International Journal of Engineering Research and General Science Volume 4, Issue 2, March- April, 2016
ISSN 2091-2730

Design and analysis of dedicated machining fixture hook for cylinder block to operate by overhead crane

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Abstract— Work gives conceptual model and mechanical design of special application fixture hook made for crane which is to be used overhead material handling application in component machining automation. Cylinder block is to be machined for drilling operation executes in line on bottom face of the component so this hook gives perfect fixturing with full proof poka yoke to move on overhead sliding panel provided in shop floor. Design and product development considered with the manufacturability and practical feasibility. Structural weldment is the out coming function for this work of innovation .Boundary conditions are examined and applied for analysis on actual behavior of the structure in working conditions. Loads are calculating by considering input parameters. Structural behavior analysis formed in ansys tool to prove its workability.

Keywords— **Design and Analysis , Fixture hook ,Cylinder Block , Modeling , Ansys.**

INTRODUCTION

Casted cylinder block is to be machined on its bottom face for drilling operation to be carried out at height of 2.2 m from ground level. Dedicated Hook will catch the component from powerised conveyor and pick and place operation will be there but the operation will not end till drilling and tapping get finished ,In assembly line this crank shaft is required to be drilled before shaft ending plate is assembled with it. For this requirement we want this production rate to be cover 12 components in every hour. Existing system is giving manually operating process with average 7 components processed in one hour.

Crane used to make hook as handler:

A **lifting hook** is a device for grabbing and lifting loads by means of a device such as a hoist or crane. A lifting hook is usually equipped with a safety latch to prevent the disengagement of the lifting wire rope sling, chain or rope to which the load is attached. A hook may have one or more built-in pulleys to amplify the lifting force. Crane & Overhead Lifting Applications Bullivants prides itself on setting the highest standards for quality and safety with all of Crane and Overhead Lifting Devices. For Lifting applications Crane and Overhead Lifting Products are designed and manufactured in accordance with all relevant Standards and are guaranteed to meet all criteria necessary to proper usage. custom design, re-certify, manufacture and repair virtually any type of lifting device used in industrial applications. standard range offers versatility across a variety of applications. Lifting & Rigging Equipment fully tested chain slings and hardware with fabricated lifting product as a complete unit so that everything is ready to go when it gets to site.

Lifting Beams

35 Tonne Container Lifting Beam • 90° maximum sling angle • Heavy duty. • Approved, tested and certified with WLL clearly marked. • Engraved ID tag • Powder coated safety yellow

Input :

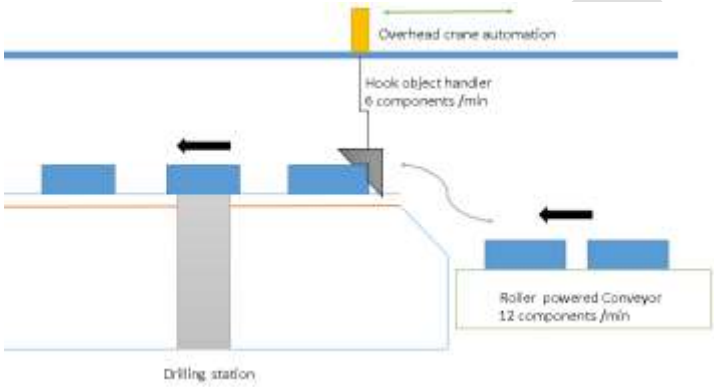
4 Cylinder block

Weight: 94 kg.

Drilling operation to be perform on bottom side ,

No of holes and size : M10 x12

Working layout:



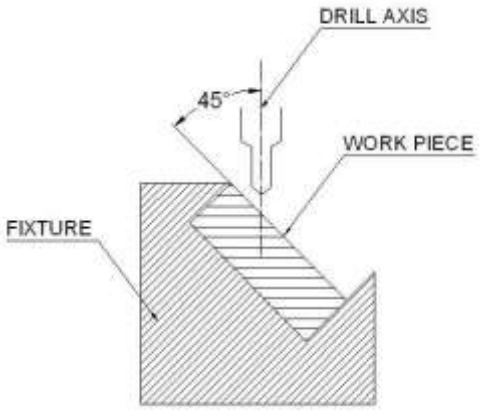
Methodology:-

Methodology for working system building:

We have a drill machine and want to make a 10mm diameter hole at the point of intersection of the two diagonals of a square plate. The hole should be inclined at 45 degree angle with the surface.

This arrangement is a simple drilling fixture.

3-2-1 Principle of Fixture Design



Sample drilling fixture

Rest the work piece on three non-collinear points of the bottom surface (XY), and you will be able to fix the +Z, CROT-X, ACROT-X, CROT-Y and ACROT-Y degrees of freedom. Now, rest the work piece at two points of side surface (XZ), and you

will be able to fix the +Y and ACROT-Z degrees of freedom. Now, rest the work piece at one point of the adjacent surface (YZ), and you will be able to fix the +X and CROT-Z degrees of freedom. So, you can successfully fixate 9 required degrees of freedom by using the 3-2-1 principle of fixture design.

Design and Development

1. Preliminary CAD model :

1. LOCATOR PIN

Locator Pin used here to restrict DOF in linear and rotational X direction i.e. to restrict 4 DOF Viz. Linear +X,-X, and rotational clockwise X, anticlockwise X.This pin plays the role for reference point also which delivers the exact position. The component having hole at bottom side which get locate with this pin at two position as shown in fixture view. Pin is designed as a dowel pin which get mount In this fixture there are total two Locator pins are used and material of construction is AISI 304

2. LOCK PAD

Lock Pad is used here to restrict DOF in Linear Z direction i.e., +Z, -Z, and Rotational clockwise Z, anticlockwise Z as shown in fixture arrangement.

MOC: UHMW

3.TROLLEY STRUCTURE

Trolley structure made up of steel flats is the platform Made for locating and Assembled the entire Fixture elements.

MOC: AISI304

4.LOCKING PAD

These pads are avoiding Metal to metal contact between fixturing and components. Pad are bolted and rested to talk the position on trolley structure.

M.O.C.:UHMW

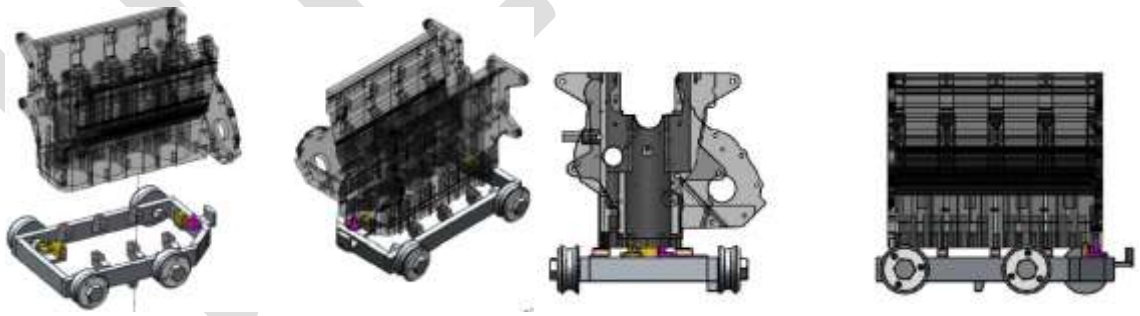


Fig: Various views of moving fixture trolley .

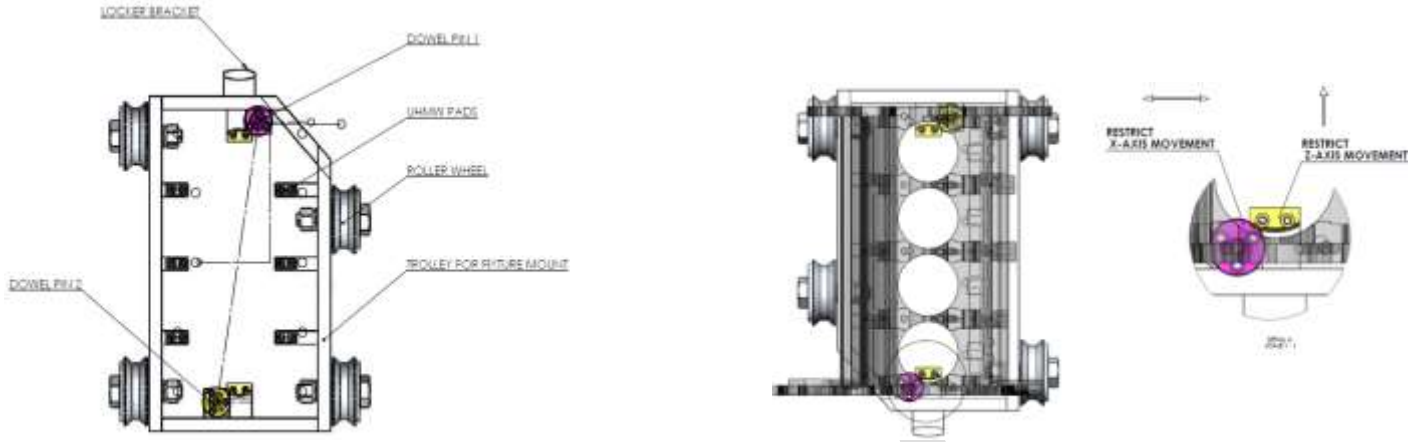


Fig. 3-2-1 principle restrictions

1. Design of Dedicated lifting hook

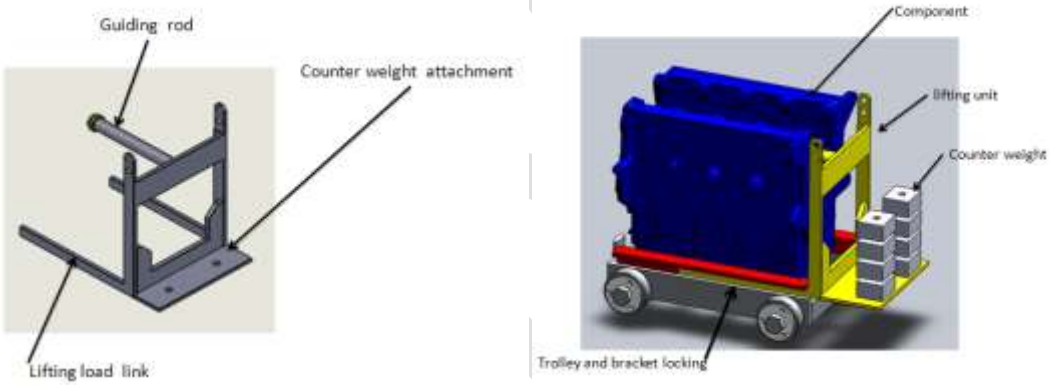
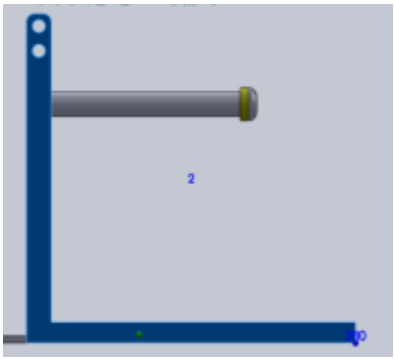


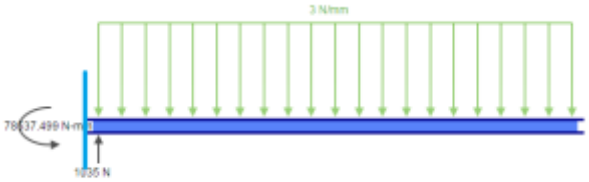
Fig : Ready Lifting unit

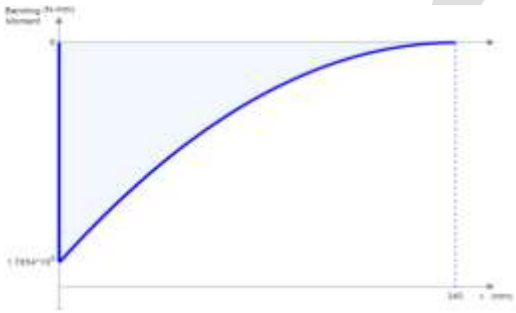
Design valuation:

Shear Force and Bending Moment Diagram



The maximum load on the bracket is distributed load of 2.75N/mm. Let the Maximum load equals to 3N/mm. The SFD and BMD are as shown.





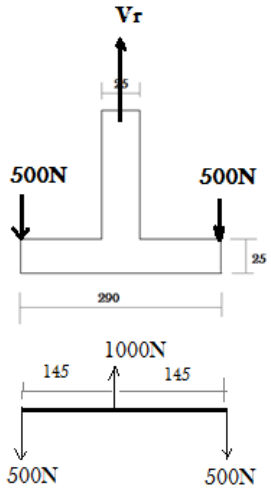
From SFD and BMD

Maximum Shear force = 1035 N

Maximum Bending Moment, M = 1.7854 x 10^4 N-mm.

Hook and hanging behavior

The free body diagram of the bracket is as shown in fig.



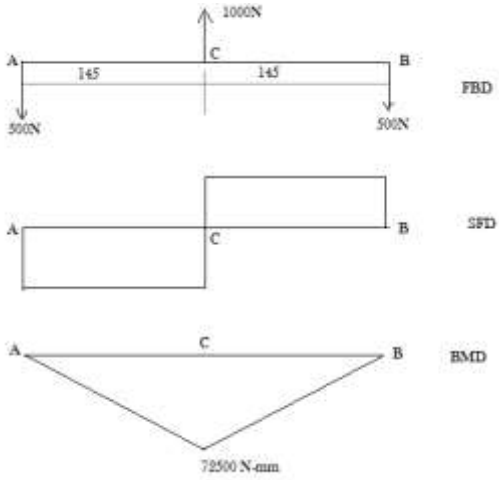
Bending moment about A = 0

Bending moment about B = 0

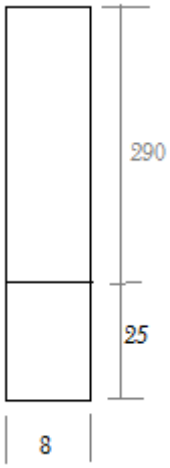
Bending moment about C = - 500 x 145 = -72500 N-mm

Maximum Bending moment occurs at c , M = 72500 N-mm.

SFD And BMD Are as shown in following figure



The cross section of the bracket is as shown in fig.



We know,

$$y = \frac{\sum AY}{\sum A} = \frac{A1y1 + A2y2}{A1 + A2}$$

$$y = 157.5\ mm$$

Moment of Inertia,

$$I = \sum (I_x + A(Y - y)^2)$$

$$I = 20.84\ x\ 10^6\ mm^4$$

As the hogging moment is there, $y = y_c$

Hence, y_t = 315-157.5mm = 157.5 mm

We have from Flexure formula,

$$\frac{M}{I} = \frac{\sigma}{y}$$

Hence,

$$\frac{72500}{20.84\ x\ 10\text{^}6} = \frac{\sigma}{157.5}$$

$$\sigma = 0.5\ \text{N/mm}^2$$

CAE validation :

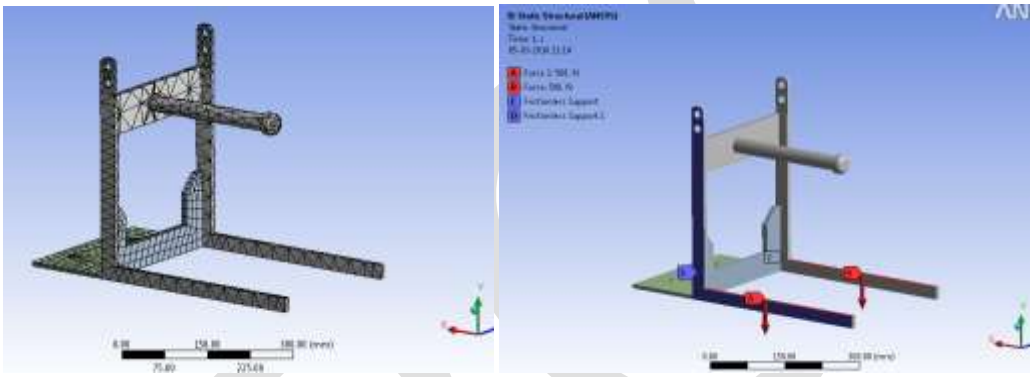
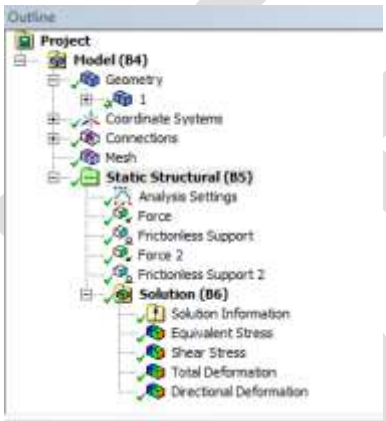
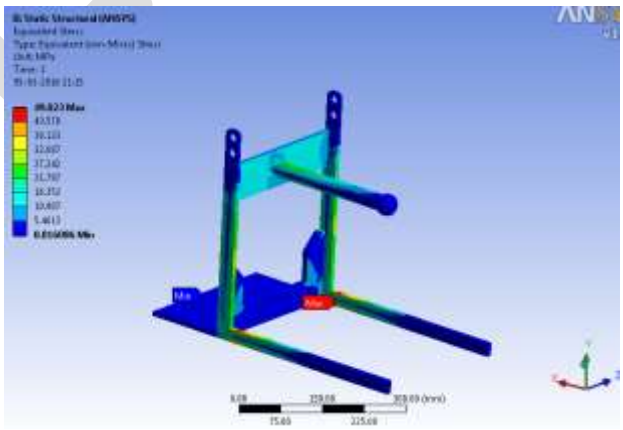


Fig: Weldment Hook Meshing Model

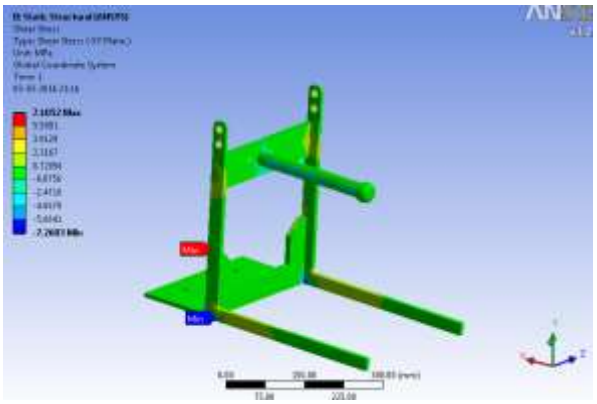
Loading conditions

Outlines of validation :

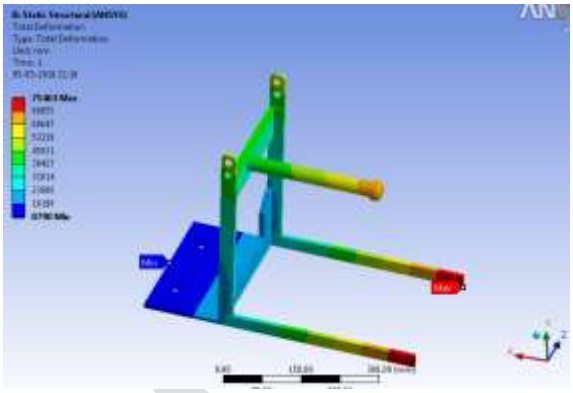




Equivalent (von-Miss) Stress



Shear Stress (XY Plane)



Total Deformation

ACKNOWLEDGMENT

I feel immense pleasure in expressing our deep sense of gratitude to Prof.Aldar.B.D my guide & Head of Mechanical Engineering Department for his excellent guidance, continuous encouragement and providing his valuable advice whenever the need arouses during the completion of seminar work.

I thanks to all those who help intellectually and materially in completion of seminar report. I would like to express my appreciation and thanks to all my friends who knowingly or unknowingly have assisted and encouraged us.

CONCLUSION

Working of hanging conveying handler is feasible found here with full proof mechanism and mounting with production requirement process feasibility.

It's found specific tool for handler only for cylinder block, for other standard component s all the assembly structure will change with its shape ,size and volume.

REFERENCES:

Reference Books:

[1] V.B.Bhandari, Design of Machine Elements, (TATA Mc-GRAW-Hill Publication).

[2] Erik K. Henriksen, Jig and Fixture Design Manual, (Industrial press inc. New York, 1902).

Papers from Journal or Transactions :

[1] Y.S.Kapnichor, V.V.Patil, P.D.Shinde "Design of Automated Rotory Cage Type Fixture For Cylinder Block" Journal of Engineering Research and application ISSN: 2248-9622 Vol . 4, Issue 8 (Version 3), August 2014.

[2] V.S.Jakukore, L.B.Raut"Combined load analysis of rotary cage fixture by FEA and Experimental approach", International Journal of Innovative Research in Advanced Engineering ISSN: 2349-2163 Volume1 Issue, September 2014.

[3] L.B.Raut , V.S.Jakukore "Cylinder Block Fixture For Mistake Proofing", American Journal of Engineering Resarch e-ISSN : 2320-0847 p-ISSN: 2320-0936 Volume-03 , Issue -10,pp-145-150.2014

[4] V.S.Jakukore , L.B.Raut "Combined load analysis of rotary cage fixture by FEA andExperimental approach"International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163Volume 1 Issue 8 (September 2014)

Internet

[1] http://www.shoho-g.co.jp/en/items/processing_assembling_jigs/,

[2] http://www.makino.com/resources/case-studies/parallel-processing-for-engine-blocks/157/

[3] http://www.industrial-lasers.com/articles/print/volume-26/issue-3/features/laser-cladding-of-worn-cylinder-boxes.html