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DESIGN OF WORK TILTING FIXTURE FOR CLUTCH HOUSING - A CASE STUDY

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Abstract - *Today's business growth is totally dependent on the productivity and the customer satisfaction through services. To make the process of workability easier, to design an tilting fixture which will work in less available space and thus reduce the time required to rotate the clutch housing from one work station to another. This study started with observing the operation in clutch housing line, understanding the existing process flow, identifying the problem and areas of possible improvements. The main aim is to design and develop the work tilting fixture for machining of clutch housing. This study gives an idea about the designing of this tilting Fixture by considering safety. Considering the selected design concept of the fixture, further designing and modeling of fixture on CATIA V5R25 software is done. This paper reflects the study conducted at one of the well known clutch housing Industry which is located in M.I.D.C. Hingna road Nagpur.*

Keywords: Fixture, Clutch Housing, Cycle Time.

1. INTRODUCTION

Clutch housing in the tractor are used to provide isolation and casing for different components of transmission line. The fixture designing and manufacturing is considered as complex process that demands the knowledge of different areas, such as geometry, tolerances, dimensions, procedures and manufacturing processes. This fixture provides various benefits like safety for user, easy handling, time saving etc. This fixture can increase productivity & reduce operation time.

1.1 Specification of clutch housing

- Weight of housing : 82 kg
- Height of housing : 756 mm
- Front Dowel width : 480 mm
- Rear Dowel width : 320 mm

Fig 1.Clutch housing

2. PROBLEM STATMENT

2.1 Introduction about industry:

This industry is known for fettling & finishing of rough foundry Castings on clutch housing & hydraulic lift unit casting and it supply to tractor manufacturing unit.

This industry is ISO 9001:2008 certified company for machining of complex & heavy casting for automobile, railways & various engineering giants of the country.

2.2 Problem Definition:

Earlier for lifting and tilting any heavy component was done by hoist and weight lifting chain arrangement. Due to hydraulic lift operated fixture and as we are observed that in production department there is some unwanted work process is done which is taking extra time and effort as well as increase in the cost of product and worker affected some unwanted fatigue, so the industry is unable to improve productivity. Hence for making loading and unloading simple, minimize time and to ease operations, it is required to design new fixture. This will overcome the above difficulties to design and developing the fixture for machining on clutch housing.

Fig 2. Work place of 1st part of roller

Fig 3. Work place of 2nd part of roller

2.3 Objectives

The main objectives of our study are as follows:

- Tilting fixture ensures that the process becomes easy as there are no complications at the workers end.
- It helps to increase productivity of machining process.
- To prevent work piece damage.

3. LITERATURE REVIEW

1) Design and Analysis of an Indexing Fixture by Prof. Sachin P. Komble, Sudhanshu Mishra, International Research Journal of Engineering and Technology (IRJET), Aug 2018 this paper reflects the study of the mechanism used to rotate a 6-cylinder Truck engine along its horizontal axis of rotation. An Indexing Fixture is a device used to rotate (index) any object through a specific angle. This study will help to streamline the manufacturing process.

2) Design & Development of Work Holding Fixture for Cylinder Block by Prof. (Dr.) V. D. Shinde, Mr. L. J. Gadsing, International Research Journal of Engineering and Technology (IRJET), July 2018, the main aim is to design and develop the Work Holding Fixture for Machining of 5L Cylinder Block. Fixture design has large impact on product quality, manufacturing lead time and cost. In this work, the work holding hydraulic fixture for machining of 5L cylinder block has been designed.

3) Analysis & Optimization of Heavy Shell Tilting Fixture by Kartik Upadhyay, Vikas Sharma, International Journal of Engineering Sciences & Research Technology, Jan 2018, the purpose of the research paper is to design and analysis of heavy shell tilting fixture for weight capacity 120 MT will use in this work. Heavy shell tilting fixture is mainly used for tilting the shell from horizontal to vertical and vice versa. For certain types of application shell have to move vertical to horizontal at that time this fixture is used.

4) A Review on Design of Fixtures by Shailesh S.Pachbhai, Laukik P.Raut, International Journal of Engineering Research and General Science, Feb-Mar 2014, this review was on machining fixtures, minimizing work piece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. Fixture is required in various industries according to their application. For that more cycle time required for loading and unloading the material. So, there is need to develop system which can help in improving productivity and time.

4. METHODOLOGY

There are a number of techniques in industrial engineering which are suitable to improve productivity by reducing cycle time in clutch housing machining plant. Among between these machines opted for design the work holding fixture.

The fixture design is carried out in following ways:

a) Identify various operations carried out on clutch housing and creating original layout of clutch housing plant.

b) Collect important data & conduct time study technique to find the time required for loading and unloading the clutch housing.

c) Analyze the collected data.

d) Conduct method study to understand existing method of doing work and identify the areas where cycle time can be reduced, develop faster method of doing the same work.

e) Conduct trial run for 2 industry visits for new design and collect the time from this design and compare the old time to new time collecting.

f) Recommend the new design to the concern.

5. WORKING PRINCIPLE

Working principle is based on a mechanism of work tilting device used in manufacturing system. A supporting platform for work piece to rest on is placed on a shaft, where the shaft is resting on the bearing which is placed in the flywheel supported by the stands on the both sides. When the work piece will be placed on the platform, operator will rotate it 90 degree and the work piece will be placed on the roller conveyor.

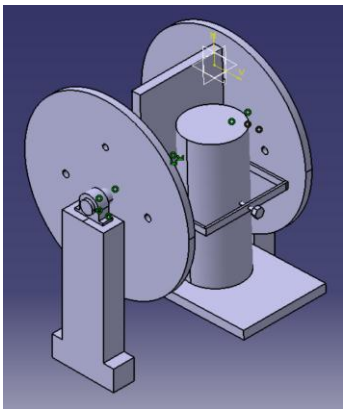

Fig 4. Actual Design of Tilting Fixture

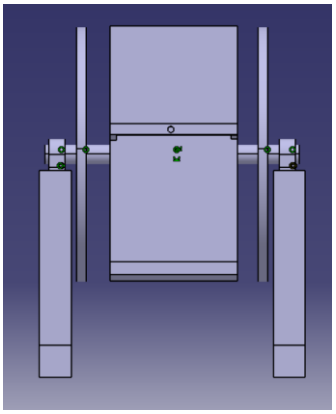

Fig 5. Front View of Tilting Fixture Without Component

6. ELEMENTS OF FIXTURE

6.1 L-Shape Plate: An L-shape plate is used for mounting the components fixture. It was casted of Cast Iron because of its intrinsic construction. Plate is attached at the centre of the shaft.

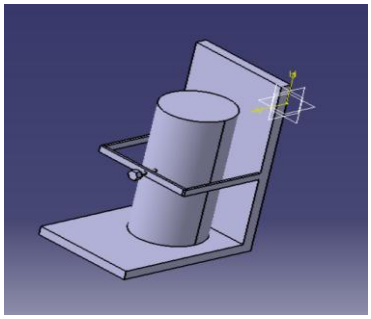

Fig 6. L-Shape plate with work piece

6.2 Support Fabrication: It is installed to provide the horizontal support to the machining component.

6.3 Shaft: Shaft is the main part of the fixture. Shaft is made up of mild steel**.** Flywheel and plate are mounted on the shaft. Overall weight applied on shaft is 100 kg.

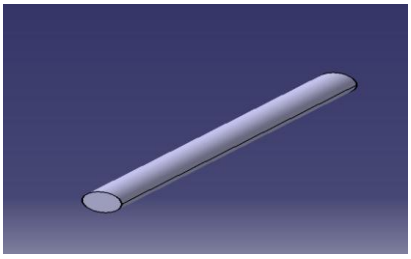

Fig 7. Shaft

3.1 Flywheel: The flywheel is mounted on shaft. Flywheel is the rotating part of the fixture. This can be rotate by manually. Flywheel is used for balancing clutch housing at the time of machining.

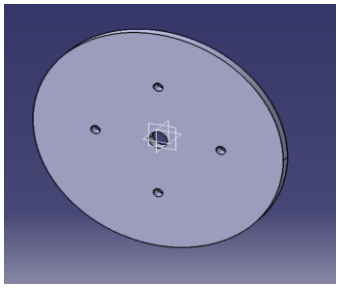

Fig 8. Flywheel

3.2 Bearing: A bearing is a machine element that constrains relative motion to only the desired motion and reduces friction between moving parts.

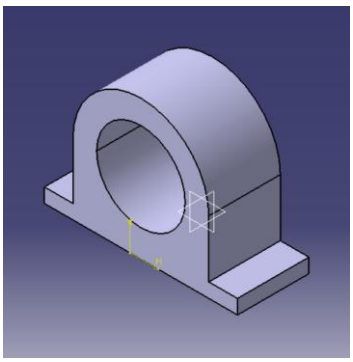

Fig 9. Bearing

7. CALCULATIONS

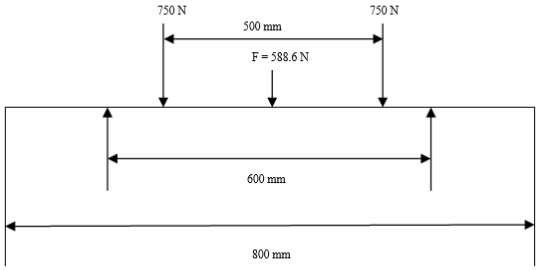

Fig 10. Shear Force Diagram of Fixture

a) Shaft Design

W = 120 Kg =120×9.81 = 1177.2N

Load on 1st Flywheel = W1 = 75 Kg = 75×9.81 = 735.75N

Load on 2ndFlywheel = W1 = 75 Kg =75×9.81 = 735.75N

Assume the radial distance of handle from shaft center = 200 mm

Torque = T = 1177.2×200/1000 = 235.44 N-m

$$T_e = \frac{\pi}{16} \times \tau_{max} \times d^3$$

$$1781.42 \times 10^3 = \frac{\pi}{16} \times \frac{49.33}{1000} \times d^3$$

$$D = 56.86 \approx 60 \text{ mm}$$

b) Bearing Design

Life of Bearing assume for 5year = L_H = 24×365×5 = 43800 Hours

Bearing No. = 6112

Deep Groove ball bearing = 6

Series = 01XX

Bore no. size = 12

Inner Dia. = 60 mm

Outer Dia. = 95 mm

Width = 18 mm

c) Flywheel Design

Flywheel outer Diameter = 800 mm

Flywheel inner diameter = 60 mm

Flywheel weight = 75 kg (assumed)

8. ANALYSIS

8.1 Analysis of Shaft

Analysis is done on the ANSYS mechanical finite element analysis software which is used to simulate computer models of structures, electronics, or machine components for analyzing strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes.

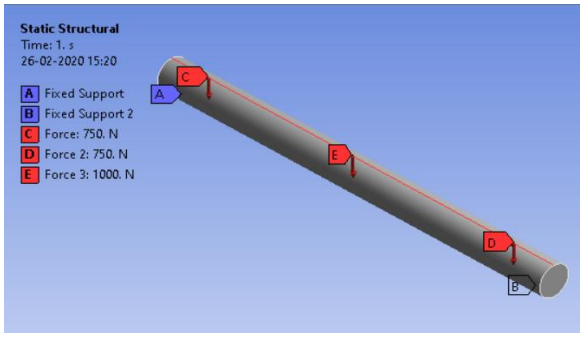

Fig 11. Static Position of Shaft

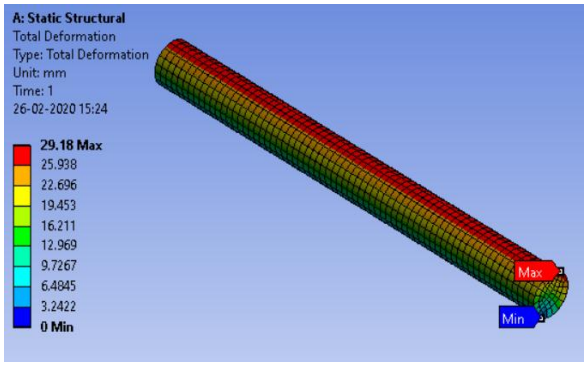

Fig 12. Deformation of Shaft

In above fig. deformation of shaft is shown, with the load application for the time duration of 1 min. in the analysis software, which is varying from 0 mm to 29.18 mm Max.

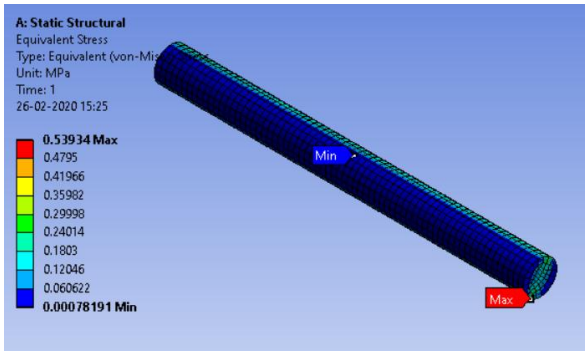

Fig 13. Stress Analysis

In above fig. stress analysis of shaft is shown, with the load application for the time duration of 1 min. in the analysis software, the stress taken place is shown in above fig. which is varying from 0.00078191 MPA to 0.53934 MPA max.

8. RESULT AND CONCLUSION

On the basis of data collected in the study, it is observed that by using of work tilting fixture it required less time for loading and unloading operation of the clutch housing.

SN. No.	Time required (sec)	
	Before Fixture Design	After Fixture Design
Machining	175 sec	175 sec
Loading & Unloading	60 sec	35 sec
Total	235sec	210 sec

Table 1. Cycle time description sheet

As per tractor manufacturing unit demand daily 70 to 180 components dispatched.

- Percentage decrease in time/component by above study is = (235-210)/235*100 = 10.63%

- Daily time saved for average demand 125 components/day Loading and Unloading operation = 125*(60-35) =3152 sec/day = 52.08 min/day

- In this study by implementing this work tilting fixture we saved the time required for loading and unloading operation by 52.08 min daily.

9. REFERENCES

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