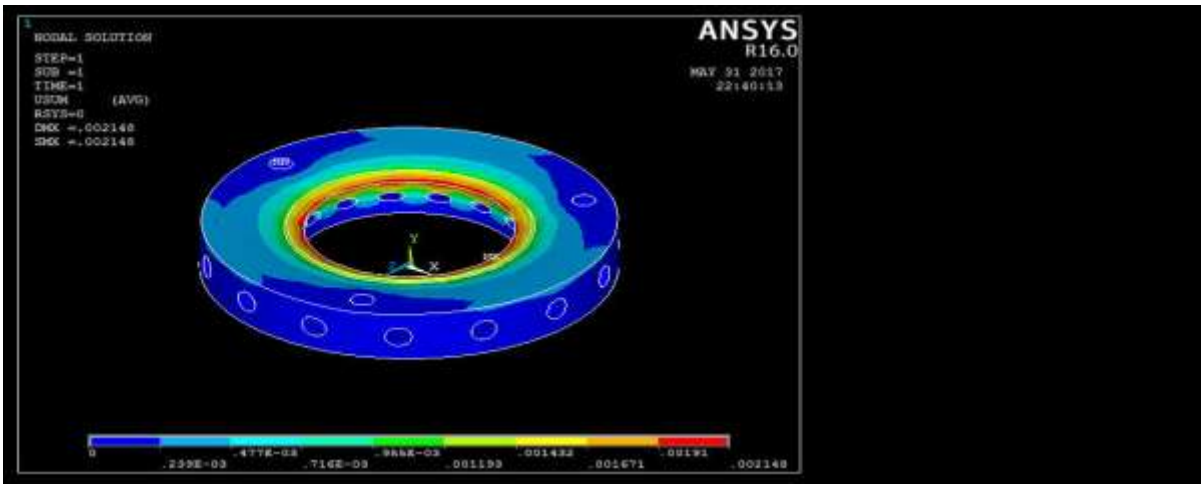

Fig-5: Nodal displacement

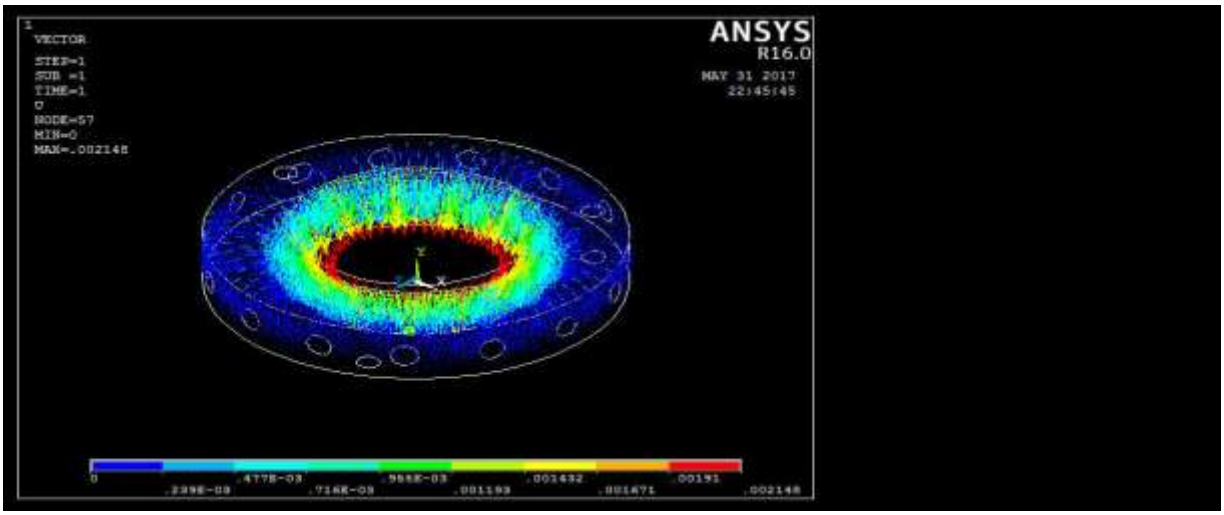

Fig-6: Nodal displacement vector

3. CONCLUSION

The fixture was in use for a period of three months, wherein it was monitored carefully to observe the effects of its implementation.

Sr. No.	Month	Rejected Quantity by Broaching Dent	Cost incurred per piece (Rs.)	Cost per month (Rs.)
1.	April	22	78	1716
2.	June	21		1638
3.	July	24		1872
			Avg. Loss per month (Rs.)	1742

Sr. No.	Month	Rejected Quantity by Broaching Dent	Cost incurred per piece (Rs.)	Cost per month (Rs.)
1.	December	2	78	156
2.	January	4		312
3.	February	2		156
			Avg. Loss per month (Rs.)	208

Fig-7: Before and After implementation of Fixture

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