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Proposed Method to Optimize the Production Process in Machining of Tibial Insert used in Knee Transplant

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Abstract—*The demand for the manufactured goods is increasing at breath taking speed. These demands are met by the industries with many new methods and technologies. From the traditional manufacturing to the evolution of Computer Numerical Control and from Computer Aided Manufacturing to the modern manufacturing techniques such as Flexible Manufacturing System (FMS), Just in Time (JIT) there is a drastic change and advancement in manufacturing.In manufacturing industry, the introduction of Flexible Manufacturing System (FMS) has given significant results such as high productivity, high quality, low-costproduction and reduced cycle time. This paper is to propose a method for optimizing the production time in machining theTibial insert used in knee transplant. The cycle time in producing a component depends on number of factors. It includes machining, cutting, setting and miscellaneous parameters. By working on the areas like optimizing the spindle speed, depth of cut, feed rate, clamping and unclamping the workpiece, reducing the number of tools, reducing the unproductive tool paths etc... the total cycle time can be reduced. This paper studies on the current working method practiced in machining the component in the company and analysis is done on the above said fields.It isfound that much of the time is consumed in setting the workpiece accurately in the fixture for machining. Thus the area of fixturing of the component is taken as the objective to optimize the cycle time.*

1. INTRODUCTION

A fixture is a work holding device used for locating, supporting, clamping the workpiece firmly in position so as to carry out the"FMS can be defined as highly flexible production unit capable of producing a range of discrete products with a minimum of manual intervention". FMS consists of CNC machines, industrial robots, inspection units and other equipment integrated with automatic material handling and storage systems. The fundamental of all these process is proper holding of workpiece at every stage.Although there are much advancement in the field of machine tools, cutting tools and production methods, the basic concept of holding the workpiece has seen very little changes. Whatever is the operation like simple drill or machining or joining or inspection the part should be accurately located and securely held throughout the operation. Like all the required operations cannot be performed in a single machine tool, every part cannot be held in a single work holding devices. And hence fixture design is necessary and is ever changing for every part.

A fixture is a work holding device used for locating, supporting, clamping the workpiece he manufacturing process like machining, assembly and inspection as per design requirements. Fixture enables accurate positioning and locating the workpiece for repeated jobs and has direct effect on machining quality, productivity and cost of products. A traditional fixture requires longer lead time and is economical for mass productions.

Modular fixtures are advisable for small and medium batch productions. Modular fixture is an assembly of set of standard components of fixturing.The cost of developing modular fixture is less as it does not require manufacturing but only the assembly. The flexibility and re configurability in modular fixturing systems are the two important factors in FMS. The dedicated fixture is not the assembly of the standard fixture elements as in modular fixturing. The fixture element is machined to suit the geometry of the component. Hence it can be used only for the component with similar profiles.

2. LITERATURE REVIEW

The primary step in the methodology of designing the fixture begins with review of the literature. The aim of the chapter is to gain sufficient knowledge about the various techniques used in the past and the technology available in the current scenario. The review includes the fixtures used in various disciplines that formed a base for proposing the methodology in design of fixture.

[1]This paper is about to increase the productivity by designing a fixture for brake spider.Modelling is done using CATIA V5 and analysis using ANSYS software. The conceptual design is done for arresting the twelve degree of

freedom by stoppers, locators, orienting and clamping. Detailed design is done in modelling software and finally analysis is done on critical components. **[2]**This paper gives genetic algorithm (GA) based optimisation method to determine the layout and to provide the location for the locators having error so that the machining errors are minimised satisfying the tolerance limits. The experiments are carried out in a 3D workpiece under 3-2-1 principle. GA is computerised search and optimisation algorithm based on mechanics of natural genetic and selection.[**3]**The objective of the work is to design the fixture for machining operation on the crank case used in commercial vehicle at an angle of 102.5º. The design is done with the systematic approach like study of the component, geometric modelling of the component, design calculations, selection of tooling material, solid modelling of the tool and analysis. Simple fixture design is developed and operations like machining, boring, drilling, tapping can be done in a single setup. **[4].**The guide disc machine tool is a special purpose machine for metal cutting. This is used to produce guide disc for hot rolling seamless steel tube. Since the guide disc is subjected to continuous rolling the wear on the outside of the disc is very high. Numerical control guide disc machine tool is developed to achieve the goal of camping he workpiece automatically with telescopic hydraulic control spindle and holistic structure design. **[5].**The aim of this work is to develop a fixture for rear axle panel. Body in White (BIW) refers to the assembly of the car body sheet metal which includes doors, hoods and side closers before adding chassis, motor, seats and electronic items. The developed fixture has improved the quality of the product, improved efficiency of the plant, reduced rework and scrap. **[6]**.The objective of the paper is to examine the effect of welding fixture which is used to reduce the distortion during the cooling process. The cooling process is done by robot controlled gas metal arc welding method. The distortions developed during the cooling process in the welding structures are analysed. **[7].**The materials undergo elastic deformation during the machining process. This leads to the changes in the dimensions and causes error. This paper focuses on the fixture layout to minimise the maximum elastic deformation of the workpiece during machining.

3. COMPONENT DESCRIPTION

The tibial insert is a part of knee transplant. It is designed to suit the Indian lifestyle; it is possible for the patients to sit cross legged after surgery. The Tibial insert is available in sizes that suit the Indian architecture. There are total of fifty four sizes and is made up of ultra- high- molecular- weight polyethylene (UHMWPE). The raw material for the manufacturing of tibial insert is the rectangular block of UHMWPE. It requires three sequences of operations and in each operation the component is clamped in different position. Currently the process is done with the help of two fixtures, in which the first fixture is designed for first two operations, that is first the clamping of the rectangular block for first machining of the profile curve. After the first operation the component is unloaded and clamped upside down in the slot provided in the same first fixture. The second fixture is for the third operation. And both the fixture used has the provision for clamping only one component and hence the cycle time is high.

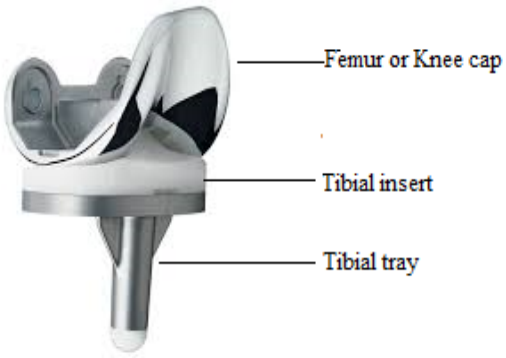

Fig. 1: Knee Transplant- Prothesis Assembly

4. NEED FOR DESIGNING THE FIXTURE

As already discussed, no single fixture can accommodate every work part, there arises the necessity of designing the fixture. The primary objective is to optimize the cycle time in manufacturing the component. The cycle time includes the workpiece loading more precisely, setting and guiding the tool, machining the component and unloading the workpiece. Most of the time is consumed in the initial setting process of the work piece and the tool accurately. The possible solution to reduce the initial setting time is to develop the fixture according to the requirement.

As there are total of fifty four types of the same family with variations in the thickness and the width, the work focuses to design a single fixture which can hold multi components and can be used for fixturing of all the components of the family. There by reducing the cost occurred in developing the fixture for the entire fifty four components. And the main objective of the project is met.

5. STATEMENT OF THE PROBLEM

Factors to be considered when designing the fixture are, 1) To determine the optimum number of components that can be machined at a time, so that the machining time is optimum. 2)To design the fixture for the size of the machine bed. 3) Design of the fixture also requires the maximum tool size used while machining the component in order to provide the safer distance for tool travel between the components. 4) Design of the fixture to suit the machine table T slots.

6. PROPOSED METHODOLOGY

The primary step starts with study of the existing setup & calculation of the cycle time. The principles of an ideal fixture are,

i.Locating and clamping should reduce the idle time of a machine to minimum

ii. Locating and clamping should not interfere with the motions of the tool

iii. Adequate clearance and configuration should allow for easy removal of chips and access of coolant

iv. Design should be robust enough to withstand all coupled cutting forces and vibrations

v. Design should encourage correct workpiece orientation, and eliminate incorrect orientation

The table shows the sequence of steps to be followed in designing the fixture

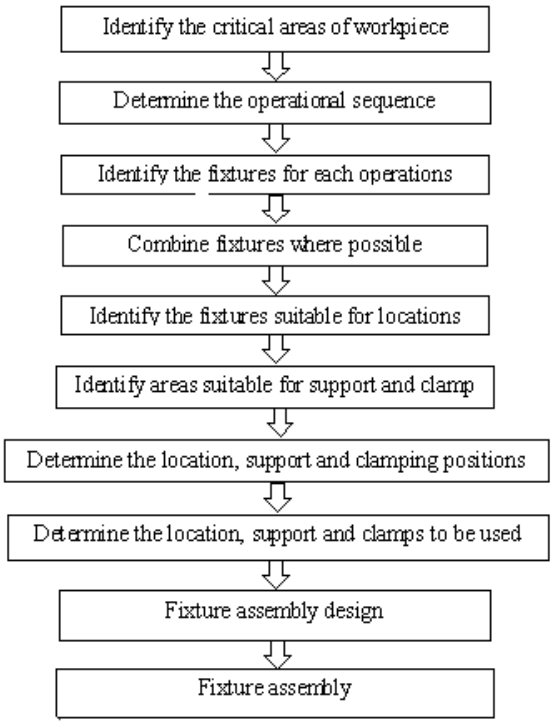

Fig. 2: Proposed Methodology in Development of Fixture

7. OUTCOME EXPECTED

The expected outcomes are,

1. *Increase in the Productivity*: By machining multiple components at a time the total machining time is going to reduce.
2. *Reduce in the Setting Time*: The modular fixtures enable easy location and clamping of the workpiece which eliminates initial setting inspections. This reduces the setting time considerably when compared to the traditional fixtures which are in use.
3. *Reduced Production Cost*: Increase in productivity implies reduced cost per component.
4. *Operated by Unskilled Labors*
5. *Accuracy of the Machining Process*
6. *Reusability*
7. *Quick Change over Time from Job to Job*.

8. CONCLUSION

This paper gives a proposal in the machining to increase the productivity. The guidelines are also provided for designing the fixture and the end results of multi holding fixture are expected to reduce upto 50% of the current cycle time

REFERENCES

[1] Dr.YadavalliBasavaraj, Pavan Kumar B K,Modelling and Analysis of Support Pin for Brake Spider Fixture by FEM using ANSYS Software IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 6, Issue 1 (Mar. - Apr. 2013), PP 10-15

[2] S. Vishnupriyan, M. C. Majumder, K. P. Ramachandran, Optimization of Machining Fixture Layout for Tolerance Requirements under the Influence of Locating Errors - International Journal of Engineering, Science and Technology, Vol. 2, No. 1, 2010, PP 152-162

[3] KiranValandi, M.Vijaykumar, Kishore Kumar S Development, Fabrication and Analysis ofFixture -– International Journal of Innovative Research in Science,Engineering and Technology, Vol. 3, Issue 4, April 2014

[4] KeYanga, Shangjun Guan, Cunlong Wang,The Design & Calculation for Hydraulic Cylinder of Workpiece Hydraulic Clamping System of a Special CNC Machine for Guide Disc,Procedia Engineering 16 (2011), PP 418 – 422

[5] Vijay Patel, NileshGhetiya, Jatin Dave and Sandip Shah,Development of a Fixture for Robotic Assembly Station for an Automotive BIW (Body in White) Line

[6] M. Vural, H.F. Muzafferoglu, U.C. Tapici,The effect of welding fixtureson welding distortions- Journal of Achievements in Materialsand Manufacturing Engineering, Volume 20, 2007

[7] M.Vasundara, K.B. Padmanaban, M. Sabareeswaran, M. Raj Ganesh,Machining Fixture Layout Design for Milling Operation Using FEA, ANN and RSM –Procedia Engineering 38, 2012, PP 1693 – 1703

[8] Liviu Segal, CameliaRomensecue&NicoleaGojinetchi, “Application of Modular Fixturing for FMS”, 2001.

[9] Retfalvi Attila, Michel Stampfer, SzeghImre,”Fixture and Setup Planning and Fixture Configuration System”, Forty Sixth CIRP Conference on Manufacturing Systems, PP 228 – 233, 2013.