DESIGN AND ANALYSIS OF WELDING FIXTURE FOR COMBINATION OF WELDING PROCESSES- A REVIEW

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ABSTRACT

In recent years the concentration of the manufacturing community has been on automated processes because they produce higher quality products and higher production rates. One of the most common automated processes in an assembly line is welding. However, an automated welding operation may not be best suited for every application. One way to increase the flexibility of a welding operation is to improve the fixturing device that holds the work piece. The addition of an active positioning adapting function increases the units, degrees of freedom, allowing for a larger range of possible motions. A specific weld fixture is to be designed by using CAD software which is one of the software used for modeling components in most of the design based industries. While the modeling of the components the material selection will be carried out simultaneously based on the design considerations related to loads, positions etc. Later the stress and strain concentration, deformation on the blade of the weld fixture will be found by applying certain load on the blade, using the Finite Element Analysis (FEA) by using ANSYS software that provides best output within few seconds.

Keyword: - *Welding Fixture, Finite Element Analysis (FEA), Creo parametric, ANSYS Software.*

1. INTRODUCTION

For a manufacturing company to remain competitive in today's market they must produce a quality product at the highest possible efficiency. Over the past century there have been large strides in manufacturing processes. Ever since Henry Ford's introduction of the assembly line, businesses have been focused on using available technologies to manufacture their products at minimal cost. During the manufacturing process there are many different parameters that need to be controlled, such as, limiting waste, assembly downtime, and labor compensation to be able to produce at a minimal cost. In recent years the concentration of the manufacturing community has been on automated processes because they produce higher quality products and at higher production rates.

One of the most common automated processes in an assembly line is welding. Automated welding is used by many companies around the world because the process is easily automated and more efficient than a professional welder. The main benefits of an automated welding process are, improved weld quality, increased productivity, decreased waste production, decreased costs associated with labor. However, an automated welding operation may not be best suited for every application. A company must consider many variables when deciding if a robotic operation is appropriate for their application. One way to increase the flexibility of a welding operation is to improve the fixturing device that holds the work piece. The addition of an active positioning adapting function increases the units' degrees of freedom, allowing for a larger range of possible motions. By increasing the degrees of freedom the welding system can perform more complex movements, thus increasing its adaptability to new work pieces. There are products on the market today that can perform these types of operations.

A fixture is a work-holding or support device used in the manufacturing industry Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchange ability Locating and supporting areas must usually be large and very sturdy in order to accommodate welding operations; strong clamps are also a requirement. For high-volume automated processes, milling fixtures usually involve hydraulic or pneumatic clamps. In this project, we will be modeling a weld fixture by using CAD software which is one of the software used for modeling components in most of the design based industries. While the modeling of the components the material selection will be carried out simultaneously based on the design considerations related to loads, etc. Later the stress and strain concentration, deformation on the blade of the weld fixture have been found by applying certain load on the blade, using the Finite Element Analysis (FEA) by using ANSYS software that provides best output within few seconds. Finally the stress and strain concentration, deformation results are presented in the report section of this document. This project also deals with the design of the welding fixture and turn three different welding fixture in to one fixture.

2. OBJECTIVE

- Design and analysis of Welding Fixture for combination of welding processes like TIG, MIG, SAW.
- To study the Stress levels & the Safe design as per strength criteria as all the stress are below the allowable limit of stress.
- To improve the Production rate & minimize the total cycle time..

3. LITERATURE REVIEW

Lots of research, work & Study have been done by many researchers in the field of design and analysis of Welding Fixture. The many authors have given various methods of design and different analysis of welding fixture in manufacturing industry. Due to time reduction and essay to assemble of manufacture component in accurate dimension. The assembly of welding component on fixture which have affect by welding thermal Stress and clamp bending stress on sheet metal part of automobile industry. For this study and observation are focused on existing system. The literature survey has been pioneered effort in this regard. Various design concepts and CAD/CAE concepts from literatures help to establish comparative study between existing and new experimentation.

Jigar D Suthar [1] Studied Drum mix plant used for mixing of concrete and other raw materials used in road construction. Impeller is used in the exhaust system of drum mix plant to remove dust particles. Fixture is used in manufacturing of impeller during welding to hold the different parts of the impeller assembly like blades (vanes), upper and lower plates. This paper shows an innovative way to use impeller structure itself as fixture and which has been resulted in the reduction of distortion produced during welding. In this paper modelling work has been done using AutoCAD, Pro-e, Solid Works software, and analysis part has been done using ANSYS workbench. Hence the design and analysis of the fixture has been presented in this paper. Unbalance mass for the impeller has been reduced to 44g for the new design from100g for the existing design. Proper selection of tolerance has been done by cut out some experimental specimen which shows that proper tolerances for the fixtureless design are H7/f7 and H8/e8. For reducing welding distortion and for proper cooling of weld, small and intermittent slots have been provided rather than longer slot. From comparison that has been made of various process namely laser cutting, plasma cutting and punch press used for sheet metals required for impeller assembly, it is found that punch press is better than plasma cutting and laser cutting in terms of energy related cost saving. Manufacturing lead time is less in fixtureless design because of less welding area, less assembly time and no fixturing requirement.

Xiumei Kang [2] This paper reviewed main methodologies in CAFP. Generally, the fixture planning consists of four phases: the problem description, fixture analysis, fixture synthesis, and fixture verification. Fixture planning is a complex activity restricted by the extreme iversity of workpieces and several environmental factors including machine tools, assembly tools, grasping devices, and cutting tools. This paper reviews methods and techniques for the geometry analysis of fixture feasibility in product development. Fixture synthesis methods including geometrical analysis and fixture assembly planning are surveyed. The implementation of CAD-based and Web-based fixture planning systems is discussed in respect to their reasoning methods, functionality, limits and potentials. A novel fixture planning system is proposed and further research activities are identified. Fixture planning is a complex activity affected by the extreme diversity of workpieces and several environmental factors. Fixture analysis and verification methods are

summarized as geometrical analysis, kinematic analysis, force analysis, and deformation analysis. In fixture synthesis, CBR methods, assembly sequence planning methods, and optimization methods are surveyed. The implementation issues in CAD-based CAFP systems, Web-based CAFP systems and information sharing are discussed. A framework of virtual fixture planning system is proposed to integrate environmental factors into fixture planning process. Further research will improve approaches for fixture design and fixture assembly motion planning based on VR techniques in respect to environmental factors.

C. A. Kubade [3] Studied welding fixture design for the components which are difficult to weld in normal way or without any holding unit. The fixture is to be designed for the cab leg sub-assembly which is to be welded with its companion for its application. The investigation involves study of basics of fixture and welding, need of fixture, location principle. In this work, welding fixtures are designed considering all the welding factors like access to its welding area, cycle time, and availability of space for fixture. Materials are selected as per functional requirements and based on previous designs. The general arrangement is made and fixture is designed with the use of analytical method which includes pneumatic cylinder selection, L-shaped bracket design and positioning of units. Power clamps and LM guides are selected as per the fixture requirements. The design is verified with the use of FE analysis for strength criteria of material and is found under safety limits. The complete fixture for welding of cab leg assembly has been designed analytically as well as critical components of the fixture assembly are analysed using FEA for safety. The design is safe as per strength criteria as all the stress levels are below the allowable limit of stress. The percentage error values of analytical and FEA design varies within the range of 5% to 15%; which is acceptable. The fixture satisfies the functionality of the welding.

S. N. Shinde [4] Robotic welding requires specialized fixtures to accurately hold the work piece during the welding operation. Despite the large variety of welding fixtures available today the focus has shifted in making the welding arms more versatile, not the fixture. The new fixture design reduces cycle time and operator labor while increasing functionality; and allows complex welding operations to be completed on simple two axis welding arms. The process of conducting operations related to welding fixtures and positioners helps in gaining a deeper understanding as well as effective project process. The prototype construction proves fruitful in analyzing the process for its potential as a finished product.In today's market all large manufacturers are automating as much of their production line as possible. Automated processes have been in high demand extensively in past two decades but there is still room for improvement. Welding fixtures closes the gap in the engineering of automated fixture mechanism. 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. A few other considerations for calculations that would ultimately improve the quality of the welding fixture are stress analysis and cost benefit analysis. Stress analysis and friction analysis would both help in the selection of material to be used for each part of the machine.

Thorough stress calculations could not be done without knowledge of the material being used for each part, because of different materials physical and mechanical properties. By also knowing the material selection a cost benefit analysis could be conducted to determine how cost effective the product is. All of these calculations would greatly add to the significance of the research already conducted.

M. Yuvaraj [5] Studied that Industrial Automation streamlines the operations in terms of speed, reliability and product output. In this thesis, welding fixture for two wheeler steering handle is modeled using CATIA software, forces are calculated, and an analysis has been carried out in the precisions placing of one circular component over another circular component during the welding process. Welding circular rod over another circular rod, the possibility of maintaining the accuracy in placing of curved surfaces is very less in the mass production. Here the difficulty is overcome by the new design of the fixture, and the angle as well as the linear movements is maintained in the accuracy of 0.1 mm without any robots. In the field of welding engineering where a consistently good quality, low cost with a maximum productivity is a must, this accuracy can be done by without automation. The process of conducting operations related to welding fixtures helps in gaining a deeper understanding as well as effective alignment process. Welding fixtures closes the gap in the engineering of automated fixture mechanism. This fixture will reduce the error due to lack of labor skill, will increase higher range of accuracy, will increase the productivity and will reduce the cycle time of the operation.

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4. PROBLEM IDENTIFICATIONS

Fig: Model of Existing component in Industry

a. Proper selection of tolerance could not be done.
b. The design is safe as per strength criteria as all the stress levels are below the allowable limit of stress.
c. Less production and more rejection of product.
d. The fixture does not satisfy the functionality of the welding.
e. The assembly of welding component on fixture which have affect by welding thermal Stress and clamp bending stress on sheet metal part of automobile industry.

5. SCOPE OF WORK

a. Change of shape from to circular to Rectangular.
b. Quantity of material comparison.
c. Multiple Welding processes like TIG, MIG, SAW, etc can be done and modified using the Design and Analysis of welding fixture for combination of welding processes
d. This project will be done in Akar Industry at MIDC, Hingna, Nagpur

6. METHODOLOGY

The complete study of Design and analysis of Welding Fixture will be done through the CAD Software Solid Works 18.

a. Study of component.
b. Component material selection.
c. Geometrical dimensional consideration.
d. Modeling using Solid Works 18 software.
e. Mould flow analysis for proper filling of component using Solid Works 18.

7. CONCLUSIONS

The complete fixture for welding of PTO safety cap assembly will be designed analytically as well as critical

components of the fixture assembly will be analyzed using FEA for safety. The safety of design will be as per strength criteria.

8. REFERENCES

[1] Jigar D Suthar, K.M .Patel, and Sanjay G Luhana, "Design and analysis of fixture for welding an exhaust impeller", Procedia Engineering 51 (2013) 514 – 519.

[2] Xiumei Kang and Qingjin Peng. "Fixture Feasibility: Methods and Techniques for Fixture Planning", Computer-Aided Design and Applications © 2008 CAD Solutions, LLC, http://www.cadanda.com

[3] C. A. Kubade, Dr. S.V. Patil and Mr. V. P. Patil, "Design and Analysis of Welding Fixture for Automotive Component using FEA" Vol-2 Issue-4 2016 IJARIIE-ISSN (O)-2395-4396

[4] Prof. S.N.Shinde, Siddharth Kshirsagar, Aniruddha Patil, Tejas Parge, Ritesh Lomte , "Design of Welding Fixtures and Positiners", International Journal of Engineering Research and General Science Volume 2, Issue 5, August-September, 2014 ISSN 2091-2730

[5] M. Yuvaraj, H. Karthick,V. Gopalakrishanan and Stanly Wilson Louis, "Design, Fabrication And Analysis Of Welding Fixture Having Higher Accuracy Without Using Robots", Int. J. Chem. Sci.: 14(2), 2016, 1-8, ISSN 0972-768X, www.sadgurupublications.com

[6] P H Joshi, "Jigs and Fixtures", Third Edition, 2004, Tata McGraw Hill Publishing

[7] V.B. Bhandari, "Design of Machine Elements", Third Edition, 1987, Tata-McGraw Hill Publication.

[8] Warren C. Young Richard G. Budynas, "Roark's Formulas for Stress and Strain", Seventh Edition, McGrwhill Publication.

[9] Hui Wang, Yiming (Kevin) Rong, Hua Li, Price Shaun, "Computer aided fixture design: Recent research and trends", Volume 42, Issue 12, December 2010, Pages 1085–1094.

[10] S. S. Khodwe, S. S. Prabhune, "Design and Analysis of Gearbox Test Bench to Test Shift Performance and Leakage" International Journal of Advance Research and Innovative Ideas in Education Volume 1 – issue2. (2015) Page 270-280.

[11] Kalpesh Khetani, Jafar Shah, Vishal Patel, Chintan Prajapati, Rohit V. Bhaskar, "Design and Thermal Stress Analysis of Welding Fixture of a Brake Pedal" International Journal on Recent Technologies in Mechanical and Electrical Engineering (IJRMEE) ISSN: 2349 -7947 Volume: 2 Issue: 5