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# Design & Development of Fixture for Lathe Machine – Reviews

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***Abstract*:** Machine tool industry has undergone with various changes to meet the requirement of customer and to manufacture the complex parts. The fixtures were developed for various machining process. Fixture study had begun in 1940's. The basic requirement of the fixture is to locate and hold the component in correct orientation to constrain degree of freedom so that manufacturing processes can be easily carried out. According to the use of fixtures, dedicated and modular fixtures can be generated. To design a fixture, various phases for fixture designing such that planning, design and assembly are to be explored. Over the past decade, much focus has been put on intelligent methods for computer aided fixture design to seek a technical breakthrough in embedding more design knowledge into semiautomatic or automatic systems.

***Keywords: fixture design.***

## I. INTRODUCTION

As per the requirement of various product, machine tool industry has undergoes through various changes, at early days it started with manufacture with basic machinery which machines were highly flexible and were not suitable for mass productions. But as per the requirement of the industries concern with mass production the various machines were invented for mass production. Those machines are only suitable for mass production and less flexible like special purpose machine, hydraulic machine tools etc. so in general moderate flexible machine were invented for component having same kind of operations having different geometry those machines are called general purpose machines. The general purpose machines filled gap between less and high flexible machine. Lathe machine with proper fixture setup have to take up this role very well.
Design of fixture required great knowledge about manufacturing process and the detail of component. After all findings and conclusions obtained from the literature review and the interaction with fixture designers are used as guide to develop the present research work.

### *A) Fixture Studies*

Fixture design is large area, but study of fixture was starting in 1940's and the results lead to several manuals on jig and fixture design such as Houghton (1956) and Wilson (1962). Henriksen (1973) considered many features of fixture design, and Boyes (1989) assembled a handbook that contained a set of guidelines for analytical design. Comprehensive research on fixturing systems probably did not begin until Imhof and Grahl (1977). As per the requirement of the industries fixtures are designed and developed. There are various factors that affect the design of fixtures, such like time require to designing fixture and cost of fixture. Reference [3]

*Types of Fixtures*

- Plate fixtures
- Angle plate fixtures
- Vise jaw fixtures
- Indexing fixtures

*Plate fixtures:*

These are the simplest form of the fixture. The basic fixture is made from a plate which has variety of clamps and locators to hold and locate the part. The simplicity of this fixture make it useful for most machining operations. Its adaptability makes it a popular type of fixture.

*Angle plate fixtures:*

It is a variation of the plate fixture, with this tool the part is normally machined at a right angle to its locator. While most angle plate fixtures are made at 90 degrees, these are times when other angles are needed. In these cases, a modified angle plate fixture can be used.

*Vise jaw fixtures:*

These fixtures are used for machining small parts with this type of tool, the standard vise jaws are replaced with jaws which are formed to fit the part. Vise jaw fixtures are the least expensive type of fixture to make. Their use is limited only by the sizes of the vises available.

*Indexing fixtures:*

These are used for machining parts which must have machined details evenly spaced. The parts shown in fig. are example of the use of indexing fixtures. Multistation fixtures are use primarily runs where the machining cycle must be continuous. Duplex fixtures are the simple form of the multisation fixture, using only two station fig. this form of the fixture allow the loading and unloading operations to

be performed while the machining operation is in progress. Profiling fixtures are used to guide tools for machining contours which the machine can not normally follow. These contours can be either external or internal. Science the fixture is continuously contact with the tool, an incorrectly cut shape is almost impossible. This operation is shown in fig.

*B) Operations to be Performed Using Fixtures*

| | | | |
|---|---|---|---|
| Assembling | Forming | Shaping | Turning |
| Boring | Grinding | Stamping | Welding |
| Broaching | Drilling | Tapping | |
| Milling | Planning | Testing | |

## II. LITERATURE REVIEW

Reference [1] Xiumei Kang and Qingjin Peng, Fixture planning is a complex activity restricted by some factors including machine tools, grasping device cutting tools.
Fixture planning consist four phases

1) Problem description
2) Fixture analysis
3) Fixture synthesis
4) Fixture verification

Fixture analysis and verification methods are summarized as

1) Geometric analysis
2) Kinematic analysis
3) Force analysis
4) Deformation analysis

The fixture synthesis consist of

1) CBR (case based reasoning method)
2) Assemble sequence planning method
3) Optimization method

Reference [2] Iain Boyle , Yiming Rong , David C. Brown, To achieve the current market requirement manufacturers need to ensure that their manufacturing practices are sufficiently flexible to allow them to achieve rapid product development. So To enable flexible fixturing, considerable levels of research effort have been devoted to supporting the process of fixture design through the development of computer-aided fixture design (CAFD) tools and approaches. Over seventy-five CAFD tools and approaches are reviewed in terms of the fixture design phases they support and the underlying technology upon which they are based.

Reference [3] N. P. Maniar, D. P. Vakharia, HMC is best solution for particular component but designer can't ask industries to replace CNC with HMC because of the cost factor, HMC cost around 12.5 million r.s where CNC 2.5 million. All operations are in single setup satisfying essential requirements. With the help of creo element/ proe 5.0 the unbalance mass and its location of C.G are found out and it is remarkably same as experimental result on dynamic balancing machine. So, computer aided mass balancing of quadrants is found more accurate to decrease in percentage error by almost 6%.

Reference [4] Yu Zheng, Chee-Meng Chew, There are parameters of fixture which are used to define or manufacture fixture such that localization, immobilization. The geometric approach of automated fixture layout design describing the 2D/3D object surface for fixturing by a set of discrete candidate points. It selects 4/7 points among them such that the fixels put there in can grip the object with superior performance in immobilization and localization. From case study it has been found that method runs very fast even using a large no of candidates.

Reference [5] R. Hunter Alarcon , J. Rıos Chueco , J. M. Perez Garcıa , A. Vizan Idoipe, Knowledge based system have evolved from computer programs that partially automate the creation of specific solution for design problems formally known as expert system. Key element such as (1) the definition of an integrated design process, (2) the identification of knowledge intensive tasks. The model involves the detailed specification of the types and structure of data involved in the execution of the inference process needed to create a fixture solution for machining a raw part

Reference [6] Necmettin Kaya, A genetic algorithm based approach is developed to optimize fixture layout through integrating a finite element code running in batch mode to compute the objective function values for each generation. GA tool is find the optimal locator and clamp positions in 2D workpiece. Algorithm of the basic GA is given as follows: 1. Initial population: Generate random population of chromosomes. 2. Fitness: Evaluate the fitness of each chromosome in the population. 3. Test: If the end condition is satisfied, stop, and return the best solution in current population. 4. New population: Create a new population by repeating following steps until the new population is complete. Reproduction: Select two parent chromosomes from the population according to their fitness. Crossover: With a crossover probability, crossover the parents to form a new offspring (children). If no crossover was performed, offspring is an exact copy of parents. Mutation: With a mutation probability, mutate new offspring at each locus (position in chromosome). 5. Replace: Use new generated population for a further run of algorithm. 6. Loop: Go to step 2.

## III. METHODS OF LOCATING, SUPPORTING AND CLAMPING

*A) Locating – Principle and Method*

For accurate machining, the work piece is to be placed and held in correct position and orientation in the fixture (or jig) which is again appropriately located and fixed with respect to the cutting tool and the machine tool. It has to be assured that the blank, once fixed or clamped, does not move at all. Any solid body may have maximum twelve degrees of freedom as indicated in Fig. 1 By properly locating, supporting and clamping the blank its all degrees of freedom are to be arrested as typically shown in Fig 2 .

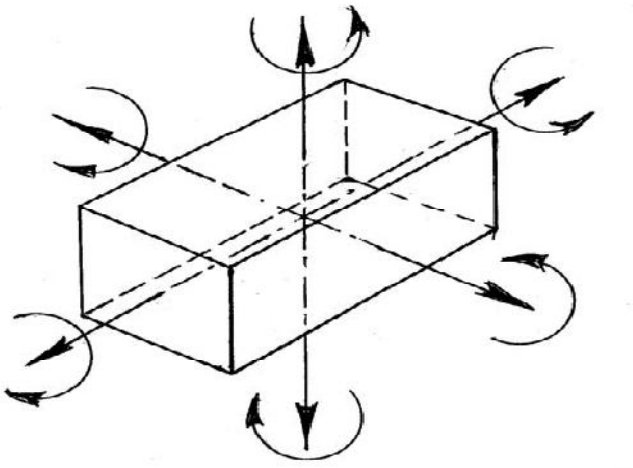

Fig. 1. Possible Degrees of Freedom of a Solid Body

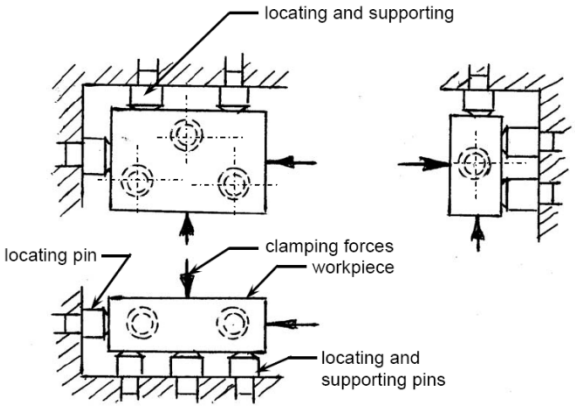


Fig. 2. Arresting All Degrees of Freedom of a Blank in a Fixture

The three adjacent locating surfaces of the blank (work piece) are resting against 3, 2 and 1 pins respectively, which prevent 9 degrees of freedom. The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping. Some of such forces may be attained by friction.

### *B) Different Ways to Locating the Components*

- Locating by flat surface
- Locating by holes
- Locating on mandrel or plug

### *C) Clamping of Workpiece in Fixtures*

In jigs and fixtures the workpiece or blank has to be strongly and rigidly clamped against the supporting surfaces and also the locating features so that the blank does not get displaced at all under the cutting forces during machining.
Various clamping devices are

- Screw clamps
- Swing Clamps
- Chucks and Vises

## IV. CONCLUSION

From the difference research paper we conclude that many approaches are found out in the field of fixture design. Fixture design process can be carried out by locating, orientation and clamping of workpiece. Among all approaches 3-2-1 principle of locating and CAFD approaches are useful for fixture design.

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