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"DESIGN OF TILTING FIXTURE & SADDLE FOR PRESSURE VESSEL : A REVIEW''

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ABSTRACT

Heavy Engineering is related to manufacturing of process plant equipment related to refinery and fertilizer, ship building etc. Manufacturing of reactor is related to heavy engineering industries. Reactor is made of two or more shell. Shell is an empty vessel which is manufactured by bending the plate. During welding of the vessels, vessels should be in a particular position for appropriate welding. For particular position of vessels, tilting is necessary. Tilting of vessel is an important part of heavy engineering industries. Tilting of vessel is done by use of two cranes, they have some limitation. Because of these reasons new mechanism required for tilting of heavy shell or vessel.

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. During the time of assembly of Dished End and shell, both vessels should be in a horizontal position. At that time shell tilting will necessary. Second time during the heat treatment, vessel should be in a horizontal position for proper adjustment into furnace.

KEYWORDS : *Manufacturing, Bending, Tilting fixtures, Pressure vessel.*

I. INTRODUCTION

A fixture is a device for locating, holding and supporting a work piece. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work piece in a given orientation with respect to measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation. 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.

II. LITERATURE REVIEW

L. P. Zick[1] presented paper on Stresses in Large Horizontal Cylindrical Pressure Vessels on Two Saddle Supports. The purpose of this paper is to indicate the approximate stresses that exist in cylindrical vessels supported on two saddles at various locations. Knowing these stresses, it is possible to determine which vessels may be designed for internal pressure alone, and to design structurally adequate and economical stiffening for the vessels which require it.

Formulas are developed to cover various conditions, and a chart is given which covers support designs for pressure vessels made of mild steel for storage of liquid weighing 42 lb. per cu. ft. The design of horizontal cylindrical vessels with dished

heads to resist internal pressure is covered by existing codes. However, the method of support is left pretty much up to the designer. In general the cylindrical shell is made a uniform thickness which is determined by the maximum circumferential stress due to the internal pressure. Since the longitudinal stress is only one-half of this circumferential stress, these vessels have available a beam strength which makes the two-saddle support system ideal for a wide range of proportions. However, certain limitations are necessary to make designs consistent with the intent of the code.

Shafique M.A. Khan [2] presented paper on Stress distributions in a horizontal pressure vessel and the saddle supports. This paper presents analysis results of stress distributions in a horizontal pressure vessel and the saddle supports. The results are obtained from a 3D finite element analysis. A quarter of the pressure vessel is modelled with realistic details of saddle supports. In addition to presenting the stress distribution in the pressure vessel, the results provide details of stress distribution in different parts of the saddle separately, i.e. wear, web, flange and base plates. The effect of changing the load and various geometric parameters is investigated and recommendations are made for the optimal values of ratio of the distance
of support from the end of the vessel to the length of the vessel and ratio of the length of the vessel to the radius of the vessel for minimum stresses both in the pressure vessel and the saddle structure. Physical reasons for favouring of a particular value of ratio of the distance of support from the end of the vessel to the length of the vessel are also outlined.

Amarnath Y. Zore[3] presented a paper on Design and Optimization of Saddle For Horizontal Pressure Vessel. It is imperative for an engineer to design and analyse the pressure vessel that will provide safety, durability and serviceability to the end user. Accomplishing this task will require a very good knowledge of design parameters, the most important being, geometry of pressure vessel that must be analysed to comply design standards. The design of saddle support for the pressure vessel is also a part of this analysis. The most common method adopted by American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code for design of saddle support was developed by L. P. Zick in 1951. Zick's analysis was based on the assumption that the supports are rigid and not connected to the vessel shell. In reality, most vessels have flexible supports that are welded onto the vessel shell. In the present paper, the saddle design is optimized for a material quantity and in turn for the cost by reducing number of gusset plates and thickness thereof. The task is accomplished by analysis of pressure vessel and saddle by finite element analysis (FEA) based software PV Elite. The result of this analysis shows a measurable 20 percent reduction in the material quantity post optimization. A Pressure vessel is a closed cylindrical vessel widely used in industries like process, power, oil and gas for the storage of fluid or gaseous products. These are of two types, horizontal and vertical. Pressure vessels are subjected to pressure loading i.e. internal or external operating pressure different from ambient pressure. For horizontal vessel the saddle supporting plays an important role in the performance of the equipment. A proper saddle supporting improves safety and durability. Horizontal pressure vessels are usually supported on two vertical cradles called saddles. The use of more than two saddles is unnecessary and should be avoided. The reason behind not using more than two saddles is to avoid an indeterminate structure, both theoretically and practically. With two saddles, there is a high tolerance for soil settlement with no change in shell stresses or loading. Even where soil settlement is not an issue, it is difficult to ensure that the load is uniformly distributed. ASME Code does not have specific procedures for the design of saddles or the induced stresses in the vessel. While the ASME Code does have allowable maximum stresses for the stresses in the vessel shell, the code does not specifically address the support components themselves. The purpose of this paper is to help understand the extent to which the saddle parameters like number of gusset plates and their thickness can be practically optimized. The optimized designs parameters reduce the direct material cost and indirect cost such as transportation and construction.

A. Limbasiya Vimal[4] presented a paper on Heavy shell tilting fixture is used for tilting the shell from horizontal to vertical and vice versa. Design and analysis of heavy shell tilting fixture has been carried out in this work. Modelling of 3-D components and assembly of tilting fixture have been carried out with the help of Solid Edge ST-2 software. Finite element analysis of fixture and its supporting elements has been carried out using Ideas NX-12 software.

Brian Dorchik[5] presented a paper on Design of a 5-Axis Fixture System. The Middleton Aerospace Corporation designs and manufactures specialty aerospace parts for aircraft manufacturers. Many of the parts require sophisticated fixturing in order to be machined. Middleton operates a variety of CNC machine brands all of which have differently designed tables. They needed a way of sharing the fixturing systems with all of the machines. After reviewing the fixtures and machines, we

designed, manufactured, and tested a fixturing system which would eliminate the need for different fixtures for each machine. In order to understand the complete manufacturing process of the parts we are dealing with, information needs to be gathered on the current parts and fixturing process at Middleton. Information on the CNC machines will be gathered and the similarities and differences of the tables and fixtures will be analyzed. Based on this data a new process and design will be created. Finally, we will look at the effectiveness of the proposed designs and improvements to verify that it will improve the manufacturing process. While working on this project there are a number of things we will need to overcome to complete the project. Some of these will include learning the manufacturing process at Middleton Aerospace and the processes used on the parts we are working with. We will also need to learn and understand some of the key processes and methods used in fixture design. By the completion of this project, we intend to be able to present a design system of fixtures to Middleton Aerospace to help optimize their current processes.

Shailesh S.Pachbhai[6] publish a paper on A Review on Design of Fixtures. - In machining fixtures, minimizing workpiece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The various methodology used for clamping operation used in different application by various authors are reviewed in this paper. Fixture is required in various industries according to their application. This can be achieved by selecting the optimal location of fixturing elements such as locators and clamps. The fixture set up for component is done manually. 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. Fixtures reduce operation time and increases productivity and high quality of operation is possible. To locate and immobilize workpieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a workpiece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts In existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process function ability.

Shailesh S.Pachbhai[7] publish a paper on Design and development of hydraulic fixture for machining hydraulic lift housing. In machining fixtures, minimizing workpiece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The recent trends in industry are towards adopting the hydraulic techniques, because it save time generates accuracy and it is having some flexibility. Hydraulic Fixture is major application in the field of designing, where in several software's are available for the purpose of design. Hydraulic lift housing is engine part of an agricultural tractor which plays an important role in application of lifting trolley of tractor and machining of hydraulic lift housing is a important task. Loading and unloading of work piece in manual clamping is time consuming process, so reducing machining time, set up time etc is a main aim of process. The job having cylindrical shape, this is a challenging task for design engineer, hence hydraulic fixture design is incorporated in manufacturing industry. Except toggle clamp, no other option is available to hold cylindrical object, hence special type of fixture is design for this case, which can be used for machining of hydraulic lift housing, Fixture reduces operation time, increases productivity, and best quality of operation is possible. The project deals with the designing of different parts of fixture assembly, 3D modeling by using Pro-E, finite element analysis of hydraulic lift housing by using ANSYS software.

III. OVERVIEW

Pressure vessel, reactors etc. are manufacturing by welding process. During welding of the vessels, vessels should be in a particular position for appropriate welding. For particular position of vessels, tilting is necessary. Tilting of vessel is an important part of heavy engineering industries. Tilting of vessel is done by use of two cranes, they have some limitation. Because of these reasons new mechanism required for tilting of heavy shell or vessel.

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Why fixture is required for tilting?

Conventional type of lifting system is not suitable because of the some disadvantage described below.

- Two cranes are used at a time for big job.
- Cost is more.
- Risk is more.
- Speed of the crane for job transfer is less.
- More time consuming.

VI. CONCLUSION

In this paper design and analysis of tilting fixture have been carried for weight capacity of 125 MT. After comparing the results of original and modified tilting fixture, some observations have been made.

The observations are as below:

1.Fixture is safe in both in neutral as well as static position

2.Stresses are within acceptable level in the critical regions of the tilting fixture.

3.Considerable reduction in the weight of the modified fixture has been observed.

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