

DESIGN AND DEVELOPMENT OF MULTIPURPOSE FIXTURE FOR VMC MACHINE

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Abstract: In machining fixture, limiting workpiece deformation because of clamping and cutting forces are required to keep up the machining precision. The different approach utilized for clamping operation utilized as a part of various application by different creators are looked into in this paper. fixture is required in different industries as indicated by their application. This can be accomplished by choosing the ideal area of fixturing components like locators and clamp. The fixture set up for part is manually. For that more process duration required for loading and loading the material. Thus, there is need to develop system which can help in enhancing productivity and time. Fixture reduce operation time and expands productivity and high quality of operation is possible.

IndexTerms– Component, Work Holding, Manufacturing, Production, Operation, Device, Machining, Work piece.

I. INTRODUCTION

The effective running of all finished large scale manufacturing relies on the exchange capacity to encourage simple gathering and decrease of unit cost. There is an essential of exceptional reason instruments which are utilized to encourage the generation activity like as machining, amassing, meeting, and so forth to spare the computation time and endeavors, four equations and three investigation models were presented for estimation of conceivable UMFs amid the get together process. For the most brief calculation time configuration process. An adjustment strategy decreased from the falling system connection has been available to align a symmetric gadget with a self-assertive test apparatus by three estimations procedures. The outcome investigation shows the got S-parameters of the test installation have a vast blunder. At the point when the reflection coefficients of the DUT are low, however the adjusted S-parameters of the symmetric DUT is constantly precise and even have bring down mistakes than the outcomes acquired by the TRL strategy.

An arrangement of disparities, which portrays the relations between the diverse quality measures are built up. The disparities strategy demonstrates that the encoded data of both area and precision, the capacity in resting outside burdens. For that the apparatus configuration on general 3-D items, and all fitting quality measures. The examination and configuration can continues well-ordered process the outlined handle arrangement G ought to be unequivocally available; The parameter mixes of (G,d) ought to be chosen that locator setup of GL is L-agreeable the parameter blend (G,w,d) must fulfills the soundness and W-receptiveness conditions. A scientific straight model is produced to depict the engendering of work piece and geometric deviation among them numerous machining stages. This straight model has a State-space frame and the states are the work piece geometric deviations. With this system which incorporates process and item data, demonstrate based blame conclusion can be created to rapidly recognize the deficiencies.

II. LITERATURE REVIEW

Taufik R.S ^[1]: He introduced the plan of dances and installations for hydraulic press machine in assembling industries. The present issue in industry is confronting the usage of hydraulic press machine when the request has expanded which happens on the grasping or holding the work piece safely. The principle target of this examination is to propose another design of fixture for hydraulic press to carry out the gripping issue from existing design. Different ideas were produced and stimulated to examine utilizing ANSYS programming software.

Shrikant V ^[2]: Peshawar find a fixture design of eccentric shaft for ginning machine. It was discovered that conformability and stability can either increment or lessening with the situation of contacts relying upon their nearness to the line of activity of the external perturbation. It was additionally discovered that clamping intensity and the principal stiffness directions have effect

the dependability of force controlled and displacement controlled fixtures. The issue of fixture design format outline for a 3D bended work piece. Fixture design support that use technological entities to represent the part. The issue of the re-usability of fixtures. The computerization of fast fixture arranging based on rapid prototype. Optimum plan way to deal with give far reaching investigations and provide a general ideal outline to satisfy the multi-functional and high performance featuring requirements.

Shravan V Murthy^[3]: He explained the important use of fixture is to find and in the cases hold a work piece during a machining. A jigs varies from fixture as it controls the tool to its right position or towards its right direction during addition to withstanding finding and supporting the work piece.

Mr. Ketul N^[4]: He displayed the assortment of central research on plasma arc cutting (PAC) process parameters which the creators have performed. Plasma arc cutting procedure is the non- conventional thermal process which performs different tasks, for example, cutting, welding, covering and so on. Plasma arc cutting is machining process where material is cut by plasma curve. In this survey the examination and advance in plasma arc cutting procedure parameters of various materials are basically assessed from alternate points of view. Some essential plasma arc cutting processing parameters and their impacts on MRR and surface roughness are talked about. This paper manages the survey of papers by creators.

K. Nanthakumar^[5]: He displayed the proposed strategy needs to outline and fabricated the Multipurpose Fixture, for that segment which has reduce the assembling process duration. When the component produced on a small size previously this is to produces the large quantities of requirements. The particular components requires for machining activities, for example, step milling, angle milling and boring and reaming. The couple of activities where been done in CNC and rest tasks are done in Conventional machine tool. The proposed technique must be outline and fabricated the multi-operational fixture for the total machining operation in a single machining centre. The Fixture design has will serve for the financial production for the components.

Jainish A. Patel^[6]: He exhibited the Plasma cutting is an assembling process is driving in developing in arc cutting process which is higher productivity efficiency and Good in quality. Nitrogen is utilized as a protecting gas in the PAC. The shielding gas an impact the cut strength, flexibility, and toughness and corrosion protection. By Plasma arc cutting slicing is simple. Optimization of the parameter will be completed by full factorial technique. We will utilize Stainless Steel 304 material which is more use in filler material, Food processing equipment, chemical containers. S.S 304 plates with Dimensions 250mm x 125mm x 6mm with straight cut. The parameters are the most vital components influencing the quality, productivity.

Ezeanyim Okechuku^[7]: He explained the meaning of fixtures, and further more distinguished the various parameters that are related with the utilization of fixture in manufacturing to include: production increase, cost decrease, interchangeability and high precision of parts, reduction of the requirement for investigation and quality control costs, reduction of accident as safety is improved, automation of machine tool to an obvious degree, simple machining of complex and heavy components, as well a slow variability in dimension which leads to consistent quality of manufactured products. The work likewise clarified that since the design is reliant on various elements which are analyzed to achieve an optimum output that fixture to be made of rigid light materials to encourage simple dealing. For satisfactory strength and rigidity, a mild steel with 16 millimeters measurement was decided for the design of a sample jig and fixture.

III. OVERVIEW OF FIXTURE

1. Fixture

A Fixture is a work holding device utilized as a part of the manufacturing businesses. Fixtures are used to securely locate the position or location and to support the work, ensured that all parts produced using the fixture will maintain conformity and interchange ability. Utilizing this fixture enhances the economy of generation by permitting smooth activity and brisk change from part to part creation.

A fixture basic role is to make a safe mounting point for a work piece, taking into account for support during operation and improve accuracy, precision, quality, and interchangeability in the completed parts. It likewise serves to decrease working time by permitting quick set-up, and by smoothing the change from part to part. It frequently reduces the complexity of a process, considering untalented laborers to perform it and adequately exchanging the skill of the tool maker to the unskilled worker. Fixtures likewise take into consideration a higher level of operator safety by reducing the concentration and exertion required to hold a piece constant.

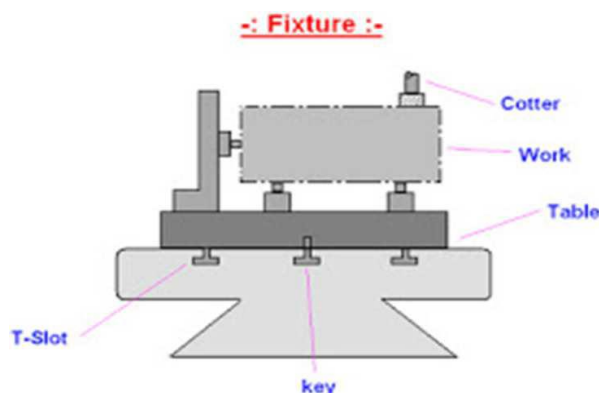


Fig.1 Fixture

The Fixtures having following features

- a. Reduction of Idle time.
- b. Cleanliness.
- c. Standardization.
- d. Hardened surfaces.
- e. Position of clamps.

2. Materials utilized in Fixture:

The Fixture are produced using variety of materials, some of which can be solidified or res. Sometimes it uses nonferrous like as phosphor bronze to reduce the wear of mating parts or nylons or strands to avoid harm. A large portion of high speed material has been utilized for this production.

IV. ELEMENTS OF FIXTURES

1. Clamping devices:

They are utilized for not very rigid clamping. Hook bolt clamp a simple device by and large utilized where the typical clamping tip can't fit in. latch clamp – this is an extraordinary clamp which gives space to the loading and the unloading of a work-piece through its latch or lid. Other clamping devices are the C – clamp, the Bridge clamp, and the Heel clamp.

2. Locating Devices-

Made with hardened steel and with various designs, the pin is the most prominent device connected for the area of work-piece in fixtures. The pin shank is press-fitted or driven into a fixture. The locating width of the pin is greater than the shank to prevent it from being squeezed into the fixture body of weight of the cutting devices or work-piece.

The pins are classified as follows:

a) Locating pins – the locating pins are utilized for the area of the work-piece when finished or reamed holes have been given on the work-piece. The two sorts of locating pins are round and hollow and conical locating pins.

b) Jack pins – jack pins likewise referred to as spring pins are utilized for the area of work-piece whose measurement will change during operation. The pin is intended to rise under spring pressure or in the contrary the heaviness of the work-piece drives it down. As the position of the work-piece is solidly settled, the locking screw is utilized to fasten the pin in the desired position.

c) Support Locating/Rest pins – these pins which guarantee reliable and secure area are made to be either curved or flat. Those with flat heads are frequently used to offer help and location to machine surface, as more contact area is open during operation.

V. MATERIAL LIST

Material list required for multipurpose fixture is given in following table. This material list is taken by referring research paper and from the exchange with organization individuals. Steel specified by SAE (Society of Automobile Engineers).

Table 1: Material List

Name	Material	No	Process
Base plate	Mild steel	1	Milling, Drilling Grinding
Pillar	En8	4	Hardening, turning, Grinding
M12	Mild steel	6	Standard
Drill brush	OHNS	3	Standard
Strap Clamp	C45	2	Standard
Locating Pin	En24 Mild Steel	6	Mill, grind, jig boring
Jig Plate	En24 mild steel	1	Mill, Grind, Jig boring

VI. DESIGN OF FIXTURE

1. The diameter to be slot drill the work pieces 10 mm

Inner diameter of bush = $d_1 F_7 \phi = 10 F_7 \phi$

Other dimensions of T slot Stud

$L_1 = 30\text{mm}$,

$L_2 = 20\text{mm}$,

$D_1 = 10\text{mm}$

2. Design of Fixture Plate

Length of the Fixture plate

= $W_w + L_p + \text{clearance on both sides}$.

Where,

W_w - work piece width = 430mm.

L_p - Length of the pillar = 50mm

Clearance on both sides = (15+5) mm.

Width of fixture plate = $430 + 50 + [15+5] = 500$ mm.

Width of the fixture plate = $L_s + \text{clearance on both sides}$.

Where,

L_s - Length of slot = 10 mm

Clearance on both sides = 5mm.

Length of fixture plate = $10 [5+5] = 20$ mm.

Thickness of fixture plate = 20 mm.

3. Design of Fixture Plate

Selection of Fixture

Number of jobs - 4 no z

Material - mild steel

Brindle hardness - 229BHN

Surface finish - 0.025mm to 0.05mm.

4. Selection of Clamping Method

To select required clamping device the clamping force should be calculated for which the cutting force is required.

$$\text{Cutting force, } F_c = \frac{(4.5 \times k \times f \times b \times d)}{C_g}$$

High carbon steel, $k = 8.5$

Feed, $f = 75 \text{ mm/min}$.

Cutting speed, $C_g = 15 \text{ m/min}$

$$\begin{aligned} \text{Cutting force, } F_c &= \frac{(4.5 \times 8.5 \times 75 \times 3 \times 3)}{15} \\ &= 1721.25 \text{ N} \end{aligned}$$

5. Thrust force

Thrust force = $1.16 \times 1.5 \times 25 \times 100 \times 0.19$

= 531.39 K_{gf}

Thrust force = 5313.9 N

Force acting on each Plate:

$$(P) = \frac{(K_s \times d \times s)}{4M} \text{ k}_{gf}$$

$$= \frac{d \times s}{4} \text{ mm}^2$$

$$= \frac{25 \times 0.19}{4}$$

$$= 1.188 \text{ mm}^2$$

$K_s = 250 \text{ kg/mm}^2$ for mild steel

$P_z = 250 \times 2.288 \text{ k}_{gf} = 297 \text{ k}_{gf} = 2970 \text{ N}$

$$\text{Torque, } M = \frac{(P_z \times d)}{20}$$

$$= \frac{(2970 \times 25)}{20}$$

$M = 3712.5 \text{ N-mm}$



6. Clamping Force

Clamping force (Q) = drilling force × factor of safety

$$= 3712.5 \times 3 = 11137.5 \text{ N}$$

7. Clamping Force Analysis of Strap Clamp

Strap clamp calculation:

They are usually made to at least the same width as the washer under the head of the bolt used to tighten the clamp. The slots are made approximately 1.5748 mm wider than the diameter of the clamp,

$$W = 2.8 \times d + 1.5748$$

Where,

$$d = 10 \text{ mm}$$

$$W = 29.5748 \approx 30 \text{ mm}$$

Thickness T of the clamp for a bolt diameter d of is given by

$$T = [0.85 \times d \times A \left\{ 1 - \frac{A}{B} \right\}]^{0.5}$$

$$T = [0.85 \times 10 \times 55 \times \left\{ 1 - \frac{55}{75} \right\}]^{0.5}$$

$$= 14.88 \approx 15 \text{ mm}$$

The load on the bolt is a function of the torque on the bolt and the diameter of bolt. Torque on the bolt,

$$T = \frac{(d \times f)}{5}$$

$$F = \frac{(A \times f)}{B}$$

$$F = \frac{(5 \times T)}{d}$$

$$= \frac{(5 \times 3510)}{10}$$

$$= 1575 \text{ N.}$$

Thus,

$$M = \frac{f \times A \times (B \times A)}{B}$$

$$= \frac{1575 \times 55 \times 20}{75}$$

$$= 22435.6 \text{ N-mm}$$

The stress on the clamp is obtained as follows,

$$S = \frac{M}{(\text{section modulus}) \text{ Section modulus}}$$

$$= \frac{[(w-c) \times t^2]}{6}$$

stress on the clamp, N/mm² Section modulu

$$s = \frac{(30-10) \times 15^2}{6}$$

$$= 750 \text{ mm}^3$$

Stress on clamp

$$= \frac{M}{(\text{section modulus}) \text{ Stress}}$$

$$S = \frac{22435.6}{750}$$

$$S = 29.78 \text{ N/mm}^2$$

Thus our design is safe

VII. RESULT ANALYSIS

Corrected type of jig and fixture increase load carrying capacity and also increase the accuracy in clamping device and very importance is to reduce the time seating time so increasing production time. it measure problem occur in when frequently change the job.

a) Sample Testing

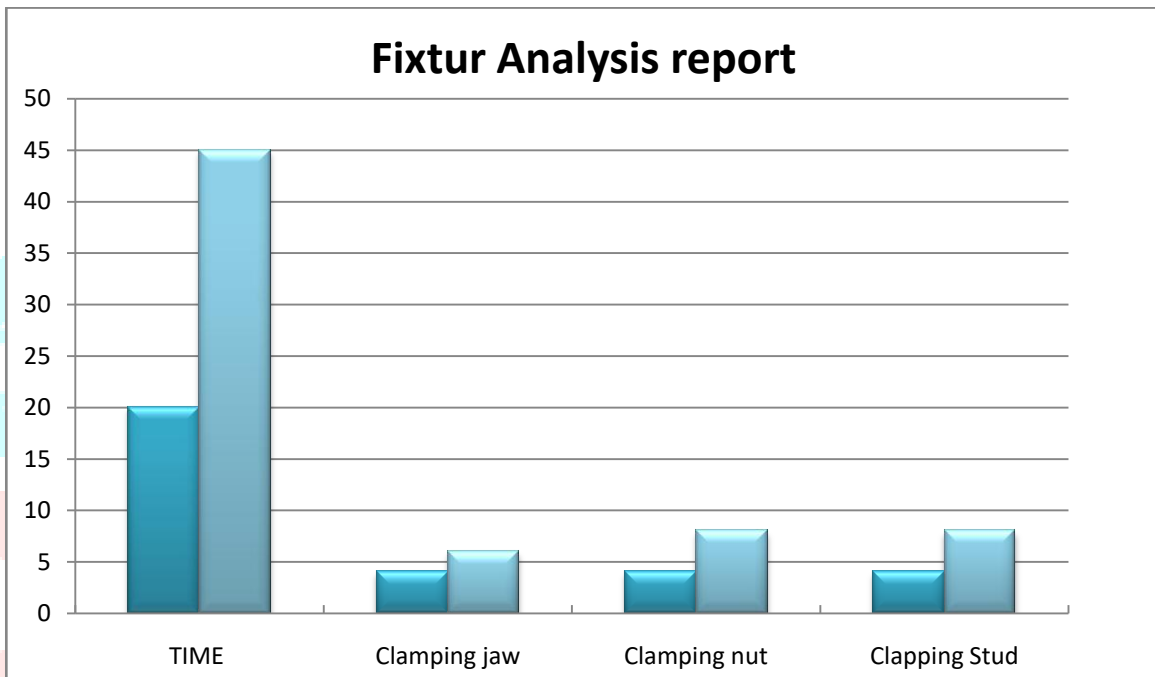


Fig.2 job 01 (Motor coupling cover)

b) Fixture analysis report

SR NO	Multi-purpose	Old Fixture
Time/min	20	45
Clamping jaw	4	6
Clamping nut	4	8
Clapping Stud	4	8

c) Comparative statement graph



d) Sample Testing:-

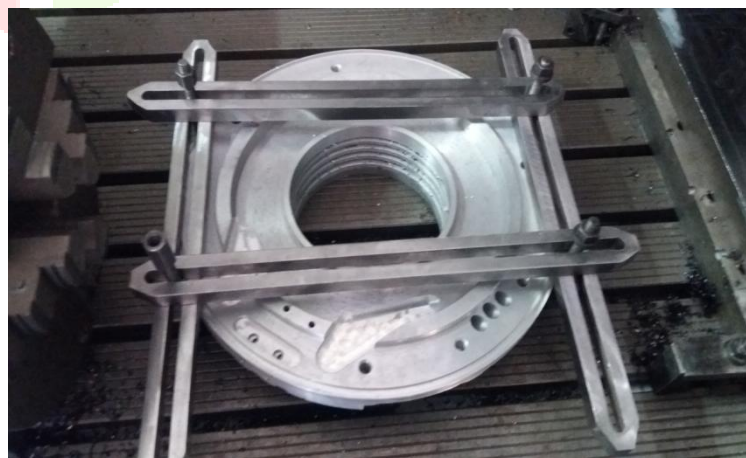
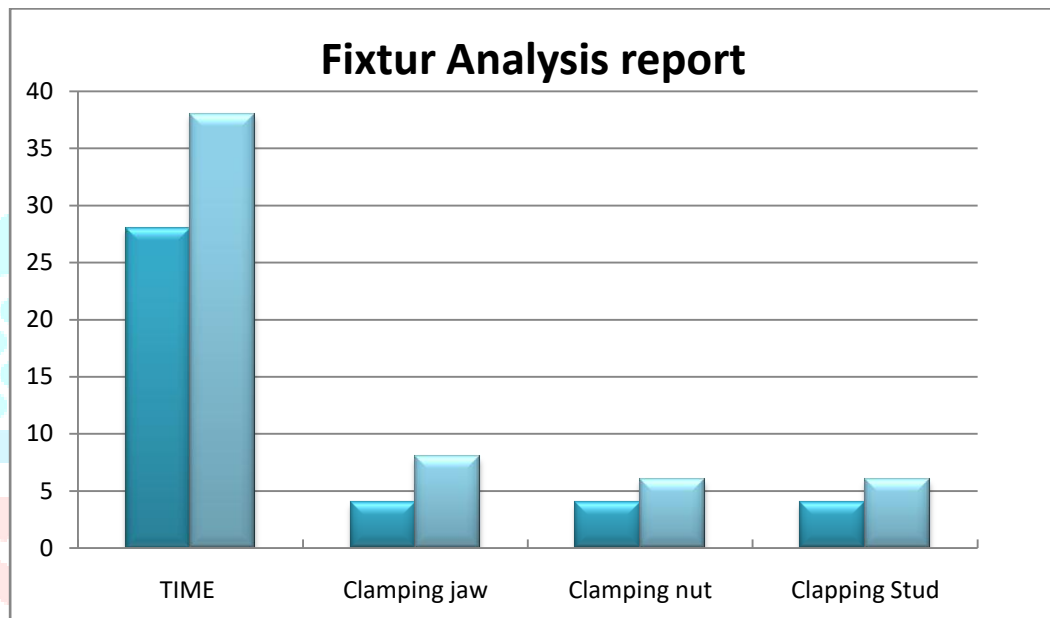


Fig.3 job 02 (Heat Sink cover)

e) Fixture analysis report

SR NO	Multi-purpose	Old Fixture
Time/min	28	38
Clamping jaw	4	8
Clamping nut	4	6
Clapping Stud	4	6

f) Comparative statement graph



g) Sample Testing:-

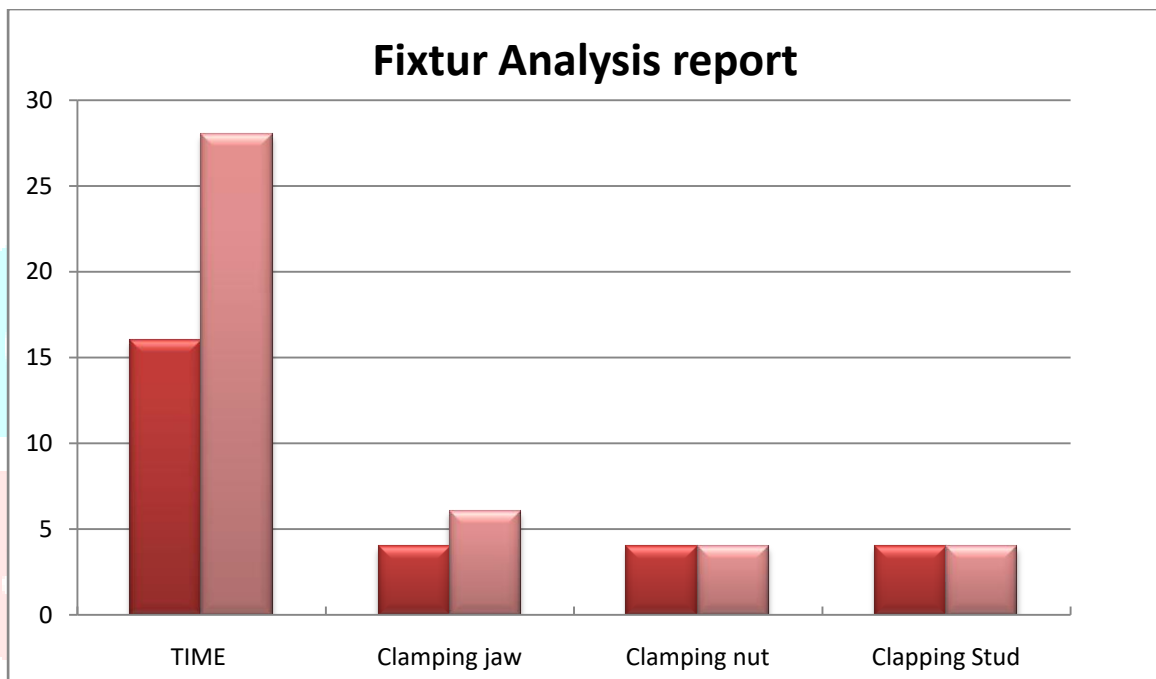


Fig.4job 03 (Slotted link)

h) Fixture analysis report

SR NO	Multi-purpose	Old Fixture
Time/min	16	28
Clamping jaw	4	6
Clamping nut	4	4
Clapping Stud	4	4

i) Comparative statement graph



j) Sample Testing:-

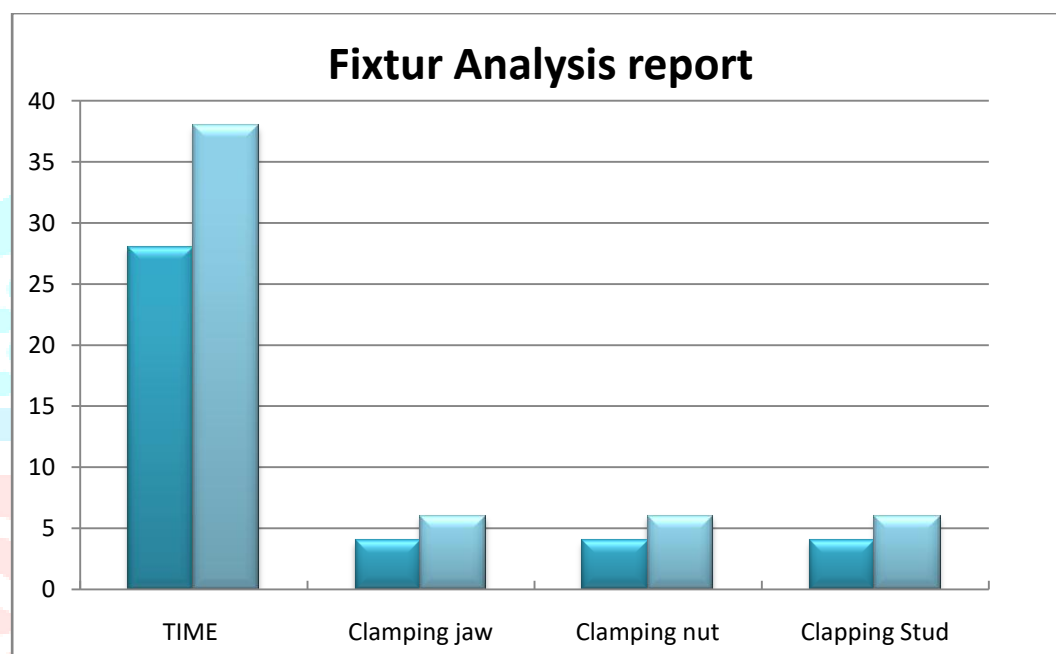


Fig.5job 04 (Holding plate)

k) Fixture analysis report

SR NO	Multi-purpose	Old Fixture
Time/min	28	38
Clamping jaw	4	6
Clamping nut	4	6
Clapping Stud	4	6

l) Comparative statement graph



VIII. CONCLUSION

Accordingly the multi-operational fixture.it has been effectively planned and designed according to the requirements of the industries from the current model. The overall plan method needs to be designed to a different analysis work. The top plate and screws and Nuts additionally designed for a specific dimension. The Fixture has serves to a lesser the cost and furthermore spares the design time. This design can be the ideal solution for the issue that was searched out. The use of this fixture will positively enable the industry in decreasing the production time and furthermore decreasing the production cost separated from increasing the productivity. The cost incurred in the manufacturing of the fixture can be obtained in the passage of time without influencing the benefit of the company.

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