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# BODY IN WHITE FIXTURE DESIGN

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**Abstract--** In automobile industry, automobile welding fixture is a component which is important to auxiliary welding. The automobile body is welded by multiple complex sheet metal parts and other auxiliary work pieces. In this process, supporting role of welding fixture is an important role. In manufacturing of car, Truck, welding fixture was designed and analyzed briefly. The design of fixture demands extensive use of heuristic knowledge, which is also coupled. For instance, when define the machining operations of manufacturing parts in assembling of fixture solution should be kept in mind and vice versa. Fixture designers have a skill and experience for several years, in achieving proper fixture designs. In the Automobile Industry, BIW (Body In White) is the common terminology used to mention the car sheet metal welded structure (body shell). Sub-assemblies like Floor body, Body side, Left Hand Side/ Right Hand Side, Front End, Roof etc. gets welded together by various metal joining process e.g. resistance spot welding. The welding fixtures are holding devices of assemblies of Car body they have different operations (reverting, welding, and stud) of geometric of car body structure.
**Keyword:** Welding Fixture; Welding Technique; Uses of software in design of fixture Catia; Fides; Unigraphics;

## I. INTRODUCTION

The fixture is a special tool for holding a work piece in proper position during manufacturing operation. For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process are eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize workpieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a workpiece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts in existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine Operation as well as process function ability.



 

The body of a vehicle is made up of several hundreds of stamped components which are joined together by spot welding process, accurate production of the car body (BIW) is essential if the automated assembly line is to fit !arts within the required tolerance, therefore we use the welding fixture.
1-Design a welding fixture is a complex process including
2-Production Process of body in white clamping plan
We can use a number of fixture unit types in welding fixture design, based on clamping plan for more detailed information on how to create a b/w welding fixture and then 3d modeling of it and design detailing it

## II- FIXTURE DESIGN PROCESS

### 2.1- Process Planning

**Design Includes: -**

- Panel Build
- Location & Clamp plan
- Weld spot distribution
- Weld guns selection
- Cycle time study
- Ergonomic Study

### 2.2-Concept design-

**Design Includes: -**

- Pre Production Tooling
- Production Tooling
- Checking Fixture Tooling
- Material Handling End effectors
- All Types of BIW Tooling
- All Types of BIW Tooling

### 2.3-Manufacturing Drawing and Bill of Material-

**Design Includes:-**

- Manufacturing Drawings
- Bill Of Materials (BOM)
- Assembling Drawing
- Flame cut Drawings

## III- PROCEDURE TO DESIGN BIW WELDING FIXTURE

The car body is manufactured in segments like Front under body (engine room), Rear UB, and Main floor - Join and form **under body, Chassis** frame, **Side body R/L**, **Roof**, **doors**- closures etc. All these parts are then assembled / joined together to form a complete body structure- **Body shell**. At the end of the framing line, the body receives the doors, bonnet, tailgate, which have been built separately.

### How to learn BIW design

You should know the basic process of Weld shop, Weld equipment's for BIW design and below detail for Fixture concept design
3.1, Fixture Concept Study
3.2, Process considerations
3.3, Usage of Standard components
3.4, Clamping and supporting arrangement
3.5, Locating Arrangement
3.6, Maintaining X, Y, & Z co-ordinates of locating points/Clamping points
3.7, Ease of loading & unloading.
3.8, Preparing Manufacturing Drawing (Detailing)
3.9, Fixture Design**: -** Input Data

i) Panel Data: CAD Models of the panels
ii) Sequence of assembly
iii) Clamping Plan
iv) Sections
v) Cycle time
vi) Base Plate

The information like how many panels to be welded, where the panel is to be clamped, supported and located, what is the cycle time, what is the sequence of loading & unloading is derived out of the above data



 

## IV-FIXTURE DESIGN FOR ASSEMBLY

Before starting the design of welding fixture is to arrive at the spot weld locations. The location and orientation of other critical units of the fixture including clamps, locators etc.They are decided based on the weld spot distribution. The weld spots for panel - side bracket assembly are located with respect to the body line of car. These weld point give in form of coordinate (X,Y,Z) .

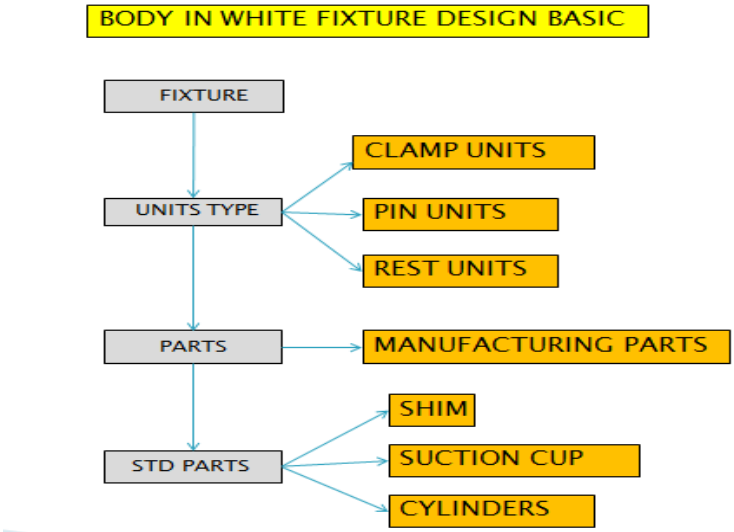


Figure: 4.1 Basic fixture Design of BIW

### 4.1 CLAMP UNIT

Toggle clamps hold the car part firmly and prevent the part from distortion while carrying out the spot welding operation. A single clamping unit consists of the following parts:

1. Finger: Finger is a movable part which is used to hold the Car part from top against the Back-up and they are usually mounted on the clamp arm.
2. L-Block: L - Shaped blocks (single or in combination) used to mount the finger to clamp arm, besides allowing adjustment for locator pin in two directions.
3. Shim and spacer: They allow the finger to be moved to the correct XYZ locating and / or allow the customer to make adjustments to improve the quality of their product.
4. Blade: Part onto which the aforesaid elements are attached to.
5. Blade spacer: It allows the finger to be moved to the correct location along one direction.
6. Riser: L- shaped tall block with regularly patterned holes to attach the above mentioned parts in modular way Blade space.

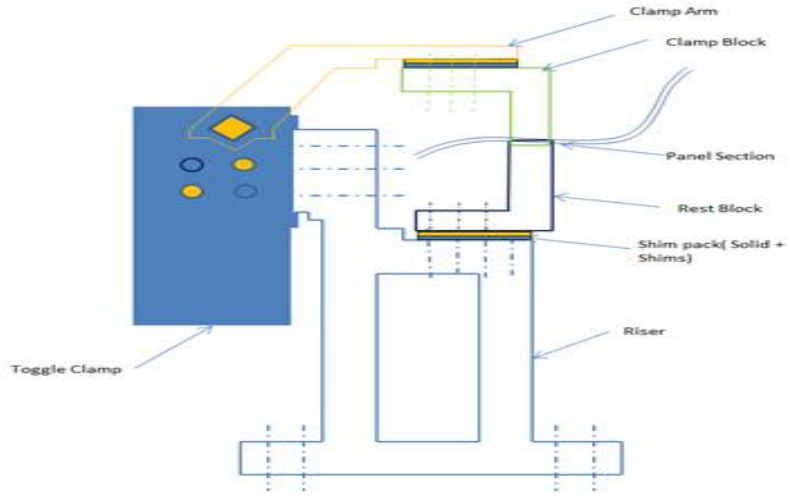


Figure: 4.2 Clamp Unit

1. Study the PLP (Principle Location Points) data along with the nearby spot data.
2. Depending on the angle of cross section. Mylars will be having shimming either in one direction or in 2 directions. General Thumb rule if the section is inclined more than 15deg or clamping surface is 3D profile then 2 direction shimming are provided.



 

3. Take an overview of the working height if you're having manual welding. For robotic welding also it's important to see the working height in consideration of the robotic gun, turn table height if manual loading is done.
4. Put the proper gun at the spot location. If process engineer has gun shape stick to X, C or Y type of gun. Do the proper gun study and place the gun as per the GEO or re-spot decision and operator approach. Once basic gun is placed considering the throat depth and throat gap start building the clamp and rest block at the PLP.
5. Panel section creation: Take a section at PLP either in clamp opening direction or normal direction .Sections should be normal to base. Panel section through X, Y or Z direction passing through PLP. Section will help in finalizing the shape of clamp and rest block. Most importantly used for finalization of gun shape.
6. Finalization of a base plate plane – consider following things before deciding the base plate. Height of maximum and minimum weld spot from the floor. No gun arm should touch the base plate. Operator ergonomic while accessing all the spots.
7. Construction of Rest and Clamp Block: If standard Mylar has to be used (Few companies make standard height and length of steel blank with few holes and dowels for clamping) then select the proper blank size as per the requirement; consider 5 mm above the panel.
8. Select the clamping cylinder as per the pivot point distance from the PLP. You may choose various cylinder 50 ◦, 63◦, 80 ◦as per the requirement (distance of clamp arm from the PLP and no of clamping mounted on each cylinder. Once clamp and rest block is build, start construction of mounting plate or fabrication structure as per the company standard to make the connection with the base plate. shimming is 5mm solid +5mm shim pack, In few companies 3mm shims are used. Make connection plate between rise and Mylar. Material can be C45, Teflon, Aluminum or S-Grun as per the customer requirement. Generally S-Grun mylars are made of more thickness.

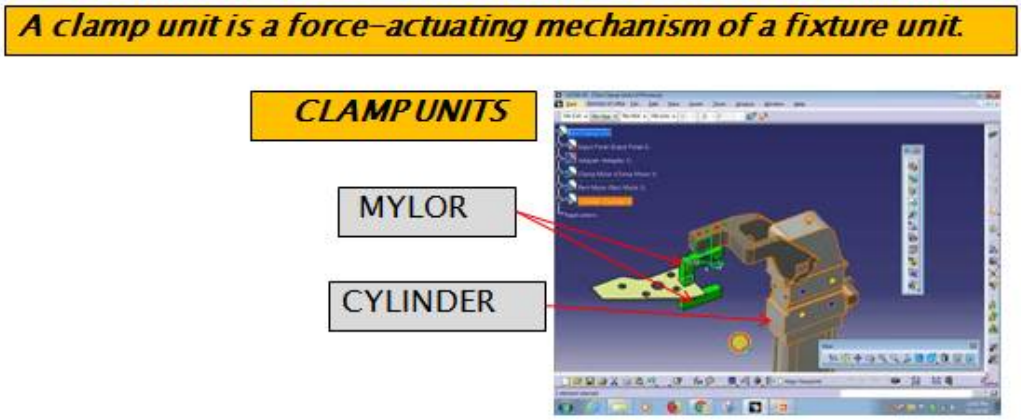


Figure: 4.3 Clamp Units

### 4.2 LOCATING UNIT

Rough locators are elements that aid the operator to guide the car panels while loading onto the fixture and ensure a fool-proof assembly. the locating pins are used to loc' a body part in a position sufficiently accurate to execute a welding process. The body part is constrained by a set of appropriately locating pin so total constraint by locating pin should be fully constrained at all times to prevent any movement. (Usually two locating pins are enough to properly locate the body part on one plane. one of the pins is round, and another one is diamond shaped. This configuration will allow easier loading of body part. The end of each pin has a round or conical shape or is chamfered for the purpose of maintaining work ability such as ease of loading prevention of damage. The taper lead angle is large, 60 degrees or less, for small-size body parts and manual operation. The difference between the locate hole in the panel or body part and the locating pin diameter should be -.05 mm and a tolerance for locating pin should be 0, +.05mm. The dimension from the panel to the locating pin leading end 2straight area3 should be 1 mm. pins are available in numerous shapes and sizes in a design. There are two configurations for position of locating pin: i) keep two dowel pins for positioning as far apart from each other as possible ii) Set the dowel pins in symmetrical positions .

One of the principal purposes of a locating surface is to locate and support the panel surfaces for performing a welding process. This is usually done with the datum surfaces that are reference for locating surface. The dimensions of datum surface are decided by selecting a necessary cross-section from the part drawing. The shape of locating surface is a form of cross-section of panel. Locating surface is configured to receive panel for setting in a correct position and locating a body part from any surface such as flat, curved, or have an irregular contour. In most applications, locating surface devices locate a panel by its external flat surfaces and flat area, such as% edges, flanges, steps, faces, shoulders, and slots



 

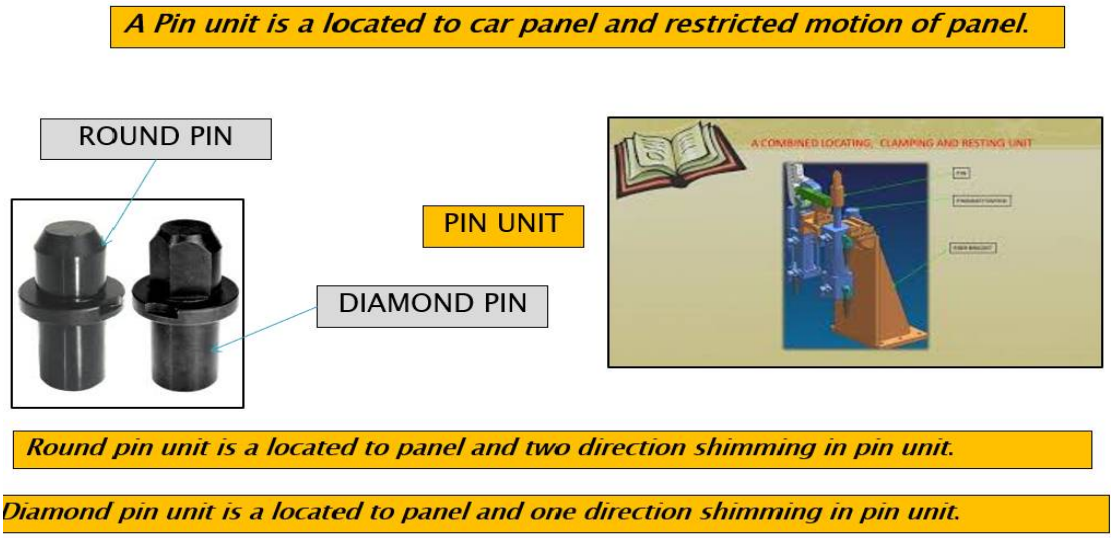


Figure: 4.4 Pin Units

### 4.3 Rest Unit

These units are used to rest the panel. Take an overview of the working height if you're having manual welding. For robotic welding also it's important to see the working height in consideration of the robotic gun, turn table height if manual loading is done. Put the proper gun at the spot location for all the spots near the rest unit. If process engineer has gun shape stick to X, C or Y type of gun. Do the proper gun study and place the gun as per the GEO or re-spot decision and operator approach. Once basic gun is placed considering the throat depth and throat gap start building the clamp and rest block at the PLP.

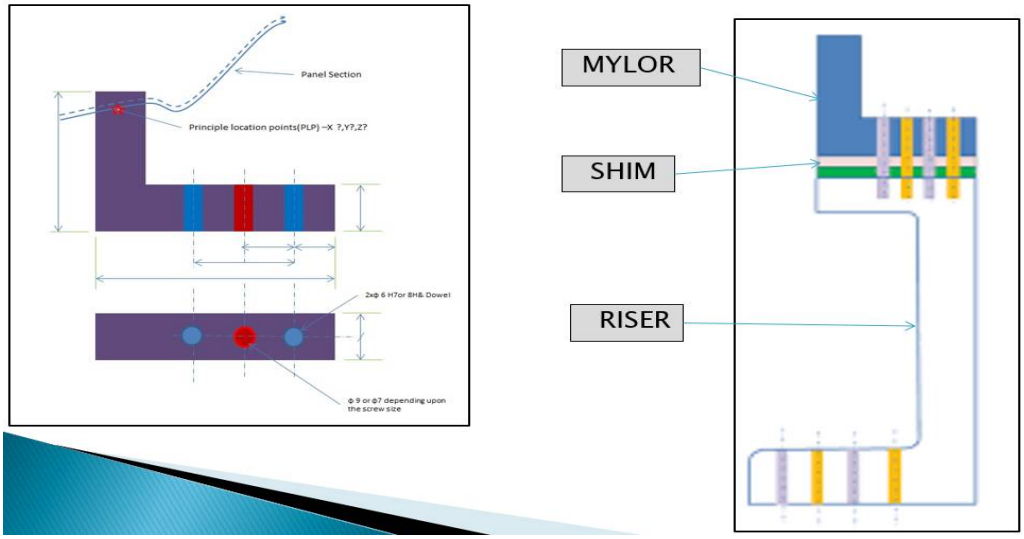


Figure: 4.5 Rest Units

Panel section creation: Take a section at PLP either in clamp opening direction or normal direction. Sections should be normal to base. Panel section through X, Y or Z direction passing through PLP. Section will help in finalizing the shape of clamp and rest block. Most importantly used for finalization of gun shape. Finalization of a base plate plane – consider following things before deciding the base plate. Height of maximum and minimum weld spot from the floor. No gun arm should touch the base plate.

Operator ergonomic while accessing all the spots. Construction of Rest Block: If standard Mylar has to be used (Few companies make standard height and length of steel blank with few holes and dowels for clamping) then select the proper blank size as per the requirement; consider 5 mm above the panel. As per your company or OEM, Tier 1 standard use the different standards mounting risers. Do not forgot to add the 5mm shim. If you are combining rough locator or part sensor bracket along with the rest unit. Take necessary care means distance of rough locator from panel. In the process of manufacturing we use Steel Aluminum, S-grun, and Plastics. And hardening is necessary in manufacturing Mylar and Pin.



 

## V- IMAGES OF DESIGN USED IN MANUFACTURING DRAWING

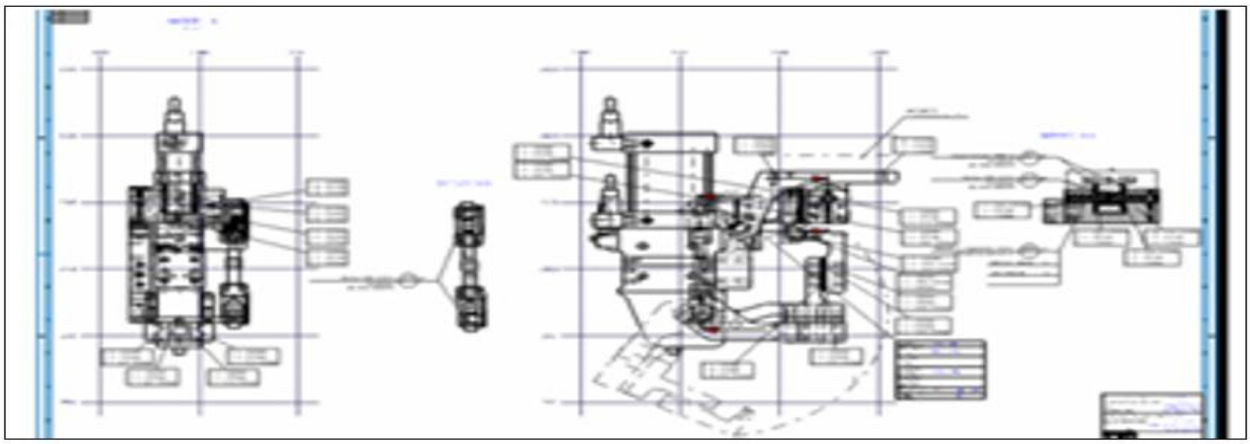

Figure: 5.1

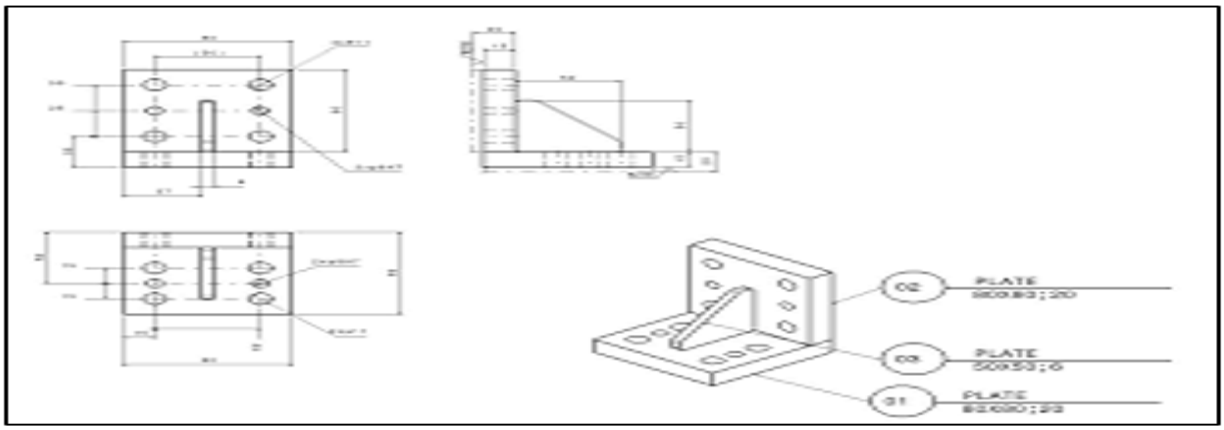

Figure: 5.2

## VI. CONCLUSION

The automotive industries are shifting from manual process to automatic and robotic manufacturing process. Using this concept; improve in quality of product, enhance efficiency of plant, reduce in rework and scrap cost. Utilization of same components when there will be change in product. Thus, from the presented work it can be concluded that, for better design, use of standard components is advisable so that tooling requirement of assembly is less. For eliminating finishing operation pre finished material is used. For ease of assembly keep liberal tolerances for the fixture components. Different type of profile of part is used in fixture design such as C shape I shape L shape and U shape. The fine machining in manufacturing part is from 2 to 5mm and some of the part profiles are made from through the flame cut, water cut, laser cut, these cut depend on the thickness of the parts. All these units mounting on base plate and maintain the working height (700-900 mm) of fixture to ground level.

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