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Design and Analysis of Welding Fixture for Fuel Tank Mounting Bracket

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Abstract— this paper deals with the design and analysis of the welding fixture for the fuel tank mounting bracket. A fixture is a work holding or support device used in manufacturing industries. Fixture are used for supporting and holding the work ensuring that all parts produced using the fixture will maintain conformity and interchangeability. Locating and supporting areas must be large and stiff enough to accommodate welding operation, strong clamps are also requirement. Thus, pneumatic clamps are used. Pneumatic clamps allow the automatic clamping. Since the fuel tank mounting bracket consist of number of child parts which have to be welded to each other with a specified tolerance and weld quality. The material used for the mounting bracket is mild steel which is commonly used in fabrication. The deformation on mounting bracket due to clamping and of rotating disc due to loading of all parts have been found using FEA by using ANSYS software. Finally the deformation results are presented in this document.

Keywords — Fixture, Design, Pneumatic clamp, clamping force, ANSYS

1. INTRODUCTION

A fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. 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 a cutting tool or 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. Fixtures are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually.

The correct relationship and alignment between the components to be assembled must be maintained in the welding fixture. To do this, a fixture is designed and built to hold, support and locate work piece to ensure that each component is joined within the specified limits. A fixture should be securely and rigidly clamp the component against the rest pads and locator upon which the work is done.

Fixtures vary in design from relatively simple tools to expensive, complicated devices. Fixtures also help to simplify metalworking operations performed on special equipments. Fixtures play an important role on reducing production cycle time and ensuring production quality, by proper locating and balanced clamping methods .Therefore to reduce production cost, fixture design, fabrication and its testing is critical.

2. INTRODUCTION TO FUEL TANK MOUNTING BRACKET

Fuel tank mounting bracket is a frame which consists of number of child parts which needs to weld with specified tolerance and weld quality. The function of bracket is to hold and support the fuel tank of respected vehicle. The bracket is of Mahindra's bolero maxi truck. The bracket is made of material of mild steel which is commonly use by industries for manufacturing.

Table No. 1 Child Part of bracket

Component	Quantity	Material
L Channel	1	Mild Steel
L Rib	1	Mild Steel
Rib	2	Mild Steel
C Channel	1	Mild Steel
Strip	1	Mild Steel

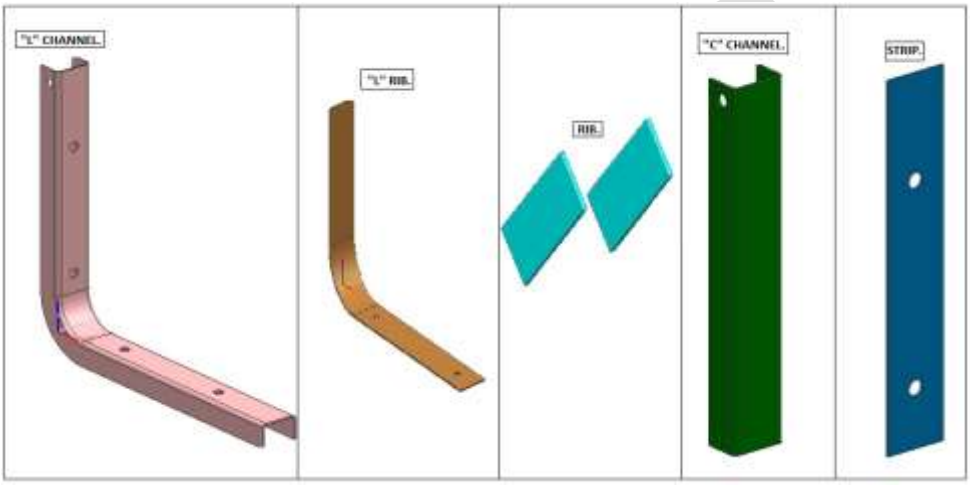


Figure No.1 Child parts of Bracket

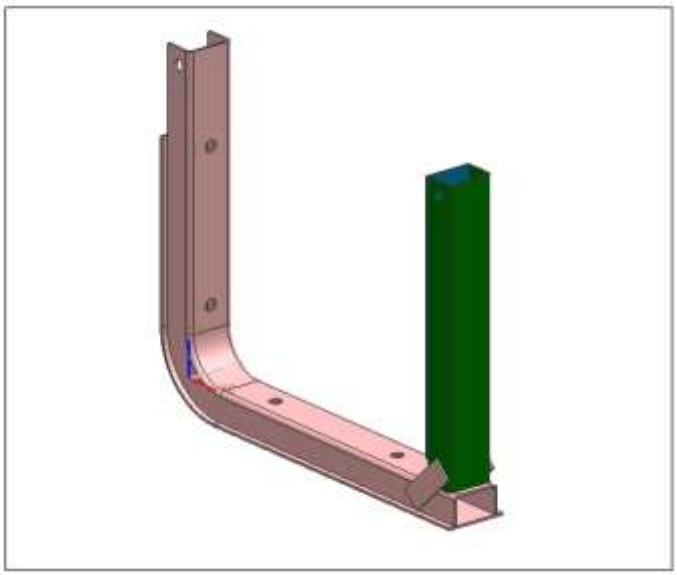


Figure No. 2 Assembled bracket

3. FIXTURE SETUP

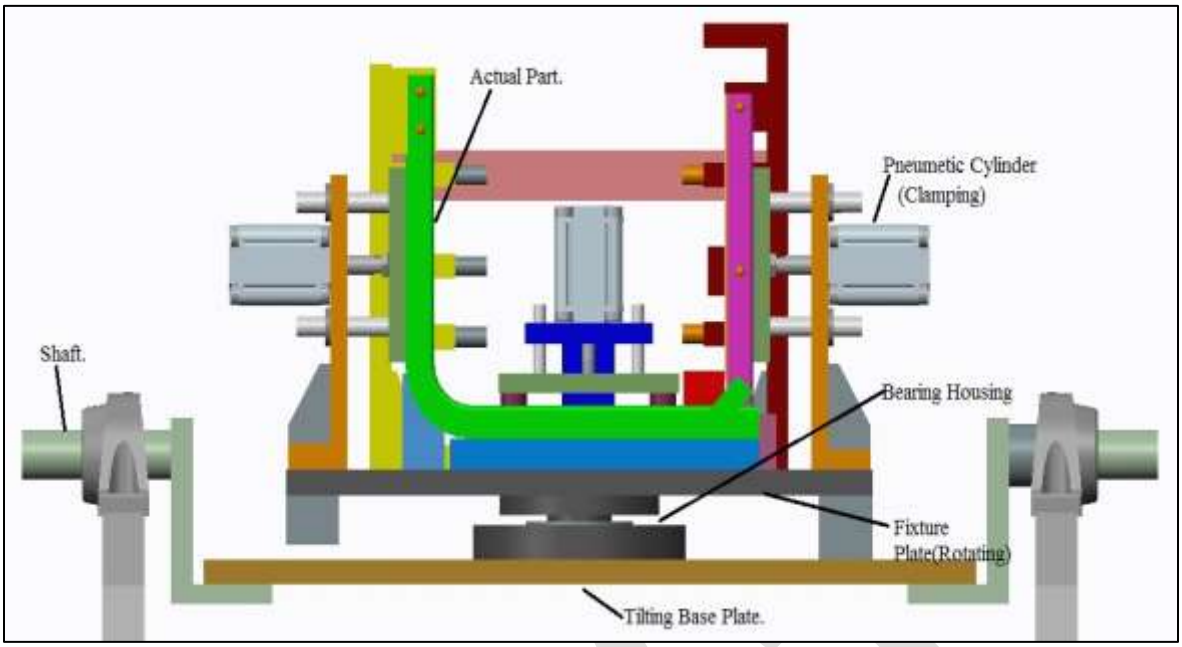


Figure No. 3 Welding Fixture setup

As fig. shows the assembly of welding fixture with fuel tank mounting bracket mounted. This welding fixture is specially design for this component to produce mass production and to reduce time consume.

This welding fixture is having 3 pneumatic cylinders to clamp the component by force actuating mechanism which exerted force on the component to hold it. Here are locators are also provided to locate the holes. It is supported on rotating plate which is on work table or trolley for mounting of fixture.

Basically this fixture is work as to reduce welder fatigue and to obtain the mass production. As shown in fig the main component is hold and supported in between the locaters and clampers. The rotating plate is mounted in plumber block to till the whole assembly of fixture is rotate up to 45°. There is a bearing housing on the rotating plate on which fixture rotating plate is mounted. That fixture rotating plate is rotate about 180° horizontally. Which reduce the time required to weld as compare to manual welding? Here is the distance is very important thing that should be as the distance is not maintain by the operator or by any technical reason the locaters locate that distance and it should not be accurate and alarm will be generated and the operator got an idea about that there is any misalignment in the component. same way the holes are presented for mounted that fuel tank on it if that holes are not present their or not made by the operator then the alarm will be generated an the operator get an idea that there is anything wrong and had to be solve and any misalignment is present in the fixture the whole system is stop and do not start welding on the component means the welding electrode is not come out from the welding arm.

4. LOCATION AND CLAMPING CONSIDERATION

It is very important to understand the meaning of location before understanding about fixtures. The basic principles of locating and holding that apply to the machining fixtures can also be applied to welding fixtures. The locating arrangement should be decided after studying the type of work, type of operation, degree of accuracy required. Before deciding the locating points it is necessary to find out the all possible degrees of freedom of the work piece. Then some of the degrees of freedom or all of them are restrained by making suitable arrangements usually the locaters are used to restrict the degrees of freedom. Usually 3 2 1 locating principle is used for locating a work piece.

A clamping device holds the work piece securely in a fixture against the forces applied over it during on operation. Provide clamps that are quick acting, easy to use and economical. Clamps should be integral part of fixture. In case of welding fixtures the Clamps used must hold the parts in the proper position and prevent their movement due to alternate heating and cooling. Clamping pressure should not deform the parts to be joined.

Considering the locating and clamping factors, the locating is accomplished by using 14 locating pins. Clamping is accomplished by using pneumatic cylinder. The complete fixture assembly weighs 98 kg excluding component weight. Pneumatic clamping allows automatic clamping for the bracket. The pneumatic cylinder is of A63 050 040 O-M of Janatics.

5. ANALYSIS

Analysis has been carried out by using finite analysis method with help of ANSYS software. The analysis of clamping component and rotating disc has been carried out.

5.1 ANALYSIS OF CLAMPING COMPONENT

Since the bracket consists of number of thin part thus the clamping force considered should not deform it. Thus the analysis of clamping component was carried out and a proper required clamping force was selected.

As per the design consideration clamping force is applied on three faces for suitable clamping. The solid model of the component is selected and geometric conditions are selected, direction of the force is selected and clamping load of 120 N is given and results are evaluated using the software.

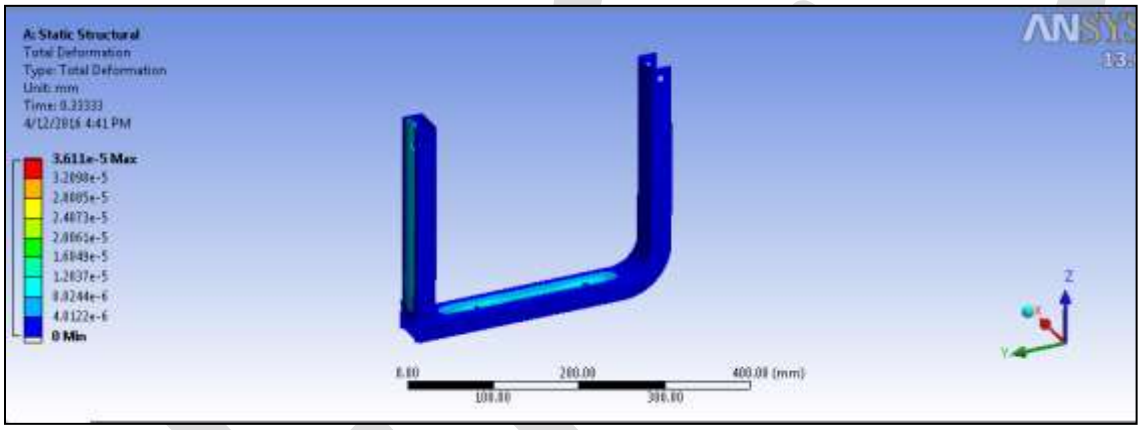
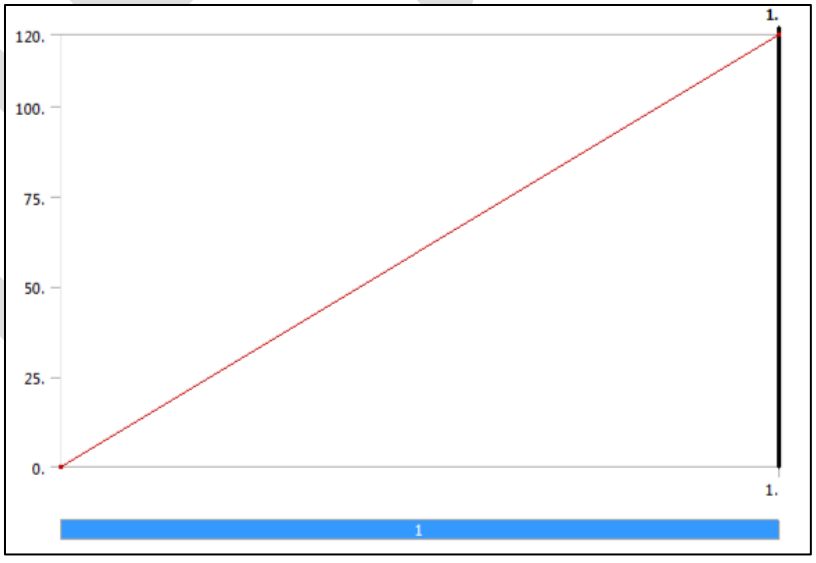
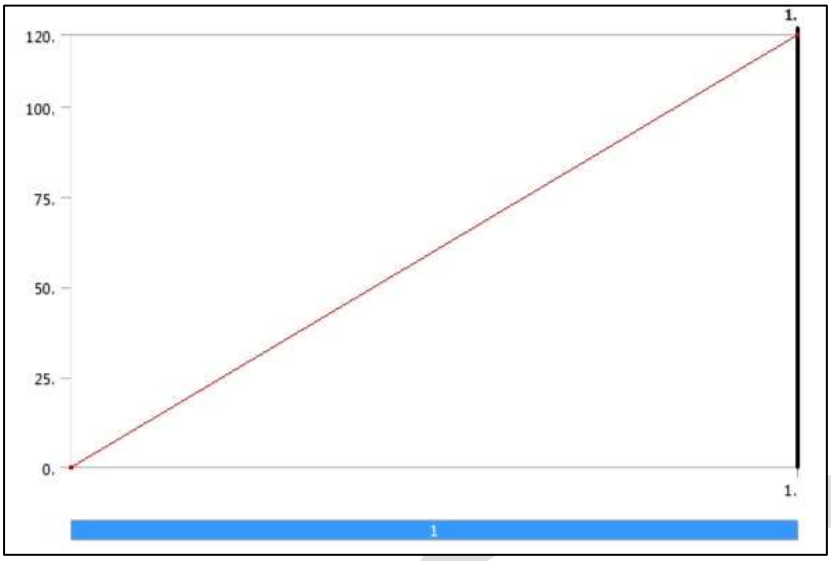


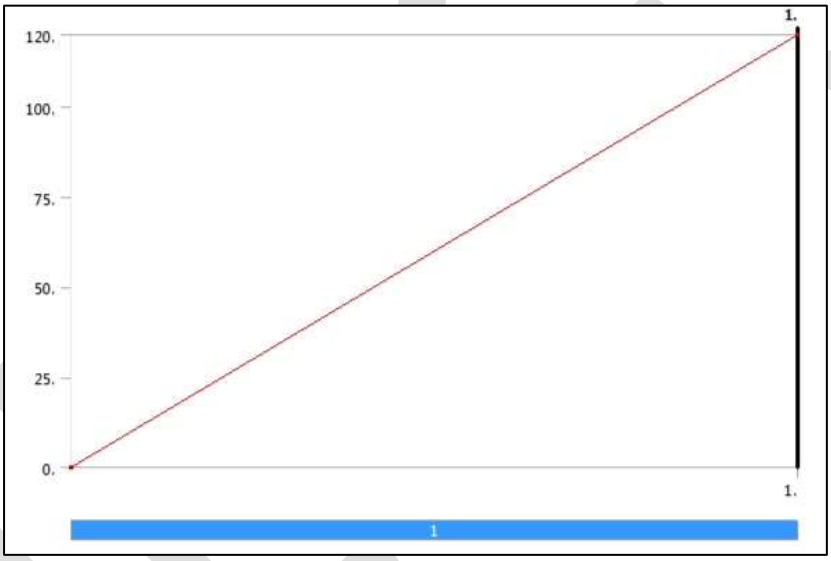
Figure No .4. Total deformation of bracket due to clamping load



Graph No. 1 Force Vs Deformation for surface 1



Graph No. 2 Force Vs Deformation for surface 2



Graph No. 3 Force Vs Deformation for surface 3

From the above graphs it can be seen that as the force applied increases the deformation also increases that is force is diuretically proportional to deformation this result is achieve for the maximum force applied. Thus the pneumatic clamp of less than 120N force needs to be selected.

5.2 ANALYSIS OF ROTATING DISC

Rotating disc is designed to achieve 180degree rotation of the base plate. It was designed to bear the load and produce a proper rotation of the base plate constituting all elements. It bears the load of all the components fastened on the disc. It bears the load about 100Kg.

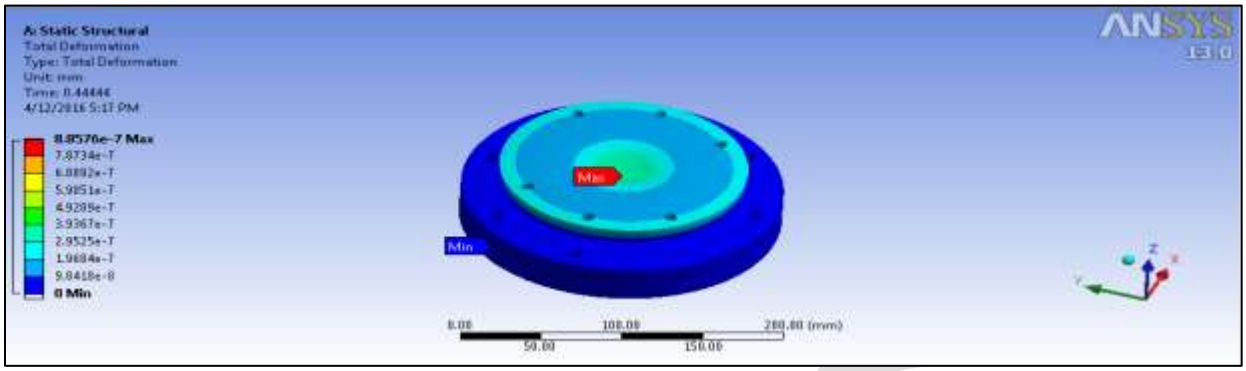
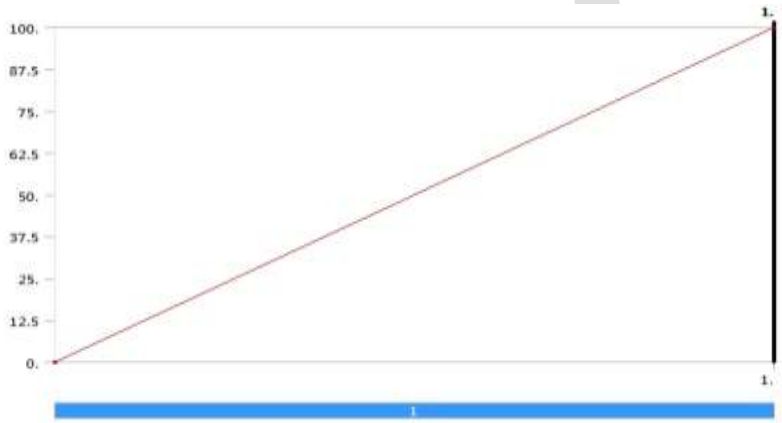


Figure No .5. Total deformation of rotating disc.



Graph No. 4 Load Vs Deformation.

Thus the rotating disc of selected dimension was found within permissible limit.

6. CONCLUSION

In this paper, the design and analysis of welding fixture for Fuel tank mounting bracket is performed successfully and in this process of designing. The analysis is done by ANSYS 13.0 WORKBENCH. This paper addresses the fixture design verification issue. In this paper, the work piece deformation in the component due to clamping load is taken into account.

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