Designing Fixtures for Transom Assembly Welding

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Abstract—Bogies are important part of train drive and its guidance mechanism. Manufacturing of bogie frame for railcar having distortion continues to be important issue and is subjected to large amount of research. Distortion effects encountered in the welding sector have been widely recognized as a feature which will never be completely eliminated. This project demonstrates the most economical and controllable method of heat straightening with the help of design of straightening fixture to eliminate the distortion. For this purpose, a specially designed welding fixture for the bogie frame structure has been implemented in order to reduce the amount of distortions.

Index Terms— Bogie frame, Distortion, Fixture, Transom assembly, Welding,

1 INTRODUCTION

A bogie is a chassis or framework carrying wheel-sets, attached to a vehicle, thus serving as a modular subassembly of wheels and axles. A bogie may remain normally attached (as on many railway carriages [cars] and semi-trailers) it may contain a suspension within it (as most rail and trucking bogies do), or be solid and in turn be suspended (as most bogies of tracked vehicles are); it may be mounted on a swivel, as traditionally on a railway carriage or locomotive, additionally jointed and sprung, or held in place by other means (centre-less bogies).

The bogie frame is an important and integral member of bogie in metro rail. The bogie in construction plays a vital part since factors like safety; speed and comfort mainly depend on the bogie on which the coach body is loosely mounted. The main purpose of the bogie frame is to withstand and transfer vertical loads of the superstructure with lateral forces caused due to negotiating the curves and interaction between rail and wheel and longitudinal force due to drafting of the coach by the engine.

The conventional bogie frame is made of heavy plate sections fabricated to form type consisting of two side frames, two transoms, two headstocks and four longitudinal. The bogie frame consists of two side frames connected by means of two circular cross section. It bares entire load of the coach and transmit to the wheel through side bearers the tractive effect which is transmitted through centre pivot pin both static and dynamic loads while running.

The control of welding distortion during assembling process is very important. Using fixtures to eliminate the welding distortion is an effective way to control the quality of welding.

When a material is welded, it experiences local heat due to the welding heat source. The temperature field inside the weldment is not uniform as the welding progresses.

The objective of the project is to develop fixtures to reduce distortion and which are also going to increase the ease of operation and maximize the accesiblity to the point of weld.

2 OBJECTIVES AND METHODOLOGY

2.1 Objectives

The main objective of the project is to design the fixtures with following features:-

- To hold the part in the most convenient position for welding.
- To provide suitable clamping to reduce distortion.
- To provide for ease of operation and maximum accessibility to the point of weld.

2.2 Methodology

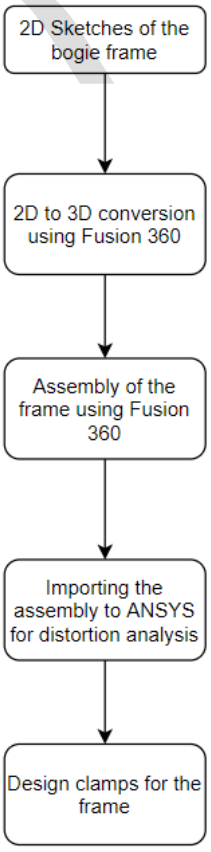

Figure 2.1: Flowchart of designing fixtures for transom

assembly welding.

The methodology implemented for designing fixtures for transom assembly application is as follows:

- The first step of the process is to have an idea about mechanism and hardware used which is acquired by referring many research papers and journals.
- A rough 2D drawing is prepared by using geometric instruments without any errors.
- This 2D drawing is further converted into 3D model with the use of FUSION 360 software.
- The 3D model is then used to study the deformation characteristics of the frame upon gravity, self-weight and both combined. Also, the temperature distribution upon welding is also analyzed. All these tests are performed on ANSYS software.
- After analyzing the results, the fixtures are designed as per the requirements.

The complete process is represented in a flowchart in Figure 2.1.

3 MODELLING

3.1 Transom assembly

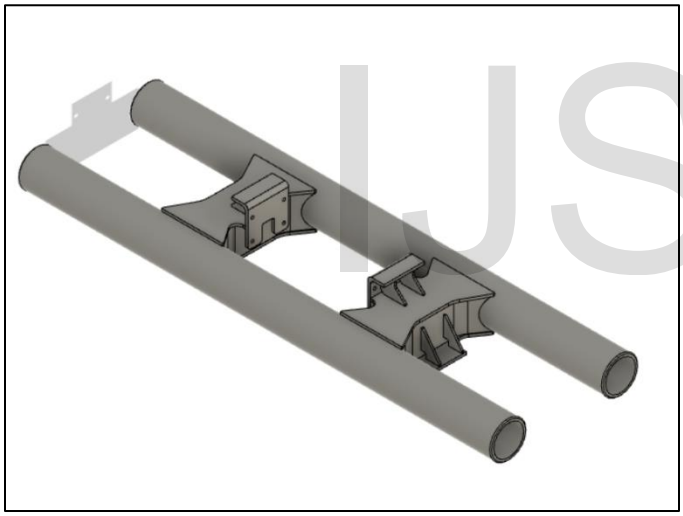

Figure 3.1: Transom assembly

Parts of transom assembly:

- Transom tubes
- Lateral buffer assembly

Material used:

- Type: SMA490BW
- Standard: JIS G 3114

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3.2 Fixtures for Transom assembly welding

4 EXPERIMENTAL WORK

4.1 Fixtures design for transom assembly

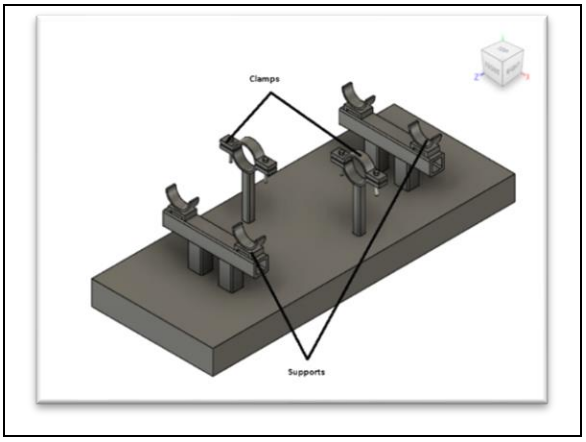

Fig 4.1:fixtures for transom assembly

4.2 Transom assembly analysis using ANSYS

4.2.1 Deformation

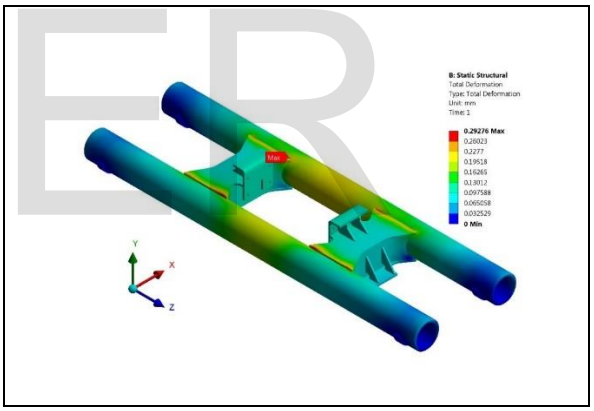

Figure 4.2:Deformation before condition

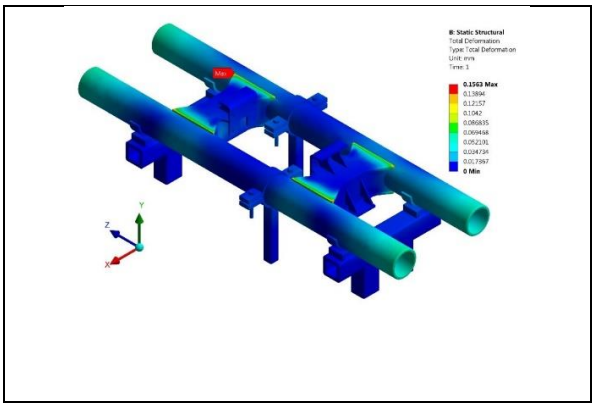

Figure 4.3:Deformation after comdition

CONCLUSION:

The before and after conditions of the stress distribution test

indicate that the fixtures designed are effective and have helped in reducing the maximum deformation by almost 50%. The maximum deformation before fixtures was 0.29276 mm and after applying fixtures is 0.1563 mm. Hence deformation has been reduced by 0.13646 mm. Providing fixtures at shorter distances will help in reducing distortion.

- Fixtures are better at eliminating DOF of the workpiece when compared to a simple support.
- The before and after conditions of the stress distribution test indicate that the fixtures designed are effective and have helped in reducing the maximum deformation by almost 50%.
- The final design of the fixture will facilitate producing different welding joints seamlessly, repeatedly and accurately.
- The design satisfies all of the functional requirements and design parameters.

In spite of initial challenges such as proper background information, faulty fixtures, insufficient resources, the objectives of this project were met.

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