Design and Analysis Jigs and fixture of Driver side and Left side body Frame of MSRTC Bus

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Abstract— The designing and manufacturing of a new bus is a process which need of a large number of technical labours and a great consumption time, starting from designing operation until full production process. The chassis manufacturing processes is quite very long throughput time, such as chassis platform assemble and welding, which lead to low production rate. The jig and fixture may lead to standardization of production, low defect and lower production time. So this paper shows use of jig and fixture for left side and driver side body frame of buses. So the production rate of manufacturing of frame is increase as the whole side body frame of MSRTC bus is manufacture first by using jig and fixture and then it is welded to the base frame.

Keywords- *Jig and fixture of bus frame, production time, accuracy, strength, safety of passengers, simplicity* .

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I. Introduction

This topic related to interest in reducing the time and efforts spent in the design, planning and production processes in the bus industry of MSRTC. The design of the internal bus skeleton structure is the basis of typical bus development of the bus industry. It contains of framework of tubes with different cross sections, which arranged in specified shapes based on the design philosophy. This arrangement is used to be safe for occupants and to sustain the extreme conditions can be matched on the road so to be accurate with our frame so that we need to take care of frame structure for that jigs and fixture used. By using jigs and fixture the time reduces for manufacturing and accuracy of frame increase so that safety of passenger obtained.

This jig and fixture is trolley type structure which can be moved from manufacturing of bus side frame department to assembly department where roof frame is welded to side frame and there is platform on the trolley type jig and fixture for standing and welding the roof frame.

II. Overview of jig and fixture

A. Jig

It is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation. Jigs are usually fitted with hardened steel bushings for guiding or other cutting tools. a jig is a type of tool used to control the location and/or motion of another tool. A jig's primary purpose is to provide repeatability, accuracy, and interchangeability in the manufacturing of products. A device that does both functions (holding the work and guiding a tool) is called a jig. An example of a jig is when a key is duplicated, the original is used as a jig so the new key can have the same path as the old one

B. Fixture

It is a work holding device that holds, supports and locates the workpiece for a specific operation but does not guide the cutting tool. It provides only a reference surface or a device. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in some cases hold a workpiece during either a machining operation or some other industrial process. A jig differs from a fixture in that it guides the tool to its correct position in addition to locating and supporting the workpiece. Examples: chucks

C. Purpose and Advantages of Jigs and Fixtures:

Following the purpose and advantages of jigs and fixtures:

a) It reduces or sometimes eliminates the efforts of marking, measuring and setting of work piece on a machine and maintains the accuracy of performance.
b) The workpiece and tool are relatively located at their exact positions before the operation automatically within negligible time. So it reduces product cycle time.
c) Variability of dimension in mass production is very low so manufacturing processes supported by use of jigs and fixtures maintain a consistent quality.
d) Due to low variability in dimension assembly operation becomes easy, low rejection due to les defective production is observed.
e) It reduces the production cycle time so increases production capacity. Simultaneously working by more than one tool on the same work piece is possible.

D. The Old process of Manufacturing Bus Frame in MSRTC

The each column of bus frames are welded to base frame so that the proper alignment of frames is not there. Production time is more as individually welded to base frame. The alignment is not proper then it may cause safety problem to passenger in case of rolling of bus. Production rate is low.

III. Jigs and fixture for side frame of MSRTC buses

A. *Material Selection*

Jigs and Fixtures are made of variety of materials, some of which can be hardened to resist wear.

1) Die steels: Used for press tools, contain 1% carbon, 0.5 to 1% tungsten and less quantities of silicon and manganese.

2) Mild steel: Used in most part of Jigs and Fixtures Cheapest material, Contains less than 0.3% carbon,It is tensile in nature.

3) Cast Iron: Used for odd shapes to some machining and laborious fabrication, Contains more than 2% carbon.It is brittle in nature. Out of these material mild steel is best suitable.

B. *Working of Jigs and Fixture for bus side frame*

It is the movable jig and fixture. The all the square tube of MS steel member are put on the jig. They are supported by strips and clamped by C-clamp. They are weld properly. Then the jig moves for assembly where all side frames are assemble to bus chassis. So the production rate of manufacturing of frame is increase as the whole side body frame of bus is manufacture first and then it is welded to the base frame. . This jig and fixture is trolley type structure which can be moved from manufacturing of bus side frame department to assembly department where roof frame is welded to side frame and there is platform on the trolley type jig and fixture for standing and welding the roof frame.

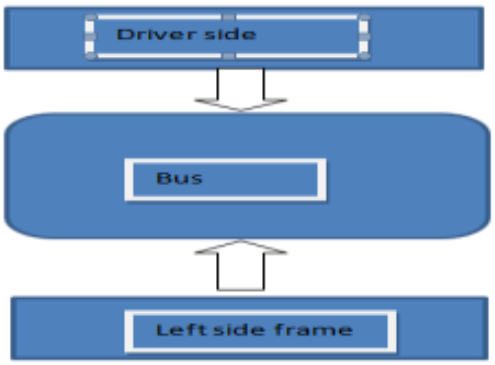

Fig. 1 Assembly of frames to chassis.

Fig. 2 Driver side jig and fixture

The green portion in the fig2 is exact copy of the drive side frame. The square tube of MS steel is placed on this structure and it is supported by strip and C-clamp. Once it is made it is transfer to assembly section where it is welded to base of chassis. Simultaneously the left side jig of bus frame is assembled. There is platform is made for the worker to stand on it and they can weld roof structure simultaneously. In this way they can make bus frame with less time and the accuracy of frame is increase. As the bus frame accuracy increases their strength increases. In case of accident it is able to sustain the shock.

C. *Calculations*

1) *Calculation of Bending Stresses on the channel cantilever at Jig*

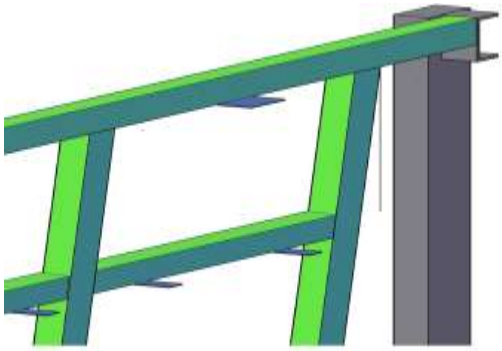

Fig. 3 Cantilever channel

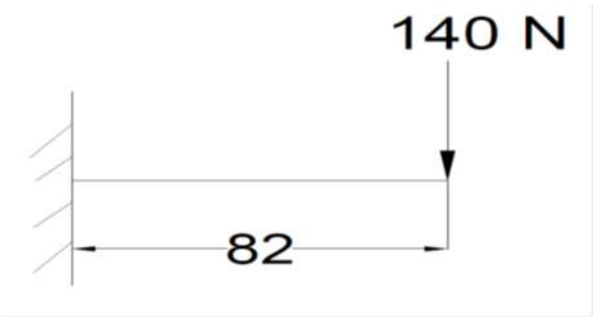

Fig. 4 Direct forces acting on the channel.

Doing analysis on ansys workbench for bending stress in cantilever channel

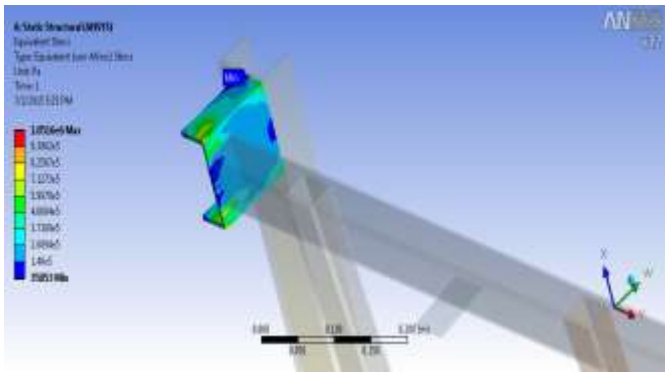

Fig. 5 bending stresses on cantilever channel

By analysis we found the maximum stress is 0.7Mpa which is very less than yeils stress of mild steel so the cantilever channel will not fail and design is safe.

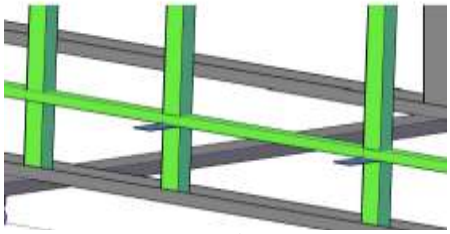

Fig. 6 Strips for holding

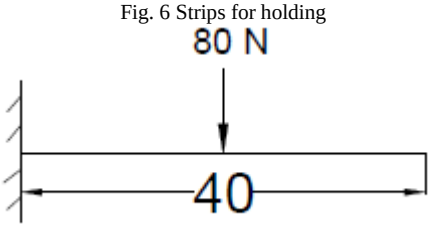

Fig. 7 self weight of square tube acting on strips

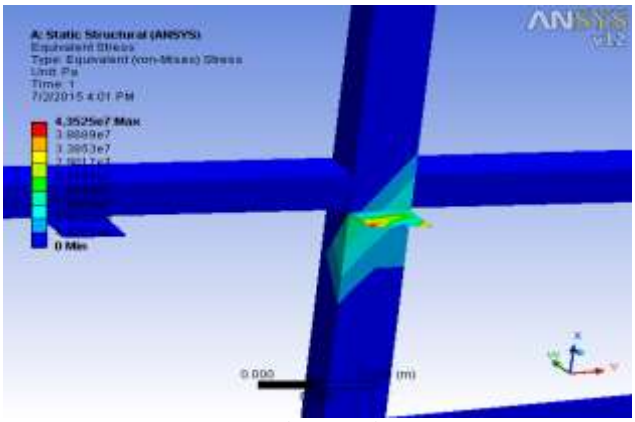

Fig. 8 bending stress due to self weight of square tube acting on strips

So the maximum bending stress is 43 Mpa and yield stress of mild steel is 200 GPa so as maximum bending stress in strip is less than yield strength the cantilever strip is safe at bending.

3) Calculation of deflection for driver side and left side jig of bus

Fig. 9 base channel of jig of bus

Considering the maximum force acting on the single member the deflection are calculated as

TABLE I
WEIGHT OF THE JIG

Font Size	Weight of the jig		
	Type of jig	**Left side of jig(N)**	**Right side of jig(N)**
1	Driver side jig	3552	2478
2	Left side of bus frame jig	3875	2478

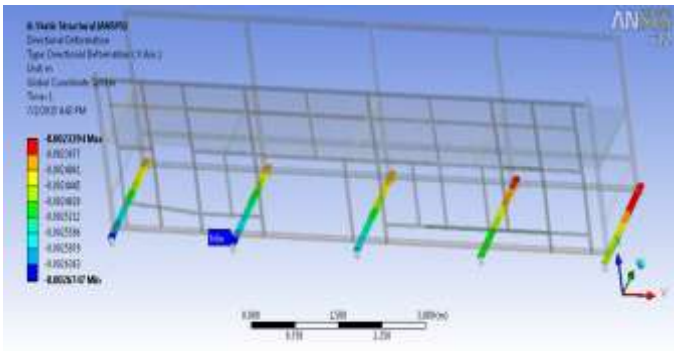

Fig. 10 deflection due to self and extra weight on jig.

The maximum deflection is find out on analysis on ANSYS is 2.39mm which is less.

- Results

The bending stresses in the highly stressed member are as follow

TABLE II
BENDING STRESSES

Sr. No	Name of the parts	Analytical Bending stresses (Mpa)	ANSYS bending stresses (Mpa)
1	For left side jig	10	9.96
2	For driver side jig	9.38	7.78
3	Channel cantilever at the corner of jig	0.615	0.59
4	Strips at bottom of column	40	43

The deflection on the members

TABLE III
DEFLECTIONS OF JIG

Sr. No	Name of the parts	Analytical deflections (mm)		ANSYS deflections (mm)	
		max	min	max	min
1	For left side jig	3.38	0.087	2.32	0.02
2	For driver side jig	3.43	0.08	2.343	0.0234

IV.CONCLUSION

So by using jig and fixture the accuracy of bus side body frame can be increase. The production rate of manufacturing of frame is increase as the whole side frame is manufacture first and then it is welded to the base frame. So the scope of project is more in future for accuracy and increasing production rate. Also by design and analysis its prove that design is safe. So using this jig and fixture the production of number of buses can be increase

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