Design and manufacturing of Welding Line and Gauging Line for Seat Frame

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Abstract: Fixture could be a work piece-locating and device used with machine tools. It is also used in inspection welding and assembly. Fixture doesn't guide the cutter, however is often fastened to machine or bench. By exploitation fixture, responsibility for accuracy shifts from the operator to the construction of machine tool. When a couple of components are to be machined, work piece clamp to the machine table while not exploitation fixture in several machining operations. However, when the numbers of components are giant enough to justify its price, a fixture is mostly used for holding and locating the work. In machining fixtures, minimizing work piece deformation because of clamping and cutting forces is crucial to keep up the machining accuracy.

I. INTRODUCTION

Fixtures is a low for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady. The most valuable function of a fixture is to reduce labor costs. It is a project of industry and aim of the project is to reduce cost and to increase productivity. The time taken for machining is also reduced. It also takes into account that unnecessary wastage of material is avoided as it contains the shimming attachment which used is to remove error in dimension and also it could modify the dimensions as per the requirements of the design. These designs are developed in NX CAD.

II. LITERATURE SURVEY

Sikstrom et al.[01] studied the role of fixtures forces on distortion in gas tungsten arc welding an experimental and modelling approach. Their objective was to evaluate the influence of fixture clamping forces on residual deformations and to validate simulation results by experimental data. During these test it was observed that frictional coefficient increased slightly after every test performed. The reason for that was the sliding side between the contact surface and fixture become rougher every test.

Vural et al.[02] studied on the effect of welding fixture in welding distortions. They found that low weld quality, geometrical tolerance faults and aesthetic defects were detected after manual welding. They concluded that first weld seam on the part creates preheating effect on the next weld seam and increases distortions. After analysis of six specimens, inversely proportional to weld speed, distortions were increased by increasing heat input.

Wang et al. [03] studied the direct impact on the machining errors of a work piece. They discussed on predicting the tolerance deviation resulting at a feature known set of errors on the locators and other is its inverse problem that involves establishing on the error of the locators to ensure that the limits specified by geometric tolerance at a features are not violated. They recognized that developing a computerized fixture design could result in high efficiency. They developed intelligent technique for computer aided fixture design. They integrated fixture system for manufacturing.

Mendez et al.[04] studied on new trends in welding in the aeronautic industry. They focused on the welding fundamentals and trends in the aeronautical industry that could be expected from the progress at a fundamental level. In their research they found that complex curved surfaces, section of the variable thickness as circular section could join without leaving a keyhole. They also found that the arc welding processes could continue to decrease in the revalance for aeronautic/aeroplane industry. They investigated that friction stir welding was likely to continue increasing its share of welding in the aeronautic industry.

Rong and Brown[05] investigated on developing the flexible fixturing system. They aimed on the development of the commercial modular fixture system. Their second research approach was to develop computer aided design process. They reviewed in depth on CAFT techniques and tools and how they would provide support across the entire fixture design process. They found that CAFT research lie within verification approach that focus upon checking work piece stability and deformation during machining and the layout planning approaches that seek to minimize work pieces deformation caused by machining forces. However the segment nature of

CAFT research and the continuing lack of focus upon unit design remain areas of concern within the fixtures design domain. In the terms of increasing the effectiveness of CAFT research output therefore, two primary avenues of the development present themselves. CAFT approaches together within the framework that incorporates and that uses this understanding to drive the fixture design process.

Sanchez et al [06] studied on analysis and compensation of point and deformation errors exploitation integrated fixturing analysis in versatile machining elements. They represented an integrating procedure for studying and compensating the main fixturing errors by integrating the positioning and deflecting fixturing analysis methods. They found that it is possible to generate a new cutting tool path in a CAM module so that the errors were compensated and machining accuracy was improved.

Gore and Langston[07] had experienced a major quality problem in the fabrication of the metal seat frame used in the manufacture of the front bucket seats of automobiles. This quality concern was failure of the seat cushion weld nuts to adhere to the metal seat frame during random quality torque testing at the lower specification limit. They concluded that successful "running change" to immediately reduce welder tip force to eliminate the defective welds. The low torque issue was solved and the multi-welder is running close to "zero defects". Cappetti et al. [08] had analyzed the capabilities of a routine, based on Fuzzy logic, for elaborating a data set coming from a CMM (Coordinate Measuring Machine). Their approach enabled to measure the holes with a number of points lower than those usually needed for the CMM software. Thus time spent for obtaining a good measure is significantly reduced. They finally concluded that the value of the diameter as corrected by the inferential system was the same of the diameter considered as real, within a negligible error. This latter could also be easily evaluated if necessary. Time for dimensional control considerably decrease by the reduction of the number of measured points. Finally Fuzzy processing on CMM can be easily implemented at a low cost as a routine processing method.

Wang et al.[09] studied that in the past decade that only very limited CAFD research and applications have been reported in the welding sector. In this field, due to the importance of welding for sheet metal assembly in automobile and aerospace industries, the assembly and welding of sheet metal has received some special attention. A weld fixture was often developed to reduce the deformation of each work piece due to heat and residual stress in the welding process and hence, to reduce the dimensional variation of the assembly, some methods of offline or online deformation analysis were developed to enhance the fixture's ability on deformation controlling. In sheet metal assembly with laser welding fixtures also should ensure a fit-up of the mating surfaces to ensure proper laser beam weld operation and laser weld quality. As a result, a traditional ''3-2-1'' locating scheme is extended to a mixed locating idea, ''total locating and direct locating for welds''. The total locating scheme was used to locate the entire assembly, and the direct locating scheme was used to locate the weld joints to meet the metal's fit-up requirement.

Boyle et al.[10] investigated and suggested in saving cycle time per job and also help in reducing the man hours, which might otherwise have been sent on manual welding of all the sub-assemblies, his paper was reviewed on Design of Fixtures. This paper gave brief information about type of locator type of clamping unit and also gave the steps of fixture design, brief overview about the 3-2-1 locating principle to design the fixture for complex parts and other clamping principles. This paper also gave the idea and procedure for fixture design, the idea about the modular fixture and dedicated fixture.

Goldberg et al.[11] researched on the evaluation method proposed to evaluate the clamping plan from several aspects as follows: Area factor, Stability factor, location of clamping point factor. In his paper they presented a fixture design and fixture modeling using NX software, using this type of concept, improves in quality of product, improve efficiency of plant, reduce in rework and scrap cost.

Patil et al.[12] investigated that positioners provide all the advantages of standard fixed height models however also include adjustable elevation to provide ergonomic working heights and improve safety.

III. PROBLEM STATEMENT

There are no fixtures for the compactor parts, this is otherwise being welded by using hoist hook carriers and rotated to desired positions every time by cranes also measuring dimensions every time so which leads to high 3m's (money, men, machine) and increases manufacturing lead time and extremely unsafe. So, it is necessary to develop a fixture to reduce the cycle time of a combine harvester. The system to be designed and manufactured of the welding fixtures and checking gauges in these project. The sub-task of the problem can be summed up in sequence
given below:

- Welding defects.
- Laborious marking out, measuring and setting operation.
- Expenditure on Quality Control.
- If the holes are not machined accurately then there is the chance of replacement of entire fixture.

IV. METHODOLOGY

Step 1: Part drawing is received from customer to the company.
Step 2: According to part drawing received from the customer conception is prepared
by the designer in the company.
Step 3: After analysis the design is been approved.
Step 4: As the Design is approval by the company, the whole design is converted into 2 D part drawing.
Step 5: According to the drawing, the number of material required for the design of fixtures are purchased by the company.
Step 6: After the material is purchased the manufacturing process is carried out which includes
1. Drilling
2. Surface grinding
3. Turning and facing operation in lathe machine
Step 7: Hardening operation is performed for the material where there will be more wear and tear. i.e., where there is direct contact between fixture and component.
Step 8: After manufacturing of the fixture, the fixtures is checked by the CMM machine to check whether the manufactured fixture is manufactured according to the design.
Step 9: If the fixtures has some errors in the dimensions then the errors are eliminated till the fixture are produced according to the design.
Step 10: The trial is taken in front of the customer. If the product satisfies the customer's requirements then the product is dispatched to the customer.

V. DESIGN

Successful fixture designs begin with a logical and systematic plan. With a complete analysis of the fixture's functional requirements, very few design problems occur. When they do, chances are some design requirements were forgotten or underestimated. The work piece, processing, tooling and available machine tools may affect the extent of planning needed. Preliminary analysis may take from a few hours up to several days for more complicated fixture designs. Fixture design is a five step problem-solving process. The following is a detailed analysis of each step.
Step 1: Define Requirements.
Step 2: Gather/Analyze Information.
Step 3: Develop Several Options.
Step 4: Implement the Design: These rules are a mix of practical considerations, sound design practices, and common Sense.

i. Use standard components.
ii. Use prefinished materials.
iii. Eliminate finishing operations.
iv. Keep tolerances as liberal as possible.

Results and discussion:

The figure is the assembly of the seat frame for which we have designed and manufactured the various fixtures. The entire assembly is divided in 3 main parts that are explained below:

1. Riser (Right hand and left hand)
2. Cushion
3. Marriage assembly

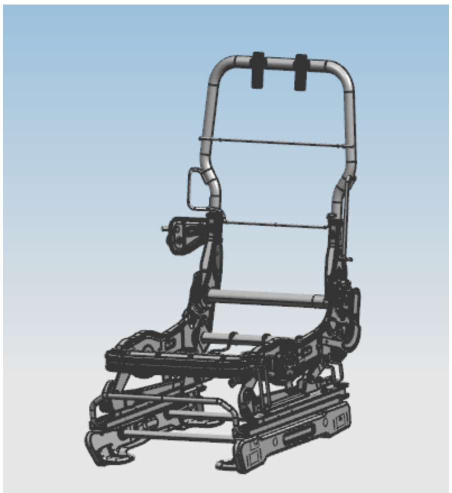

Fig.1 Seat frame.

Sr.No	Description	Clamp
Fixtures		
1.	Riser Main Fixture	Manual
2.	Link Fixture	Manual
3.	Marriage Assembly Fixture	Manual
Gauges		
1.	Side Member 1	Manual
2.	Side Member 2	Manual

Table 1 Components of frame

5.1 Design of welding fixtures

Design of welding fixture is done as per following:

1. Riser
2. Link
3. Marriage Assembly

5.1.1 Design of fixture for riser

The figures given below are of one of the component of seat frame i.e. of the riser. It is located at the bottom of the seat frame. Different angles views are shown below. The component is imparted in NX software from where it is fixture of riser is being designed according to the dimension of riser.

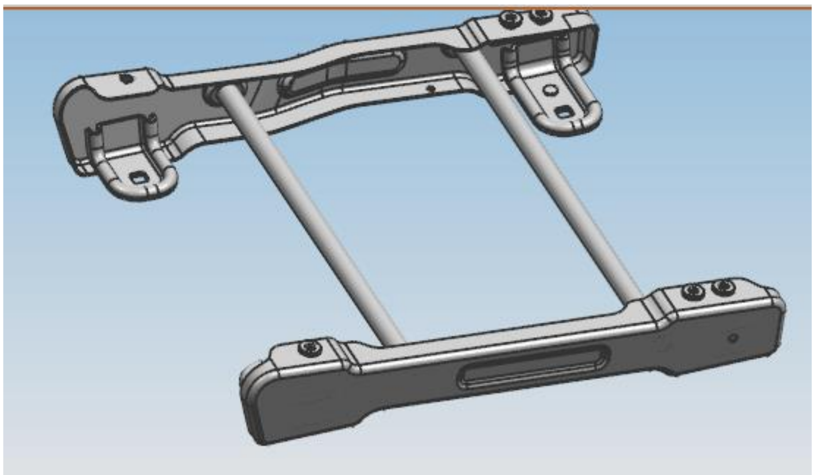

Fig. 2 Riser of which fixture is to be designed

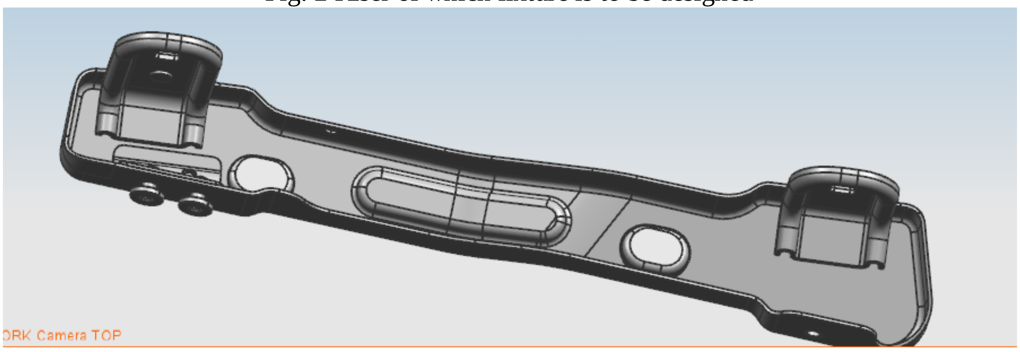

Fig. 3. Left hand side riser of seat frame

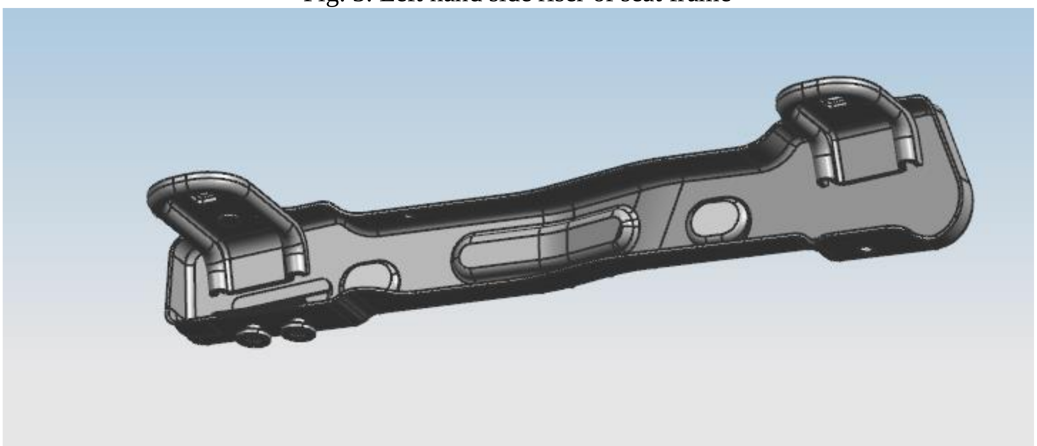

Fig. 4 Right hand side riser of seat frame

5.1.2 Fixture of riser assembly

For the riser of the seat frame we have designed and manufactured the welding fixture the below figures shows the fixtures with riser in figure 5

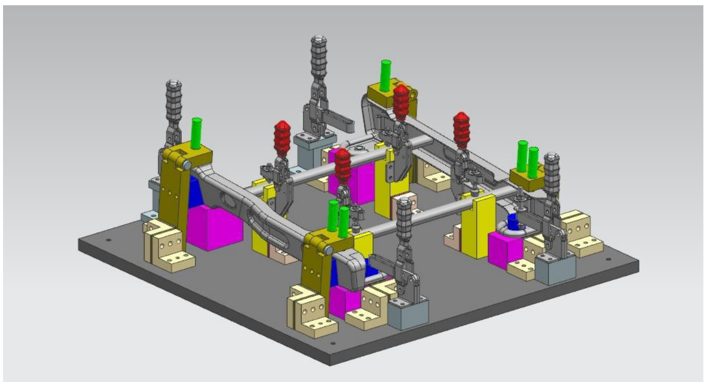

Fig.5 Riser fixture with component

5.1.3. Link fixture

Link is one of the components of main seat frame which is in between the top part and the riser member; it is shown in figure 6 below.

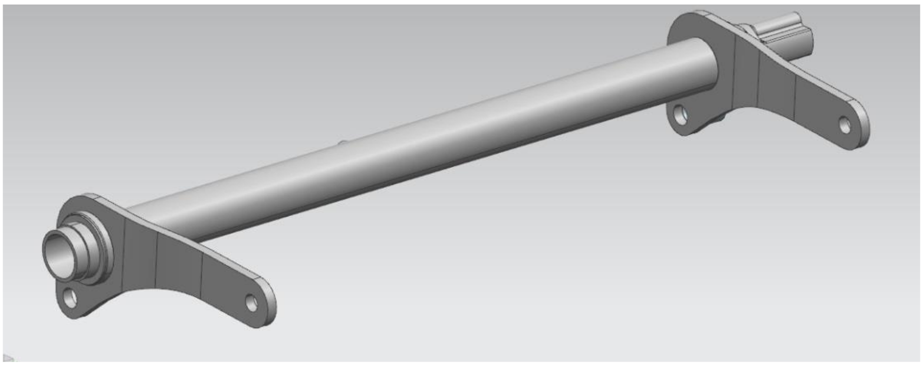

Fig.6. Link component

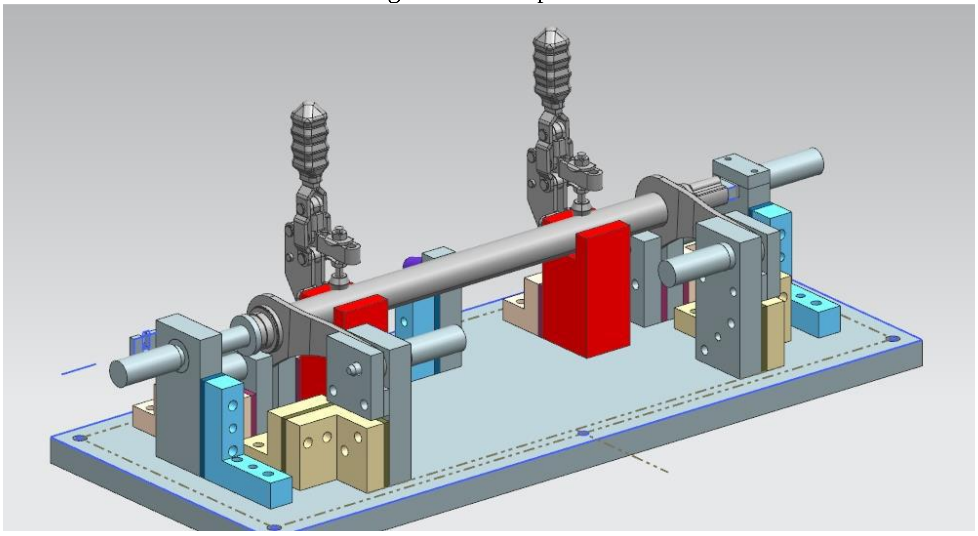

Fig.7 Link fixture with link component

5.1.4. Marriage Assembly

The following shows the design of marriage assembly of welding fixture.. The component is imparted in NX software from where it is fixture of riser is being designed according to the dimension of marriage assembly.

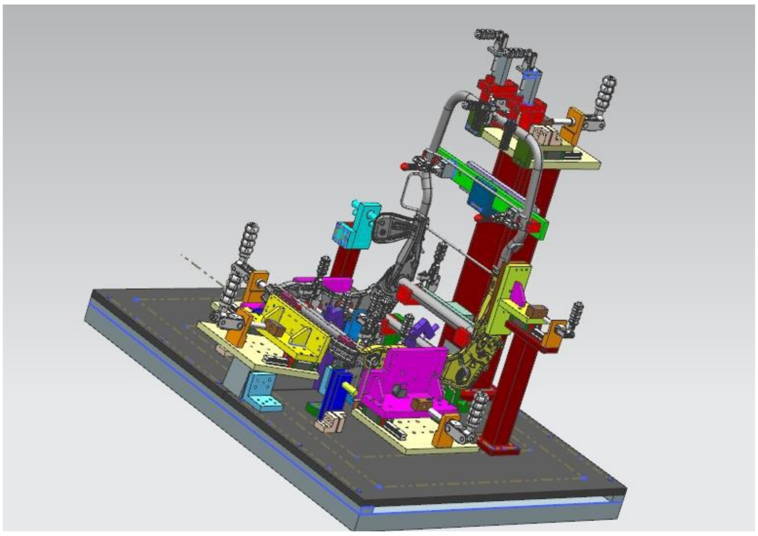

Fig.8 Isometric view of Marriage fixture

5.1.5. Checking gauges:

Checking gauges are the fixtures which are used to check whether the component is correctly manufactured according to design.

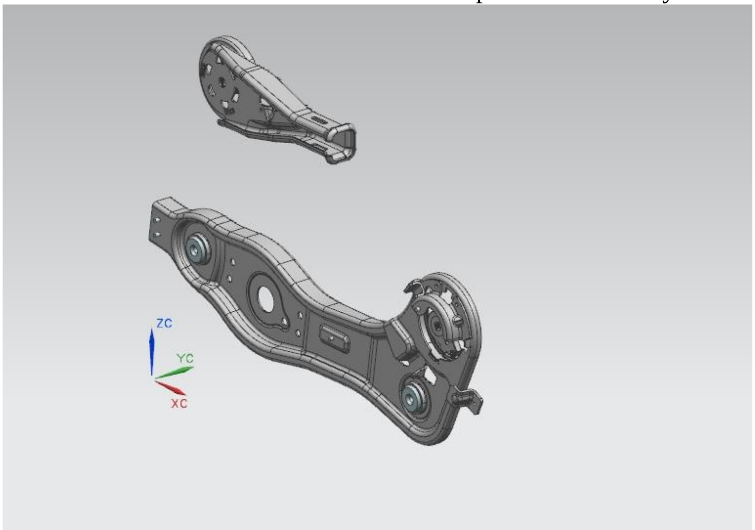

Fig.9 Side member component

The figure below shows the checking gauge fixture with the side member component.

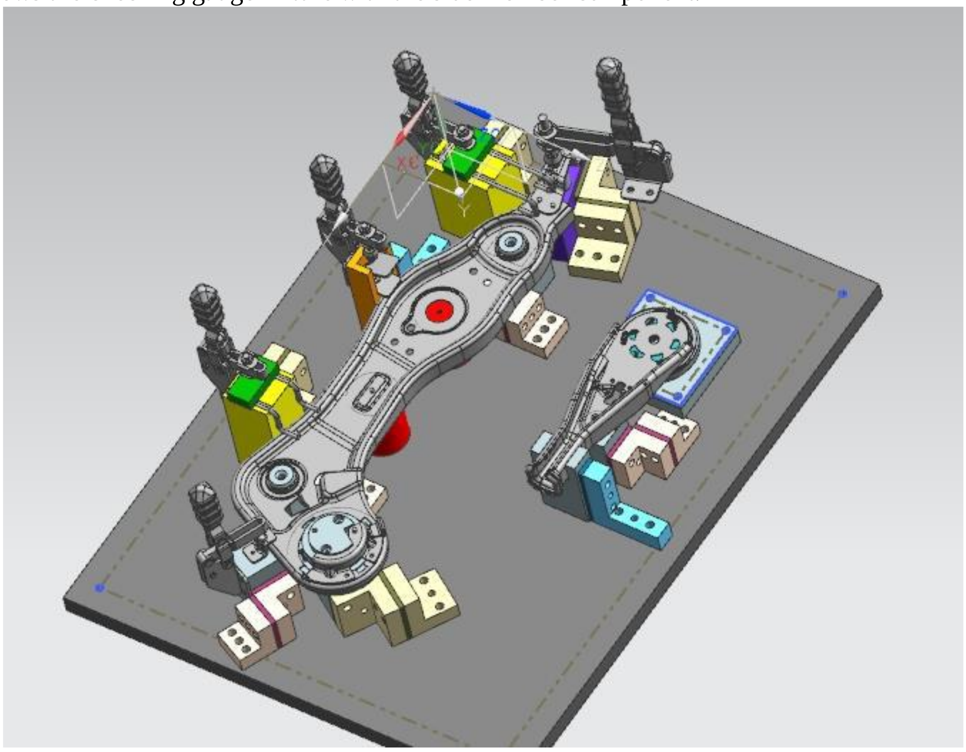

Fig.10 Side member checking gauge

5.2 Raw materials for Fixtures

RM LIST FOR VRM RISER FIXTURES.				
Sr. No.	RM TYPE.	RM SIZE.	FINISH SIZE.	QTY.
01	MS. BRIGHT.	40 X 40 X 105.	40 X 40 X 102.	08
02	MS. BRIGHT.	75 X 75 X 78.	75 X 75 X 73.	02
03	MS. BRIGHT.	75 X 75 X 105.	73 X 75 X 100.	02
04	MS. BRIGHT.	50 X 50 X 105.	50 X 50 X 100.	04
05	MS. BRIGHT.	20 X 50 X 141.	20 X 50 X 136.5	02
06	MS. BRIGHT.	20 X 50 X 181.	20 X 50 X 176.5	02
07	MS. BRIGHT.	20 X 50 X 150.	20 X 50 X 144.5	02
08	MS. BRIGHT.	20 X 50 X 70.	20 X 50 X 65.	08
09	MS. BRIGHT.	20 X 50 X 50.		02
10	MS. BRIGHT.	40 X 50 X 50.		02
11	MS. BRIGHT.	10 X 50 X 50.		04
12	MS GAS CUT.	20 X 650 X 650.	20 X 650 X 650.	01
			Total.	**39**
			Need " L " 50 X 50.	**08**
			Need " L " 40 X 40.	**16**

Table.2 List of raw material for riser fixture

RM LIST FOR VRM MARRIAGE ASSLY FIXTURES.				
Sr. No.	RM TYPE.	RM SIZE.	FINISH SIZE.	QTY.
01	MS. BRIGHT.	20 X 40 X 55.	20 X 40 X 50.	08
02	MS. BRIGHT.	20 X 40 X 105.	20 X 40 X 100.	02
03	MS. BRIGHT.	20 X 40 X 142.	20 X 40 X 137.	02
04	MS. BRIGHT.	20 X 40 X 175.	20 X 40 X 175.	04
05	MS. BRIGHT.	20 X 40 X 190.	20 X 40 X 185.	02
06	MS. BRIGHT.	40 X 40 X 35.	40 X 40 X 35.	02
07	MS. BRIGHT.	40 X 40 X 45.	40 X 40 X 45.	01
08	MS. BRIGHT.	40 X 40 X 55.	40 X 40 X 50.	04
09	MS. BRIGHT.	40 X 40 X 65.	40 X 40 X 60.	02
10	MS. BRIGHT.	40 X 40 X 70.	40 X 40 X 64.7	02
11	MS. BRIGHT.	40 X 40 X 85.	40 X 38 X 80.	01
12	MS. BRIGHT.	16 X 40 X 80.	16 X 40 X 75.	04
13	MS. BRIGHT.	16 X 40 X 105.	15 X 40 X 100.	04
14	MS. BRIGHT.	16 X 40 X 145.	15 X 40 X 140.	04
15	MS. BRIGHT.	16 X 40 X155.	16 X 40 X 150.	01
16	MS. BRIGHT.	16 X 40 X 305.	16 X 40 X 300.	01
17	MS. BRIGHT.	16 X 50 X 71.	16 X 50 X 66.	02
18	MS. BRIGHT.	16 X 50 X 80.	16 X 50 X 75.	01
18	MS. BRIGHT.	16 X 50 X 475.	16 X 50 X 470.	01
20	MS. BRIGHT.	20 X 20 X 45.	20 X 20 X 40.	02
21	MS. BRIGHT.	20 X 20 X 55.	20 X 20 X 50.	01
22	MS. BRIGHT.	20 X 20 X 65.	20 X 20 X 60.	01
23	MS. BRIGHT.	20 X 20 X 104.	20 X 20 X 99.	02
24	MS. BRIGHT.	20 X 20 X 164.	20 X 20 X 169.	01
25	MS. BRIGHT.	20 X 20 X192.	20 X 20 X 197.	01
26	MS. BRIGHT.	16 X 75 X 47.	16 X 75 X 41.9	01
27	MS. BRIGHT.	16 X 75 X 60.	16 X 75 X 55.	01
28	MS. BRIGHT.	16 X 75 X 80.	16 X 75 X 75.	01
29	MS. BRIGHT.	16 X 75 X 80.	16 X 75 X 85.	02
30	MS. BRIGHT.	16 X 75 X 120.	16 X 75 X 115.	01
31	MS. BRIGHT.	16 X 75 X 170.	16 X 75 X 165.	01
32	MS. BRIGHT.	16 X 75 X 200.	16 X 75 X 195.	01
33	MS. BRIGHT.	16 X 75 X 255.	16 X 75 X 250.	02
34	MS. BRIGHT.	16 X 75 X 285.	16 X 75 X 280.	01
35	MS. BRIGHT.	20 X 50 X 65.	20 X 50 X 65.	01
36	MS. BRIGHT.	20 X 50 X 95.	20 X 50 X 90.	04
37	MS. BRIGHT.	75 X 75 X 34.	75 X 75 X 29.	02
38	MS. BRIGHT.	75 X 75 X 144.	75 X 75 X 108. 60	01
39	MS. BRIGHT.	12 X 40 X 85.	12 X 40 X 80.	01
40	MS. BRIGHT.	12 X 75 X 85.	12 X 75 X 80.	01
41	MS. BRIGHT.	20 X 63 X 130.	20 X 60 X 125.	01
42	MS. BRIGHT.	20 X 100 X 255.	19 X 100 X 250.	02
43	MS. BRIGHT.	25 X 25 X 55.	25 X 25 X 50.	05
44	MS. BRIGHT.	25 X 50 X 45.	25 X 50 X 40.	02
45	MS. BRIGHT.	30 X 30 X 150.	30 X 30 X 145.	01
46	MS. GAS CUT.	16 X 230 X 255.	16 X 230 X 250.	03
47	MS. GAS CUT.	16 X 135 X 250.	16 X 135 X 250.	01
48	MS. GAS CUT.	20 X 40 X 255.	19 X 40 X 250.	02
49	MS. GAS CUT.	20 X 190 X 195.	20 X 190 X 190.	01
TOTAL QTY IN Nos.				95

Table.3 List of raw material for marriage fixture

RM LIST FOR VRM CU. SIDE MEMBER.				
Sr. No.	RM TYPE.	RM SIZE.	FINISH SIZE.	QTY.
01	MS. BRIGHT.	25 X 100 X 63.	25 X 57.1 X 90	01
02	MS. BRIGHT.	75 X 75 X 110.	50 X 75 X 105.	01
03	MS. BRIGHT.	25 X 40 X 120.	25 X 40 X 115.	01
04	MS. BRIGHT.	40 X 40 X 69.	40 X 40 X 63.7	01
05	MS. BRIGHT.	50 X 50 X 113.	50 X 50 X 107.	01
06	MS. BRIGHT.	40 X 40 X 72.	40 X 40 X 66.8	01
07	MS. BRIGHT.	40 X 40 X 66.	40 X 40 X 60.7	01
08	MS. BRIGHT.	50 X 50 X 63.	50 X 50 X 57.5	01
09	MS. BRIGHT.	25 X 50 X 90.	25 X 50 X 85.	01
10	MS. BRIGHT.	40 X 40 X 60	40 X 40 X 54.7	01
11	MS. BRIGHT.	50 X 50 X 52.	50 X 50 X 47.	01
12	MS. BRIGHT.	40 X 40 X 360.	FOR Shimming "L"	04
			Total.	15

Table.4 List of raw material for Side member gauge

VI. FUTURE SCOPE

Following are the point that describes the scope of the welding fixtures:

- Design of welding fixtures that will facilated the welding of complete structural sub-assemblies in one operation while maintaining all dimensional and geometric tolerances.
- Easy modification if the dimensions of the part are modified.

CONCLUSION

We have studied the different types of fixtures, locating and clamping devices, and the various principles and factors that should be considered wile designing the fixtures, with the help of these principles we have designed the fixtures effectively. Here we have conducted operations related to welding fixtures and positioners help in gaining a deeper understanding as well as effective project process. In order to meet the requirements of the fixtures customization is done by making the clamping system very practical for various size and geometries and by also knowing the material selection a cost benefit analysis could be conducted to determine how cost effective the product is following points gives the conclusion of the project which are listed Below:

1. To minimize the defects caused during welding hence the skill requirement becomes moderate
2. Fixtures are best suited for the batch production, it reduces the overall cost
3. Fixture design only is a partial process in manufacturing and it should obey to the total objective of work piece manufacturing requirements which often are related with production resources, equipment, cost and machining process, etc.

References

[01] Sikstrom F., Christiansson A., Lennartson B. “Role of Fixture Forces on Distortion in Gas Tungsten Arc Welding – an Experimental and Modelling Approach “August 2010.

[02] Varul M., Muzafferoglu H., Tapici U., “ The effect of welding fixtures on welding distortion” JAMME, volume 2, Jan-Feb 2007.

[03] Wang Hui, Rong Y., Li Hua., Price Shaun “Computer aided fixture design: Recent research and trends” July 2010.

[04] Wang Hui., Rong Yiming., “Case base reasoning Method For Computer Aided Welding Fixture Design “,ELSEVIER, Computer-Aided Design 40(2008).

[05] Patricio F., Mendez “New Trends In Welding in the Aeronautic Industry”, Massaachusetts Institute of Technology, Cambridge , MA 02139, USA.

[06] Boyle I., Rong Y., Brown D., “A review and analysis of current computer aided fixture design approach.” May 2010.

[07] Sanchez H., “Analysis and Compensation of Positional and Deformation Errors Using Integrated Fixturing Analysis in Flexible Machining Parts “Springer-Verlag London Limited , Jan 2006.

[08] Gore David, Langston D., “University and industry collaboration to solve welding quality problems using designs of equipment.” February 2006.

[09] Cappetti N, Naddeo A, Vellecco F., “Fuzzy approach to measure correction on Cordinate Measuring Machines: The case of hole-diameter verification” June 2016.

[10] Wu Y., Rong Y., Ma M., LeClair S., “Automated modular fixture planning: Geometric analysis” July 1997.

[11] Goldberg K., “A complete algorithm for designing planer fixtures using modular components” February 1996.

[12] Patil A., Parge T., Lomte R., “Design of welding fixtures and positioners” September 2014.

[13] Rong Yiming., Brown David., “A Review and Analysis of Current Computeraided Fixture Design Approaches" , ELSEVIER, Robotics and Computer –Integrated Manufacturing 27 (2011).