Review Paper on Design Strategies for Manufacturing Fixtures as per Machine Operations

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Abstract **- To make the standard machine tool, more versatile to work as specialized machine tools, the use of special production tools, jigs and fixtures is necessary. They are normally used in large scale production by semi-skilled operators; however they are also used in small scale production by when interchangeability is important.Various areas related to design of fixture has been studied and described by various authors. Those ideas and techniques should be summarized and needs to be applied practically in industries. This paper 'Review Paper on Design Strategies for Manufacturing Fixtures as per Machine Operations' summarizes the research work done by the authors on fixture designing and tried to form an effective way of fixture designing comprising all the aspect of designing and fulfilling the operational requirements.**

Index Terms- Design, Design Methodologies, Material Selection, Structural Analysis

I. INTRODUCTION

It is necessary to improve the methods for designing reliable and long-lasting machines and production systems. Fixtures are the tools used to locate and hold the work piece in position during the manufacturing process. Fixtures are used to hold the parts firmly which are to be machined, it is used to produce the duplicate parts accurately. In order to produce parts with required accuracy and dimensions the parts must be firmly and accurately fixed to the fixtures. To do this, a fixture is designed and built to hold, support and locate the work piece to ensure that each work piece is machined within the specified limits. Set blocks, feeler or thickness gauges are used in the fixture to refer the work piece with the cutter tool. A fixture should be securely fastened to the table of the machine upon which the work is to be done. Though largely used on milling machines, fixtures are also designed to hold the work for various operations on most of the standard machine tools. Fixtures vary in design based on the use of relatively simple tools to expensive or complicated devices. Fixture helps to simplify metalworking operations performed on special equipments.

II. METHODOLOGY

Methodology is a systematic approach for realization of a total task. [1] Methodology comprises Knowledge of Component, Dimensional Data of Component, Design Calculations, Material Selection, Modeling and Analysis of Fixture. Lot of research work has been done on the various aspects of the designing by various authors.

A. Knowledge of Component and Fixture

The fixture designing and manufacturing is considered as complex process that demands the knowledge of different areas, such as geometry, tolerances, dimensions, procedures and manufacturing processes. [2].The specifications & limitations of the machine limit the ideas of designing.Designer must be able to visualize exactly how the work piece is to be made.He must have knowledge of standards and procedures. He must understand how tools perform their function.Nirav P. Maniar et al. [3] gives the details in reference with rotary fixture for CNC such that the component is Flow TEE body, made up mild steel, weighing 46.5 kg and is one of the components of petroleum refinery. The component is used as a joint or coupler for pipes through which petroleum liquid products flow and gets mixed. The component in raw material form is forged, proof machined with 3 mm machining allowance on conventional lathe with 24 inch swing over diameter. The operations to be performed

on component, using designed fixture set up, are front facing, outside diameter turning, grooving, boring and back facing.

B. Dimensional Data

Finished Part Drawing, 3D Views of Raw Component, Cross-sectional Views of finished Parts, 3-D Views of Finished Parts should be known to designer [3]. Detailed dimensional data of unprocessed component and processed component should be made available for designing purpose.

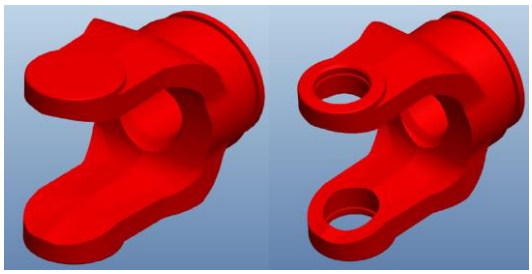

Fig 1 (a) 3D view of Raw Component
(b) 3D view of finished Part [2]

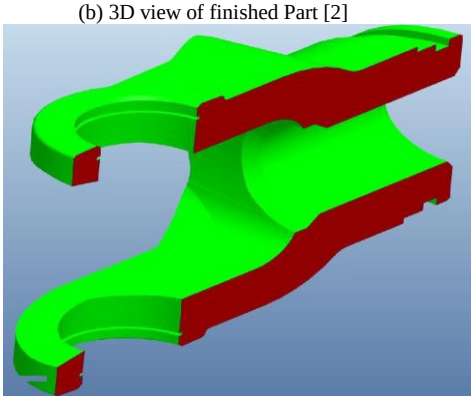

Fig 2 3-D cross-sectional view of finished Part [2]

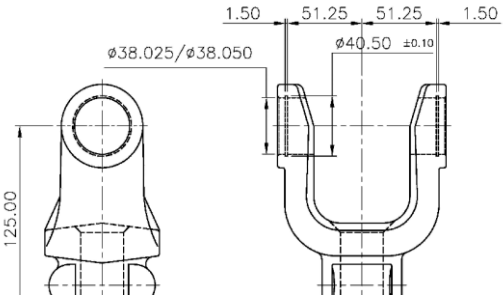

Fig 3 2D Drawing of finished Component [2]
The shown figures of yoke give the detailed dimensions of yoke for the designing fixture to bore on VMC. [2]

C. Design Calculations

In machining, work holding is a key aspect, and fixtures are the elements responsible to satisfy this general goal. Centering, locating, orientating, clamping and supporting are considered the functional requirements of fixtures. [2] According to the component size, functional requirements, Loads coming on it, comprising the various errors (such as Locator errors, Machine tool volumetric errors, clamping errors) [4] the dimensions of the fixture are calculated. There is advanced theory of Design known as Robust Design [4] can be applied for designing. It is more efficient than any other since the design withstand to critical conditions. Also various methodologies are available to for this purpose. Finite Element Method (FEM) determines Elastic Deformation of workpiece. Artificial Neural Networks (ANN), Response Surface Methodology (RSM) predicts the positioning of fixture elements. [5]

D. Material Selection

Material selection is the major step in designing procedure. It's most necessary the development of high functional density and smart applications must overcome certain technical and commercial restriction such as available cost, operating environment, available space, and response time. [6] Fixture can contain various components or a rigid single piece depending upon the requirements. Hence material should be chosen accordingly. Material should withstand the forces

coming on it and shouldn't affect the dimension of the component. Now days, there is lot of research has been going on the Shape Memory Alloys (SMA.)[6] They can be proved to be best alternatives.

E. Modeling and Analysis

Before manufacturing if it is possible to see the performance of design then it is convenient to make the required changes in it. Also it is not necessaryto simulate the design for analysis. There are various softwares which serve these facilities. Computer Aided Drawing (CAD) can be used for modeling which will give us various advanced features. [7] Using Finite Element Analysis (FEA) we can simulate the operating conditions and can observe the effect of working conditions on our design. So that it allows us to optimize our design accordingly. [5]

III. CONCLUSION

The content gives the thorough idea of Fixture design process. This strategy can be used for further designing of fixture for any one. Also there are various alternatives which allow us to alter the design for best results.

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