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Review on Multi Station Jig

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ABSTRACT: This project deals with the Design optimization and Analysis of Multi station Jig, where we perform multiple operation like Drilling and threading of holes on single jig. In this project we have tried to minimise costing, loading and unloading time through fast clamping and easy location of work piece, we can do machining of four components in a single setting with different operation, this jig is called multi station jig. This jig is provided indexing to locate component at each station to perform operation. There are different parts of jig which needs to be precisely machined, locating surface of jig should be properly finished for which surface grinding machine is used, and for the guidingoftool(Boring/Drilling/Reaming/Threading) bush is used, for which CNC Lathe machine is used. All the designing and modelling part is done through Auto CAD & Solid works software's.

I. INTRODUCTION

This chapter provides a comprehensive literature review pertaining to the research area established in chapter one. The review encompasses various fields of significance, elucidating the current boundaries of knowledge within the research area. The concept of Jigless Assembly, which serves as the ultimate goal of this research, is introduced with a clear definition of a 'jig'. This clarification ensures consistent usage of related terms such as 'jigs, fixtures, and tooling' throughout the thesis. The rationale behind the pursuit of Jigless Assembly is outlined, highlighting the strong focus of aerospace manufacturers on this objective. Numerous examples of Jigless Assembly implementations in the aerospace industry and ongoing developments in academia are presented, along with relevant examples from non-aerospace industries. These examples illustrate the diverse applications and wide-ranging techniques employed in Jigless Assembly. For the development of methods and methodologies aimed at designing jigless assembly and modeling the jigless assembly process, it is crucial to explicitly deliver and represent a Jigless Assembly solution while accommodating conventional assembly methods that still require the use of jigs. The subsequent portion of the literature review concentrates on three key areas that significantly contribute to achieving Jiggles Assembly: Design and Assembly Processes' Methods and Methodologies, Feature Based Methods, and Tolerance Representation and `Analysis. The section on Design and Assembly Processes' Methods and Methodologies presents established examples developed by researchers and practitioners. It is divided into two subsections: Design related Methods and Methodologies and Assembly Process related Methods and Methodologies, which are relevant for designing jigless assembly. The Design subsection covers existing Formal Design Methods that formalize the design process, while the Assembly Process subsection outlines two examples of Assembly Modelling Methodologies. The review also emphasizes the growing prominence of 'Features' in the design, manufacturing, and assembly of products. Feature Based Methods, which have evolved beyond Feature Based Design to areas such as Feature Based Design for Assembly and Feature Based Costing, are advocated for designing jigless assembly. The current state-of-the-art in Feature Based Methods is illustrated through the work of others.Lastly, the literature review presents several examples of Tolerance Representation and Analysis, all of which are Feature Based. One such example, AnaTole, is highlighted to demonstrate the typical functionalities of Computer-Aided Telebanking systems, showcasing their potential as enablers for jigless assembly. By reviewing the literature in these areas, this chapter lays the foundation for the subsequent research and contributes to advancing the understanding and implementation of Jigless Assembly in various industries.

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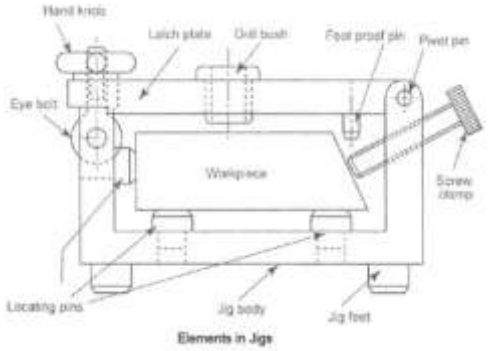

Above Figure shown Parts of Jig and Fixture Design.

II. LITERATURE REVIEW

The Section aims to explore and analyse the existing body of knowledge related to fixture design, rigidity, vibration analysis, finite element analysis (FEA), fixture stability, workpiece deformation, clamping forces, and part location error. This section provides a comprehensive understanding of the concepts, theories, and research conducted in these areas, which serves as a foundation for the research conducted in this project.

[1] **Sheldon Levine**,thepaper emphasizes the importance of rigidity in the fixture design. It states that the fixture should be as rigid as possible within weight limits. It also highlights the need to avoid resonances within the frequency range of interest, with the first resonant frequency being above the maximum specified tested frequencies.

[2] **Eiji Nabata& Yuji Terasaka**, the paper addresses the problem of vibration in machining processes and proposes the development of vibration analysis technology using 3D-CAD to analyze the system and mitigate the effects of insufficient dynamic rigidity.

[3] Necmettin **Kaya**, the paper highlights the significance of proper clamping in fixture design for achieving rigidity. Additionally, it recommends the use of ANSYS for finite element analysis of the fixture.

[4] **Yi Zheng**,the paper presents a finite element model for fixture unit stiffness and experimental methods for contact stiffness identification. It also proposes a mathematical calculation approach for finite element analysis, facilitating the construction of a fixture stiffness database for use in Computer-Aided Fixture Design (CAFD).

[5] **J.E. Akin**, The paper highlights Finite Element Analysis (FEA) as the common tool for stress and structural analysis across various fields. It explains the concept of FEA, which involves replacing complex shapes with a union of simple shapes (finite elements) to accurately represent the original part in analysis.

[6] **Xiamen Kang and Qingjin Peng**The paper concludes by discussing the research trend of computer-aided fixture planning and emphasizes the usefulness of Finite Element Analysis (FEA) for modelling fixture-workpiece interactions and optimizing fixture layout and clamping forces to minimize workpiece deformation.

[7] **David Roylance**, FEA is proposed as the foundation of a multibillion-dollar industry, enabling numerical solutions to complex stress problems.

[8] **Haiyan Deng**, the paper presents a procedure for analysing dynamic stability in machining fixture design, considering work piece deformation, machining motion, geometry changes, and material removal effects to ensure fixturing stability.

[9] **S.Ratchev, K.Phuah, G.Lammel, W.Huang**, The paper introduces an innovative simulation methodology for dynamic analysis of fixture-work piece systems using FEA, incorporating spring-damper elements for contact modelling. Experimental work using design of experiment techniques validates the approach.

[10] Shane P. Siebenaler, Shreyes N. Melkote Finite element analysis (FEA) is employed to model a fixture-work piece system, considering the influence of fixture body compliance on work piece deformation, which is crucial for ensuring quality part production.

[11] Peter**Avitabile**Vibration fixtures with resonant frequencies in the test range cause issues. Control at a point doesn't address fixture resonant behaviour. This article addresses these problems.

[12] Vaibhav **H. Bankar**Milling fixtures can be created during intermediate process steps by referencing gauge blocks. Modelling explores the influence of fixture compliance on work piece deformation and examines the effects of vibration on natural frequency prediction.

[13] **KulankaraKrisnakumar, Shreys N. Melkite**Machining fixtures function to locate, constrain, and support the work piece. Optimizing the fixture layout minimizes work piece deformation and ensures dimensional/form accuracy.

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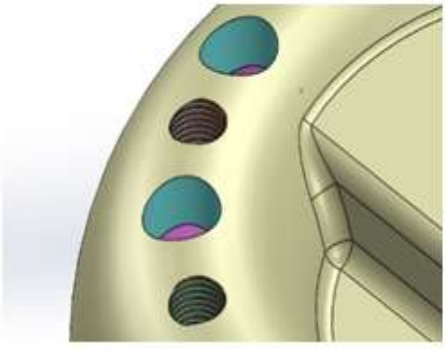

III.OBJECTIVES

1. Design optimization and Analysis of Multi station Jig.
2. Check for Location with fool Proofing
3. Quick clamping
4. Tool cost minimization.
5. Reduction of loading and unloading time

IV. SCOPE OF WORK

1. Doing provision to perform multiple operation in a single setting
2. Bush design for multiple operation.
3. Check for the vibrations during machining process
4. Design calculations

V. METHODOLOGY

The complete study of Design optimization and Analysis of Multi station Jig through the CAD Software Auto CAD, Solid Works 21. & Ansys.

1. Study of drawing is done to identify clamping area from which our component is clamp on the JIG
2. Using Auto Cad software drawing is prepared to proceed for the Jig design.
3. Design calculation of Bushing and jig elements for design of Jig.
4. Static Stress analysis of plates with boundary conditions by using Ansys 19 software.
5. Conceptual design of multi station with provision of machining of multiple work piece by using Auto CAD software
6. Final Design and modelling of JIG prior to approval of Client.
7. Modelling of Multi station Jig by using Solid works 21 software.
8. Drafting as per the requirement of manufacturing.

VI. FACILITIESAVAILABLE

1. Library facilities are available in the Vidarbha Institute of Technology, Nagpur.
2. Also, internet facilities available in college.
3. JMD Engineering Hingna, Industry is available for support and technical data sharing.

VII. REFERENCES

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