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Conceptual design and analysis of electron beam welding fixture for truss rod assembly in the construction of ITSC-15 in GSLV MK-II

Moniha P

pmoniha@gmail.com

J. J. College of Engineering and Technology,
Tiruchirappalli, Tamil Nadu

Ajithkumar M

ajithscorpionjo@gmail.com

J. J. College of Engineering and Technology,
Tiruchirappalli, Tamil Nadu

Mahalakshmi S

smahalakshmitnj@gmail.com

J. J. College of Engineering and Technology,
Tiruchirappalli, Tamil Nadu

Thiyagu M

thiyaguaero55@gmail.com

J. J. College of Engineering and Technology,
Tiruchirappalli, Tamil Nadu

ABSTRACT

The scope of our project deals with the design of a welding fixture for Electron Beam Welding to weld the Truss rod Assembly of Inter Tank Structure and Lower Thermal Shroud for GSLV MK-II. According to this, the result of the welding is pure and dense, porosity and inclusions are not present in welds due to the absence of oxidation in the chamber. The role of our project is to design the fixture to support the components that has to be fusing in order to increase the geometrical accuracies and mainly concentrated to reduce the fabrication errors that comes under the manufacturing process.

Keywords: Fixture, Welding fixture, AutoCAD, UniGraphix.

1. INTRODUCTION

Tool Design is a specialized phase of Tool Engineering. As an important aspect of manufacturing, it occupies a position between product designs of manufacturing and product productions. It is a process of designing and developing the tool methods and techniques necessary to improve manufacturing efficiency and productivity. It successfully provides special tooling needed for today's high speed, high production rate. It keeps the products cost competitive. Since each part requires different types of tools many in numbers, tool designing is an ever growing process.

1.1 Role of Fixture

A fixture is a work-holding or support device used during welding in the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability. Using a fixture, improves the economy of production by allowing smooth operation and quick transition from part to part, reducing the requirement for skilled labour by simplifying how work pieces are mounted, and increasing conformity across a production run.

2. GENERAL REQUIREMENTS OF TOOL DESIGNING

The main objective of tool design is to reduce manufacturing cost to its minimum with increased quality and production rate.

Some important general requirements of tool design are:

- High productivity.

- Ability to provide the required accuracy of shape and size and also necessary surface finish.
- Simplicity of design.
- Safety and convenience of controls.
- Low cost of manufacturing and operation.

2.1 Specialisation of Welding Fixtures

Welding fixture can be prepared very quickly as no spare parts are required. The understand parts to be used in their fabrication can be readily obtained from stores.

A number of different fixture can use the same standard parts which result in considerable saving of time, labour and material that would have been wasted in making or purchasing these parts every time they were required.

3. DESIGN CONCEPTS OF FIXTURE

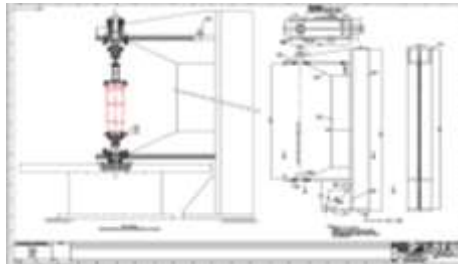


Figure 3.1 Two Dimensional Design Structure of Fixture.

The truss rod are clamped by using rotating positioner of fixture. The technology used in the welding fixture impose the actuators and clamping mechanism. Rotating rings are used to clamp and align the component in welding fixture and holder ring is used to hold the component in the fixture for fine positioning.

In existing fixture, it has only one rotating positioner on its bottom end and the other end is fixed with flat plate. Due to the rotating positioner, the fixture automatically rotates the component during welding process. It is easy to handle the fixture. The pivot which is mount on the rotating positioner is used to rotate the component upto 180°. After completing the semi arc weld, the component must be removed and change the position to continue the weld, while removing and changing its position it is possible for the misalignment and it takes lot of time to complete the work.

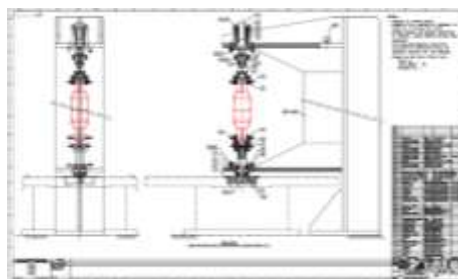


Figure 3.2 Conceptual Design of Fixture Assembly

Here we justified our idea in the project thoroughly by implementing the concept of rotating positioner placed at both ends in the fixture. By imposed the pivots on both side, it can able to weld and rotates the component upto 360°. Due to this, no need to remove the component till the work has to be done.

3.1 Modelling of Welding Fixture



Figure 3.3 Schematic diagram of the welding fixture

4. RESULT



Figure 4.1 Displacement of welded frame deflection at max = 0.605 mm of the fixture

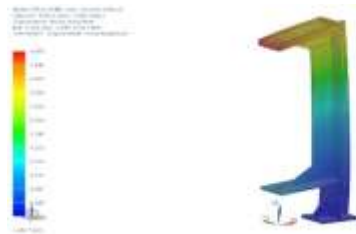


Figure 4.2 Displacement of welded frame deflection at max = 0.485 mm of the fixture



Figure 4.3 Displacement of welded frame deflection at max = 0.471 of the fixture



Figure 4.4 Displacement of welded frame deflection at max = 0.386 of the fixture

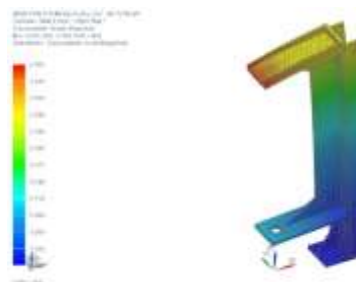


Figure 4.5 Displacement of welded frame deflection at max = 0.354 of the fixture



Figure 4.6 Displacement of welded frame deflection at max = 0.180 mm of the fixture

Table 4.1 Comparison of Various Deformation in Frame Structure.

SI NO.	TYPE OF FRAME	APPLIED LOAD (N)	MAXIMUM DEFLECTION (mm)
1	Without gussets	3000	0.605
2	With gussets	3000	0.485
3	With gussets placed horizontally	3000	0.471
4	Double column gussets	3000	0.386
5	Thick double column gussets	3000	0.354
6	Double frame double column gussets	3000	0.180

5. CONCLUSION

In existing fixture, rotating ring is present at bottom end and another end is fixed by flat plate with a pivot. The main disadvantage of this fixture is chance of mis-orientation between top and bottom ends and also consequent time lag. Due to this, we proposed the concept of two rotating rings or positioner mount on its both ends of the fixture. From the concept of implementing the rings in fixture, it is possible to weld the several parts of the component without removing or changing the set-up in the fixture. Apart from achieving above mentioned functionality, weight reduction of the fixture to 121.31 Kg from 300 Kg is also done by simulating the configuration & loading conditions. Maximum deformation is obtained with the above configuration is about 0.18 mm on the welded frame.

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