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Design Of Fixture For Tank Body Assembly

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Abstract: *Fixture is designed and developed for checking the alignment of ports with the tank. Three ports are welded to the tank : two outlet ports and one drain port. But sometimes the ports don't get welded to the tank properly. Instead of vertical alignment sometimes the ports get inclined slightly during welding due to which it becomes difficult to connect hoses to the tank. Internal threading of hose and external threading of ports does not match due to misalignment due to welding. The fixture used earlier was designed for one tank only and every time new fixture was required to accommodate tank of different capacity. Different fixtures were necessary for inspection for different sizes of tanks.*

In this project the fixture is designed in such a way that it can accommodate the tanks of different capacities and sizes. The tanks of different sizes can be inspected using proposed one fixture.

Thus cost of design and manufacturing of different fixtures for different tank is reduced. The new fixture will be useful for inspection of tanks of different capacities reducing the inventory as well as set up and inspection time.

Keywords: *Fixture, tank, frame, ports, plate, rods, bearing.*

1. INTRODUCTION

Fixtures are the tool used to locate and hold the work piece in position during the manufacturing process. Fixtures are used to hold the parts firmly which are to be machined, it is used to produce the large number of parts accurately. In order to produce parts with required accuracy and dimensions the parts must be firmly and accurately fixed to the fixtures. A fixture is designed and built to hold, support and locate the work piece to ensure that each work piece is machined within the specified limits.

Definition of fixture

1. The fixture can be defined as strong and rigid mechanical devices which attaches to a machine and allows the stock to slide while being held firmly enabling easy, quick and consistently accurate locating, supporting and clamping, blanks against cutting tool(s) and result faster and accurate machining with consistent quality, functional ability and interchangeability. (ref.1)

2. Fixture is also defined as a device which secures a single object to a location in space relative to a specific reference plane and/or point by limiting at least four of its possible six degrees of movement in space (along the x, y and z axis and rotation about said axis). (ref.2)

2. LITERATURE REVIEW

In research paper named as "Jigs and fixture design, 2014", Hamad Abouhenidi stated the definition of fixture and purpose behind its application. The force is central on the workpiece. Therefore, it prevents sliding of the parts of the workpiece.

In research paper named as "Computer aided fixture design: recent research and trends, 2010", Hui Wang proposed use of design software to design the fixture. Developing a computerized fixture design can result in high efficiency, stable accuracy, short setup time and low cost.

In research paper named as "A Review on Design and Analysis of Work Holding Fixture", by Shivaji Mengawade has reported reduced product cycle time and increase productivity using fixtures.

3. PROBLEM STATEMENT

The tank used for storage of resin and hardener consists of three ports at the bottom : two outlet and one drain port. The fixture is used to check the alignment of these ports with the tank. Every time when the capacity of tank changes, need of different fixtures suitable for that particular tank capacity arises. If a separate fixture is designed as per the size and capacity of the tank, it increases cost of inspection of alignment of ports with the tank. So there is a need to design such a fixture that will check the alignment of ports with the tank for all capacity tanks. This will also save the time of designing and cost of manufacturing of new fixture every time whenever the capacity of tank changes.

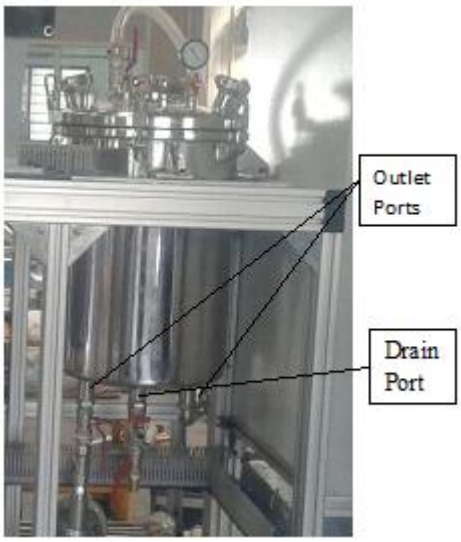

Fig 1: *Tank with bottom ports*

4. DESIGN OF FRAME AND PLATE

In design method, the problem statement was firstly we understood by us. Alternative solutions to overcome the problem and to atomise the operation were studied by us.

The difficult task of designing is that to follow the path of uneven profile of component then on that basis various conceptual rough drawings of frame and plate were made.

Detail analysis the design engineers of the company approved the proposal and finalized the design. Model of machine of rough drawings on the designing software CREO was made.

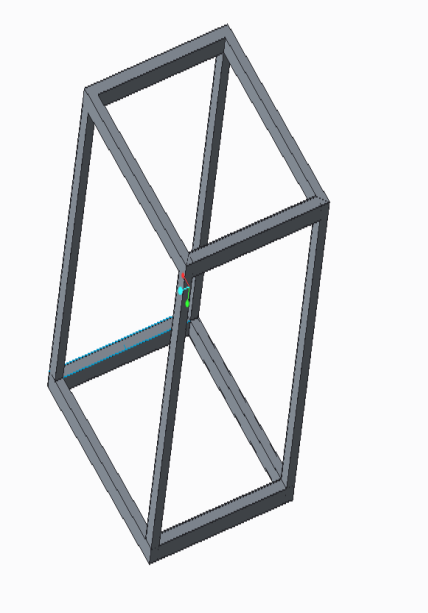

Fig 2: *Frame*

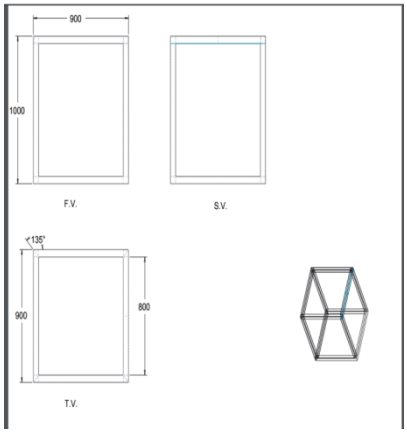

Fig 3: *Different views of frame*

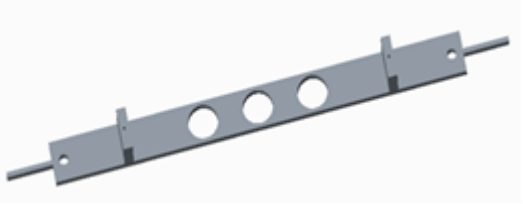

Fig 4: *Bottom plate for 100 litre tank*

Fig 5: *Bottom plate for 45 and 60 litre tank*

5. LAYOUT OF FIXTURE

The layout of fixture is simple. In layout, the various component position shown in below fig.6

Fig 6: *Assembly of fixture*

The specification of components in fixture assembly are-

- Frame : MS tubes

Cross section of tube: 50*50*3mm hollow rectangular cross section

- Tank: Volume=0.15cubicmeter=150Litres

Ports : Inlet, Outlet, Drain.

Material: SS 304

Weight : 60kg

- Bottom Plate for checking alignments : Mild Steel
- Four Bearing : Sliding contact linear motion bearing

Series : SBR20

- Two MS Rods : 20mm Diameter
- Powder Coating with Epoxy powder for frame
- Mechanism Used: Plate bolted to bearing for Adjustment of Tank

6. SIMULATION OF FIXTURE

Simulation for fixture consists of –

Simulation modelling is the process of creating and analyzing a digital prototype of a physical model to predict its performance in the real world

Simulation modelling allows designers and engineers to avoid repeated building of multiple physical prototypes to analyze designs for new or existing parts. Before creating the physical prototype, users can virtually investigate many digital prototypes. Using the technique, they can

1. Optimize geometry for weight and strength.
2. Select materials that meet weight, strength, and budget requirements.
3. Simulate part failure and identify the loading conditions that cause them.
4. Assess extreme environmental conditions or loads not easily tested on physical prototypes, such as earthquake shock load.
5. Verify hand calculations. Design and Analysis of fixture for tank body assembly
6. Validate design, robustness, rigidity, safety and survival of a physical prototype.

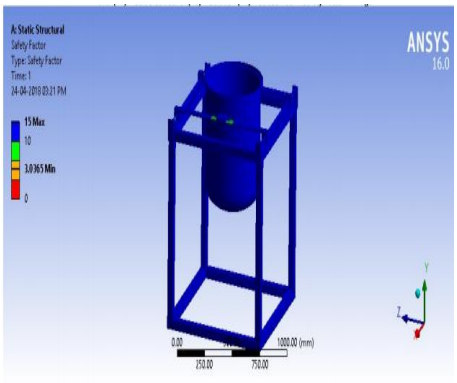

Fig 7: *Testing of tank in ANSYS*

Factor of safety : 3

Design is safe under applied load of tank i.e. 600 N.

7. MANUFACTURING PROCESS

1. Welding Process

For mild steel MIG (Metal Inert Gas) Welding or GMAW (Gas Metal Arc Welding) is used.

2. Laser Cutting Process

Laser cutting is used for cutting holes in plate.

The CO_2 laser is suited for cutting.

Stepwise Manufacturing procedure:

1. Cut the MS tubes in required dimensions.
2. Weld them according to the drawing; basic frame of fixture will get ready.
3. Weld the small pieces of required dimensions to frame of fixture to bolt the side support which is required to support the rod over which the bearings will slide.
4. Mount the bearings over the side rods.
5. Bolt the MS plate to linear bearings.
6. Check for the movement of plate along with the bearing.
7. Weld the scale to the fixture frame.
8. Cut holes on bottom plate for inspecting the port alignment with tank.
9. With the help of welding and bolt attach the side rod to fixture frame in order to move the bottom plate for inspecting the port alignment with the tank.
10. Check the vertical movement of bottom plate .

8. CONCLUSION AND FUTURE SCOPE

1. CONCLUSION

1. One fixture can be used for different capacities of tank (45,60,100)litre for checking alignments of ports with tanks.
2. Because of one fixture for all capacities of tank time can be saved.
3. Fixture is robust and safe at required load 600N.
4. Proper care need to be taken during welding and laser cutting process.
5. Tank of capacity more than 100litre cannot be inspected.

6. Manual operated fixture is manufactured.

2. FUTURE SCOPE

More research work is needed in the field of fixture using checking alignment with tank port. Currently this fixture is used for multi tank inspection manually and only up to 100 liters tank capacity . The scope for future is making automation for the tank inspection. As well increasing the size of fixture in order to use it for tank capacity more than 100 liters.

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