

Design of Fixture for rotary welding SPM

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Abstract – This project is to design a fixture for rotary welding operation with the help of SPM (Special Purpose machine). This fixture is designed for holding the parts on which rotary weld performed. The parts to be welded on this fixture are the under bracket, steering shaft and steering stem. This project aims in designing of a fixture for increased efficiency in production of rotary welding operation. This fixture is designed to accommodate various types of parts that are to be rotary welded. By introduction of this fixture mounted on the SPM, the load bearing of welding can be improved along with increase in welding strength, decreasing welding error hence improving of overall efficiency compared to manual welding. In general, manual rotary welding is very critical process with high chances error. To overcome this error fixture is required.

Key Words: Fixture Design, SPM, Welding fixture, FEA of welding fixture, CAD design.

1. INTRODUCTION

The world is already moving with high pace towards automation. For manufacturing companies to remain competitive and survive in today's market they must produce quality products with highest possible precision and efficiency. Production based industries require minimization of cycle time of machining components along with minimum errors in dimensions.

Considering current industry scenario many industries have moved to use SPM for various manufacturing process. For this SPM, locating and holding of workpiece is achieved with the help of different type of fixtures. The fixture design depends on the accuracy of the dimensions of the components to be machined and the reliability of the fixtures to be checked. On manufacturing assembly line, the most common process to be automated is that of welding as it requires precision. Most of the companies prefer automated welding as it is to automate and after automation the entire process becomes more efficient and economical compared to that of the professional welder. Benefits like improved welding quality, increased productivity, decreased waste production and cycle time, decreased labour cost can be seen in an automated welding process. Various types of fixtures are used depending upon the manufacturing processes.

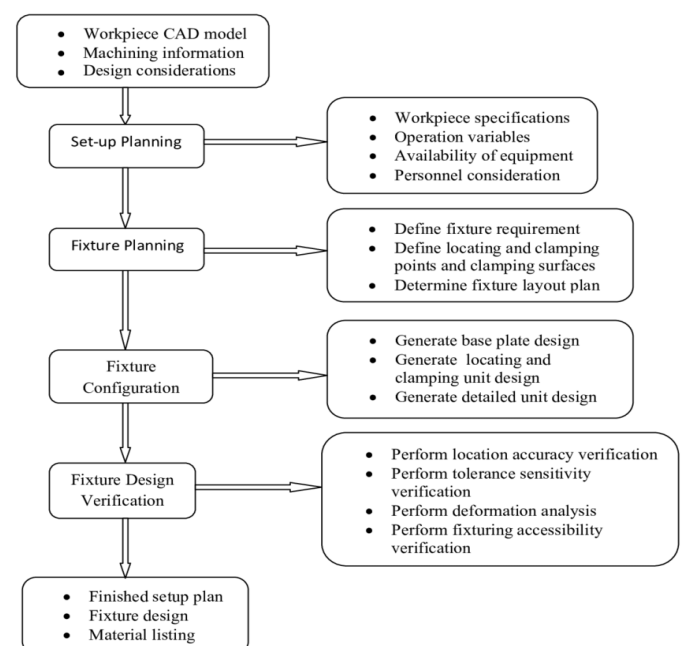
1.1 Different types of fixtures are listed below: -

- a. Welding fixture
- b. Milling fixture
- c. Broaching fixture
- d. Grinding fixture
- e. Boring fixture
- f. Indexing fixture
- g. Tapping fixture
- h. Turning fixture
- i. Assembly fixture

2. OVERVIEW OF FIXTURE DESIGN PROCESS

Fixtures are mostly used for workpiece holding and supporting that specific workpiece in manufacturing industry. The main function of a fixture is to securely locate and position the holding workpiece with precision in order to carry out various manufacturing processes with complete uniformity and accuracy.

2.1 Fixture design Process chart -



3. METHODOLOGY

The project will be completed in following steps:

- a. Problem identification
- b. Project idea conceptualization
- c. Data collection
- d. Design on 3D CAD software
- e. Material selection
- f. Analysis on ANSYS software
- g. Results and Conclusion

4. PROBLEM STATEMENT

Design a multi-component fixture to perform rotary welding operation on Special Purpose machine. Rotary welding on the vehicle parts like steering shaft, steering stem and under bracket is critical process without fixture and SPM. Below images are some examples of vehicle parts on which rotary welding operation is performed. Holding of these parts on SPM fixture is required.



Fig -2: Under bracket of two-wheeler

5. MODELLING OF ROTARY WELDING FIXTURE

Following are parts and assembly of rotary welding fixture.

5.1 Design of model

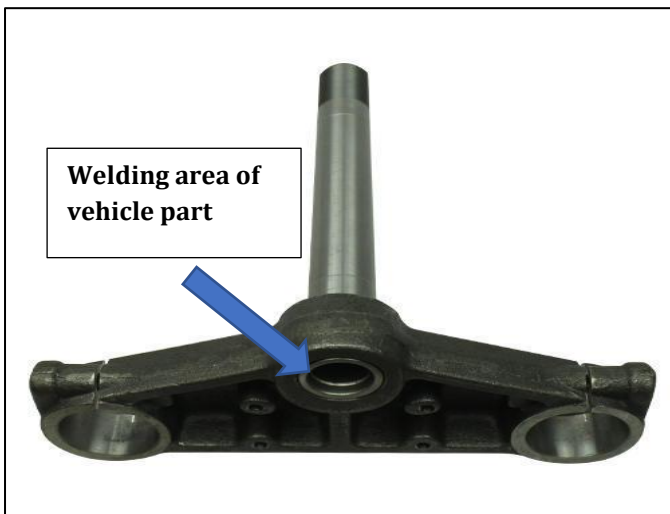


Fig -1: Steering Stem of two-wheeler

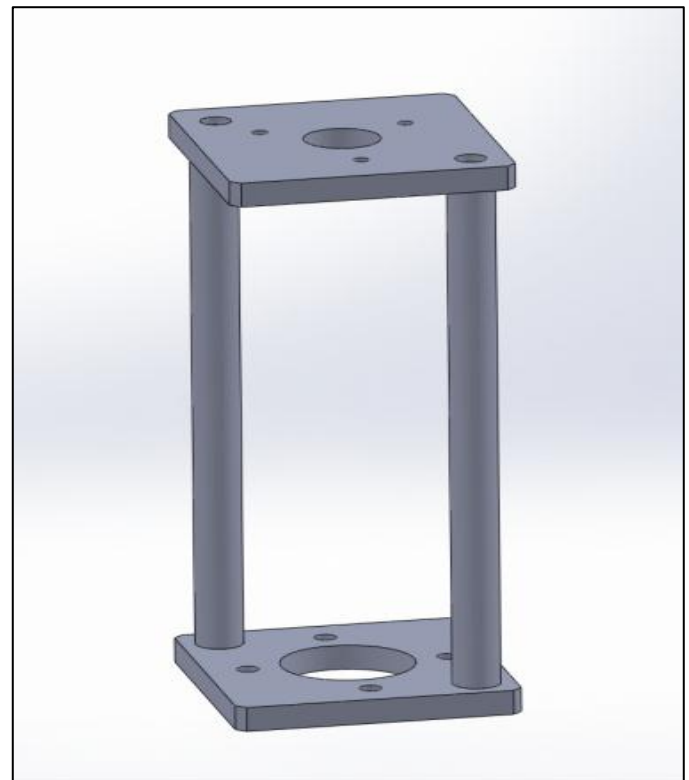


Fig -3: Assembly of fixture

5.2 Construction details with CAD design

Part Name: Top plate of fixture

Material Used: EN31 steel

Dimension: L=150mm, B=150mm, W=16mm

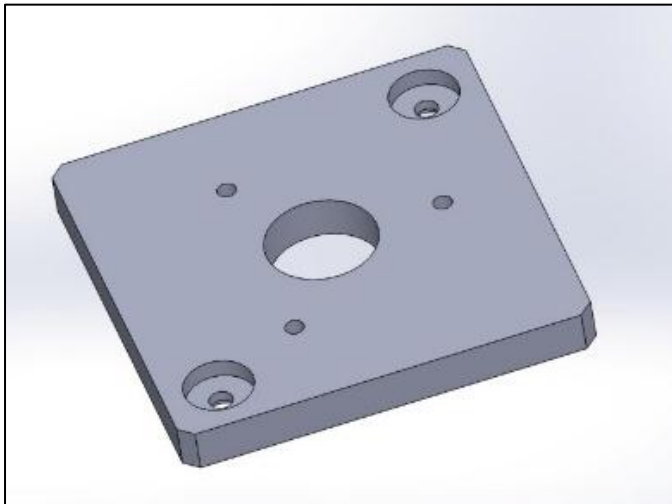


Fig -4: Top plate of Fixture

Part Name: Two Pillars of fixture

Material Used: EN31 steel

Dimension: L= 350 mm, D= 25mm

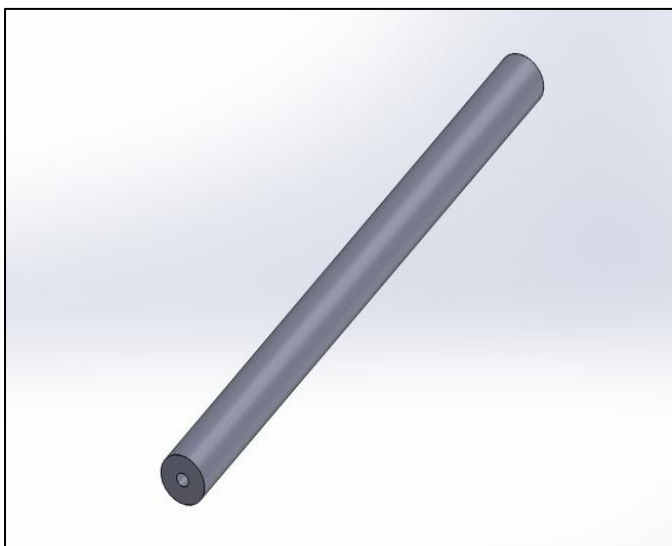


Fig -5: Pillar of fixture

Part Name: Bottom of fixture

Material Used: EN31 steel

Dimension: L=150mm, B=150mm, W=16mm

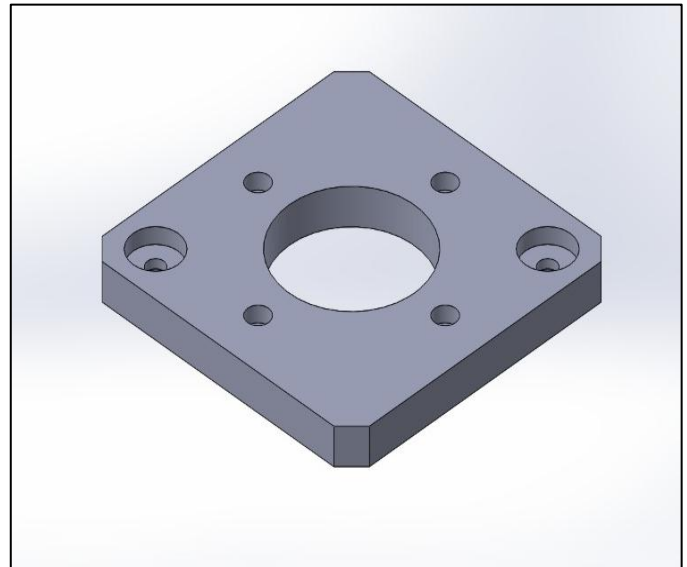


Fig -6: Bottom plate of fixture

6. MATERIAL SELECTION

For this project EN31 steel material was selected. To achieve high degree of hardness, compressive strength and abrasion resistance EN31 which is high carbon alloy steel is utilized. EN31 steel is used in the automotive industry for achieving outstanding surface characteristics and dimensional accuracy while machining.

Table -1: Material properties of EN31 steel

Element	Objective
Tensile strength	750 N/mm ²
Yield strength	450 N/mm ²
Elongation	30%
Density	7.8 kg/m ³
Hardness	63 HRC
Modulus of elasticity	215000 N/mm ²
Compressive strength	750 N/mm ²

7. ANALYSIS OF ROTARY WELDING FIXTURE

For this project, to find the structural analysis result ANSYS software is used. The assume workpiece weight on which welding is performed is 8 kg. Following are the analysis results of rotary welding fixture.

I. Equivalent Stress

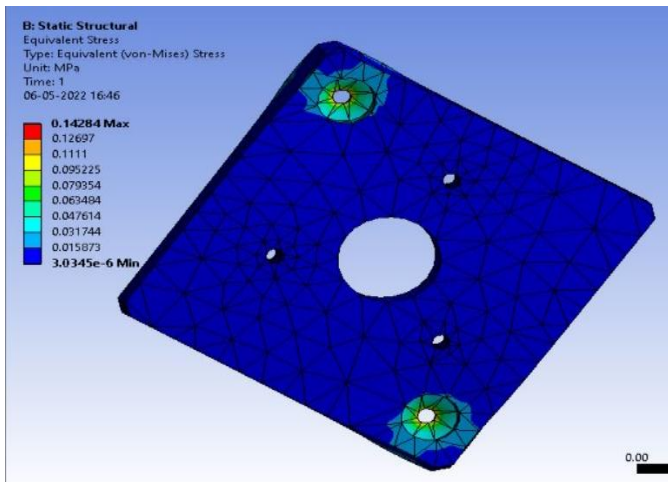


Fig -7: Top plate of fixture

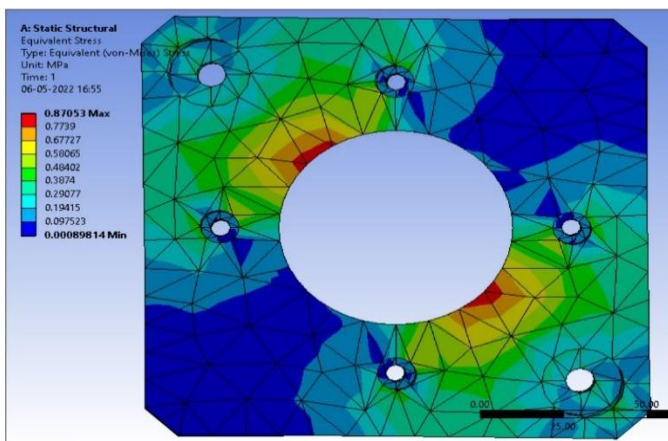


Fig -8: Bottom plate of fixture

II. Total Deformation

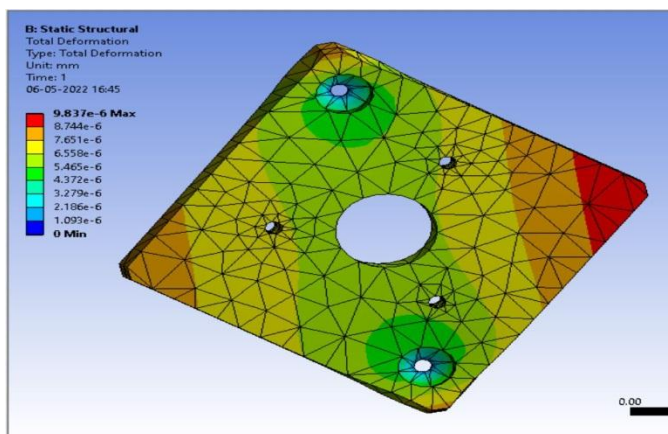


Fig -9: Top plate of fixture

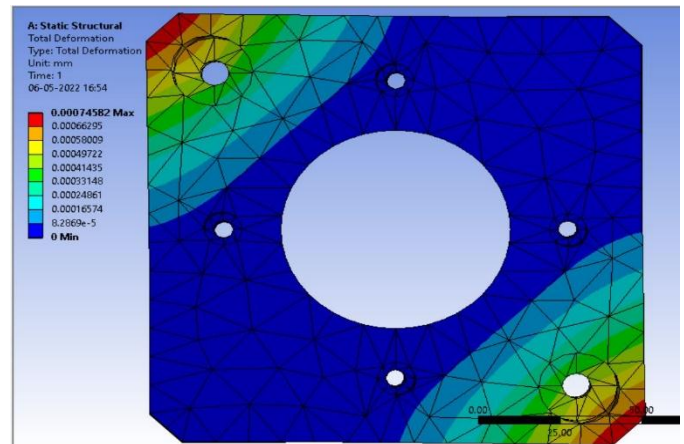


Fig -10: Bottom plate of fixture

8. RESULTS

I. Equivalent stress

Table -2: Results of equivalent stress

SR. No	Part Name	Maximum values	Minimum Values
1	Top plate of fixture	0.14284 MPa	3.0345e-6 MPa
2	Bottom plate of fixture	0.87053 MPa	0.00089814 MPa

II. Total deformation

Table -3: Results of total deformation

SR. No	Part Name	Maximum values	Minimum Values
1	Top plate of fixture	9.837e-6 mm	0 mm
2	Bottom plate of fixture	0.00074582 mm	0 mm

From the results it can be observed that the design fixture can sustain the load which is found to be more than that of assume weight. Hence the fixture is safe to be utilized in manufacturing process.

9. CONCLUSION

In this paper, we have designed the fixture for rotary welding SPM. By observing the analysis result obtained from ANSYS software is less than permissible stress value for the respective material. Hence the fixture is safe to

carry out welding operation. Our fixture is used to hold the workpiece to carry out rotary welding operation in vertical SPM.

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