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Design and Development of Fixture for eccentric shaft: A Review

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ABSTRACT

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

Keywords- Eccentricity, Fixture design, Computer aided fixture design (CAFD)

1. INTRODUCTION

The fixture is a special tool for holding a work piece in proper position during manufacturing operation. It is provided with device for supporting and clamping the work piece. Fixture eliminates frequent checking, positioning, individual marking, vacillate uniform quality in manufacture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages.

Eccentric shaft is a circular or cam type disc solidly fixed to rotating axel with its centre offset from that of the axel. eccentric shaft is the important element, which plays the important role in ginning operation.

Shaft provides an oscillatory motion to moving knives and widely appreciated for its features like effective performance, corrosion resistance, reliability, long service. Reducing manufacturing cycle time and achieving high quality of operation fixture design is very important. Designer design a compact type fixture for eccentric shaft for fulfilling production target and high quality of work and increases productivity.

1.1 Material of fixture

Steel specified by SAE (Society of Automobile Engineers) and AISI(American Iron and Steel Institute) classification and standards.eg. SAE 1020 first two digit indicate the class to which the steel belongs, the last two digit indicate carbon contain.

CLASS	TYPES OF STEEL
1) 10XX	Plain carbon steel
2) 11XX	Free cutting (carbon)steel
3) 13XX	Manganese steels
4) 2XXX	Nickel steels
5) 3XXX	Nickel –chromium steels
6) 4XXX	Molybdenum steels
7) 5XXX	Chromium steels
8) 6XXX	Chromium vanadium steels
9) 7XXX	Tungsten steels
10) 8XXX	Nickel chromium molybdenum steels
11) 9XXX	Silicon manganese steels

SAE 1015 and below are highly ductile and are used for press work but not for fixture.(ref from Jig and Fixture Design manual by Erik Karl Henriksen)

2 .LITERATURE REVIEW

2.1 Fixture designers support expert system and concurrent engineering

Researcher give the main lines of their process, that fixture design support system is developed on the basis of an expert system shell. Researcher show how the use of that kind of tool is determinant factor for reactivity in the fixture design process in concurrent engineering.

The paper focuses of the development of fixture designer's support. Researcher present a structuring of the design method and expression of the trade rules in the expert system formalism. Researcher has developed using industrial expertise SEACMU (System Expert d'Aide il la Conception des Montages d'Usinage for expert system for fixture design). That is a fixture designers' support expert system..SEACMU is based on a fitted part modeling to the fixture design.

The correspondent model is defined from the part CAD/CAM data using RI rules. RI rules are the necessary link between the part CAD/CAM and the future design expert system. The general organization set out on figure 3 results of the decomposition in rules basis.

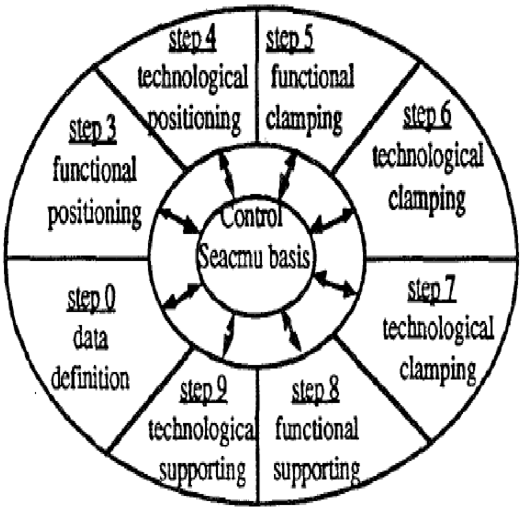
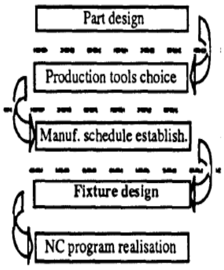


Fig.1.Knowledge bases organization[1]

A simultaneously development of the fixture design, the manufacturing schedule establishment and the NC programmed design is then allowed[1].



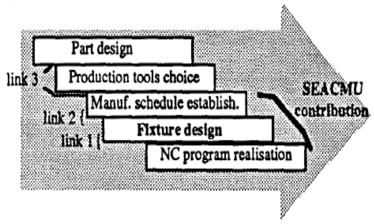


Fig.2. Sequential form of the steps [1]

Fig.3 Concurrent engineering of the part its machining process[1]

2.2 FIXTURE DESIGN SYSTEM (COMPUTER AIDED FIXTURE DESIGN)

The manual design of fixture is traditionally a time consuming work in manufacturing and the experience of designer plays an important role in fixture design.

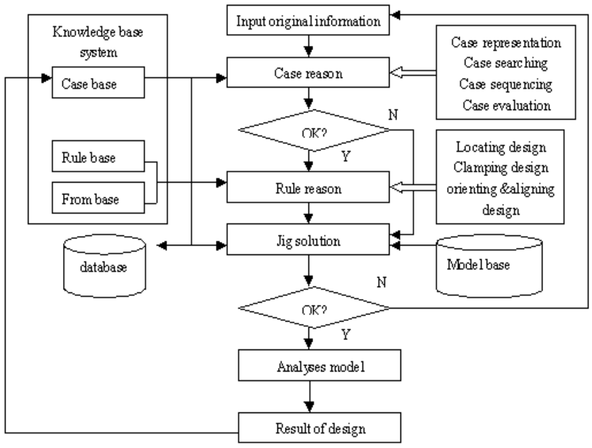


Fig.3. Flow diagram of the CAFD system [2]

The jig and fixture parts and component are divided into following categories: (a) Locating components, (b) Clamping mechanisms,(c) Tool guiding components, (d) Support components, (e)Body of fixture, (f) Fixing components for fixture, (g) Auxiliary mechanisms, (h) Operating elements, (i) Power mechanisms, (j) Miscellaneous components.. Paper explored the technology of intelligence and optimization in the process of the jig and fixture design [2].

Two conformability metrics are introduced to account for global and local conformability's his design variables are: the number and position of fixture element, fixture element length, static coefficient, fixture element tip radius, and direction of the fixture principal stiffness. Both force controlled and displacement controlled fixtures are considered.

It was found that conformability and stability can either increases nor decrease with the position of contacts depending on their proximity to the line of action of the external perturbation. Clamping intensity and principal stiffness directions have opposing effects on the stability of force controlled and displacement controlled fixtures [3].

2.2 PARAMETRIC STUDY`

A. Number and position of fixture element

Fig. 4 shows that the local conformability metric for *P*-controlled and U-controlled fixtures (CZ,, and *Cza*, respectively) follow very similar trends as *L4* moves in the
+XA direction. In scenario #2 *(P2)*, the addition of *L4* came's an increase in both conformability metrics and also an increase in stability with respect to the reference case.

Locator *L4* helps to support the bottom part of the sphere. This explains the increase in stability from *PI* to *P2*.Conformability and stability decrease as *L4* moves from *P2* to *P5* as shown in Fig.4

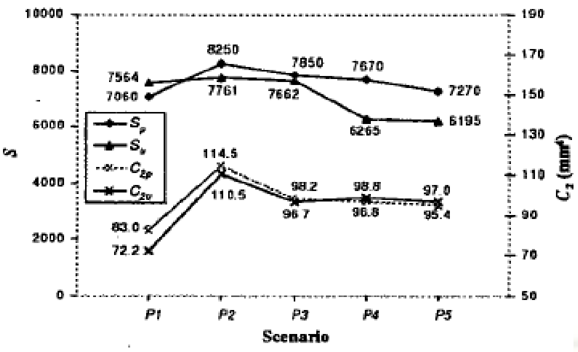


Fig.4.Effect of the number and position of fixture element[3]

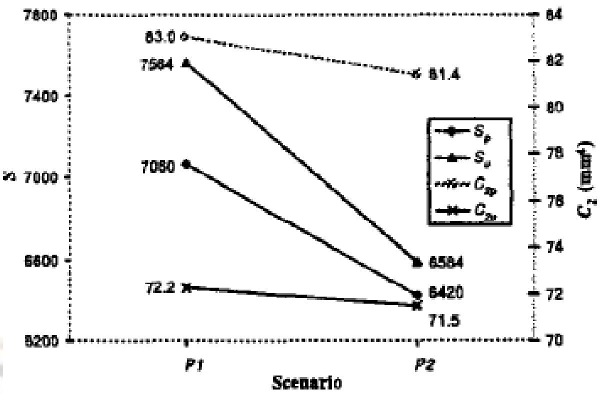


Fig.6.Effect of the Clamp Orientation.[3]

B. Clamping intensity

For the case of the P-controlled fixture, the clamping
Force was changed from 800 N in PI to 900 N in P2 and
to l000 N in P3. Similarly, the prescribed clamping
Displacements for P2. P3 and *P4* are 12.5, 15.0 and 17.5
pm, respectively. Fig. 5 shows that S, and *Czp* increase
With clamping intensity. Higher clamping loads produce larger work piece and contact elastic deformations causing an increase in *Czp.* In the case of the U-controlled fixture stability decreases slightly with increasing clamping intensity while Cz, is not significantly affected.
The normal clamping loads necessary to produce the prescribed displacements of the U-controlled fixture do not change significantly when going from 12.5 to 17.5 pm *(D'F,, = 659* N, *D2F=n* 590 N for 12.5 pm; *DIFn*= 680 N, *D2F,=,* 623 N for 17.5 pm). As a result, the fixture-work piece reaction forces remain almost unchanged from *PI* to *P4.* This explains the small variation of *Czu* shown in Fig.5 [3].

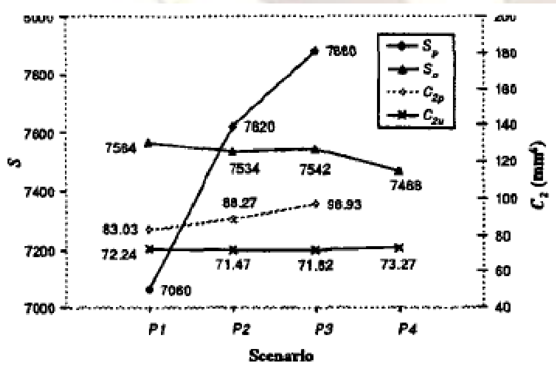


Fig.5. Effect of the Clamping Intensity [3]

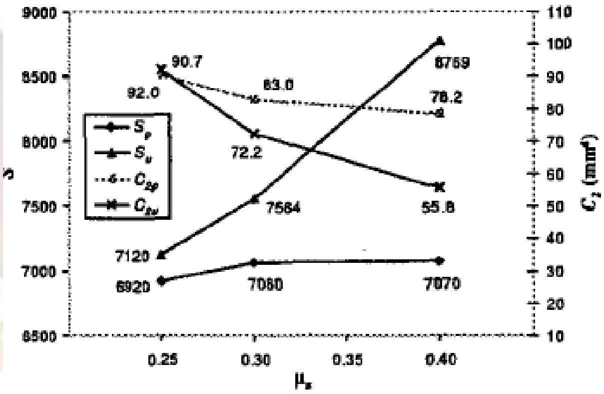


Fig.7. Effect of the Static Coefficient of Friction [3]

Requirements should be satisfied for fixture:(i)total restraint of the work piece or form closure;(ii)accurate locating of work piece ; (iii)limited deformation of work piece; no interference between fixture components and machine tool;(iv)including ease of loading/unloading a work piece. The first two requirements that are essential for the design of fixture layout and can be viewed as the first step of fixturing system design for determination of the number, type and location of fixturing points. researcher propose an efficient algorithm to identify seven frictionless fixturing point ensuring form closure and small positioning error of the work piece from original dense set. Paper addressed the problem of fixture layout design for a 3D curved work piece [4].

Facing a continuously increasing competition worldwide, manufacturing industry are undergoing a critical transition from traditional methods to advanced manufacturing technology many of which are computer based.

In order to increase competitiveness, manufacturers are seeking to improve product quality. Lower production costs, and increase the speed of bringing innovative products to the market. Early years of computer aided fixture design (CAFD), the designer simply used the CAD tool to assemble the drawings on computer screen with a library of standard fixture components.

Fixture assembly operations are performed by specifying coordinates and rotation angles in x-y plane, which still takes time for manipulating geometric entities. One of the most important goals of CAFD is to reduce the manufacturing lead time. the problems associated with current CAFD applications include: 1) functions of automated fixture design systems are limited and many complex fixture designs still need human interaction and using CAFD systems with commercial CAD packages is time consuming as it manipulates geometric entities around on screen.

Outline of rapid fixture design system (RFDS) which includes several modules and databases: a) locating method selection'*s)* work piece information retrieval; c) locator/clamp selection; d) fixture unit generation and placement; e) interactive fixture design modification; f) locating method database and g) fixture component database. In fixture design, the locating method and locator clamp selection are based on fixturing requirement analysis.

To help fixture designers in the locating method selection, a menu-driven locating method classification tree is designed which makes the fixture design process more logical and requires less experience.

Researcher presents a rapid fixture design system which combines the automated modular fixture configuration design technique for fixture unit generation and interactive fixture design functions for selections of locating methods and locating clamping components [5].

Only concerned with achieving three point contacts, which is necessary to re-use the fixture, Manufacturing and installation of fixtures are costly for high volume production runs. In this paper we address the problem of the re-usability of fixtures. Researcher addresses both types of variation in the context of modular fixtures. For tolerance variation, they give a method for comparing fixtures in terms of how much geometric tolerance they will permit before failing. For design variation, they identify design rules that can rapidly check if a proposed part design is consistent with a given previous fixture [6].

Fixture design is a critical manufacturing activity in the production cycle and has great effect on product quality, lead time, and cost targets.

With the development of computer aided fixture design (CAFD) system, the efficiency of fixture design and the cost of production have been improved obviously. Fixture planning is an important early step in CAFD process, which determines the locating and clamping points on work piece surfaces, it contributes so much to fixture design.

Fixture requires simple configuration, small clamping force, multi-varieties and small batch production, short design and manufacturing cycle, and low cost. Compare to conventional manufacturing processes, the primary advantage of RP is its ability to create almost any shape or geometric feature, in this case, production efficiency and manufacturing flexibility will be greatly improved.

The evaluation method proposed in this paper is going to evaluate the clamping plan from several aspects as follows: Area factor. Stability factor, location of clamping point factor. The automation of fixture planning plays a vital role in improving the efficiency of fixture design and manufacture **[**7**].**

Fixture layout is the primary task of the fixture design. Fixture design is a practical problem and is crucial to product manufacturing. During the course of manufacturing processes, such as machining, assembly, or inspection, it is necessary to immobilize, support, and locate the work piece, this is also referred to as work holding.

A fixture is comprised of a number of basic work holding elements such as locators, supports, and clamps. The task of fixture layout is to determine the number, type, and location of the work holding elements. Second task is referred to as fixture setup, and its main concern is to avoid collision and interference between the machine tool and the fixture. Basic Fixture Components is locator, support, clamps. Fixtures have six basic functional Requirements: (a) stable resting, (b) accurate localization.(c) Support reinforcement, (d) stable clamping, (e) force-closure (or total restraint), and (f) quality performance.

The focus of the researcher paper is on effective fixture modeling and efficient numerical techniques for automatically generating, analyzing, and optimizing fixture layout designs for any complex-shaped 3D work pieces [8].

A fixture is usually modeled as a set of supporting, locating and clamping points called fixels. These fixturing points (or fixels) should be selected to satisfy two fundamental requirements: the form-closure constraint and accurate locating of the work piece in addition to requirements like even load distribution among the fixturing points, non-intersection among the fixels, etc.

The form-closure constraint guarantees that the work piece is fully constrained without being disturbed by any force and moment generated during manufacturing processes. The requirement of accurate localization is to ensure accuracy of manufacturing operations.

A fixture must satisfy various functional and non-functional requirements listed as follows: total restraint of the work piece or form-closure, i.e. able to reject any force and moment generated during manufacturing courses; Accurate locating of

the work piece, i.e. the positioning Errors of the work piece should be minimized with given positioning accuracy of the fixturing points; even load distribution among the fixturing points.
No interference between fixture components and Machine tools and "Goodness "under various criteria, including ease of Loading/unloading a work piece.

Researcher paper presents a simple and complete algorithm for automatic and optimal fixture design on 3D work pieces represented by discrete points. A new performance index is proposed to simultaneously address three fundamental requirements: form-closure constraint, minimum locating errors of the work piece, and even load distribution among the fixturing points [9].

A fixture is used to establish and maintain the required position and orientation of a work piece in machine tool. A poor design can lead to undesirable work piece deformation. Consequently, the positions of the locators, clamps and supports should be strategically designed and appropriate clamping forces should be applied. Typically, it relies heavily on the designer's experience to choose the positions of the fixture elements and to determine the clamping forces.

The fixture layout and the clamping forces optimization become two important aspects in fixture design. The positions of locators and clamps should be properly selected, and the clamping forces should be calculated so that the work piece deformation is minimized and uniformed. In this paper, a dual optimization method is presented for the fixture layout design and dynamic clamping forces optimization. The objective is to minimize the maximum elastic deformation of the machined surfaces and maximize the uniformity of the deformation [10].

3. DISCUSSION AND CONCLUSION

The system has enhanced the efficiency and reliability of the jig and fixture design and has made the result of the jig and fixture design more reasonable [1].

It was found that conformability and stability can either increase or decrease with the position of contacts depending on their proximity to the line of action of the external perturbation. It was also found that clamping intensity and the principal stiffness directions have opposing effects on the stability of force-controlled and displacement controlled fixtures [2].

The problem of fixture layout design for a 3D curved work piece [3].Fixture design support that use technological entities to represent the part [4]. The problem of the re-usability of fixtures [6]. The automation of rapid fixture planning based on rapid prototype [7].
Optimum design approach to provide comprehensive analyses and determine an overall optimal design to fulfill the multi-functional and high performance fixturing requirements [8]. Dual fixture layout and dynamic clamping forces optimization method based on optimal fixture layout could minimize the deformation and uniform the deformation most effectively and it is meaningful for deformation control in NC machining [10].

An attempt is made in this paper various design and analysis methods in the context of to improve the life of fixture, different fixture geometries are compared experimentally and are selected. The proposed eccentric shaft fixture will fulfilled researcher Production target and enhanced the efficiency, fixture reduces operation time and increases productivity, high quality of operation, reduce scarp.

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