Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research

International Journal of Recent Scientific Research
Vol. 6, Issue, 3, pp.3033-3036, March, 2015

ISSN: 0976-3031

RESEARCH ARTICLE

DESIGN AND ANALYSIS OF MILLING FIXTURE FOR PNEUMATIC ACTUATOR COMPONENTS

Shivanand Vathare[1], Sudhir S Mathapati*[2] and Poojesh Anvekar[3]

[1,2]M-Tech Scholars, GIT Engineering College Belagavi
[3]Assistant Professor, Girijabai Sail Institute of Technology Karwar

ARTICLE INFO

Article History:

Received 2nd, February, 2015
Received in revised form 10th, February, 2015
Accepted 4th, March, 2015
Published online 28th, March, 2015

Key words:

Design, Analysis, Milling Fixture, Solid Edge, ANSYS

ABSTRACT

The manufacturing industry of small scale provides wide range of products to fulfill the market needs. To face many challenges of market these industries should increase their production rate with good quality and accuracy. The manual production is of low production rate and long throughput time. Moreover, standardization of manual processes is difficult and also its difficulty in maintenance, thus fixtures is used on the machines. Therefore, this study aims to design a Fixture. Basically, Fixture is a work holding device to guide the tool. The main purpose of making this fixture is to perform the milling operation without any need of shifting the job regularly. This results in reduction of production time and increase in production rate. This will lead to decreasing manufacturing time and also the machining cost. In this work the Milling fixture is designed and analyzed for the stresses and deformation that occur during the machining process. The Solid Edge V20 Software is used to model the Milling fixture and analysis work was carried out by using ANSYS 13 Workbench Software.

INTRODUCTION

Now a day, the small scale industries are trying to increase the demand of the product and increase the mass production. To meet these challenges it has become very important for companies to increase their production rate. The successful running of any mass production depends upon the interchangeability of the work parts to facilitate easy assembly and reduction of unit cost. Mass production demands a fast and easy method of positioning work for accurate operation on it. The main intention of any company is to provide good quality product and increase in production rate in order to get profit over it. This can be achieved by minimizing manufacturing lead time and cost of production by using work holding guiding device. This work holding device is fixture. Fixtures are designed such that large number of components can be machined or assembled identically. Fixtures are special purpose tools which are used to facilitate production when work piece are to be produced in mass production scale. They provide predetermined tolerance between work and the cutting tool. Once the fixture is properly setup, any number of duplicate parts can be readily produced without any additional setup. Hence increasing the productivity and increasing accuracy by reducing setup cost and manual fatigue.

Problem Definition

Fig. 1 shows pneumatic cylinder actuator. A pneumatic cylinder mainly consists of a piston, a cylinder and a valve or port. The piston is covered by a diaphragm, or a seal, which keeps the air in the upper position of the cylinder, allowing the air pressure to force the diaphragm downward, moving the piston underneath, which in turn moves the valve system, which is linked to the internal part of the actuator. Pneumatic actuators may only have one spot for single input, top or bottom, depending on action required. In this project head and cover part of the actuator should be milled. Here milling fixture is designed for head and cover part of the pneumatic actuator.

METHODOLOGY

Depending upon the study of the components suitable location and clamping methods have been adapted.

Location

1. For the components spigot location is taken. According to the dimension of the spigot the fixture base plate is cut for location purpose, and four resting pads are been provided to rest the component on it. Now the component is located on the spigot location and is rested on the resting pad. Due to the spigot location and resting pads the part cannot move/rotate horizontally with respect to x-y direction. Hence 4-DOF (translator motion) and 4-DOF (rotational motion) are arrested. In z-direction, downward motion is arrested. But still the part rotating with respect z-axis.

Corresponding author:* **Sudhir S Mathapati
M-Tech Scholars, GIT Engineering College Belagavi

2. The locating pin is provided to arrest the rotation motion with respect to z-axis. Hence 2-DOF (rotational motion) is arrested.
3. Remaining 2-DOF is left free for loading and unloading purpose during machining operation this DOF can be arrested by suitable clamping devices.

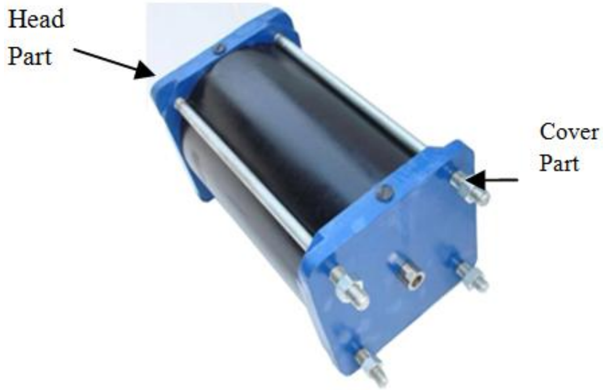


Fig.1 Pneumatic Cylinder Actuator

Clamping

1. Here it is used strap clamps. Strap clamps are provided to hold the component rigidly on fixture base plate.
2. Liner is used to press fit the locating pin.
3. Four resting pad are used at the bottom of fixture plate.

By using the above methods, design drawings of fixture are done. The 3-D model is created by using solid edge v20 software. The model consist of work part, fixture base plate, locating pin, work part resting pads, base plate resting pads, stud bolts, nuts, washer and strap clamps. Here Front, Top, and Isometric view of the Milling Fixture is shown in Fig.2, 3, 4 respectively.

Analysis

In this work the analysis is carried out on fixture and cover part assembly. To study the fixture analysis, stress effect and deformation. Fixture and cover plate assembly are modeled, meshed and forces are applied for the analysis to be carried out. The steps are explained below.

Step 1: Importing the geometry

In this work modeling is carried out by using SolidEdge V20 Software and saved it into .step format.

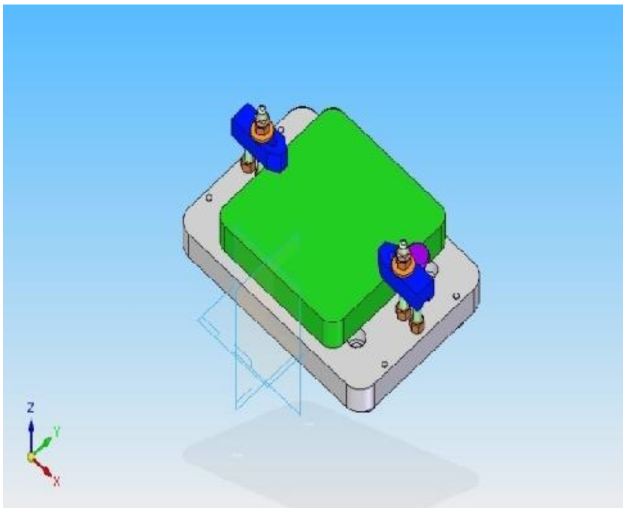


Fig.4 Isometric View of the Milling Fixture

Step 2: Assigning material properties

The material properties are given below.

Table 1 Material properties

Material	Young's modulus(E)	Poisons ratio(υ)
Mild steel	210 Gpa	0.3
Stainless steel	200 Gpa	0.29
Cast iron	170 Gpa	0.3

Step 3: Meshing

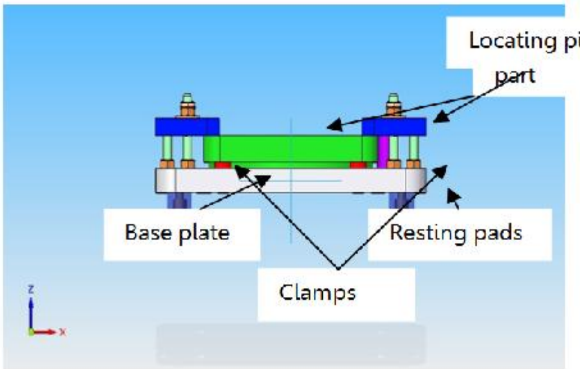
The meshing is done by using SOLID187 element. Now identify the contact pairs and define target and contact surface and also define the type of contact region is bonded.

Table 2 Mesh information

Number of total nodes	41558
Number of contact elements	7844
Number of spring elements	0
Number of solid elements	19386
Number of total elements	27202

Table 2 gives the meshing information, like number of nodes, contact elements, spring elements, number of solid elements and total number of elements.

In above figure 6 shows the boundary conditions were applied on milling fixture,



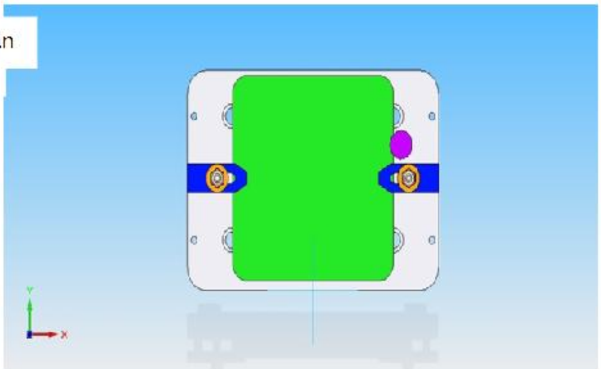


Fig.2 Front View of the Milling Fixture **Fig.3** Top View of the Milling Fixture

Step 4: Applying boundary conditions

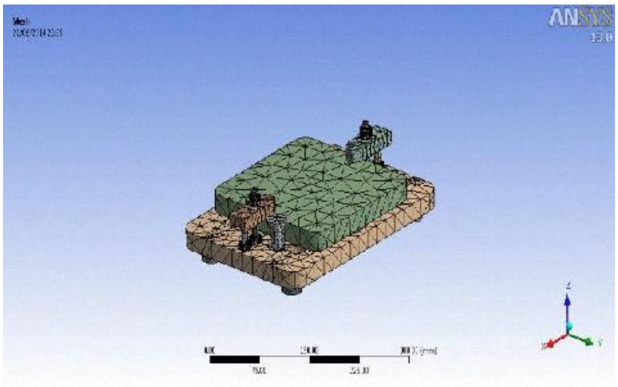


Fig 5 Meshing of a Milling fixture

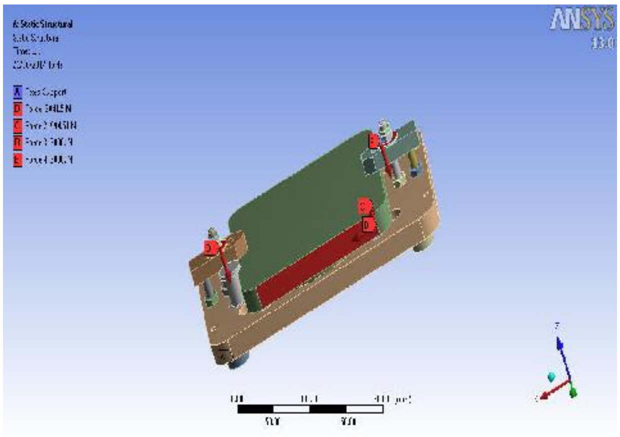


Fig 6 Applying boundary conditions on milling fixture

Step 5: Solve the problem and obtain the results

ANSYS workbench solver is used to solve the above problem and graphical results are obtained and these results are plotted as shown below.

Equivalent stress

The calculated cutting forces are applied on the fixture assembly. And clamping force is applied on both the clamps of about 3000 N. We get the following results.

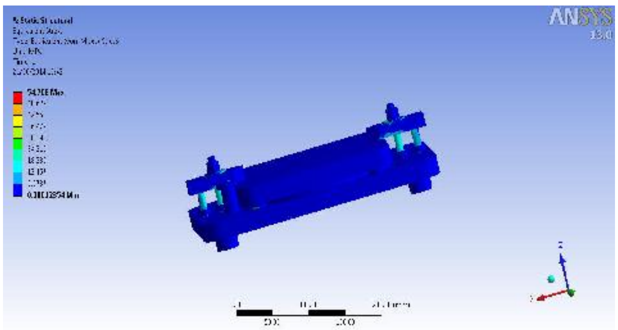


Fig 7 Equivalent stress of fixture assembly

The maximum stress obtained is 54.708 MPa which occurs on the clamp plate is less than yield strength of the clamp plate material (Mild steel 250 N/mm^2)

Total deformation

This is carried out to find the deformation occurs when the above boundary conditions are applied. The result is shown below.

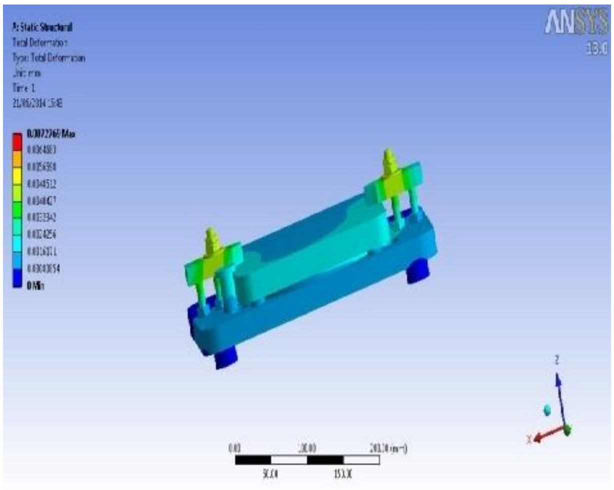


Fig 8 Total deformation

The maximum deformation occurred in the clamp plate is about 0.0072769 mm which is negligible. Hence there is no much deformation.

Elastic strain

This is carried out to find elastic strain for the assembly model. We get following results.

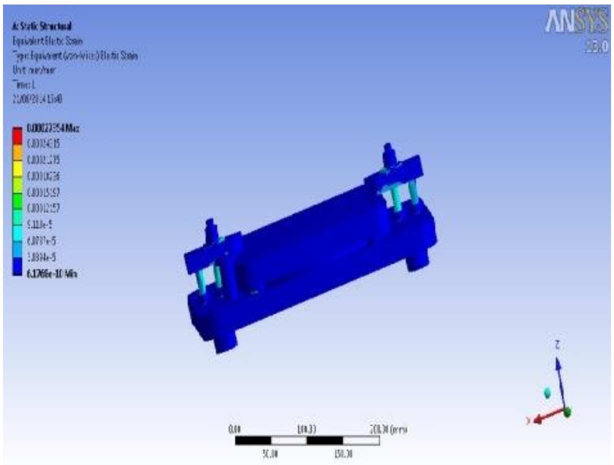


Fig 9 Elastic strain

The maximum elastic strain occurred is 0.00027354.

Validation of Ansys Results With Theoretical Calculations

Table 3 Validation of results

	Von-misses stress In MPa	Deformation in 'mm'	Strain
ANSYS result	54.708	0.0072769	0.00027354
Theoretical result	56.657	0.007799	0.0002697

The stress and deformation of clamp plate and assembly is within the limit hence there is no chances for failure. Hence the design is safe.

CONCLUSION

Analysis carried on the assembly of the fixture gives good result where the stress and deformation formed on the materials of the fixture assembly are under the limit which is less than the yield strength of material (i.e. 250 MPa) and hence there is no chance of failure. The ANSYS result was also validated theoretically and gives good accuracy for result.

References

1. Cyril Donaldson, G. H. LeCain, V.C. Goold, “Tool Design”, 3rd edition.
2. Edward G. Hoffman, “Jig and fixture design”, 5th edition.
3. H.V. Lakshminarayana, “Finite Element Analysis: Procedures in engineering”.
4. Herman W. Pollack, “Tool Design”.
5. Machine tool design handbook “CMTI”.
6. P.H. Joshi, “Jigs and fixtures”, 3rd edition.
7. S.S. Ratan, “Strength of Material”

How to cite this article:

Sudhir S Mathapati *et al.*, Design and Analysis of Milling Fixture for Pneumatic actuator Components. *International Journal of Recent Scientific Research Vol. 6, Issue, 3, pp.3033-3036, March, 2015*

****