International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 4, Issue 4 (July-Aug, 2016), PP. 72-76

DESIGN AND ANALYSIS OF LIFTING TACKLE FOR V ENGINE

Girishkumar Nagnath Jagdale[1], Rajratna A. Bhalerao[2],Dhanajay K. Patel [3]
[1]M.E. mechanical design, [2]Assistant Professor, [3]Design Engineer
Jayawantrao Sawant College of Engineering Hadapsar, Pune
[1]girish2323@yahoo.com,[2]rajbhalerao1988@gmail.com,[3]dkphingani@gmail.com

Abstract-**This paper deals with the design and development of mechanical device to lift v engine of 300 kg and put at different locations in the manufacturing plant with safety and economic considerations. Three models are designed in CATIA and analyzed in ANSYS with different loading conditions and finalized one for manufacturing and testing with actual load..**

Index terms-**V-engine, Hook and belt system, lifting models, load distribution SFD BMD, Static structural analysis CAE.**

I. INTRODUCTION

Hoisting operations cause the serious hazard to both trained and untrained workers. Every year many workers, across the world are killed or injured while operating with this type of equipment"s. The basic cause behind that they do not recognize the dangers associated with equipment and particular task to be performed. Health and safety is the most important issue and it should be considered same conventionally the engine is tackled with the flexible belts and hook arrangement, but it has many disadvantages which overcome all the benefits from it.

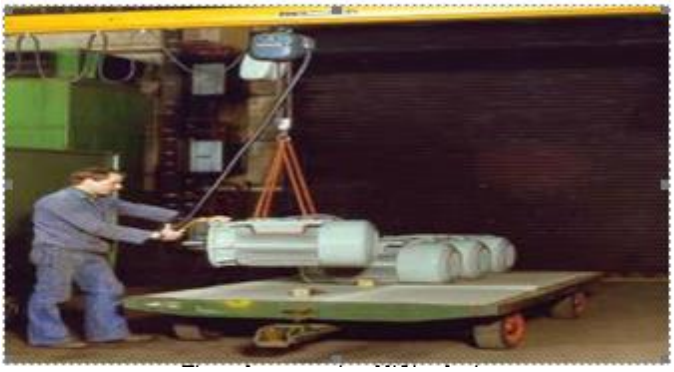


Figure 1: conventional lifting device

It can become the cause of accidents, damages to properties. Some of the reasons why this system is not so much safe for the lifting of heavy duty equipment"s are given like 1. Lifting with flexible belts is can make the system imbalance due to is random distributed outrights. 2. Height of gantry matters in lifting of heavy engines, due to large weight it can"t be lifted too much height from the gravity and have a risk of misbalancing. 3. In gantry system lifted engine is moving over the head of labours, which is very risky and it may cause an accident uncertainly.

So instead of conventional system new system is designed to lift the block with safe condition. Three suitable models are designed in CATIA 3D modelling software. Then found out general loading condition accordingly the engine block and applied on the model to find shear forces and bending moments for the frame. Along with these results all three models are analysed in ANSYS software to find out compatibility of each model.

[1] Industrial manual for material handling published 2007 by the California Department of Industrial Relations. It was distributed under the provisions of the Library Distribution Act and Government Code Section 11096. This gives "Improving Manual Material Handling in Your Workplace" lists the benefits of improving your work tasks. The plan helps you identify problems, set priorities, make changes, and follow up. [2] Lifting Operations and Lifting Equipment Regulations 1998 republished in 2014, This Approved Code of Practice (ACOP) and associated guidance provide practical advice on how you can compatible with the Lifting Operations and Lifting Equipment Regulations 1998. This book is for employers and duty holders, as well as anyone who has responsibility for controlling lifting equipment. Throughout this book they have referred to the employer and others who have duties where the guidance is addressed to some other duty holder. Material Handling Equipment Michael G. Kay [3] Fits Dept. of Industrial and Systems Engineering North Carolina State University January 12, 2012. Given the material flow requirements for one or more, material handling system alternatives can be determined by selecting appropriate

material handling equipment that, in some way, "satisfies" the requirements. Operational guide for lifting devices prepared by the crane manufactures association of America, Inc. [4] Finite element stress analysis of crane hook with different cross sections by Chetan N. Benkar, Dr. N. A. Wankhade[5] published in international journal for technological research in engineering, volume 1, issue 9, may 2014, 2347-4718. Design and analysis of crane hook with different materials by Patel Hirak [6] published in international journal advanced computer technology in 2015, 2319-7900. But there is no such material or literature available for exact case of v engine lifting tackle assembly. So above literature used as background and for conventional reference only.

II. LIFTING TACKLE MODELS

For the purpose of designing the lifting tackle for v engine block three models are prepared. These are the more probable suitable designs for the lifting the engine block. These are modeled and assembled in CATIA software. Models are analyzed on different criteria‟s using analysis software like ANSYS for selecting the optimized model for the given objective. Developed three models and these are as follows;

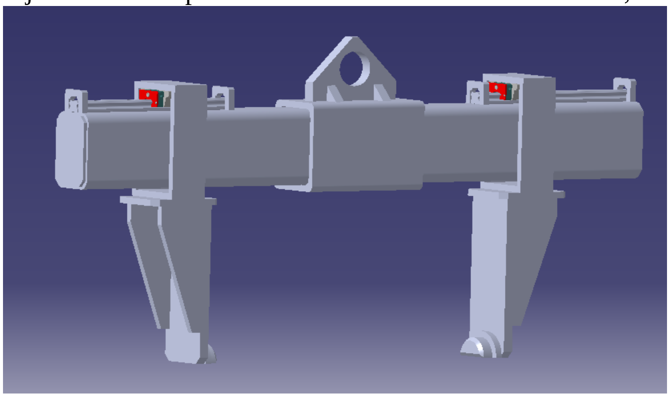


Figure 4: First lifting tackle model

This is the first model for lifting tackle system. It is simple model in which, two lifting arms are attached to main support and operated with the help of rails. Rails give sliding motion to the arms. These arms are going to fit in holes provided for in and out ends of crankshaft. Support has provision for attachment for hook of hoists. This assembly grips the V engine and moves it to desired location in industry.

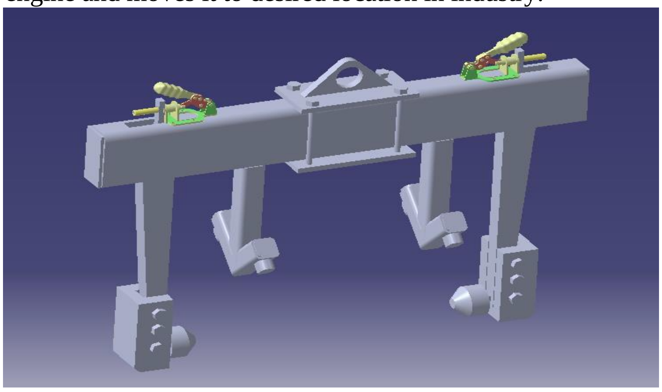


Figure 5: second lifting tackle model

This is the second model for lifting tackle system. It is combined model in which, two lifting arms are attached to main support and operated with the help of livers. Livers give engagement and disengagement motion to the arms. These arms are going to fit in holes provided for in and out ends of crankshaft. Intermediate part gives support to the V engine from rotatory slipping by blocking it between two V shaped cylinders. Support has provision for attachment for hook of hoists. This assembly grips the V engine and moves it to desired location in industry.

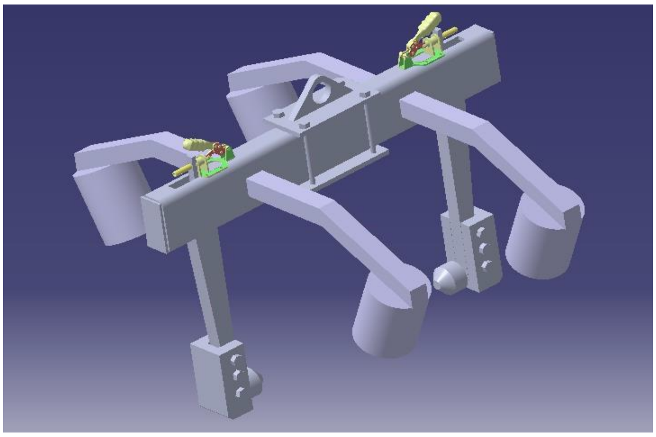


Figure 6: third lifting tackle model

This is the third model for lifting tackle system. It is combined model in which, two lifting arms are attached to main support and operated with the help of livers. Livers give engagement and disengagement motion to the arms. These arms are going to fit in holes provided for in and out ends of crankshaft. Intermediate part gives support to Engine from rotating itself after lifting, which cause the imbalance system. Supports in the shape of gripper are introduced in the bore of cylinders. Main support has provision for attachment for hook of hoists. This assembly grips the V engine and moves it to desired location in industry.

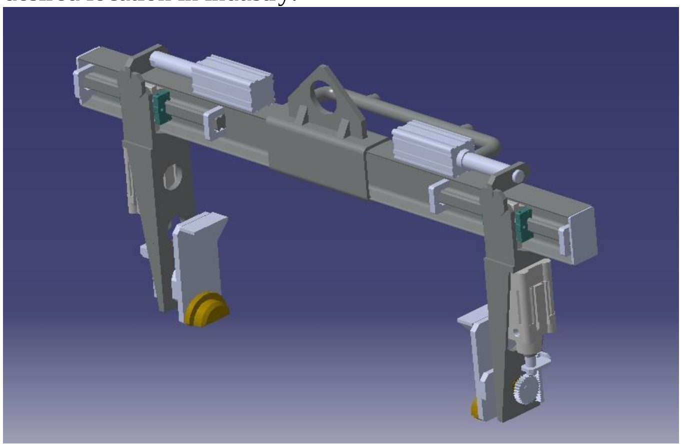


Figure 7: Fourth lifting tackle model

This is the fourth probable model for lifting v engine from machining line. This is partially automatic operated tackle, the motion of arms is works with pneumatic actuators attached over the frame or I beam. Rails give sliding motion over it. In this system there is handle which helps to give the position to tackle at the time of engagement with engine block. Also this model avoids rotation of a lifted engine through provision given to the arms like rack and pinion arrangement given. It gives axial motion to the brass knobs. Similarly these arms are going to fit in and out end bores for a crank shaft. This lifts the engine block from machining line and put it different desired locations.

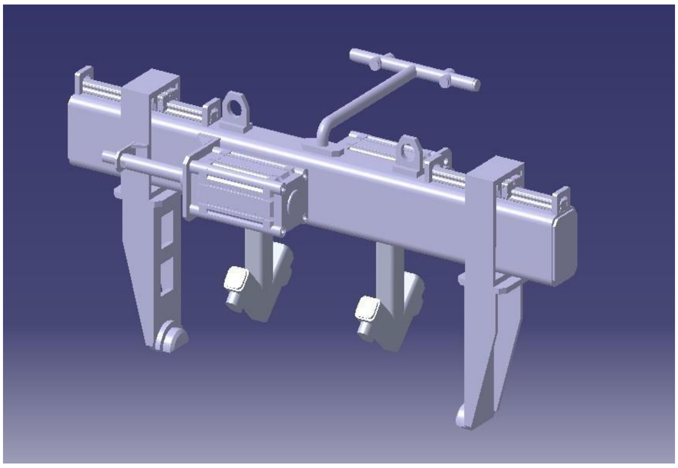


Figure 8: Fifth lifting tackle model

This is the fifth probable model for lifting v engine from machining line. This is partially automatic operated tackle, the motion of arms is works with pneumatic actuators attached side to the frame or I beam. Rails give sliding motion over it. In this system there is handle which helps to give the position to tackle at the time of engagement with engine block, it is different design from fourth model‟s one. Similarly these arms are going to fit in and out end bores for a crank shaft. This lifts the engine block from machining line and put it different desired locations.

III. MATERIALS

There is variety of materials available for the manufacturing this component. Some have good strength, properties and cost. But material should available easily and have required properties in reliable cost, this only reduce economic factor of the project. Mild steel is selected as a manufacturing material for structure of tackle. Engine is of gray cast iron which is universal and given to us. Other parts like grippers of liver, end of balancing arms are made up of hard plastic material. Mild steel is also known as low carbon steel. Here are some reasons why mild steel used: 1. Composition of 0.05%-0.25% carbon and up to 0.4% manganese. 2. It is a low-cost material that is easy to shape. 3. While not as hard as higher-carbon steels 4. Carburizing can increase its surface hardness.

IV. FINITE ELEMENT ANALYSIS

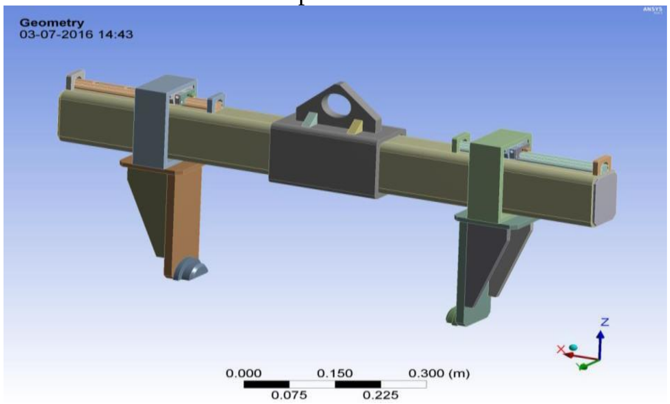
After this finite element analysis of the same model with same load condition i.e. CAE of the model is carried out in ANSYS software and generated results are as follows;

Steps used in finite element analysis are as follows:

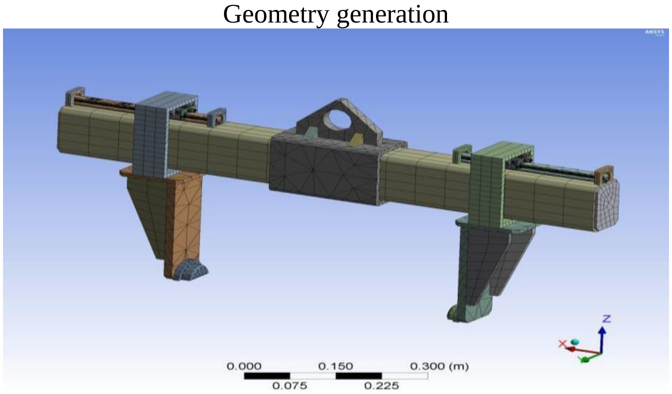
1. Geometry generation
2. Connections examination
3. Mesh generation
4. Application of support
5. Application of forces
6. Solution for results-

- Total deformation
- Equivalent Von-Mises stress

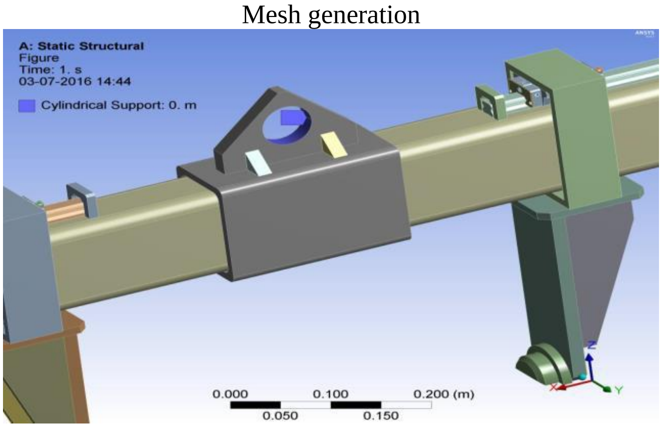
Common steps used in ANSYS-



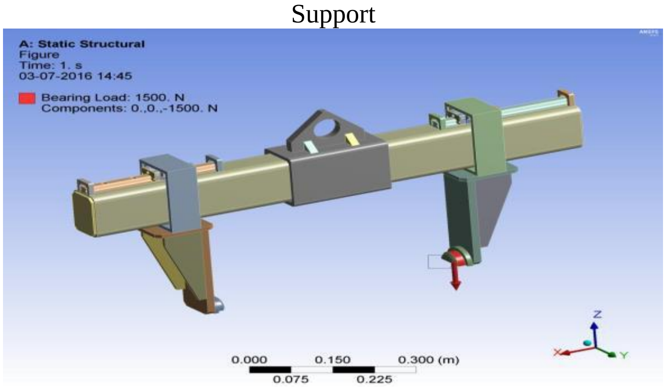
Geometry generation



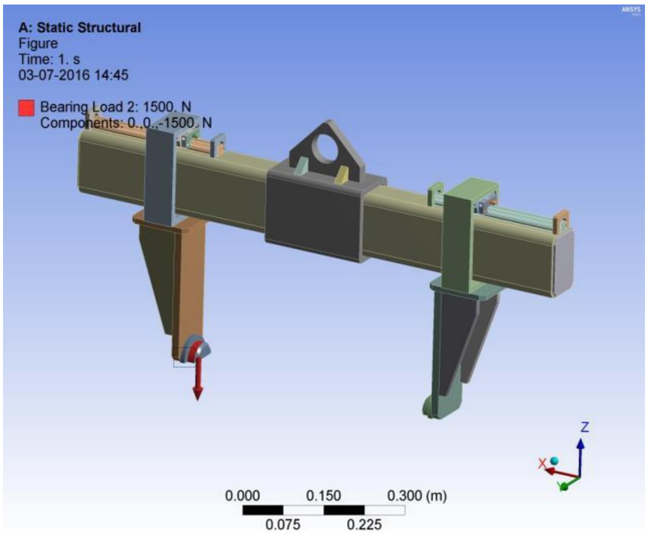
Mesh generation



Support

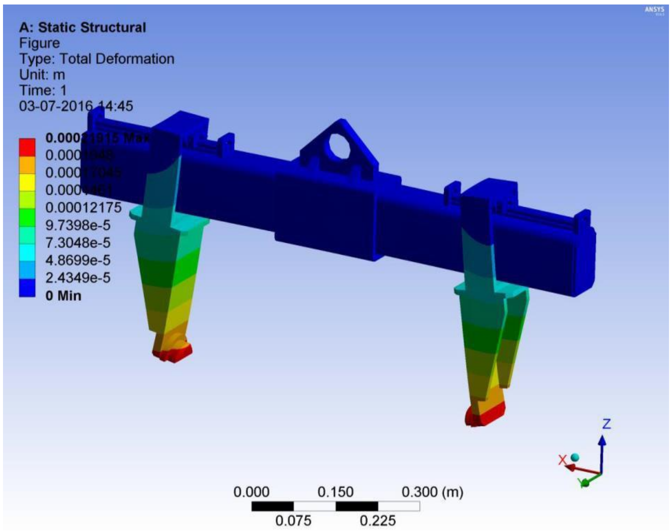


Force 1 = 1500N

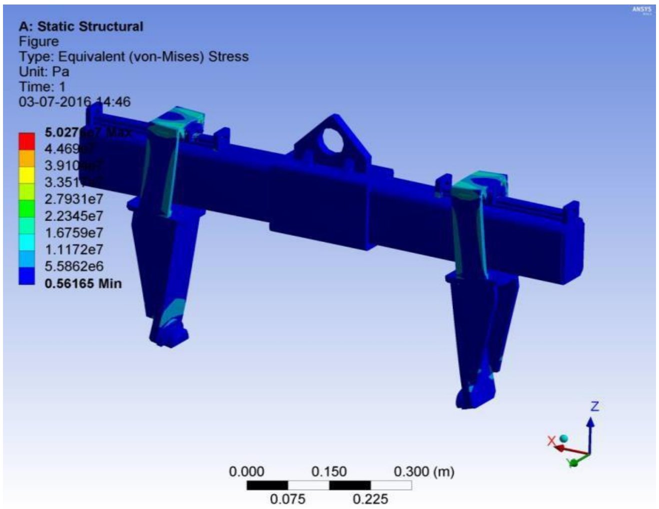


Force 2 = 1500 N

Results obtained for 1st model

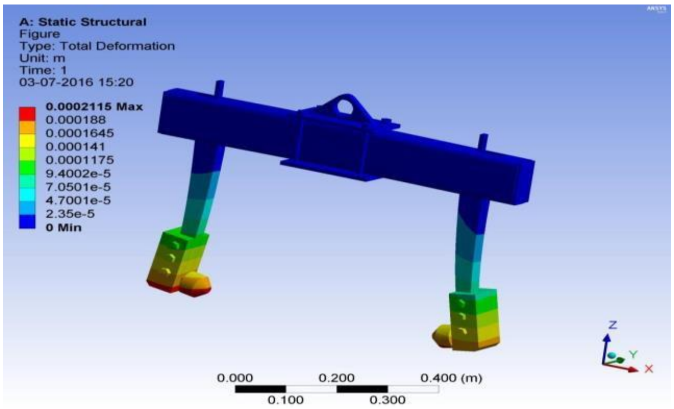


Total deformation

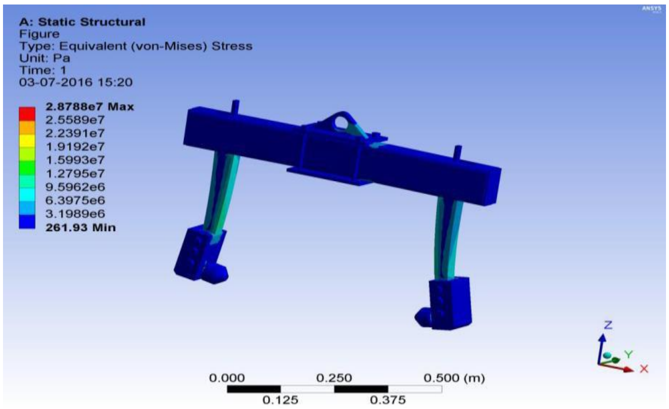


Equivalent stress

Results obtained for 2nd and 3rd model

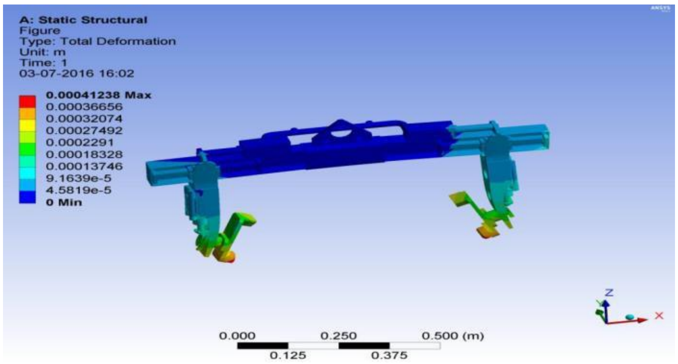


Total deformation

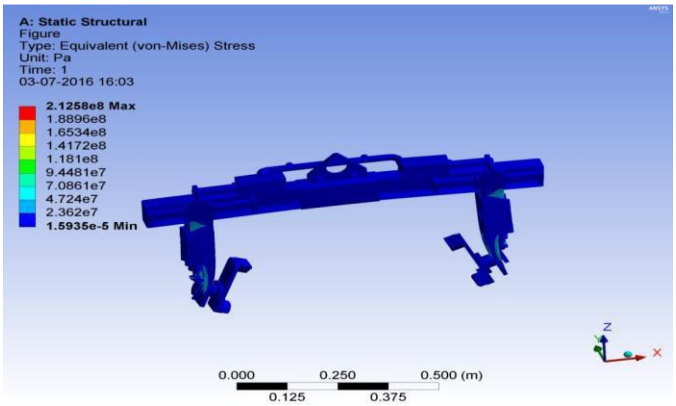


Equivalent stress

Results obtained for 4th model

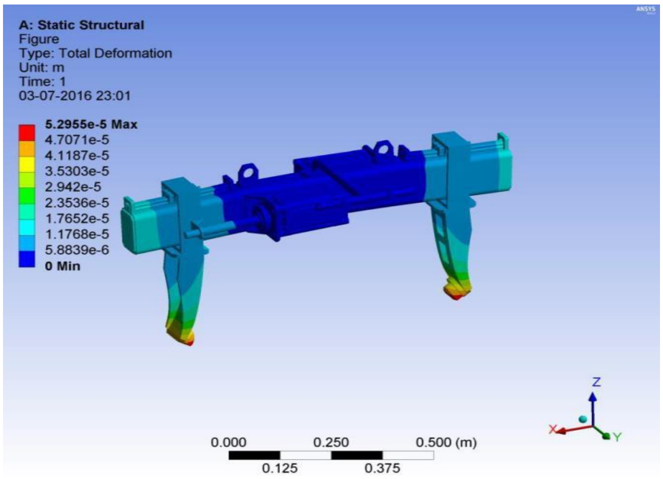


Total deformation

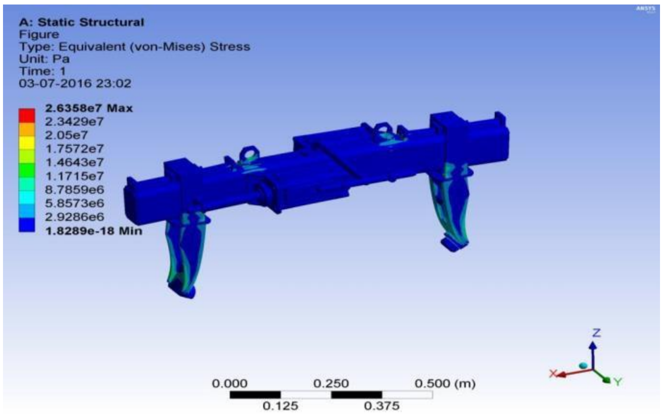


Equivalent stress

Results obtained for 5th model



Total deformation



Equivalent stress

V. RESULTS AND DISCUSSION

Model no	Mass (Kg)	Total deformation (max.) (mm)	Equivalent Von-Mises stress (MPa) Max
1	50.115	0.2191	50.276
2	43.557	0.2115	28.788
3	43.557	0.2115	28.788
4	36.224	0.4123	212.58
5	**41.364**	**0.0529**	**26.35**

For selection all the three factors considered simultaneously,

1. Model should be less in weight to reduce the cost of development
2. Deformation and stress should be within the standard limits
3. If deformation is less it should preferred, because it indicated long life and reliability of model
4. For locking and unlocking purpose standard pneumatic actuators are used.

So fifth model is selected and developed in industry. It is tested over there for two parameters: deformation and stresses and values are compared with experimental results as follows;
Deformation: 0.0593 mm
Stress: 28.92 MPa
After comparing it with finite element analysis results;

Parameter	ANSYS	TEST	Variation
Deformation	0.0529	0.0593	12%
Stress	26.35	28.92	9.75%

VI. CONCLUSION

This paper gives the five suitable models for the lifting tackle for the V Engine with safety, reliability, compatibility, economic considerations. These systems are analyzed by using analysis software, for the selecting the optimal solution of problem. Test results matches with analysis results with 12% and 9.75% variation in results, but it may be due to environmental conditions, machining methods, imperfect shapes in real life product and due to point load application in real test while in software it is applied through bunch of nodes. This is going to validate this paper.

VII. ACKNOWLEDGEMENT

Sponsorship of the project is offered by the Hingani E Portal Company, I would especially like to thank Prof. Bhalerao R. A. and Mr. Dhananjay Patel for providing necessary help as & when required. Thanks to „Hingani‟ for giving me chance to do work with them and sponsoring this project.

References

[1] NIOSH, Manual material handling, California department of industrial relations, 2007, issue-131
[2] HSED, Safe use of lifting equipment, lifting operations and lifting regulations 1998, revised in 2014
[3] Michael G. Kay, Material handling equipment, Fitts Dept. of Industrial and Systems Engineering North Carolina State University, 2012
[4] CMAA, Operational guide for lifting devices, The Crane manufactures association of America Inc., 2006
[5] Chetan N. Benkar, Dr. N. A. Wankhade, Finite element stress analysis of a crane hook with different cross sections, International journal for technological research in engineering (IJTRE), volume 1, Issue 9, May 2014, 2347-4718
[6] Patel Hirak, Design and analysis of crane hook with different material, International journal of advanced computer technology (IJACT),
2319-7900, 2015
[7] Ajeet Bergaley, Structural analysis of crane hook with finite elements method, International journal of science and modern engineering (IJISME), volume 1, Issue 10, 2319-6386, 2013
.