

Design and Modelling of Boring Fixture for Roller Stand

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Abstract— A Fixture is a device that must be able to position, hold support the workpiece throughout machining operation. When number of parts to be machined is large, fixture provide time saving criterion to locate work for accurate machining operations. Various areas related to design of fixture are well illustrated by many scholars but there is need to couple the research with the industrial application to put the matter in practice. This paper aims to provide sufficient condition to establish correct relation to workpiece and fixture in terms of positioning and locating work with the machine tool to have fine dimensional accuracy. The cast component, roller stand is main part of cutting machine. The major operation to be performed are boring and milling slot. The real time criteria are to bore exact hole and slot with respect to each other with dimensional accuracy within limit. The research work include 3D assembled and exploded view of fixture and its components using Cero Elements and AutoCAD 2012 in addition to detail & Assembly drawing

Keywords— Modular fixture, contact, Pro E, VMC

I. INTRODUCTION

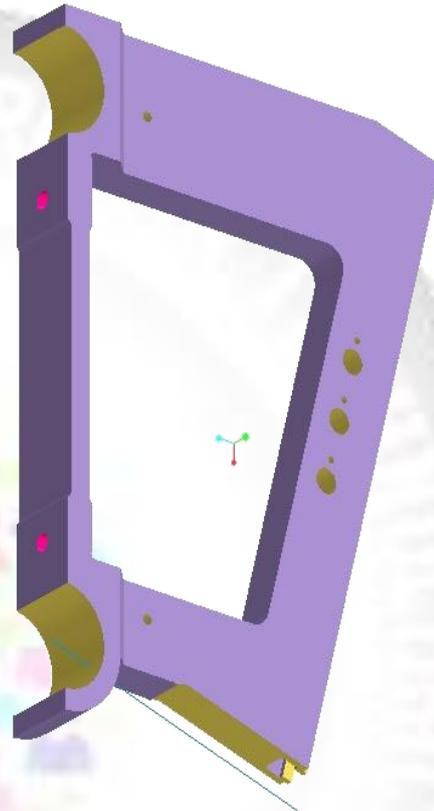
A fixture is a device that is used to locate, clamp and support workpiece during machining, assembly and inspection operation. The basic criteria are to provide adequate stability to workpiece along with correct positioning against cutting tool by holding it firmly without any deformation. A proper design establish proper relation between workpiece and cutting tool and hold workpiece with optimum clamping force to minimize geometric error and at the same time does not create unnecessary clamping force that cause deformation in workpiece.

Fixture design involves setup planning as the number of operation that carried out on the workpiece depends on geometry of workpiece and machining capability, each setup is unique in terms of overall requirement of design criteria. Setup planning involves determination of operations and part geometry. A location layout and clamping arrangement is another task that prompt impact on better design of fixture. A 3-2-1 principle of location is widely accepted principle for correct location. Clamping force calculation helps to provide adequate clamping force, as low clamping force will create vibration and tends to lift the work during machining, results in poor machining. On other hand unnecessary clamping force create geometrical change in workpiece. A 3Ddimensional model will help to provide better view to verify correct relations with each component of fixture as well as provide necessary conditions for further modification and analysis.

A. Fixture Design includes.

- Setup planning: determination of no of setup required, positioning the workpiece
- Fixture Planning: determination of locating surface, locators, clamps, and clamping force

- Fixture Modeling: a 3D model to generate keeping all aspect design and manufacturing
- Fixture Design: a trial base manufacturing of model and modification.



II. COMPONENTS OF FIXTURE

A fixture should possess the following components or elements:

- A sufficiently rigid body (plate, box or frame structure) into which the workpiece is loaded.
- Locating elements
- Clamping elements
- Tool setting element
- Elements/Fasteners to hold fixture on machine table

III. LITERATURE REVIEW

Rétfalvi Attila, Michael Stampfer, Szegh Imre [1] this paper hints out the number and order of setup required to and proposals on appropriate fixture needed at machining a given workpiece. The input data are CAD model of the workpiece saved in IGES format and technological requirement ad output is CAD model of needed fixture

N kaya, F Öztürk [2] this paper provide useful means to develop a fixturing system capable of positioning, holding and supporting the workpiece throughout the machining process. A modular fixture design verification analysis is carried out for time varying machining force

using non-linear finite element analysis. Chip removal effect is taken in consideration using element death technique.

U. Farhana and M. Tolouei-Rada [3] in this paper a modular fixture design is presented. Modular Fixture is made by assembling a number of fixture elements in a feasible sequence that is properly determined. A CAD-based 3D-modelling and simulation system to determine the types and of feature elements and the sequence of assembly. Such a system can help designers to find the proper Modular Fixture designs by defining the relationships between fixture elements and workpieces. Designing Modular Fixture and fixture elements is a very complex and time-consuming task even by making use of CAD software. A methodology has been developed to simplify this task by determining fixture elements and assembly sequences in a 3D-modelling environment. A fixture elements database is established and the fixture elements are divided into different categories depending on geometries and functions. These elements are pre-manufactured components that include base-plates, clamps, and locators; and they can be re-used after disassembly. These can later be used for other workpieces within a specified range of sizes and shapes

Nirav P. Maniar, Dr. A. B. Andhare, Dr. D. P. Vakharia, Chetan Patel [4] The boring fixtures so far are generally used for small-lot production or for relatively large workpiece. The present volume of this paper includes the unique aspect of designing of a boring fixture for VMCI (APC2) for mass production. This fixture provides locating and clamping provisions for performing following operations in sequence on four connecting rods in one cycle. The connecting rod is to be assembled in engine of Mahindra & Mahindra four wheeler passenger vehicle.

SOO WAI HONG [5] in these theses the Modular Jig and Fixture developed using CATIA. The purpose of carrying out this project is to investigate the development of modular jig and fixture using the CATIA software. The purpose is to increase the knowledge of student on modular jig, fixture and the CATIA software. In the initial step of the project, many researches are done to gather information. After that, the information is gathered to create the sketch drawing which is the basic before designing the jig and fixture. When the design is ready, a library is added to the CATIA software and also the assembly and testing process

Y. Wang, X. Chen and N. Gindy [6] Finite element (FE) analysis is very useful in the early stage of a fixture development in order to reduce or eliminate design problems. Accurate prediction of fixture-workpiece deformation requires an appropriate representation of the contact relationship between fixture elements and workpieces. The paper addresses the special features of the deformation analysis between complicatedly shaped components and fixture elements. The effectiveness and the scope of applicability of commonly used methods are analyzed. The verified FE analysis is used to predict surface error arising from deformations, and to evaluate the deformation distributions from fixture elements and workpiece. Based on the FE analysis, the tolerance can be allocated to the fixture elements and the workpiece.

Anand Raghu, Shreyes N Melkote [7] several error encounters in fixture is due to improper location and insufficient clamping force. Insufficient clamping force may

occur due to improper sequence of clamping elements which in turn results in geometrical errors. This paper provides sufficient knowledge for proper clamping sequences.

A. Senthil kumar*, J.Y.H. Fuh, T.S. Kow [8] This paper describes an automated modular fixture design system developed using a CAD-based methodology and implemented on a 3-D CAD/CAM software package. The developed automated fixture design (AFD) system automates the fixturing point's determination and is integrated on top of the previously developed interactive and semi-automated fixture design systems. Apart from determining the fixturing points, the system is capable of producing cutting tool collision-free fixture design using its machining interference detection sub-module. The machining interference detection is accomplished through the use of cutter swept solid based on cutter swept volume approach.

Djordje VUKELIC Janko HODOLIC [9] This 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 reached conclusions are presented with the expected directions of future researches.

Z. An, S. Huang and Y. Rong [10] in this paper a dedicated fixture designed for pre-defined component. The design methodology is divided into two stages: basic design and detail design. The basic design activities include 1) selection of functional fixture components such as locators and clamps from a standard fixture component database, 2) generation of customized supports with variable dimensions for different fixture design requirements, and 3) assembly of fixture components into a final configuration on a fixture base. In this paper, the principles and implementation of basic design are presented.

IV. CONCLUSION

The fixture design is unique for each component and it is thus differ from its neighboring similar components in respect to dimension and the locating surface that are a base for correct position. In my PG dissertation work my aim is to provide correct positioning and to provide sufficient clamping pressure so as to achieve dimensional accuracy as well as part must be mounted within short period of time to maximize production rate which is ultimate goal of any fixturing system.

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