Fixture Design for Rooftop of Metro

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Abstract

Researching the possibilities for fixture design aided by computers has been in the sphere of interest of a number of authors worldwide for a longer period. Research results have led to the precise and systematised knowledge on the possibilities offered by computer application in fixture design process. The paper emphasises the importance of fixture design automation. It presents a general structure of the automated design system with a special highlight on the fixture design systems and their main characteristics. It also shows a structure and a part of output results of the automated modular fixture design system. Finally, the reached conclusions are presented with the expected directions of future researches. In industrial ergonomics a manipulator is a lift assist device used to help workers lift, maneuver and place articles in process that are too heavy, too hot, large or otherwise too difficult for a single worker to manually handle.

Index terms— welding, fixture, manipulators, solidworks, plc.

1 Introduction

ixture design is typically a setup cost function, making it very valuable in flow time and indirect cost calculations. Due to the rapid response required in many applications, the fixture design principles must be integrated and properly detailed so as to facilitate the fast design development of a fixture. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process are eliminated by fixture. This increase productivity and reduce operation time. Welding fixtures are normally designed to hold and support the various components (workpieces) to be welded. Fixture is a device for locating, holding and supporting a work piece during a manufacturing industry [2]. It is necessary to support them in a proper location which is capable of preventing distortions in workpieces during welding. For this the locating elements need to be placed carefully, clamping has to be light but firm, placement of clamping elements has to be clear of the welding area and the fixture has to be quite stable and rigid to withstand the welding stresses. With the aid of manipulator the welding fixture on which the rooftop will be placed is rotated for welding purpose. After necessary welding operations being performed, the fixture is rotated back to its original position. Then the rooftop is unclamped and unscrewed from its fixture in order to get lifted by the crane to be placed on the train top. For carrying out these operations appropriate design and functioning of this mechanism is of prime concern.As a result of complex alignment and positioning equipment are important as they are required in nearly all research andmanufacturing processes [1]. Current production systems in manufacturing industry are characterized by product range extension, high frequency in changing production programs, demands for constant product quality improvement, shortenings in production time, constant need for increasing technological level of products and decreasing their manufacturing costs.In industries it is however, with the availability of 64 digit computers and refined FE tools, welding engineers around the world are more biased towards the computer simulations of complex welding phenomenon instead of the conventional trial and error approach on the shop floor is the most common practice nowadays [5]. With such market demands, and intensive development of science, technique and information technologies, the level and the trend of further development of technological machining processes in metal manufacturing industry depend

on all the composing factors, those being the following: type of blank, machining process, order of operations, machinery, operation and sequence concentration, tools, fixtures, measurements, etc II.

2 Materials and Components

Out of many types of steel used for manufactring we have choosen plain carbon steel while designing and manufacturing as it is robust, cheaper than other steels and easily available.

i.

The fabrication System mounted on the base is made up of mild steel. ii.

For hard parts which are prone to inducing friction is made up of alloy steel grade EN-19 having high tensile strength, good ductility and shock resisting properties. iii.

Pins are made up of 20MnCr5 which are toughened and case hardened for smooth operation.

Jigs and Fixtures are made of variety of materials, some of which can be hardened to resist wear. Materials generally used: -

? High speed Steel: Cutting tools like drills, reamers and milling cutters.

? Carbon steels: Used for standard cutting tools.

? Non shrinking tool steels: High carbon or high chromium.

? Very little distortion during heat treatment. ? Used widely for fine, intricate press tools. ? Nickel chrome steels: Used for gears.

? High tensile steels: Used for fasteners like high tensile screws ? Mild steel: Used in most part of Jigs and Fixtures Cheapest material contains less than 0.3% carbon ? Cast Iron: Used for odd shapes to some machining and laborious fabrication ? CI usage requires a pattern for casting. ? Contains more than 2% carbon. ? Has self-lubricating properties.

Our finalized design is a product of the several different ideas and components originally created in the design phase. a) Manipulator:-In industrial ergonomics a manipulator is a lift assist device used to help workers lift, maneuver and place articles in process that are too heavy, too hot, too large or otherwise too difficult for a single worker to manually handle. As opposed to simply vertical lift assists (cranes, hoists, etc.) manipulators have the ability to reach in to tight spaces and remove workpieces. **??**) Brake Motor:-A Motor is a device that creates motion. It usually refers to an engine of some kind. It may also specifically refer to Electric motor, a machine that converts electricity into a mechanical motion. Brake motor consists of an induction motor coupled to a disk brake, forming an integrated compact and robust unit. The brake used is sturdy with few moving parts and minimum of maintenance. This type of motor is mainly used in applications requiring quick stop and positive action and stand still like conveyors, gear reducers, machine tools etc. The motor used in our project is 1.5 HP with a rotational speed of 0.5 rpm as per our application. f) PLC :-The main concept of this research is implementation of a control system, by using an intelligent device, which controls the fixture so that manipulation of job becomes easy.A Programmable Logic Controller, PLC, is an electronic device used for Automation of industrial processes, control of machines and automation of factory assembly lines implying that PLC is an industrial computer which has multi-purpose use in order to handle complex parts and processes safely [3]. Mostly, temporary support is not adopted, while in others it becomes essential to protect the crew and equipment from any side fall. When the entire assembly is turned by the manipulator, the rooftop is supported by these components so that welding operation can be carried out easily and safely.

3 DESIGN PROCEDURE

Before starting with the designing of the component there are rules which we followed which are:-1. Compare the cost of production of work with present tools with the expected cost of production, using the tool to be made and see that the cost of buildings is not in excess of expected gain.

4 Decide upon locating points and outline clamping

arrangement Make all clamping and binding devices as quick acting as possible 3. Make the jig fool proof Make some locating points adjustable Avoid complicated clamping arrangements 4. Round all corners 5. Provide handles wherever these will make handling easy 6. Provide abundant clearance 7. Provide holes on escapes for chips Locate clamps so that they will be in best position to resist the pressure of the cutting tool when at work 8. Place all clamps as nearly as possible opposite some bearing point of the work to avoid springing action Before using in the shop, test all jigs as soon as made The complete planning, design and documentation process for a fixture can be carried out systematically in 3 phases based on application which are design pre planning, fixture design, and design approval [4]. The steps considered during designing are as follows:-

? Analytical design for fixture.

5 Design Calculations a) Theoretical design calculation of duct

To calculate defleciton of duct having rectangular cross section when subjected to full loading condition :

6 a) Analytical design for fixture

It includes the design of base plate, base vblock, threaded block, supporting v-block, clamp, hexagonal bolt with washer, supporting pin.

7 b) 3D Modelling in SOLIDWORDS

It includes generation of 3D models of all part details of the fixture like base plate, blade, shim, spacer, bolts, riser, etc.

8 c) Fixture assembly

It includes assembly of all the parts of the fixture step by step. Various Processes and Machines used for our ComponentTherefore, F eff =(K a * K m * F t) / K v = (1.

? Gas cutting: -Oxy-fuel cutting is a process that uses fuel gases and oxygen to weld and cut metals, respectively. Pure oxygen, instead of air, is used to increase the flame temperature to allow localized melting of the workpiece material (e.g. steel) in a room environment. A common propane/air flame burns at about 2,000 °C (3,630 °F), a propane/oxygen flame burns at about 2,500 °C (4,530 °F), and an acetylene/oxygen flame burns at about 3,500 °C (6,330 °F). ? Arc welding: -Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. Each weld on any component is welded using a specific welding process with the aid of highly focused electrode shielding gas, largedegree of control the welder has over the heat intensity leads to production of very strong and consistent welds [6].

? Special purpose machine: -Special purpose machines are designed to perform some specific applications which cannot be carried out using conventional machines. In our company the SPM is of the company SCHARMANN is used mainly for job setting and machining the components using operations like sizing, drilling, rimming, boring, finishing etc.

9 Manufacturing Procedure

The actual manufacturing phase which plays a very important role is mainly classified into three categories:-

? Fabrication: Metal fabrication is the building of metal structures by cutting, bending, and assembling processes. This stage plays a very simple but a crucial role. Fabrication shops and machine shops have overlapping capabilities, but fabrication shops generally concentrate on metal preparation and assembly as described above. By comparison, machine shops also cut metal, but they are more concerned with the machining of parts on machine tools.

? Machining: Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled materialremoval process. The three principal machining processes are classified as turning, drilling and milling. Other operations falling into miscellaneous categories include shaping, planning, boring, broaching and sawing In minimum cost studies, it is found that when changes occur in a common variable (In this case it is operational speed), the change may modify other cost aspects of the problem in such a way that the combined problem effect produces a minimum value. Precision cutting and forming of sheet metal is utilised for manufacture of superstructures including drivers cab engine hoods, and compartments for housing electrical equipment. All activities connected with pipes like pickling, bending, cutting, forming and threading of pipes of various sizes are undertaken in another well-equipped work area.

All electrical equipment is assembled in the fabricated control compartments and driver's control stands are done in another work area.

The manufacturing process which we selected must be an economical balance of materials, manpower, product design, tooling and manpower, plant space, and many other equipment factors influencing cost and practicality. High Horse Power (HHP) under frame is fabricated using heavy fixtures, positioners to ensure down hand welding. VII.

10 Results

From the above design calculations the type of gear which we have chosen is spur gear because it has proportional Brinell hardness number, high power transmission efficiency, highly reliable and unlike belt drives have no slip condition.

From the above bending condition the design of duct is not suitable, so it is required to take a plain rectangular duct with square cross section in order to reduce the bending below 10mm. By changing the cross section the inertia will change leading to decrease in the deflection. Thus it is advisable to design a duct 100*100mm with 8mm thickness and 6mm chamfer.

Bearing selection also plays a very important role and based on our application it is highly recommended to select single row deep grove ball bearing as they can sustain some axial load in either direction as well as radial loads, and the two raceway cross-sections are simple circular arcs which can be very precisely finished so that the bearings have low friction and very little noise or vibration. Several different cage designs are available with different characteristics and the choice depends upon the individual application.

11 Acknowledgement

Inspiration and guidance are invaluable in every aspects of life, especially in the fields of academics, which we have receivedfrom our company. We would like to thank them as they are responsible for the complete presentation of our project and also for the endless contribution of time, effort valuable guidance and encouragement given by professor S.N.Shindeto project work.

12 IX.

13 Conclusion

Conclusion is drawn on the basis of the information collected on each aspect of our project. It leads to a belief that if applied will create an even better machine than we have designed. The process of conducting operations related to welding fixtures and positioners helps in gaining a deeper understanding as well as effective project process. From finding a resource for research material to design updates of the part causes the task of accurately prototyping the real design difficult. It is important that the design satisfies all of the functional requirements and design parameters which were outlined at the start of the project. In order to meet the requirements of the fixture customization is done by making the clamping system very practical for various sizes and geometries. By also knowing the material selection a cost benefit analysis could be conducted to determine how cost effective the product is.

Design data handbooks detail mechanical component design analysis with sufficient information provided regarding material specification, properties, requirements for design, etc. This facilitates designers to apply their exact requirements and choose from available resources. Also, verification with the design data books allows one to confirm that correct procedures are being followed. Similarly, the idea behind the preparation of a guide for fixturing as undertaken in this project is to develop a guide that [1]

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Figure 1: Figure 1 :

[1]

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Figure 2: Figure 2 :

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Figure 3: Figure 3 :

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Figure 4: Figure 4 :

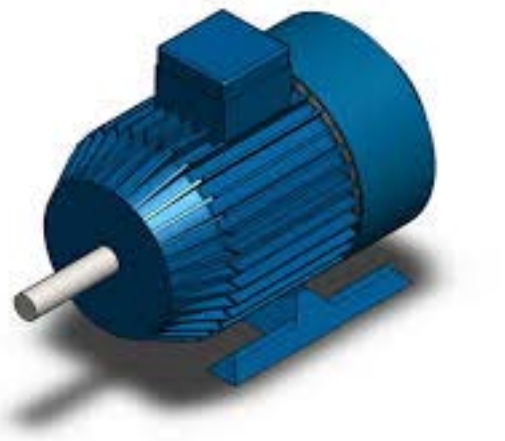

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Figure 5: Figure 5 :

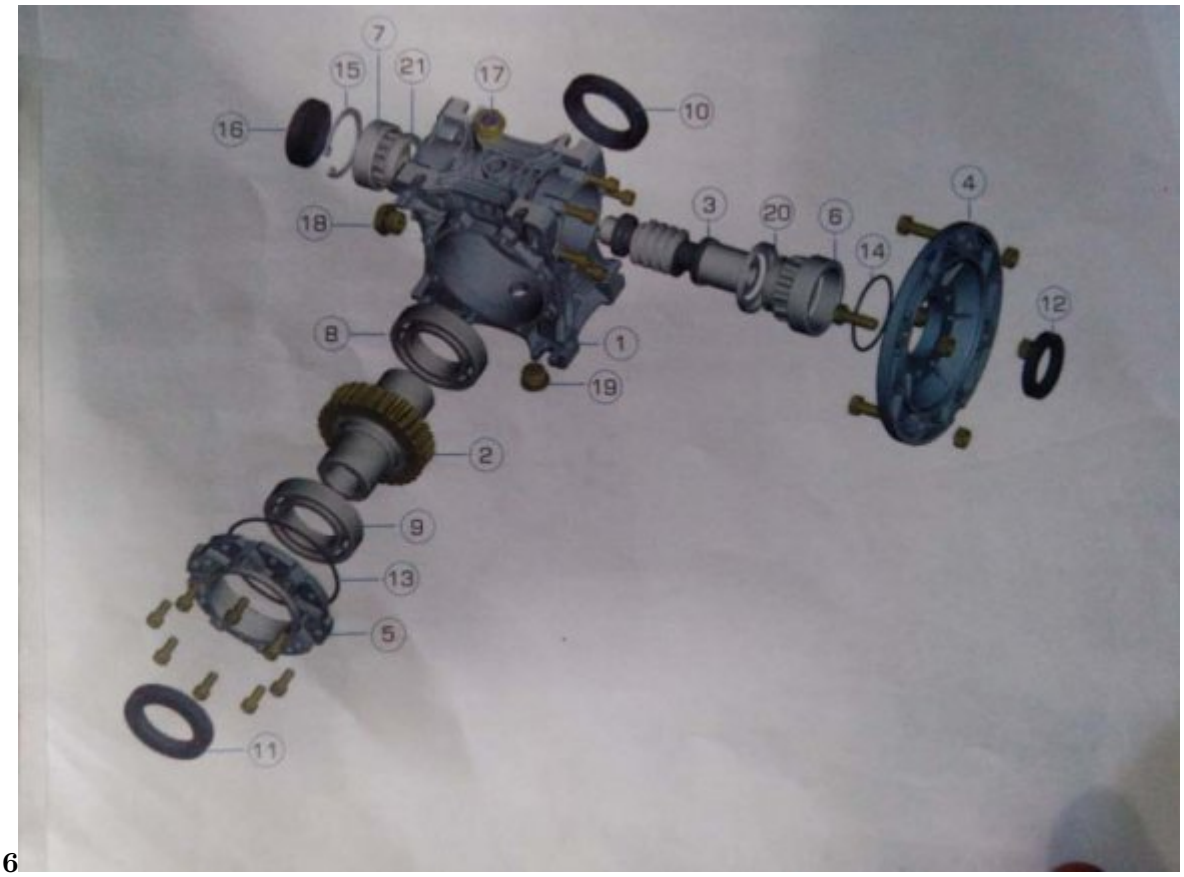

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Figure 6: Figure 6 :

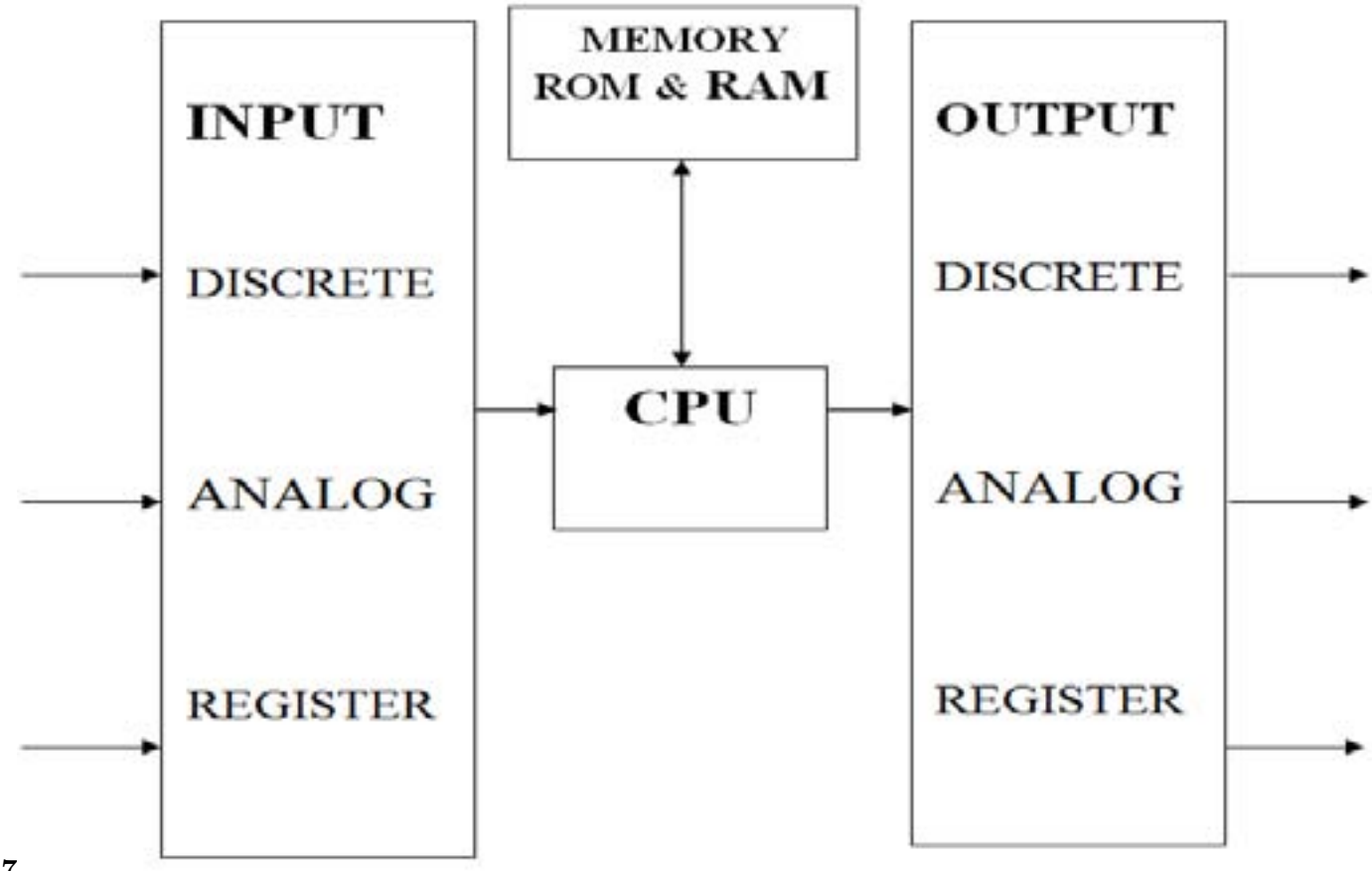

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Figure 7: Figure 7 :

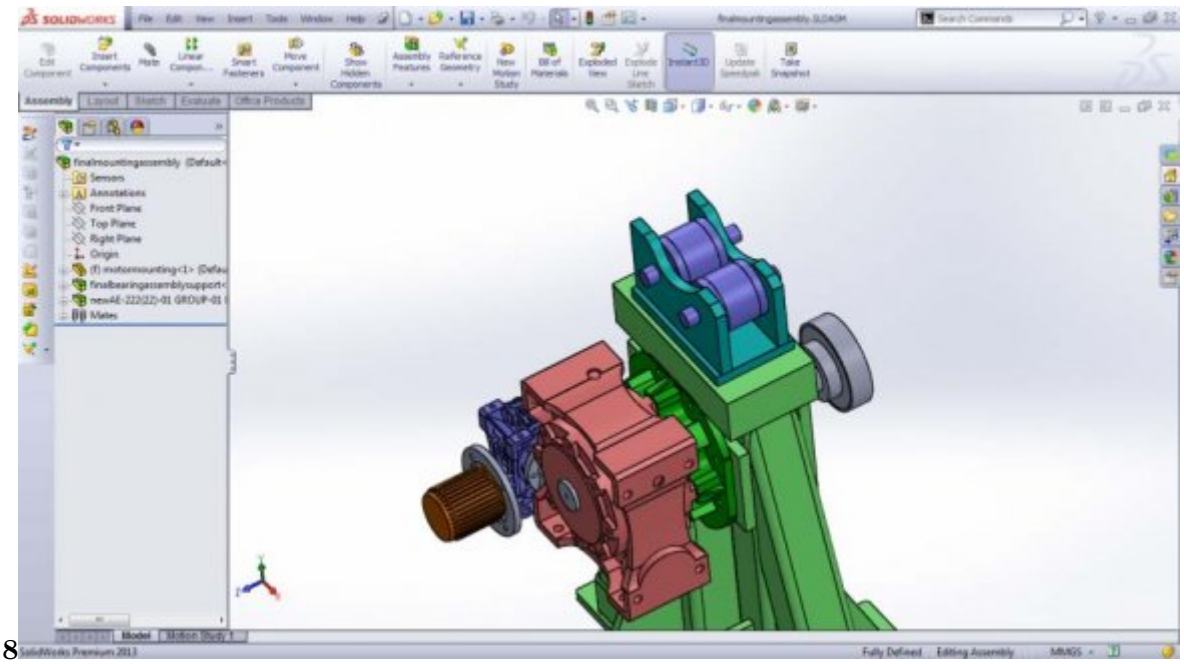

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Figure 8: Figure 8 :Fixture

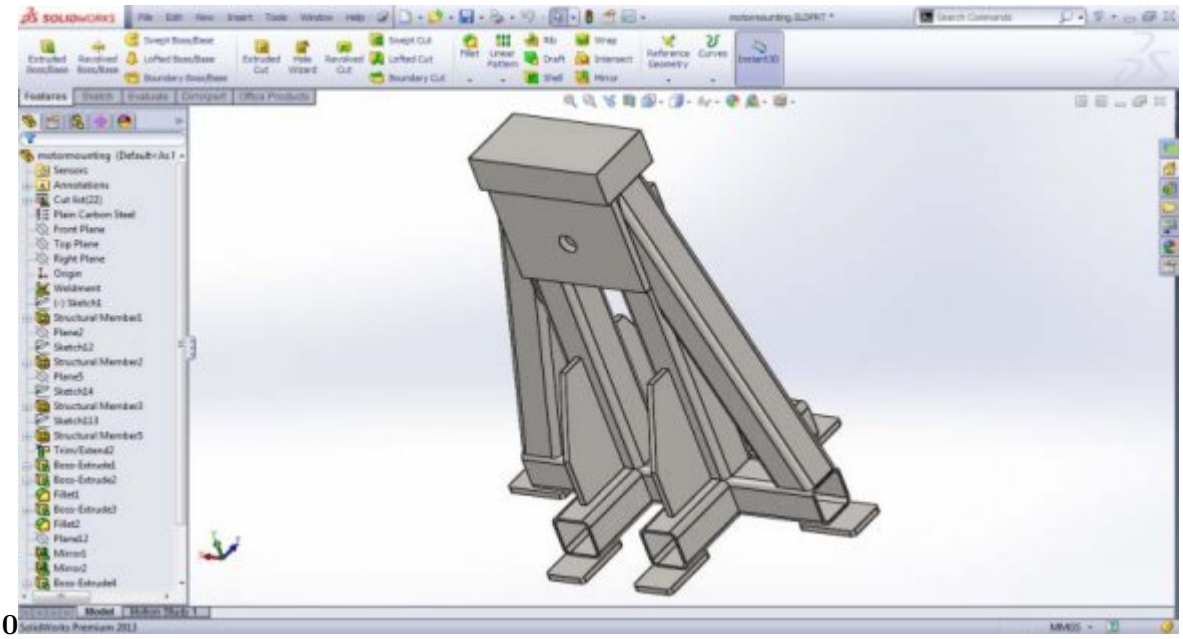

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Figure 9: Figure 10 :

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Figure 10: Figure 11 :

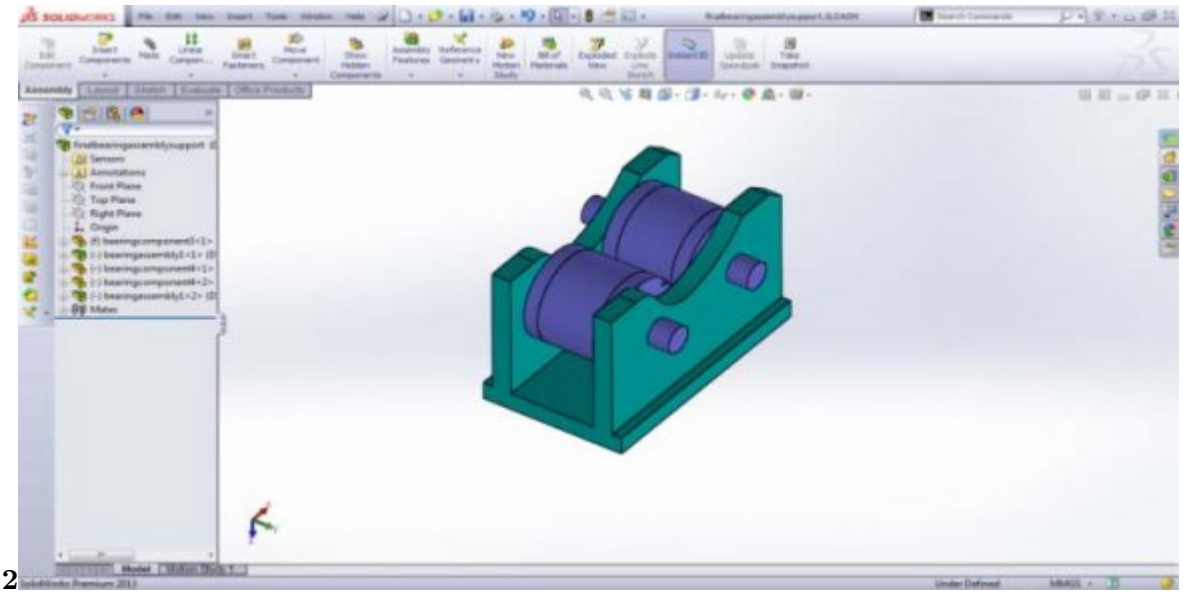

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Figure 11: Figure 12 :

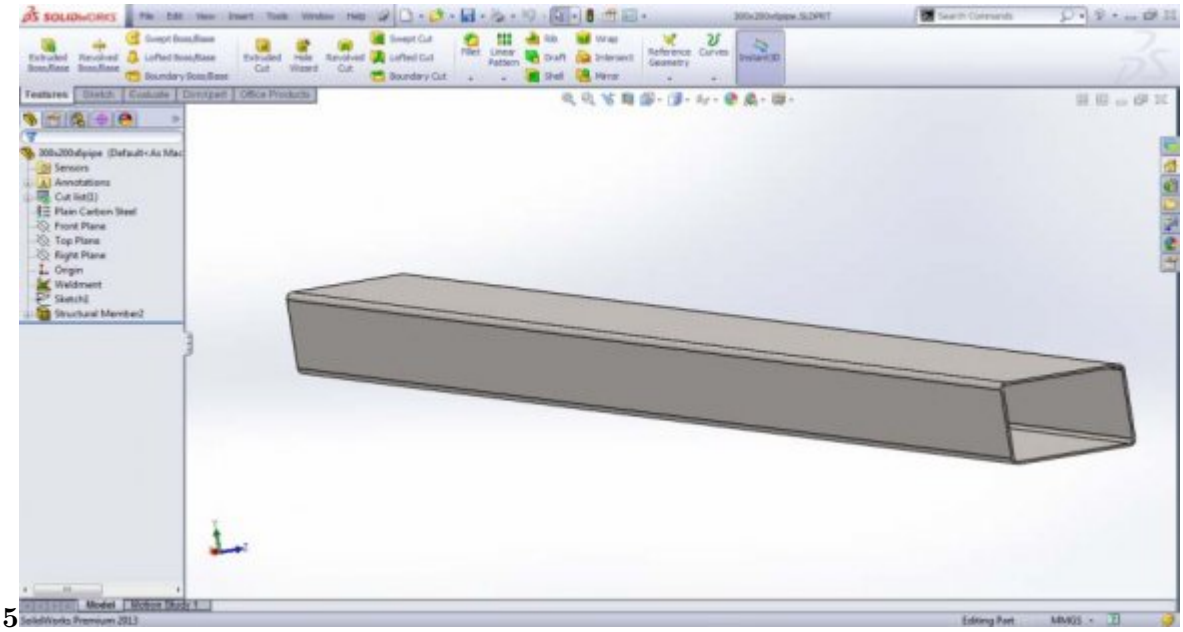

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Figure 12: Figure 14 :Figure 15 :

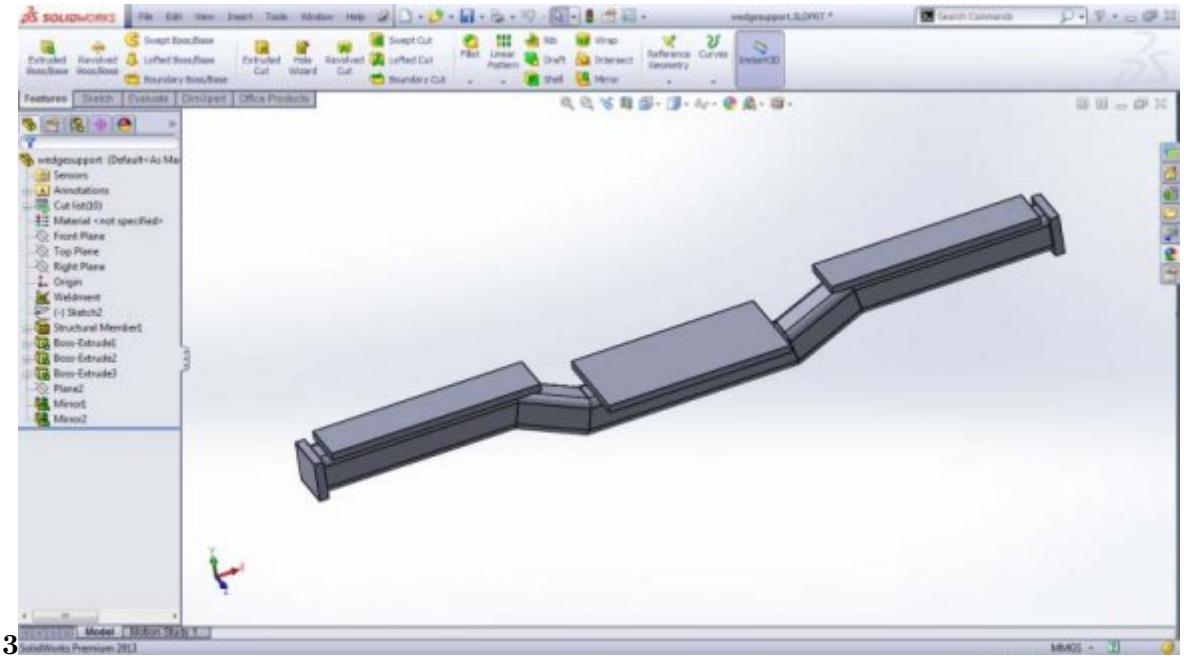

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Figure 13: ? 3 -?

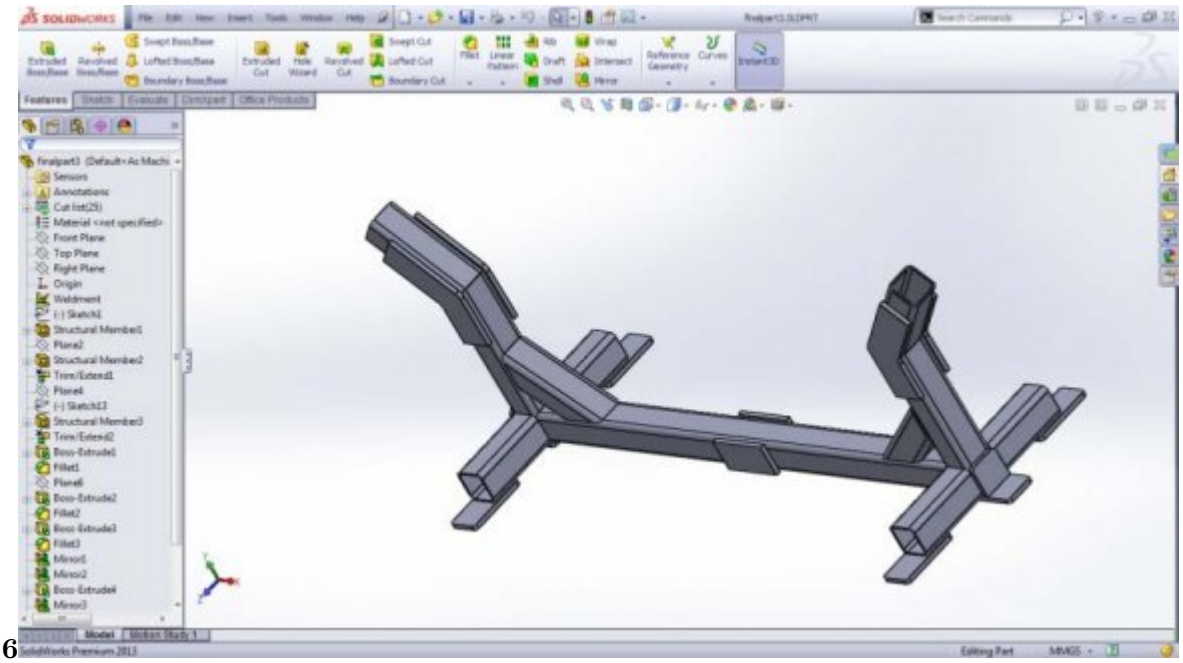

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Figure 14: Figure 16 :

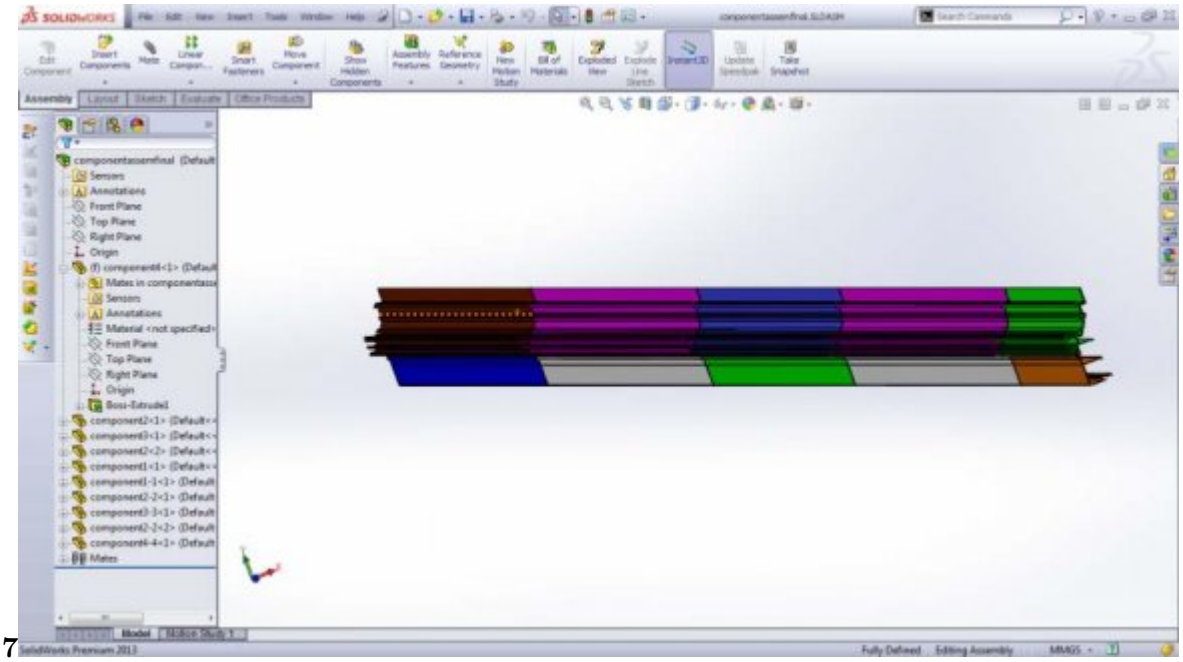

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Figure 15: Figure 17 :NowFixture

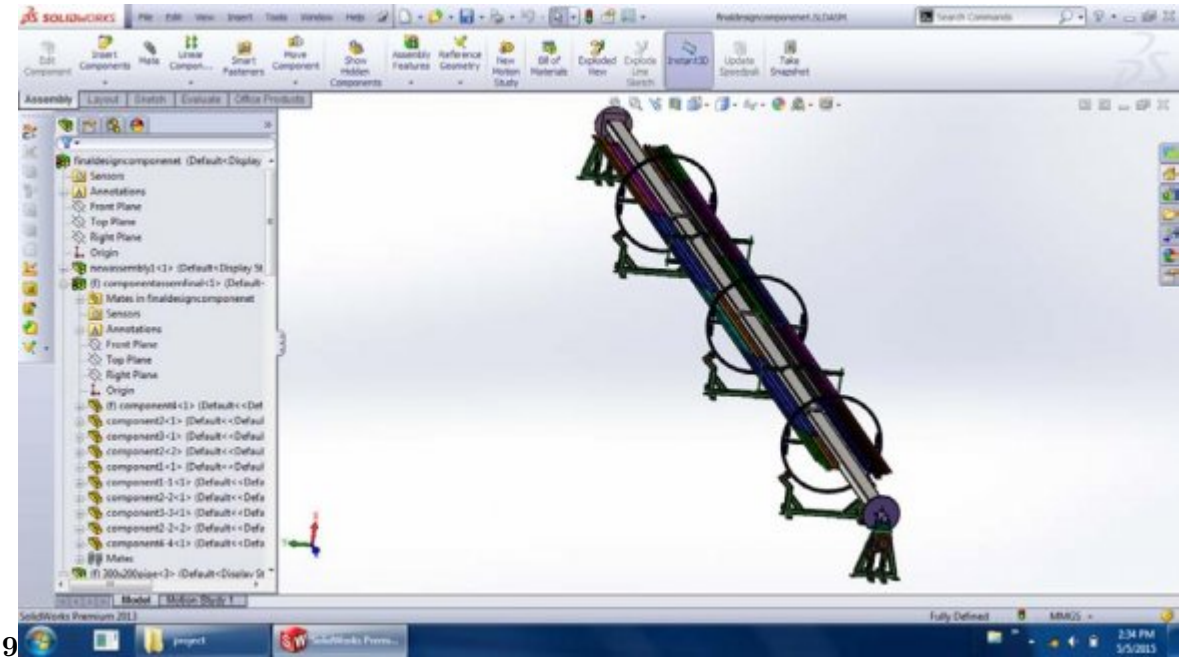

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Figure 16: Figure 19 :Fixture

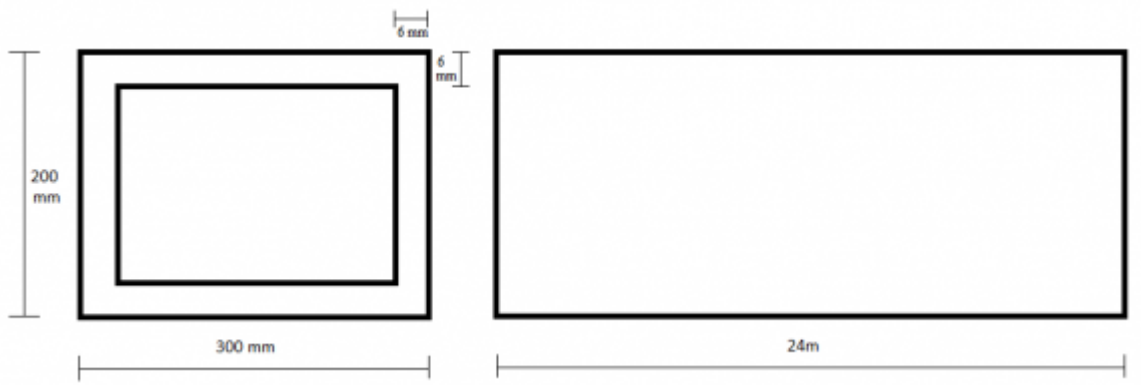

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Figure 17: Figure 21 :

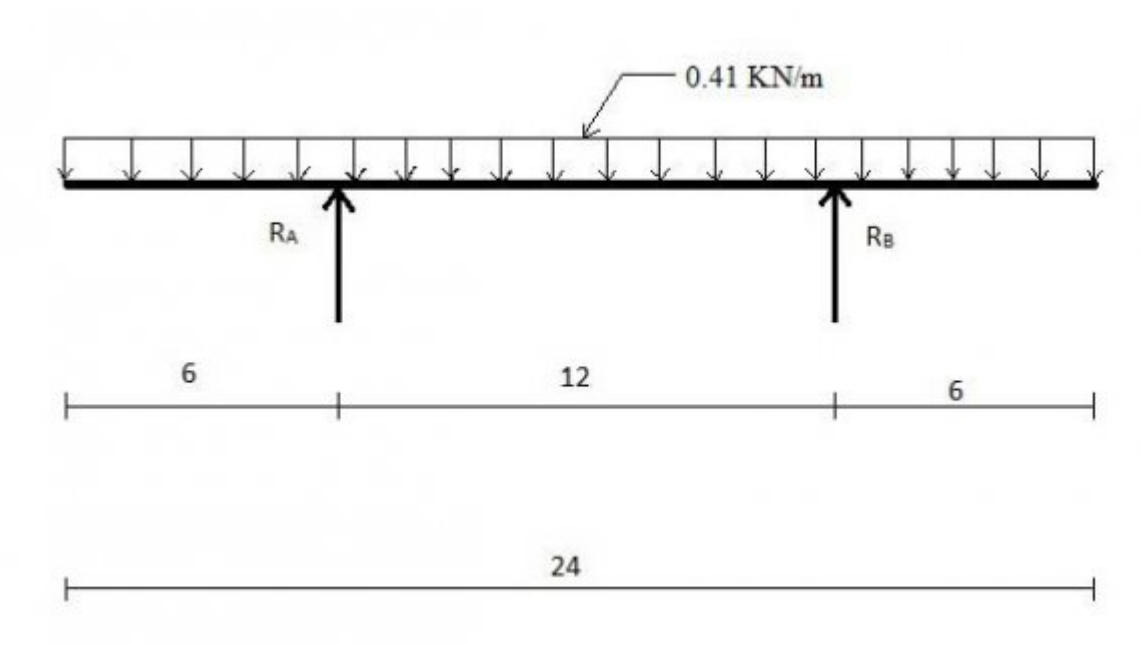

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Figure 18: Figure 22 :Fixture

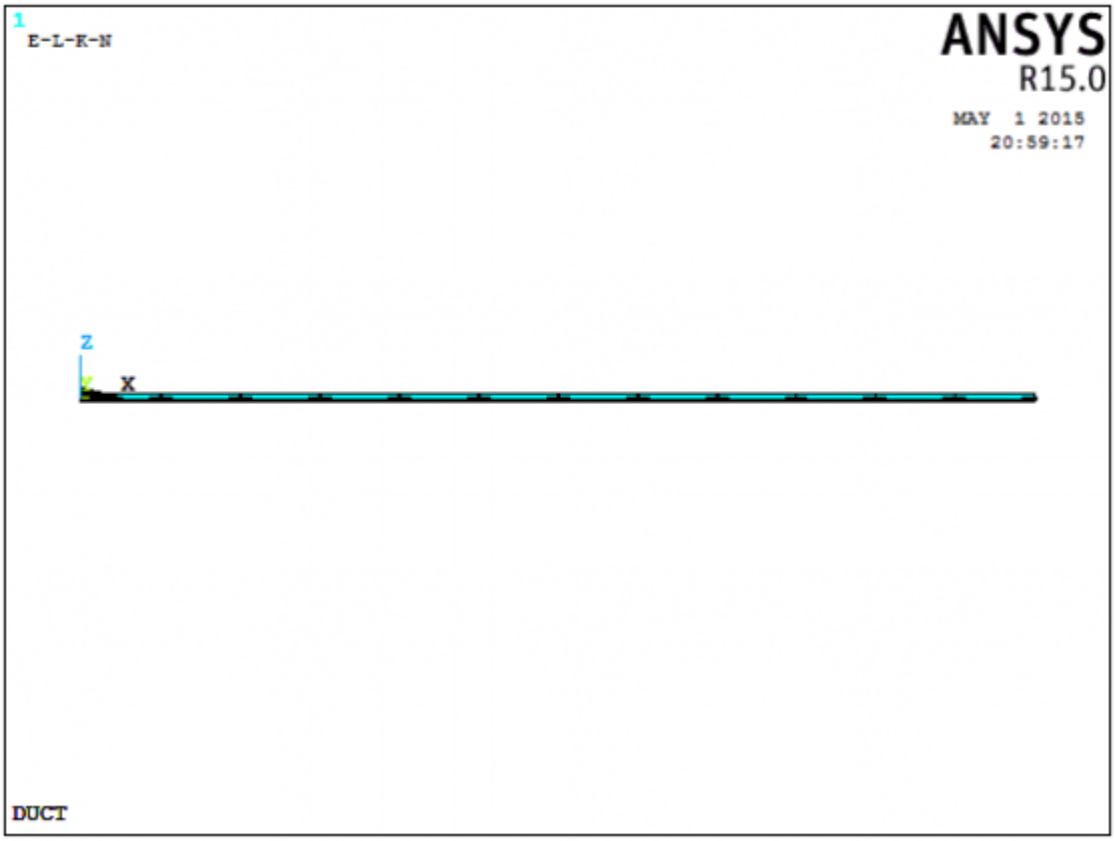

Figure 19: ?

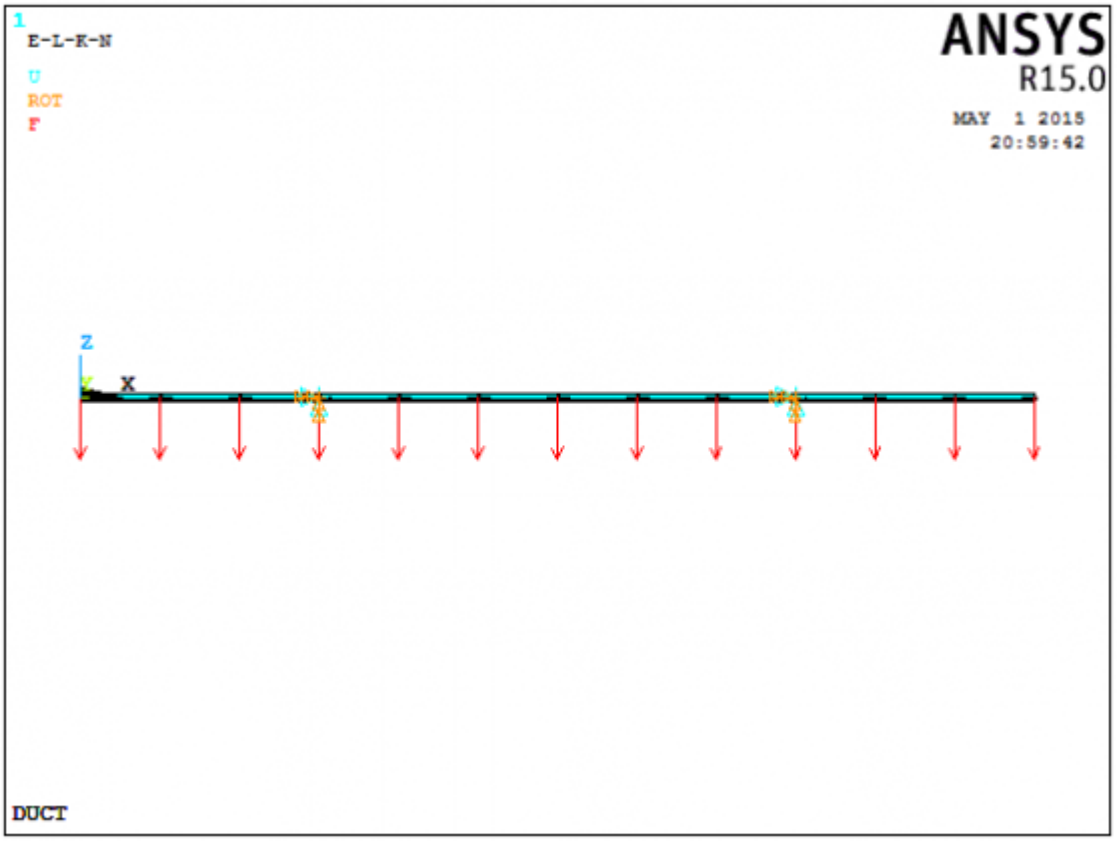

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Figure 20: Figure 26 :

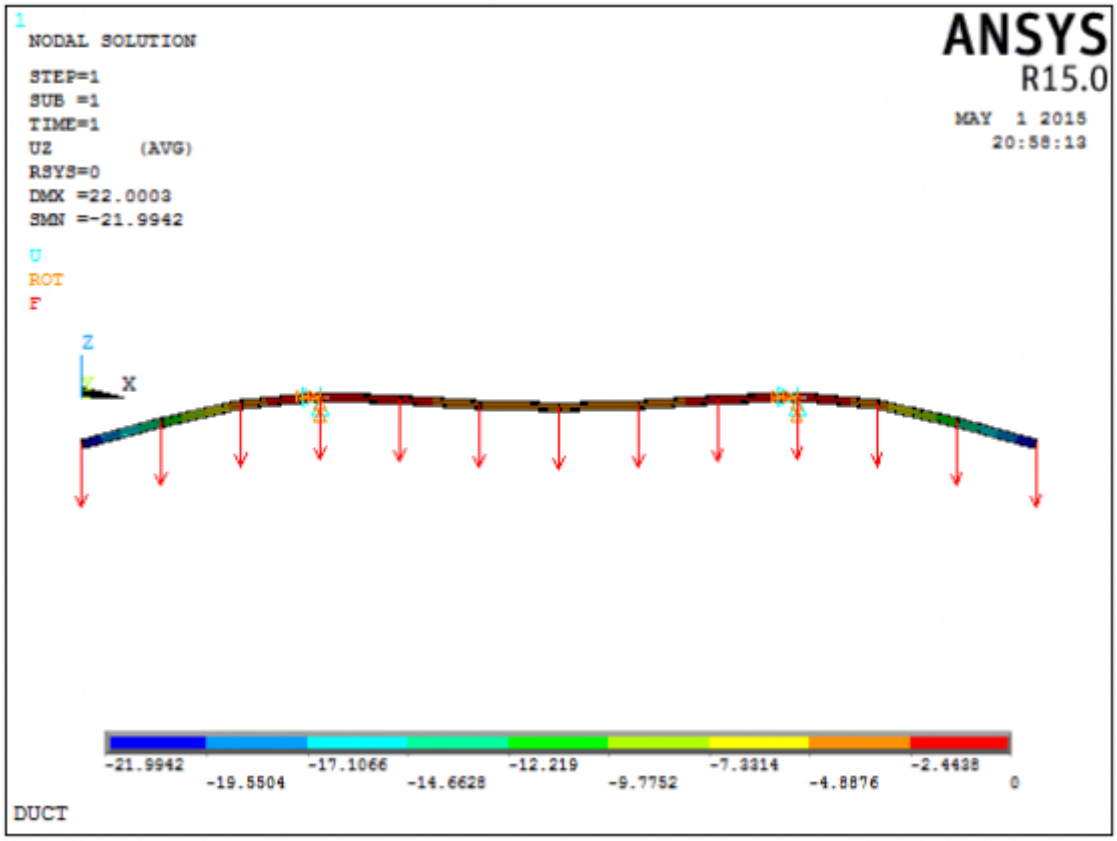

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Figure 21: 1 .Fixture

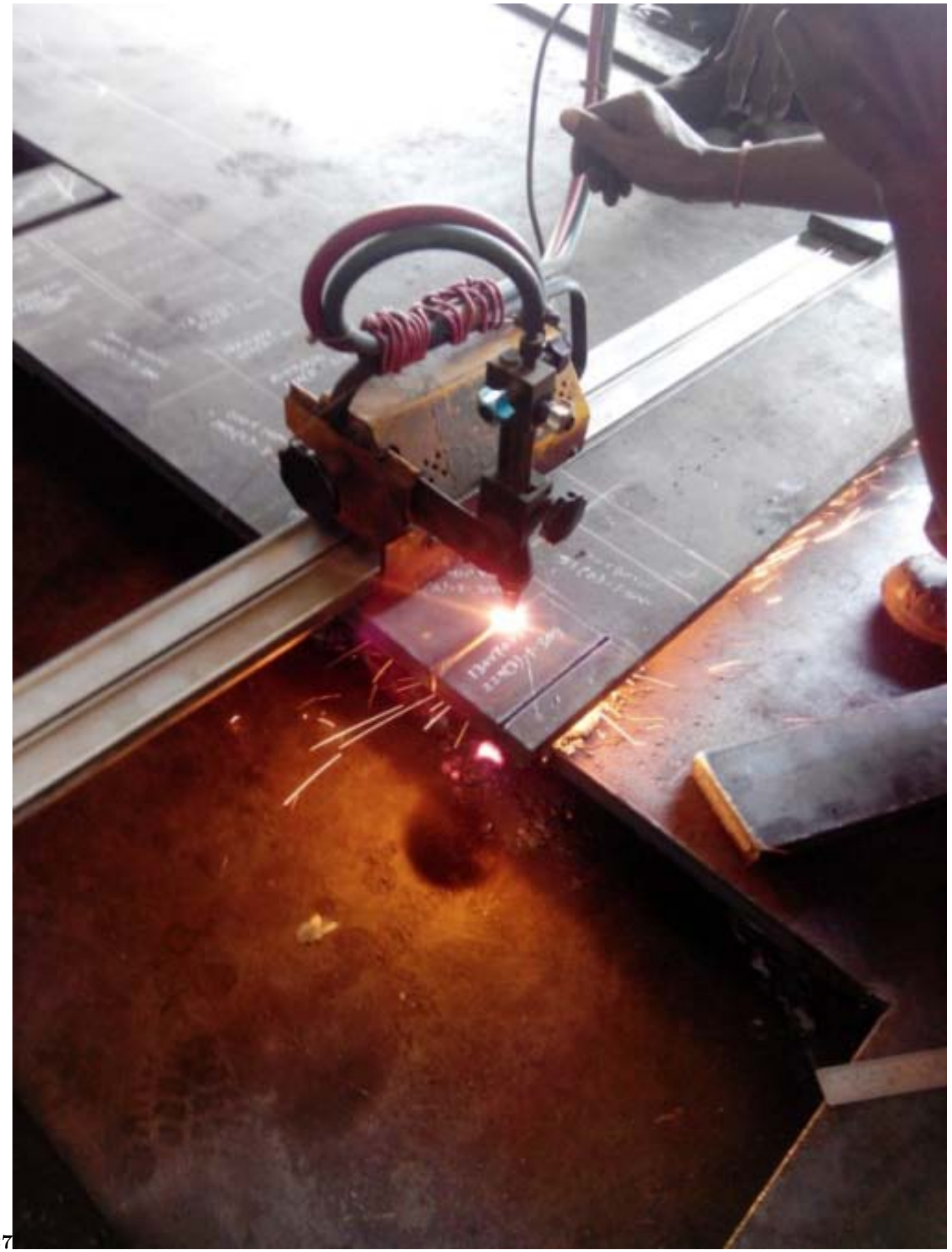

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Figure 22: Figure 27 :

Figure 23: Fixture


MITSUBISHI
HARTROL-M500
0 4
G00 G90 G54 G17 G40 G80 G60 ;
Z200.0 G54 ;
M03 S0150 ;
/ G51.1 X0 ;
G98 G85 X0.0 Y-300.0 Z-17.5 Q4.0 R4.0
F50 ;
(D10H8) ;
X-737.2 Y-545.6 ;
X-397.2 Y-228.6 ;
X469.6 ;
X809.6 Y-545.6 ;
/ M98 P40 ;
;
G00 G90 ;
Z200.0 ;
M30 ;
%
mm ABS G40 G54
MEMORY
SEARCH
PROGRAM
LARGE
FILE

Figure 24:

.1 Global

could be used as a ready reference while designing jigs and fixtures. This project represents the first phase of designing a comprehensive roadmap for fixture design, to assist Tinker Engineers, designers and shop supervisors alike, as well as sub-contractors.

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