iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 Issue: III Month of publication: March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3607

Design and Analysis of Hydraulic Ram Repairing Fixture

Aditya Maske[1], Akash Salodkar[2], Sanket Motikar[3], Abhishek Sakhare[4], Prashik Patil[5], Shubham Dhanare[6], Rushikesh Wankhed[7]
[1, 2, 3 ,4, 5, 6, 7,] *Department of Mechanical Engineering, Nagpur Institute of Technology*

Abstract: The scope of this work is to design and analyze a fixture to fulfill a specific purpose of holding and supporting a hydraulic actuator unit while performing maintenance operations. Stress calculation is necessary as the hydraulic cylinder vessel bears a pressure of about 5000 Pascal, any damage due to clamping and machining forces can damage the unit. The component design is done using Catia V5 and then converted into IGS format for analysis. The deflection, deformation and stresses as well as the machining loads on the fixture are analyzed by (FEM) using ANSYS 14.5 workbench.
***Keywords:* Catia, Ansys, Finite Element Analysis, stresses, clamps, IGSetc.**

I. INTRODUCTION

Fixtures are widely used in manufacturing and repairing workshops. Fixtures provide minimum work-piece deformation due machining forces and also save time.

With the ever increasing demands for mining, construction and heavy loading activities the use of hydraulic rams is inevitable and with continuous usage and careless handling the hydraulic unit develops a number of deformities and failures. all heavy duty machines makes use of hydraulic rams and actuators. they are source of power for loading and lifting activities. These failures and deformities developed are the result of various circumferential and axial stresses in the cylinder vessel and piston rod failures like rod buckling, stop collar failure, load bearing failure, etc. Other minor defects are leakages in pipes, valves seal breakage caused due to sudden variation in pressure transients or wearing and shearing. The hydraulic ram needs maintenance, repairing and replacement of hydraulic fluids regularly.

The proposed design will hold the cylinder vessel in position with the help of a metal pin of some appropriate diameter as the rod eye and the cylinder will be held firmly with e help of screw clamps and bolts.

The entire structure will be bolted or welded to a rectangular rigid frame made of thick metal rods. The frame can be fixed to floor/platform with the help of bolts to provide extra stability. The proposed Fixture once installed will successfully reduce the time and effort of a semi-skilled or unskilled worker. The designed fixture will have a significant impact on the productivity and efficiency of a small scale garage or workshop.

II. FIXTURE ELEMENTS

A. Locators

The locators will establish the position and direction of the hydraulic cylinder as well as piston rod. The piston will be placed on the side where holes of appropriate sizes are cut.

B. Clamps

To stabilize the cylinder vessel it is fastened with the help of Screw clamps of appropriate size. The clamps are provided with rubber pads to avoid unnecessary damage.

C. Frame

The frame consists of two rigid side members of 5.6ft(L),12 cm(B), thickness 1cm and two rods of 5.2ft(L),10cm(B), thickness 1cm welded or bolted to each other forming a rectangular structure. The frame should be able to withstand deflection and all the stresses developed during processing of the work piece.

D. Cylinder fixing and securing bridges

The platforms on which the piston rod and cylinder vessel are fixed are raised above the frame at a height of 1ft approx. It gives comfort to the worker and provides sufficient space for inspection.

III. DESIGN

A. What are hydraulic actuators/rams?

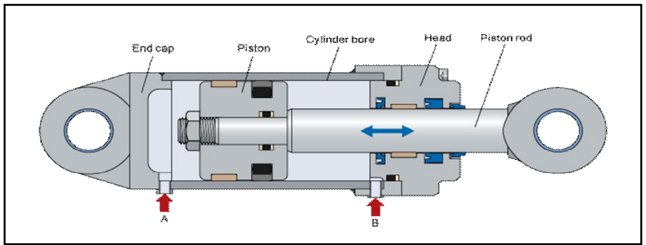


Fig: Hydraulic Actuator.

Hydraulic actuator comprises of a hollow cylinder and a piston that depends on hydraulic power or pressurized fluid to facilitate mechanical operation. The motion can be linear or oscillatory. The actuating motion can be single acting or double acting. The fluid pressure is increased with the help of compressor. The system is based on the principle of Pascal's Law:

"Pressure is distributed equally throughout the fluid at any point and exerts pressure upon every part of the confining vessel."

F= P * A

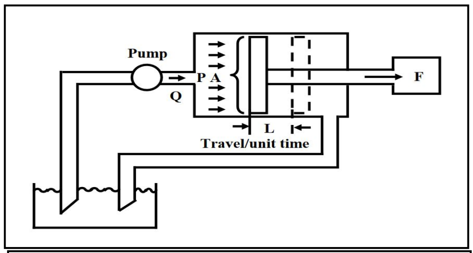


Fig: schematic of a simple hydraulic unit.

B. Principle of design of fixture

Also known as the six pin locating method. Before designing a fixture the major portion of time is spent on the how to locate the work piece in fixture. There are 6 translational and 6 rotational degrees of freedom:

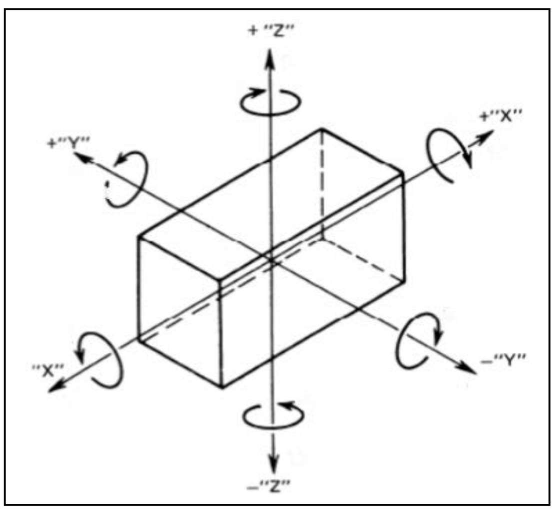
Translational: x, y, z,–x,-y,-z

Rotational –X, Y, Z (clockwise) and

X, Y, Z (counter clockwise)

Except –x, -y and –z all other 9 degrees of freedom must be fixated. The work piece should rest at two points of side surface (XZ) and rotational degrees of freedom (Y, -Z).

.



C. Part Design

The design of fixture parts includes consideration of material of fixture and their relative parameters. The components are designed and assembled using CATIA V5. The parts are divided into two categories, major and minor components. Following are the part designs*:*

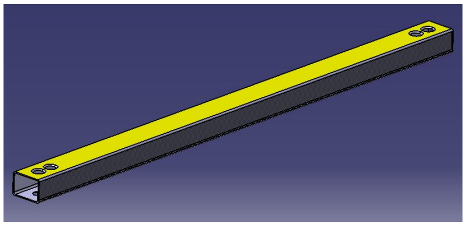


Fig 1: side members: Forms the major part of the frame and serves as load bearing beams.

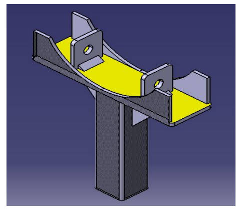


Fig 3: cylinder body clamping bridge for

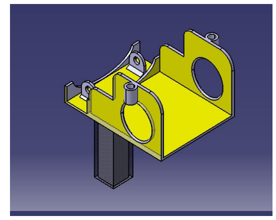


Fig 4: Cylinder vessel is fixed with help of a C.I pin.

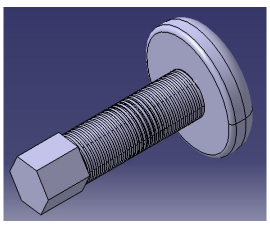


Fig 5: screw clamps to fix and secure the work piece.

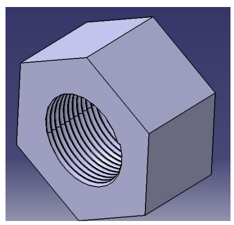


Fig 6: Nuts to secure and fasten Screw clamps, frame bolts and other

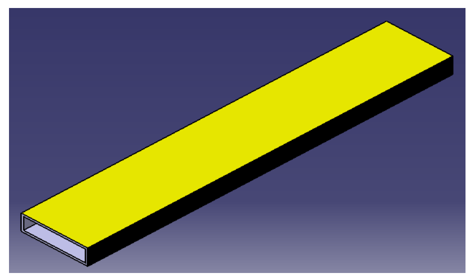


Fig 10: support beam.

D. Locating the components

Locating the components ensures the geometrical stability of the work piece. They make sure that the work piece rests in the correct position and orientation for the operation by addressing and impeding all the degrees of freedom the work piece possesses. The dimensional accuracy mainly depends upon the relative position of the work piece and machine tool. Therefore it is essential to create new location scheme according to the work piece and operation requirements. Determination of locating method and positioning other fixture elements are an integral part of the system. Clamping forces should be determined before applying against locators.

TABLE I DESIGN PARAMETERS

Sr.no	Stress calculations		
	Description	Formulae	Fig no.
1	Clamping force calculation of screw clamp	$F_s = F_h L / R \tan(\alpha + \varphi)$	FIG 5.
2	Width of clamp	$W = 2.3d + 1.57$	FIG 5.
3	Crushing Stresses (on clamps)	$\Sigma_c = \frac{P}{\pi/4(d_o - d_i)}$	—
4	Work piece deformation caused by clamping forces	$\sigma = F / A$	—

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

E. Material Data

TABLE III
MATERIAL DETAILS

Name	Material	Quantity
SIDE MEMEBERS(FRAME)	Cast iron	4
SUPPORT BEAM	Cast iron	1
BODY CLAMPING BRIDGE	Cast iron	1
CYLINDER EYE FIXING BRIDGE	Cast iron	1
SCREW CLAMPS AND NUTS	Cast iron	4

F. Deflections

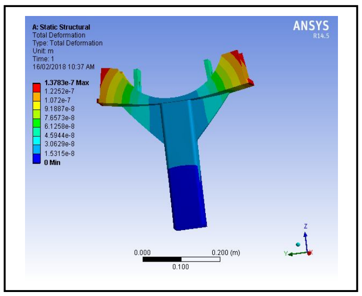


Fig 7: Deflection on cylinder clamping bridge.
Maximum deformation: 1.3783e-7.
Minimum deformation: 1.5315e-8

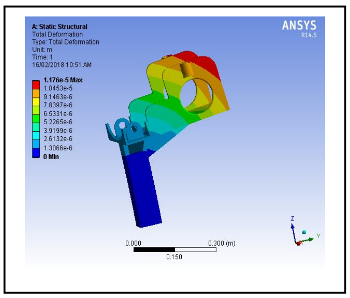


Fig 8: Deflection under a pressure of 300 Pascal and load of 400 N.
Maximum deformation: 1.176e-5
Minimum deformation: 1.3066e-6

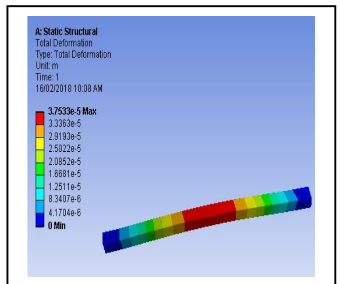


Fig 9: Deflection of bars.
Maximum deformation: 3.753e-5
Minimum deformation: 4.170e-6

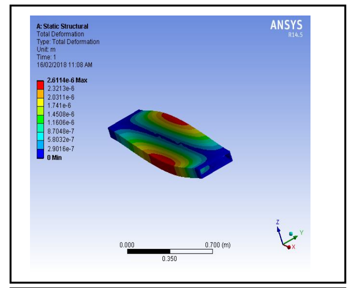


Fig 10: stress bearing column.
Maximum deformation: 2.611e-6
Minimum deformation: 2.9016e-7

G. Stress analysis of designed fixture

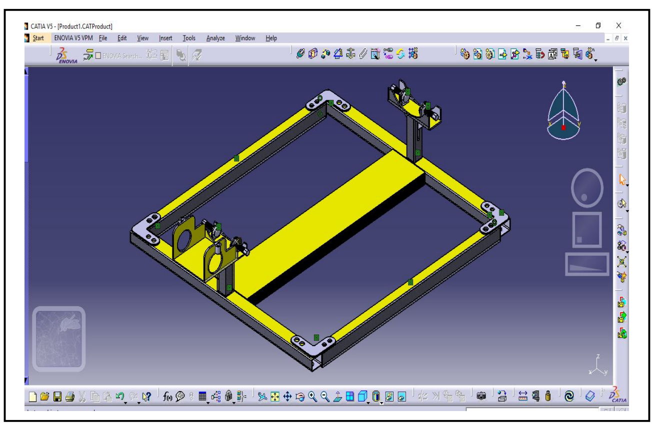


Fig 11: Designed fixture

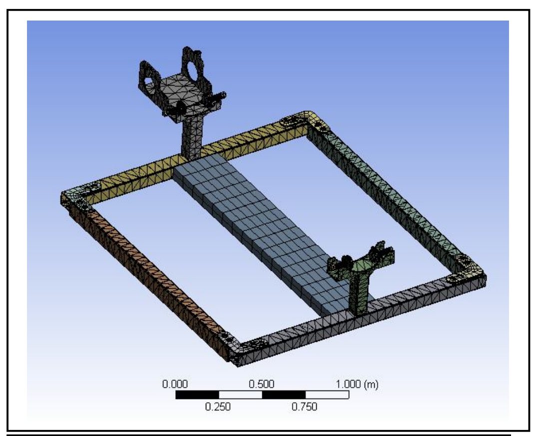


Fig: meshing created in ansys.

The components are imported to ansys 14.5 after the .CAT files into .Igs or Iges format. The analysis settings is deteremined in the static structural system and then the meshing is generated. The outcome expected is total deformation and then solve. Maximum And Minimum Stress of Fixture: below figure shows that the maximum stress is at the point where the color has become red and is having the maximum value 0.053402 N/mm^2 and the minimum deflection is highlighted by blue color is found to be $0.053123 N/mm^2$.

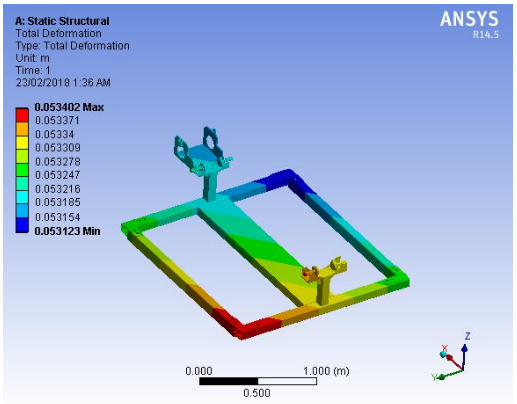


Fig 12: Assembled product analysis.

Results	
Minimum	5.3123e-002 m
Maximum	5.3402e-002 m

Density	7200 kg m^-3
Coefficient of Thermal Expansion	1.1e-005 C^-1
Specific Heat	447 J kg^-1 C^-1
Thermal Conductivity	52 W m^-1 C^-1
Resistivity	9.6e-008 ohm m

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
	1.1e+011	0.28	8.3333e+010	4.2969e+010

IV. CONCLUSIONS

The proposed fixtures once installed will successfully reduce the time and effort of a semi-skilled or unskilled worker. The designed fixture will have a significant impact on the productivity and efficiency of a small scale garage or workshop.

The cost of fabrication and installation is estimated according to the formulae:

TOTAL COST =

$$\frac{\text{SETUP COST}}{\text{SIZE OF RAMS/CYLINDERS}} + \text{RUN COST} + \frac{\text{MATERIAL COST}}{\text{WORK HRS}}$$

Time of changing or replacing parts will depend upon the availability of spare parts and distance to the store.

Therefore,

TOTAL TIME =

Servicing/repairing time + Part availability + Clamping time

= 30 minutes + 15 minutes + 60 seconds

Fabricated Fixture

REFERENCES

[1] Hamad Mohammed Abouhenidi, Jig and Fixture Design, International Journal of Scientific & Engineering Research, Volume 5, Issue 2, February 2014.

[2] J V. R. Basha, J.J. Salunke., An Advanced Exploration on Fixture Design Int. Journal of Engineering Research and Applications, Vol. 5, Issue 6, (Part -3) June 2015.

[3] Sangamesh,V. Kulkarni, "Design and Fabrication of Indexing Set Up For Drill Jig," International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue 06 June-2016.

[4] Nestor F. Michelena and Alice M. Agogino, "Multiobjective Hydraulic Cylinder Design," Received July 08, 1987; Online November 19, 2009.

[5] Kiran Valandi, M.Vijaykumar, Kishore Kumar S.,Development, Fabrication and Analysis of Fixture, International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 4, April 2014

[6] Sandeep Soni , Mr Ravindra Mane, Design and Modelling of Fixture for Cylinder Liner Honing Operation, Global Journal of Research in Engineering, Aug. 2013.