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"A STUDY OF FIXTURE DESIGN CONCEPTS AND FACTORS AFFECTING: A REVIEW"

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ABSTRACT

Manufacturing process-time optimization is a key element of new industries which not only save time but also increases productivity as well as decreases cost of production. For the optimization of process-time fixture plays an important role, but before the fixture design, we need to have followed design steps of fixture design. This paper represents a study of the detailed process of fixture design and shows a methodology to the development of fixture. The need of this study is based on the requirement to handle Radiator Panels through SPM instead of manually handling which ensure the increment of productivity and high-quality machining process.

Keyword: *SPM, Clamping, SPM*

I. INTRODUCTION

The fixture is a device or a tool which hold a work piece in proper location so that machining operation can be performed on workpeice. The main components of the fixture are supporting and clamping device which requires a important concerns when we design. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a workpiece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Fixture design plays an important role at the setup planning phase.

II. PROBLEM STATEMENT

Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts In existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process functionability.

III. LITERATURE REVIEW

Michael Stampfer [1] explain in his paper which deals with the problem of setup and fixture planning for the machining of box-shaped parts on the horizontal machining centers. The setup and fixture planning involves the definition of setups, the setup sequence and conceptual design of fixtures for each setup. The central topic of this research is the automation of the conceptual design of fixtures. This topic is interconnected with the setup planning, and

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accordingly, the aim of the author has been the integrated handling of tasks of setup and fixture planning and the finding of solution in an integrated system. Based on the workpiece model, the developed system automatically determines the setup sequence, the content of setups and the conceptual solution of fixture for each setup. The paper presents the problems of fixture solutions and the partial tasks of workpiece holding, the typical solution of partial tasks and the conditions of their application and finally offers a new method, which makes the integrated handling of tasks of setup and fixture planning and finding solution in an integrated system possible.

Ajay Juneja et. al. [2] Worked on research which deals with the problems of setup and fixture planning for the machining of prismatic parts. The overall aim is to design the minimum number of setups that can be fixtured and machined using the available fixture elements and tools on the shop- floor. Setup planning takes into account machining sequence constraints, machine tools, as well as the feasibility of fixturing. A general scheme for search strategies in such planning is developed and implemented. The greater part of this work is aimed towards the development of an automatic fixture planner. A generalized representation scheme for a variety of fixture elements using geometric as well as functional properties is developed. A methodology is described to build up assemblies of fixture elements complete with the workpiece. The proposed approach has been implemented as part of an existing automated process planning system called the Quick Turnaround Cell.

Djordje Vukelic et. al. [3] search possibilities for fixture design aided by computers has been in the sphere of interest of a number of authors worldwide for a longer period. Research results have led to the precise and systematized knowledge on the possibilities offered by computer application in fixture design process. The paper emphasizes the importance of fixture design automation. It presents a general structure of the automated design system with a special highlight on the fixture design systems and their main characteristics. It also shows a structure and a part of output results of the automated modular fixture design system. Finally, the conclusions reached are presented with the expected directions of future researches.

Laukik P. Raut [4] In machining fixtures, minimizing workpiece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The various methodology used for clamping operation used in different application by various authors are reviewed in this paper. Fixture is required in various industries according to their application. This can be achieved by selecting the optimal location of fixturing elements such as locators and clamps. The fixture set up for component is done manually. For that more cycle time required for loading and unloading the material. So, there is need to develop system which can help in improving productivity and time. Fixtures reduce operation time and increases productivity and high quality of operation is possible.

M. Montsinger [5] explained pointed out that safe loading of transformers by temperature requires not only an accurate knowledge of the thermal laws but also a knowledge of what is a safe temperature limit to be maintained continuously which condition seldom, if ever, happens with the present method of limiting the load to nameplate rating. In view of our present knowledge and experience the author questions the advisability of loading transformers continuously up to the present A. I. E. E. limit of 105 deg. cent. hot spot and argues for the establishment of a differential of 10 deg. cent. between the limit to be maintained continuously by means of overloads and the limit to be reached occasionally with rated load. In other words, for continuously maintained maximum temperatures the hot spot should not exceed 95 deg. cent. It is shown by the use of the thermal laws that without increasing the maximum or hot spot temperature, transformers can be overloaded 1 per cent for each degree centigrade by which the ambient is below 30 deg. cent. (air) for self-cooled transformers, 25 deg. (water) for water-cooled transformers. The results of laboratory aging tests conducted on class A insulations in air and in oil are given. These tests show that the rate of aging is roughly double for each 8 deg. cent. Increase in temperature.

Shrikant v Peshatwar et.al [06] explained fixture design system of eccentric shaft for ginning machine.. Fixture is required in various industries according to their application. Designer design fixture according to dimension required by industry to fulfill our production tar gate. In traditional manufacturing process performing operation on eccentric shaft is critical. so holding a work piece in proper position during a manufacturing operation fixture is very necessary and important. Because the shaft is eccentric so for this requirement of manufacturing process Designer design proper

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fixture for eccentric shaft. Fixtures reduce operation time and increases productivity and high quality of operation is possible.

IV. STEPS OF FIXTURE DESIGN

Successful fixture designs begin with a logical and systematic plan. With a complete analysis of the fixture's functional requirements, very few design problems occur. When they do, chances are some design requirements were forgotten or underestimated. The workpiece, processing, tooling and available machine tools may affect the extent of planning needed. Preliminary analysis may take from a few hours up to several days for more complicated fixture designs. Fixture design is a five-step problem-solving process. The following is a detailed analysis of each step.

Step 1: Define Requirements
To initiate the fixture-design process, clearly state the problem to be solved or needs to be met. State these requirements as broadly as possible, but specifically enough to define the scope of the design project. The designer should ask some basic questions: Is the new tooling required for first-time production or to improve existing production?

Step 2: Gather/Analyze Information
Collect all relevant data and assemble it for evaluation. The main sources of information are the part print, process sheets, and machine specifications. Make sure that part documents and records are current. For example, verify that the shop print is the current revision, and the processing information is up-to-date. Check with the design department for pending part revisions. An important part of the evaluation process is note taking. Complete, accurate notes allow designers to record important information. With these notes, they should be able to fill in all items on the "Checklist for Design Considerations." All ideas, thoughts, observations, and any other data about the part or fixture are then available for later reference. It is always better to have too many ideas about a particular design than too few. Four categories of design considerations need to be taken into account at this time: workpiece specifications, operation variables, availability of equipment, and personnel. These categories, while separately covered here, are actually interdependent. Each is an integral part of the evaluation phase and must be thoroughly thought out before beginning the fixture design.

Step 3: Develop Several Options
This phase of the fixture-design process requires the most creativity. A typical workpiece can be located and clamped several different ways. The natural tendency is to think of one solution, then develop and refine it while blocking out other, perhaps better solutions. A designer should brainstorm for several good tooling alternatives, not just choose one path right away. During this phase, the designer's goal should be adding options, not discarding them. In the interest of economy, alternative designs should be developed only far enough to make sure they are feasible and to do a cost estimate.
The designer usually starts with at least three options: permanent, modular, and general-purpose workholding. Each of these options has many clamping and locating options of its own. The more standard locating and clamping devices that a designer is familiar with, the more creative he can be. Areas for locating a part include flat exterior surfaces (machined and unmachined), cylindrical and curved exterior surfaces. The exact procedure used to construct the preliminary design sketches is not as important as the items sketched. Generally, the preliminary sketch should start should start with the part to be fixtured. The required locating and supporting elements, including a base, should be the next items added. Then sketch the clamping devices. Finally, add the machine tool and cutting tools. Sketching these items together helps identify any problem areas in the design of the complete fixture.

Step 4: Choose the Best Option
The total cost to manufacture a part is the sum of per-piece run cost, setup cost, and tooling cost. Expressed as a formula:

$$Cost\ per\ part = run\ cost + \frac{Setup\ Cost}{Lot\ Size} + \frac{Tooling\ Cost}{Total\ Quantity\ Over\ tooling\ lifetime}$$

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These variables are described below with sample values from three tooling options: a modular fixture, a permanent fixture, and a hydraulically powered permanent fixture.

Step 5: Implement the Design
The final phase of the fixture-design process consists of turning the chosen design approach into reality. Final details are decided, final drawings are made, and the tooling is built and tested. The following guidelines should be considered during the final-design process to make the fixture less costly while improving its efficiency. These rules are a mix of practical considerations, sound design practices, and common sense

V. CONCLUSION

Jigs and fixture designind depends upon different different factors and these factors should be analysized and optimized based on various inputs.

Factors are as followed:

(1) Detailed Study of workpiece and final component size with Geometry.
(2) Machine Capacity and its type with automation features.
(3) Provision of locating devices in the machine.
(4) Availability of clamping arrangements used in Machine.
(5) Available indexing devices, their accuracy.
(6) Variability evaluation through performance result of the machine.
(7) Rigidity and of the machine tool under consideration.
(8) Study of safety devices, ejecting devices, etc.
(9) Required level of the accuracy in the work and quality to be produced.

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