



Design of brake pedal assembly welding fixture

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Abstract

This paper deals with the design of welding fixture for the brake pedal assembly of Auto rickshaw. The brake pedal welding fixture consist of five parts namely brake pedal, Bush, brake pedal stopper, bracket, washer, that have to welded each other with the specified tolerance and welding quality with minimum time requirement and with minimum forces act. The material used in the manufacture of different parts of brake pedal welding fixture assembly is mild steel. Which is one of the most useful material in automobile and production industries. We have modified brake pedal welding fixture because to reduce the work handling time and good quality of welding. All the parts of brake pedal welding fixtures carried out or modeling with the help of CATIA V5 and ANSYS SOFTWARE. There are lots of types of manual welding fixture using in different types of Companies.

Keywords: fixture, welding fixture, CATIA V5, FEA, analysis, design, auto rickshaw, brake pedal, assembly

Introduction

Fixtures are tools that are used to hold a work piece in place while it undergoes a machining or assembly process. Fixtures are used to ensure high quality and low variability in parts. Fixtures can be used in low or high volume fabrication operations. Originally the vast majority of fixtures was dedicated fixtures since they were only created for one work piece. These fixtures have many benefits due to the high rigidity and the high tolerances that could be achieved but they are also very costly. With the advent of flexible manufacturing systems, setups that are able to change depending on the type of product required to be created, and fixtures that are able to adapt to the changes are the most desirable 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 is 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 work pieces 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 work piece, whereas clamps exert clamping forces so that the work piece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design.

Principle of Fixture

Fixtures are tools that are used to hold a work piece at a place while it undergoes a machining or assembly process.

Requirement of Fixture

The fixture is a special tool for holding a work piece in proper

position during manufacturing operation Fixtures are used to ensure high quality and low variability in parts.

Problem Statement

It is required while assembly part of brake pedal, bush, and brake pedal bracket, stopper bracket, bracket for brake pedal, washer. With minimum time requirement and with minimum forces. It also required proper alignment, proper location, proper clamping while assembly.

Objectives

- To design and develop the welding fixture are brake pedal assembly.
- To minimize time required for the assembling the brake pedal component.
- To minimize efforts required for the assembly.
- To increase the accuracy and productivity.
- To minimize product cycle time.

Methodology

The design of the welding fixture for brake pedal assembly is carried out as per the given in table design the fixture In this table, the initial step starts with the material information and machine specifications geometric dimensions and tolerances required to be achieved on the component, and different parts of the brake pedal sub-assembly and their cad drawings which are modeled using the software AUTO CAD and CATIA V5 Before the design of the welding fixture the fixture requirements have to be considered.

Scope

If proper welding is not done it will directly affect the strength of the component Fixture is the manufacturing tool that is employed to reduce interchangeable and identical components.

It reduces or sometimes eliminates the efforts of marking, measuring and setting of work piece on a machine and maintains the accuracy of performance. Increase in productivity and maintain product quality consistently.

Fixture Design

Mass production aims at high productivity to reduce unit cost and interchangeability to facilitate easy assembly. This necessitates production devices to increase the rate of manufacturing and inspection devices to speedup inspection procedure. Generally, all the jigs and fixtures consist of following.

- A. Locating Elements:** These position the work piece accurately with to the tool guiding or setting elements in the fixture.
- B. Clamping Elements:** These hold the work-piece securely in the located position during operation.
- C. Tool Guiding Elements:** These aid guiding or setting of the tools in correct position with respect to the work-piece. Drill bushes guide the drills accurately to the work-piece. Milling fixtures use setting pieces for correct positioning of milling cutters with respect to the work-piece.

Every part has 6 degrees of Freedom (3 Linear + 3 Rotary) which need to be arrested to ensure proper location of the part in space. Fig. 1 shows the locating principles. The Location Principle used to achieve this is called the 3-2-1 Principle.

3-2-1 Principle

- 1. Stands for:** Minimum 3 Rests with clamps to establish a part plane thus restricting 1 Up-Down motion + 2 Rotary motions.
- 2. Stands for:** A Round locating pin in a round hole that restricts motion in the 2 directions in the established plane.
- 3. Stands for:** A Round locating pin in a slot that restricts the rotary motion in the established plane about the Fixtures are made from a variety of materials, some of which can be hardened to resist wear.

Design calculation

1. Base plate area

Formula: $A = L*B$

Where, L = length of plate (mm)

B = width of plate (mm)

$$A = 300*260$$

$$= 78000 \text{ mm}^2$$

Cosidering force 500 to 1000N.

2. Bush for brake pedal

2.1 Surface area of bush (base)

$$\text{Base area} = \pi(R^2-r^2)*h$$

$$A = \pi(10^2-7^2)*60$$

$$= 9608.4 \text{ mm}^2$$

2.2 Total surface area of bush

$$= 2\pi(R+r)*(Rr+h)$$

$$= 2*3.14*(10+7)*(10*7+60)$$

$$= 6725.88\text{mm}^2$$

2.3 Locating pin

Length of pin = 45mm

Inner dia. = 10mm

Outer dia. = 17.5mm

$$A = 151.66\text{mm}^2$$

$$B = 314\text{mm}$$

$$d = 13.9\text{mm}$$

2.4 Width of clamp

$$W = 2.3d+1.5748$$

$$= 2.3*13.9+1.5748$$

$$W = 33.54\text{mm}.$$

2.5 Thickness of clamp

$$t = (0.85da(1-(a/b)))^{0.5}$$

$$= (0.85*13.9*151.66*(1-(151.66/314)))^{0.5}$$

$$t = 42.32\text{mm}.$$

2.6 Load on bolt

$$T = (df/5)$$

$$F = (5T/d)$$

$$F = (5*8110/13.9)$$

$$F = 2917.26 \text{ N}.$$

2.7 Moment on the strap

$$M = (FA (B-A))/(B)$$

$$M = (2917.26*151.66*(314-151.66)) / (314)$$

$$M = 228739.98\text{N-mm}.$$

3. Toggle resting block

$$A = 6a^2$$

3.1 Area of top plate = l*b

$$A_t = 65*65$$

$$A_t = 4225\text{mm}^2$$

3.2 Area of side plate = l*b

$$= 60*65$$

$$= 3900\text{mm}^2.$$

3.3 Surface of area toggle resting block = 6a²

$$= 4(\text{side plate}) + 2(\text{top plate})$$

$$= (4*3900) + (2*4225)$$

$$A = 24050\text{mm}^2.$$

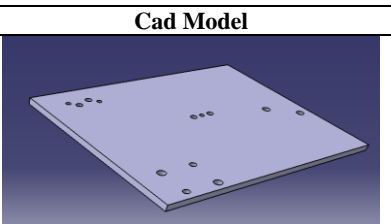
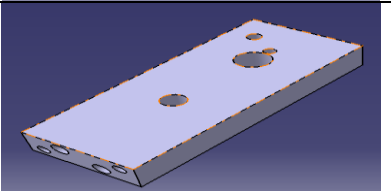
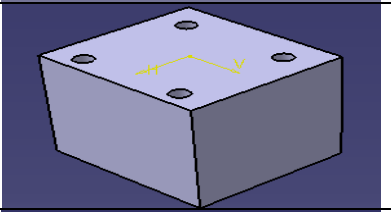
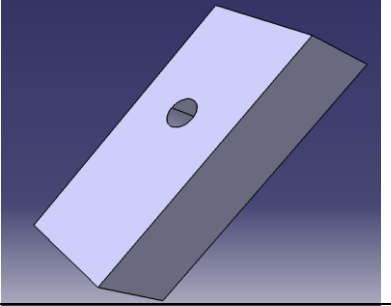
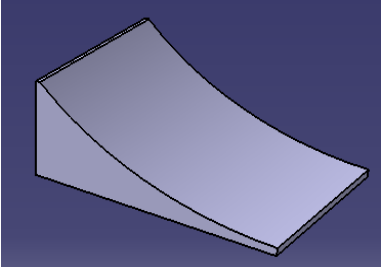
3.4 Resting block for brake pedal

$$A = b*h*t$$

$$= 40*90*20$$

$$A = 72000\text{mm}^2.$$

Table 1: Cad model of fixture component

Sr.No	Part Name	Cad Model
1.	Base plate Size :- 300*260 Material :- MS	
2.	Pin Guide Block Size:- 50*128 Material :- MS	
3.	Toggle Resting Block Size:- 65*65 Material:- MS	
4	Resting Block Size:- 90*40 Material :- MS	
5	Supporting Block Size:- 42*60, R8,H30 Material:-MS	

Design and analysis

The welding fixture is to be designed for welding a brake pedal assembly; hence according to the requirement of welding, components of fixture are decided. Following parts are

1. Base Plate

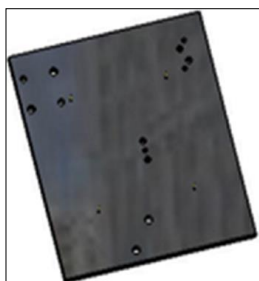


Fig 1.1: Base plate

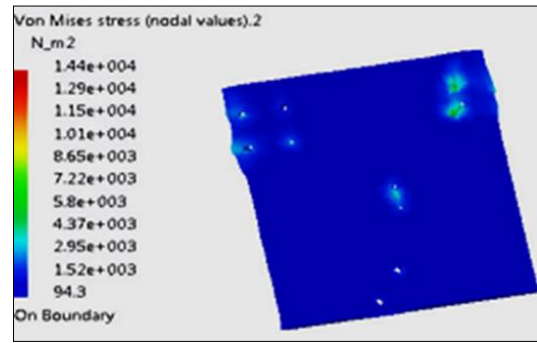


Fig 1.2: Deformation on base plate

2. Pin Guide Block



Fig 2.1: pin guide block

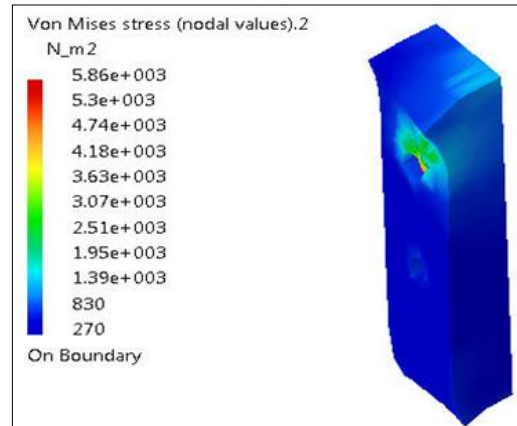


Fig 2.2: Deformation on pin guide block

3. Resting Block



Fig 3.1: Resting Block

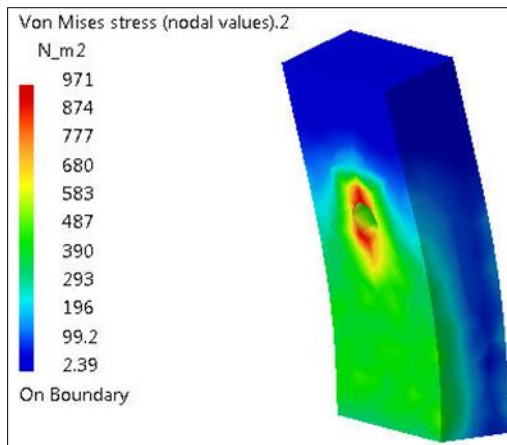


Fig.3: 2Deformation on Resting Block

4. Toggle Resting Block

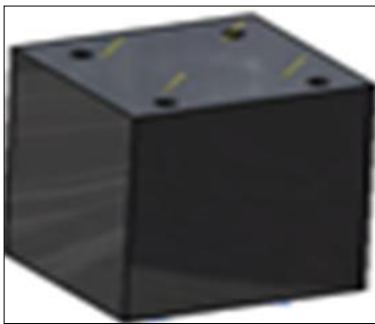


Fig 4.1: Toggle Resting Block

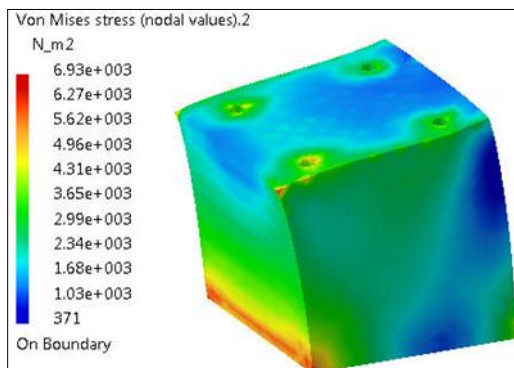


Fig.4.2: Deformation on Toggle Resting Block

Final assembly

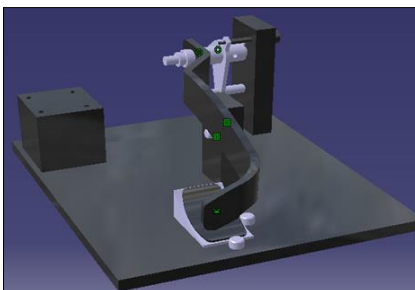


Fig 5

Summary

We have designed the brake pedal assembly welding fixture so the job loading and unloading of the parts will be easy for the labor or worker with minimized time requirement.

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

The minimum gap between the clamp and weld edge is found to be 12mm and this has been followed in the design practice of the welding fixture and at the bottom of clamp plate the arsenic copper provide the support so that there is no effect of clamping force on the part head end sub-assembly.

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