# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Machhe, Belagavi-590018, Karnataka

A Project Report

on

## "Joining And Bending Test of Various Ferrous Metals Using Rotary Friction Welding"

*In partial fulfilment of the requirement for the award of the degree of*

**BACHELOR OF ENGINEERING**

**In**

**MECHANICAL ENGINEERING**

***Submitted by***


| | |
|---|---|
| ABHISHEK SIDDGOL | 1DT19ME400 |
| B G SANAT | 1DT18ME008 |
| CHIRANTH B V | 1DT18ME013 |
| BHARATH RAJU S B | 1DT19ME404 |


***Under the guidance of***


**Dr. Mallikarjun Biradar**

Associate Professor

Department of Mechanical Engineering

DSATM, Bengaluru-560082



**DAYANANDA SAGAR ACADEMY OF TECHNOLOGY & MANAGEMENT**

**Department of Mechanical Engineering**

Udayapura, Opp. Art of living, Kanakapura Road, Bengaluru – 560082.


**2021 -2022**

**DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT**

(Affiliated to Visvesvaraya Technological University, Belagavi & Approved by AICTE, New Delhi)

Udayapura, Opp. Art of living, Kanakapura Road, Bangalore – 560082.

# DEPARTMENT OF MECHANICAL ENGINEERING

Accredited by NBA, New Delhi

NAAC Accredited with A+ Grade

## CERTIFICATE

This is to Certify that the project work entitled "**Joining and Bending Test of Various Ferrous Metals Using Rotary Friction Welding**" carried out by Mr./Ms. **ABHISHEK SIDDGOL, B G SANAT, CHIRANTH B V, BHARATH RAJU,** bearing the USN: **1DT19ME400, 1DT18ME008, 1DT18ME013,** and **1DT19ME404,** are bonafide students of **Dayananda Sagar Academy of Technology & Management**, in Partial fulfillment for the award of the degree of **Bachelor of Engineering** in **Mechanical Engineering,** from **Visvesvaraya Technological University, Belagavi-590018,** during the Academic year **2021-2022.** It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said Degree.

| Guide | Head of the Department | Principal |
|---|---|---|
| Dr. Mallikarjun Biradar | Dr. Manohar H. S | Dr. Ravishankar M |

**EXTERNAL VIVA VOCE**

| | Name of the Examiner | Signature with Date |
|---|---|---|
| 1. | Dr. Manohar. HS | 28/7/22 |
| 2. | Dr. Vijaya. G | 28/7/22 |

**DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT**
**(Affiliated to Visvesvaraya Technological University, Belagavi & Approved by AICTE, New Delhi)**
Udayapura, Opp. Art of living, Kanakapura Road, Bangalore – 560082.

**DEPARTMENT OF MECHANICAL ENGINEERING**

Accredited by NBA, New Delhi

NAAC Accredited with A+ Grade

# DECLARATION

This is to Certify that, we have followed the guidelines provided by the institute in preparing the project report and hereby declare that the dissertation work entitled **"Joining and Bending Test of Various Ferrous Metals Using Rotary Friction Welding"** have been independently carried out by ourselves, and whenever we have used materials (data, theoretical analysis, figures, and text) from other sources.

We have given due credit to them by citing them in the text of the project report and giving their details in the references. We have not submitted this dissertation either in part or full to any other university for the award of any degree.

| Sl.No. | Name | USN | Signature |
|---|---|---|---|
| 1. | ABHISHEK SIDDGOL | 1DT19ME400 | |
| 2. | B G SANAT | 1DT18ME006 | |
| 3. | CHIRANTH B V | 1DT19ME013 | |
| 4. | BHARATH RAJU | 1DT19ME404 | |

# ABSTRACT

The comparative study of various ferrous materials for joining techniques by Rotary Friction Welding process. The joints between different stainless steel grades was conducted by fabricating a different combination EN8 – EN8, EN8 - SS304, and SS304 - SS304 respectively using a rotary friction welding technique. The objectives of this work is to find out the best suitable combination of joint from the above-selected materials and carried out an X-RAY Diffraction test by using Spectroscopy and Three-point Bending test as per ASTM. The best combination of similar or dissimilar materials is expected to have better joint strength. The above technique of joining process is really helpful to designers to know about the material and their strength for various applications such as automobile and aerospace. was observederve to accept and to have better alloying elements of the above-mentioned materials which effects on weld ability.

**KEYWORDS:** Ferrous material EN-8 and Stainless steel 304, Rotary friction welding, XRAY Diffraction Technique, Bending test.

# ACKNOWLEDGMENT

In the journey of present project work, numerous personalities, directly or indirectly have extended their support and co-operation. We are truly indebted to them and here by acknowledge their contributions. We are very thankful to our Parents for supporting us while doing this project.

We would like to express our sincere gratitude to **Dr. Ravishankar M, Principal, Dayananda Sagar Academy of Technology and Management, Bengaluru** for his patron age, motivation and constant encouragement in completing the project work successfully.

We take immense pleasure in thanking **Dr. Manohar H.S, Professor and Head of Department of Mechanical Engineering, Dayananda Sagar Academy of Technology and Management, Bengaluru** for guiding us and having facilitated us to complete our project work successfully.

We would also like to express our gratitude to our project guide **Dr. Mallikarjun Biradar, Associate Professor of Department of Mechanical Engineering, DSATM, Bengaluru** for his constant support and guidance throughout the project work.

We consider it a privilege to express our thanks to our **faculty members, Department of Mechanical Engineering, DSATM, Bengaluru** for their constant support and in valuable guidance.

**ABHISHEK S** **1DT19ME400**

**B G SANAT** **1DT18ME008**

**CHIRANTH B V** **1DT18ME013**

**BHARATH RAJU** **1DT19ME404**

# LIST OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER-01

# INTRODUCTION

Welding is a process to join two parts permanently by the application of pressure and (or) heat. The welding processes can be classified based on whether the weld base metal is melting or not. The type of welding process in which the faying surfaces of base metal melt down by the application of heat is known as fusion/conventional welding. If the pressure is applied instead of applying the heat, then it is called solid-state welding. However, in this process heat may produce internally without melting the base materials. Friction Welding, Pressure Welding, Friction Stir Welding, Forge Welding, Cold Welding, Diffusion Welding, Explosive Welding, and Ultrasonic Welding are solid-state welding. Resistance Welding, Gas Welding, Arc Welding, Plasma Arc Welding, Laser Beam Welding, Electron Beam Welding, Gas Metal Arc welding, and Gas Tungsten Arc Welding are fusion welding. Utilization of advanced welding techniques to join dissimilar metals is needed as the conventional welding processes are ineffective. In conventional welding, materials are prone to participating in the reaction at elevated welding temperatures [1]. The conventional problems related to the welding of dissimilar joints can be overcome by the solid-state welding process [2]. Since the melting is not reached, solid-state welding processes will not produce the welding defects as in fusion welding [3].

As the different chemical compositions and materials properties, joining of stainless steel with aluminum is difficult by fusion welding processes; both can be successfully welded by the Friction welding process, which is a solid-state non-fusion joining method. The significance of FW is the bonding temperature that is lesser than the melting temperature of the base metals and the suitability for high production in industries. Solid-state welding especially friction welding is popular in the production industries as a consequence of the benefits such as a reduction in material wastage, less production time, easy management of welding parameters, high production rate, low power consumption for joining, eco-friendly method, well reproducibility and excellent work performance [4, 5]. During FW, temperature and stress developed are governing welding parameters, so a piece of knowledge is needed to identify the optimum parameters thus improving the design of joining dissimilar metals.

This paper aims to explain the fundamental concepts behind the FW process with its applications, significance, safety and characteristics. Further, this paper includes the challenges

# CHAPTER 4

# METHODOLOGY AND EXPRIMENTATION

## 4.1 Friction welding installation

A more practical aspect of this thesis was to assist in assembling a friction welding machine which was redesigned during a previous thesis by Bart Derynck and Dries Bonte (26). Fig. 31 shows the friction welding machine in its finished form. The following description of this machine is summary of their work supplemented with information out of the original manual. A schematic illustration of the entire friction welding installation is shown in Fig. 30. The description of the hydraulic power pack and the control cubicle is based on the construction book of the original machine

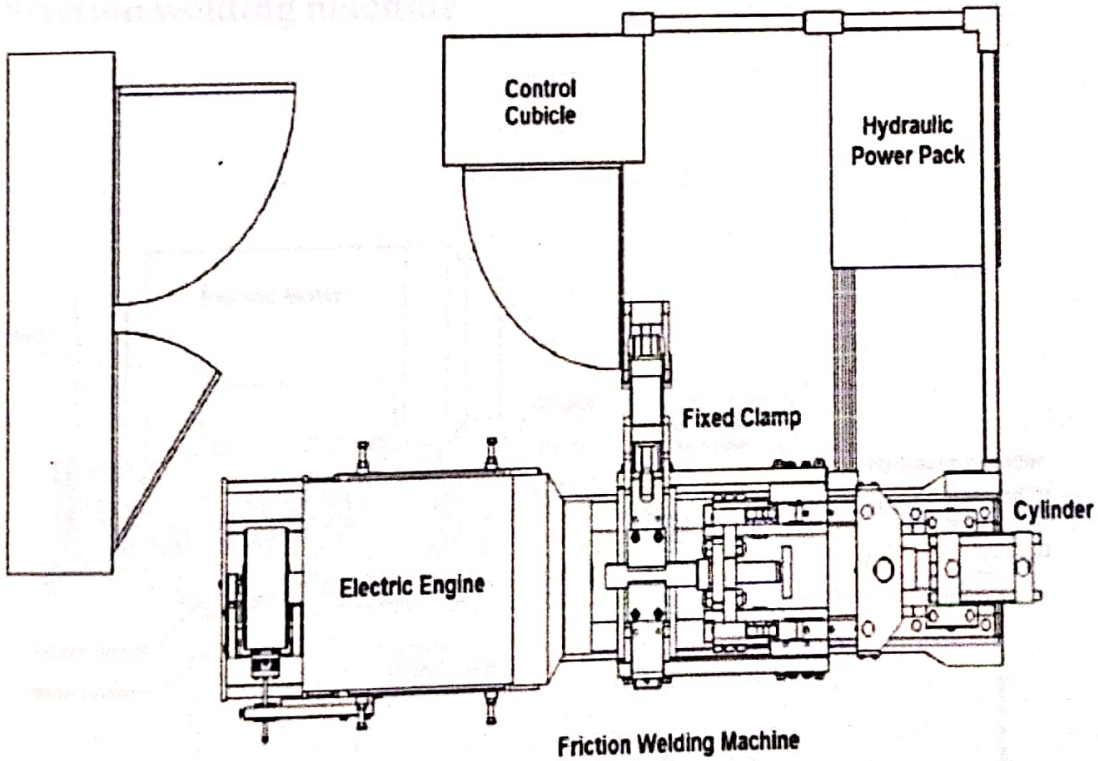


**Fig. 4.1: Basic layout of the complete installation**

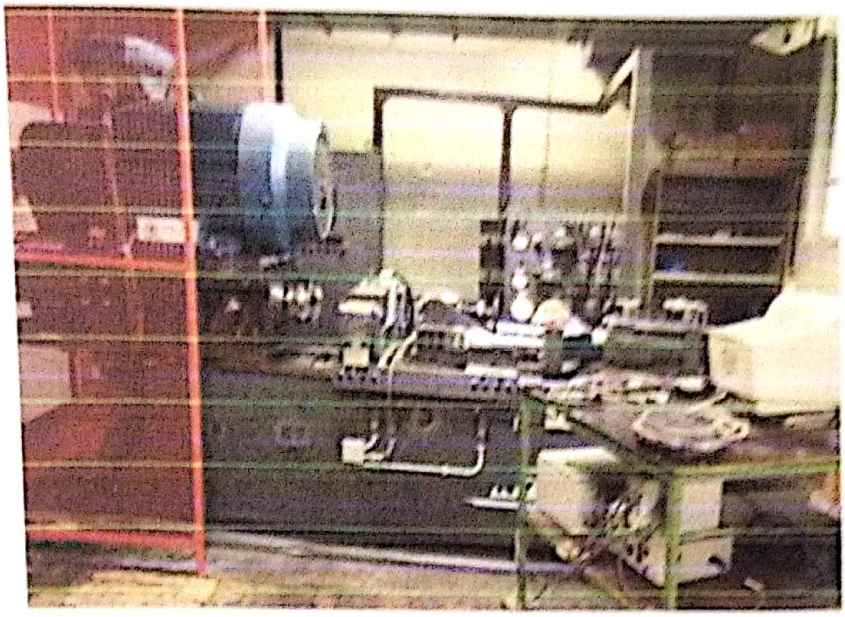

Fig. 4.2: Friction welding machine

## 4.2 Friction welding machine

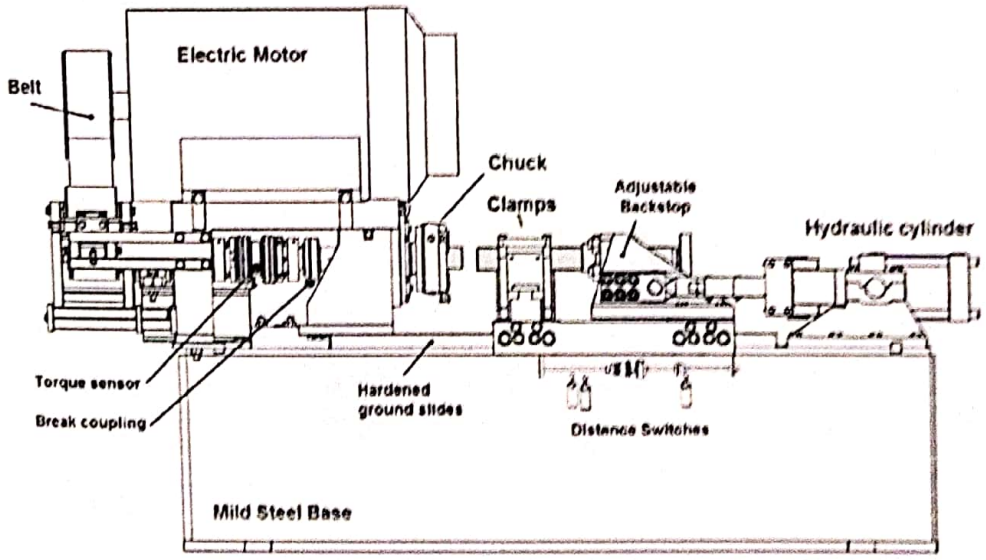


Fig.4.3: Overview of the basic components of the friction welding machine