iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** I **Month of publication:** January 2019

DOI: http://doi.org/10.22214/ijraset.2019.1114

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

Numerical Investigation of TIG welding Process using Finite Element Method

Nitish Kumar Singh[1], Mahendra Kumar Malviya[2], Vinay Chandelkar[3], Saurabh Pathak[4], Mohd. Asad Khan[5]
[1, 2, 3, 4, 5]*Department of Mechanical Engineering, National Institute of Technical Teachers' Training and Research, Bhopal*

Abstract: welding parameter play a vital role in joining of work piece using welding .The motive of this research to calculate the temperature distribution in TIG welding process using finite element method using ANSYS APDL 16 software. In this study welding of steel plate has been performed by using TIG welding .the process parameters such as welding current ,voltage, standoff distance, welding speed ,gas flow rate for TIG process are chosen carefully .

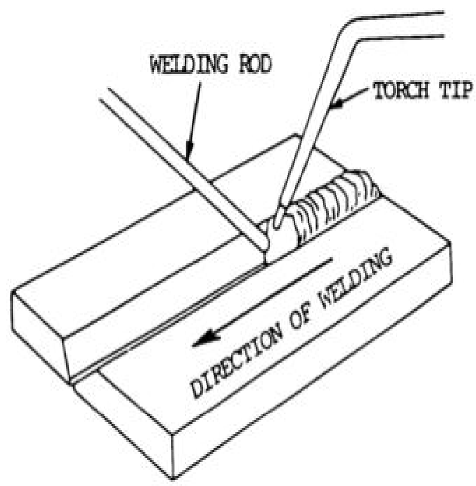
I. INTRODUCTION

Tungsten inert gas (TIG) welding is also known as Gas Tungsten arc welding process which is an arc based welding process that uses the arc between a non consumable tungsten electrode and work piece.

TIG welding is a process where parts are joined together by application of heat generated due to an arc struck between a non consumable tungsten electrode and the job in presence of a shielding gas. TIG welding is applied to weld sheet, tube, pipe, plate. TIG welding process was developed during world war second.

TIG welding become success in the 1940's for joining magnesium and aluminium.

TIG welding process



TIG welding mechanism

II. FINITE ELEMENT PROCEDURES

A. Finite Element method

The finite element method (FEM) or finite element analysis (FEA), is a numerical method for solving problems of engineering and mathematical physics. ... To solve the problem, it subdivides a large problem into smaller, simpler parts that are called finite elements.

B. proposed methodology

In this section the frame work is developed to perform numerical studies on TIG welding process. the purpose of simulated study is to investigate the behaviour of the TIG welding process and to predict the tensile strength of the welded component. This chapter gives details about the methodology adopted to perform above studies and the path to be followed. Related mathematical formulations and theory are being discussed in this chapter.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

1) Steps to Be Followed

To perform investigations, the adopted methodology comprises of following steps:

a) Activity 1: Identification of area of research
b) Activity 2: Literature review
c) Activity 3: Formulation of research problem
d) Activity 4: Formulation of objectives
e) Activity 5: Study of exiting FE models to simulate TIG welding and selection of best model.
f) Activity 12: Integrating optimized parameters to develop FE model of an TIG welded component.
g) Activity 13: Prediction of residual stresses and tensile strength of welded pipe.
h) Activity 14: Results analysis and report preparation.

C. Basic Steps of Finite Element Method

1) Select suitable field variable and the type of element.
2) Discretize the continua.
3) Select interpolation function.
4) Find the element properties.
5) Assemble element properties to get global properties.
6) Impose the boundary conditions.
7) Solve the system equations to get the nodal unknowns.
8) Make the additional calculation to get the required values

III. MATERIAL PROPERTIES AND WELD GEOMETRY

Simulation of two butt joint steel pipe.
Weldments defined parameters
L=1E-1 Weldment length
W=1E-1 Weldment width
H=6E-3 Weldment height
V=20 Welding voltage
I=160 Welding current
V=0.01 Welding speed
YITA=0.7 Welding thermal efficiency
R=0.007 Effective heat arc radius
Q=V*I*YITA Arc thermal efficiency
Qm=3/3.1415/R**2*Q Centre best spot heating flux

Material Properties

TEMP	T1	T2	T3	T3	T5	T6	T7	T8
	20	200	500	750	100 0	150 0	170 0	250 0
KXX	50	47	40	27	30	35	40	55
Specific Heat (C)	460	480	530	675	670	660	780	820
Density	782 0	770 0	761 0	755 0	749 0	735 0	730 0	709 0
Thermal Expansio n (10^5)	1.1	1.22	1.39	1.48	1.34	1.33	1.32	1.31

IV. SIMULATION RESULT

A. Mathematical Model

The first part of the finite element simulation of TIG welding is heat transfer analysis. In the finite element formulation, this equation can be written for each element as follows

$$[C\ (T)]\ \{\check{T}\} + [K\ (T)]\{T\} = \{Q\ (T)\} \qquad (1)$$

This analysis requires an integration of the heat conduction equation with respect to time. The Crank – Nicholson/Euler theta integration method is applied to solve these system equations. This element type has a three-dimensional thermal conduction capability. The heat input from the welding electrode was modeled by using heat flux as the input for the heat transfer from the rod to the work piece. This heat flux is based on the welder setting and the efficiency of the arc. $Q = \eta\ VI$

B. Calculation of Heat Flux (q)

$$q = Q/A$$

$$\text{where } Q = V * I * \eta$$

V. RESULT

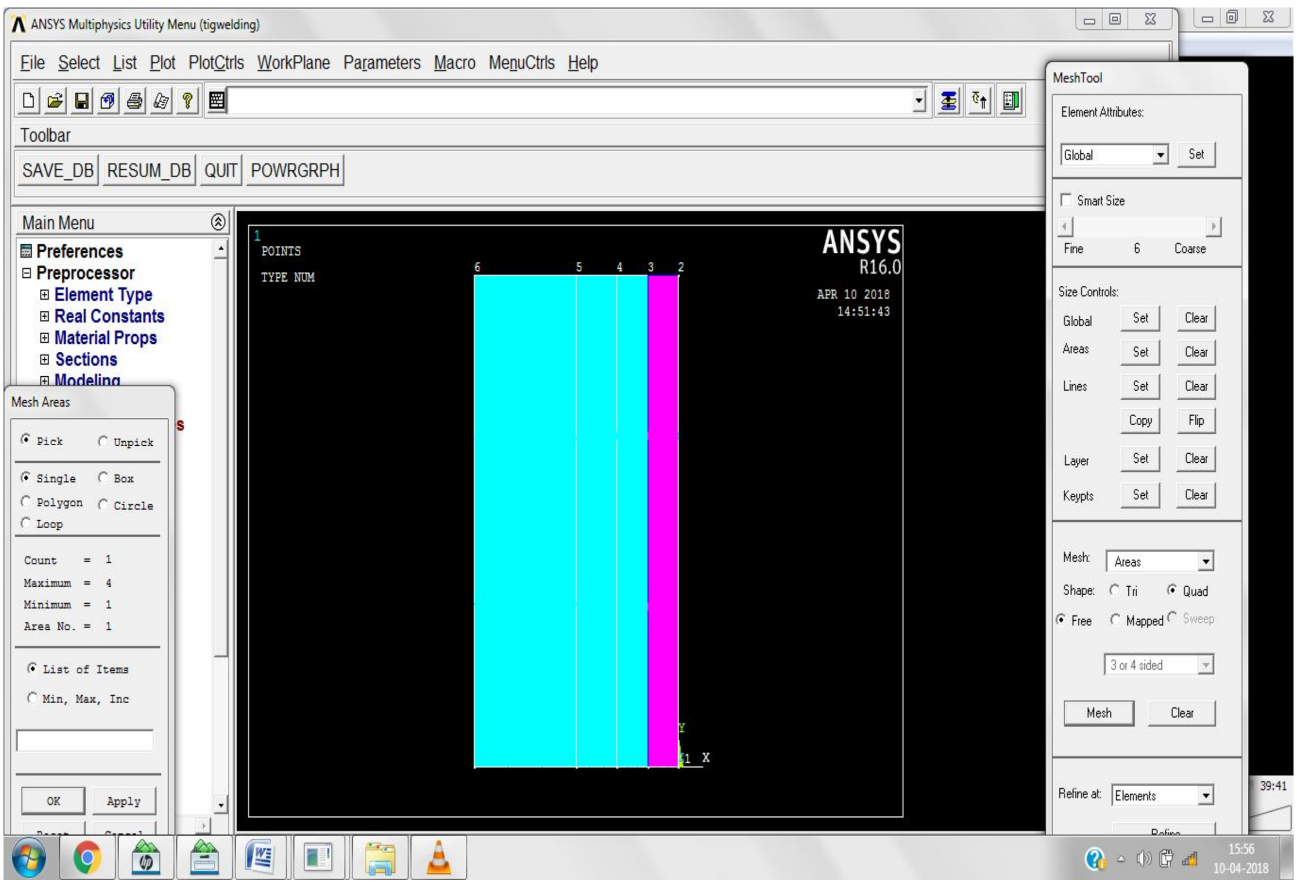
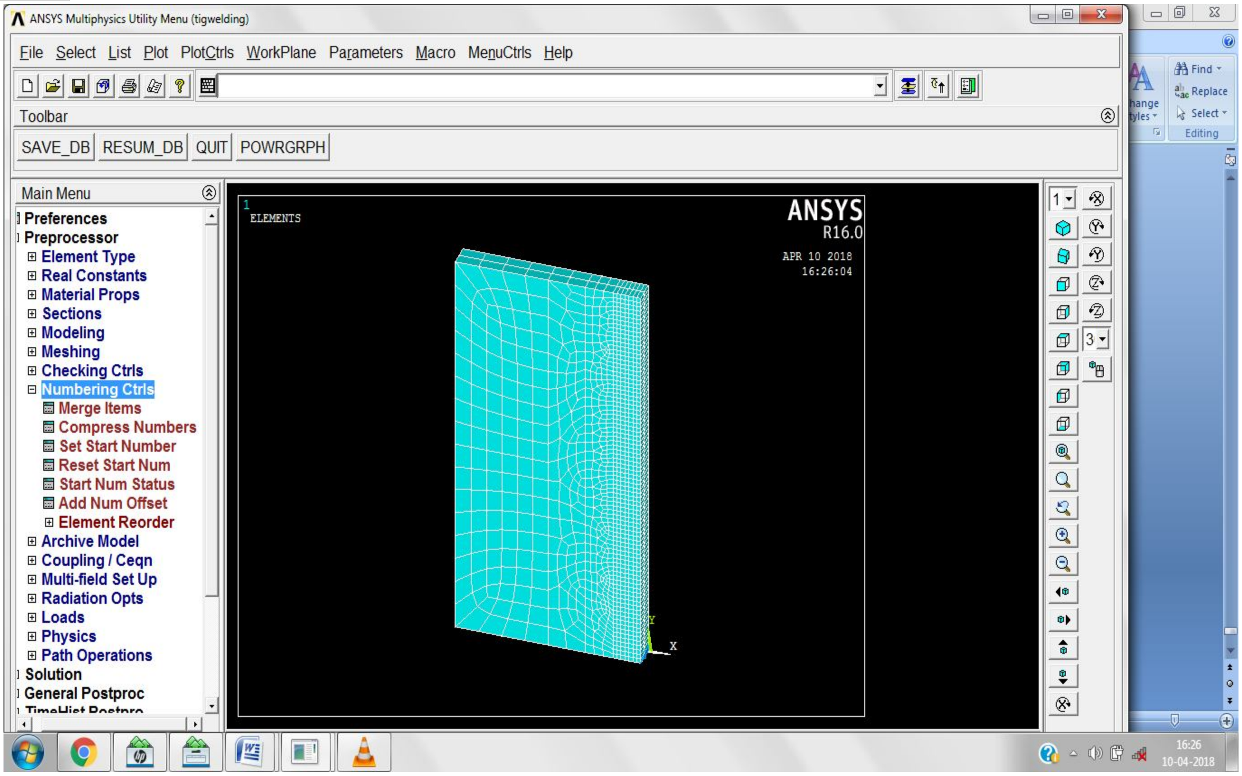


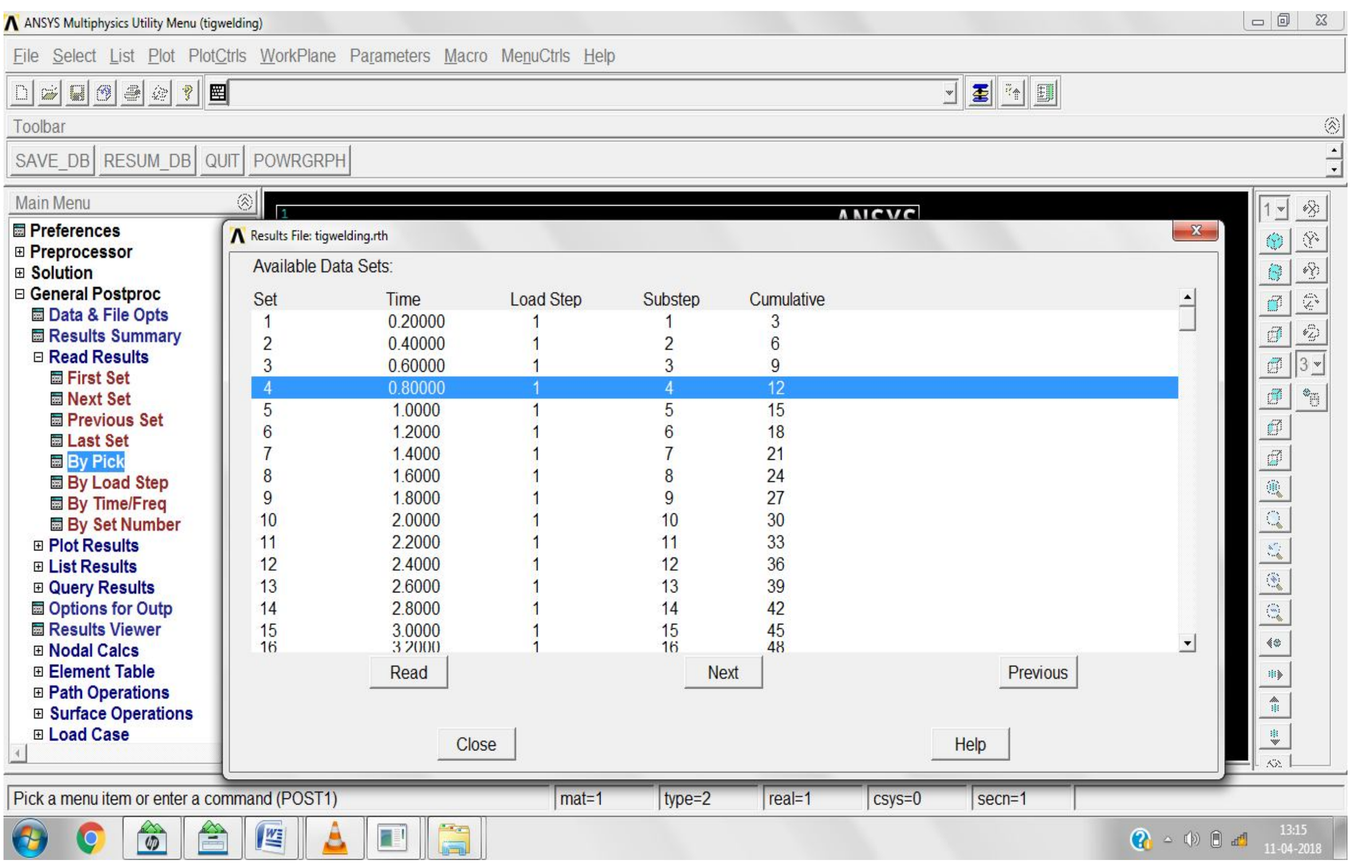
Fig geometry of weld speciman

Meshing

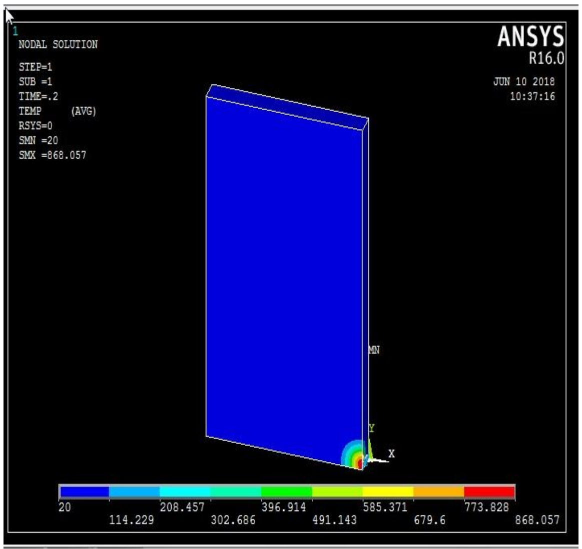
Size Element edges length	0.0012	0.0025	0.005	0.0065
NDIV(no of element Division)	0	0	0	0



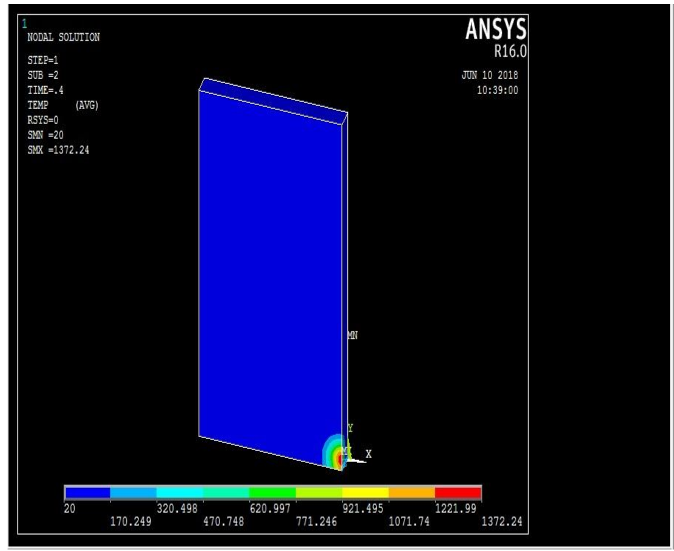
Meshed geometry



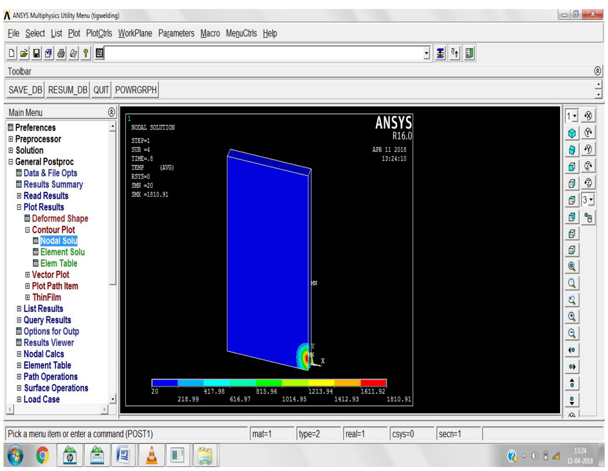
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com



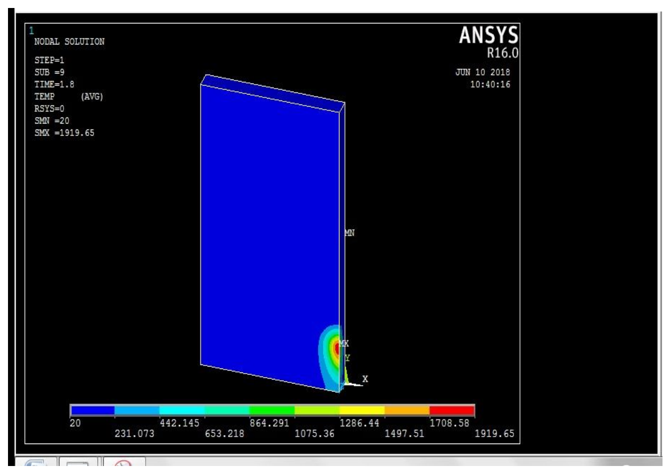
Temp. distribution alog the weld line at time t=0.2sec



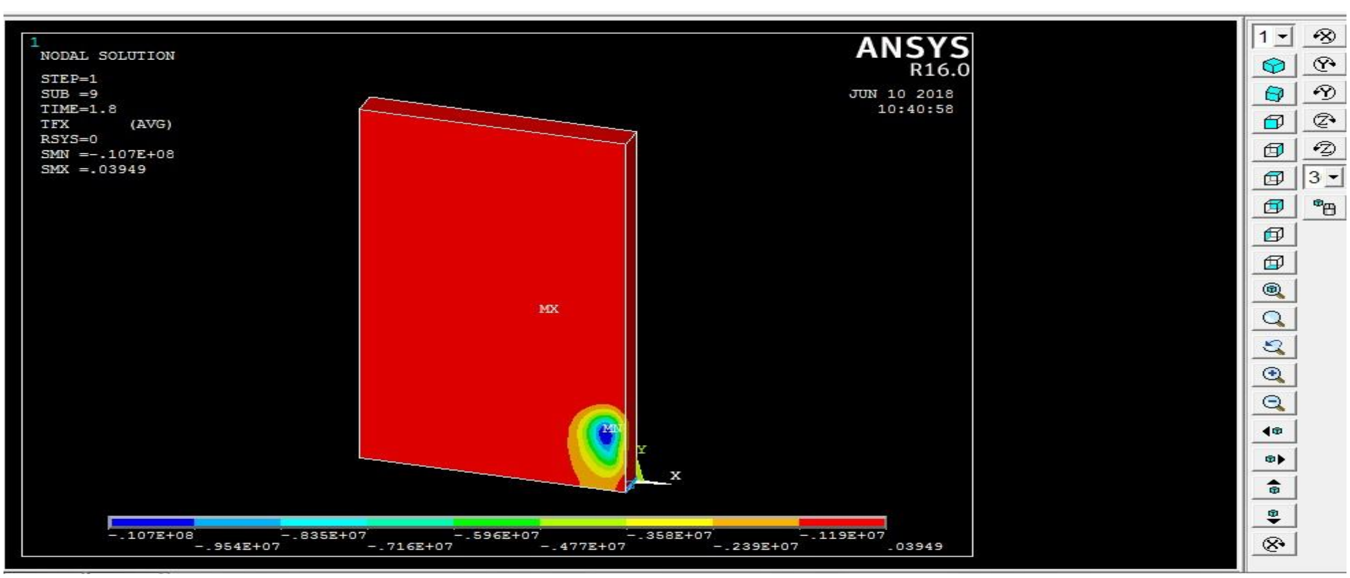
Temp. distribution alog the weld line at time t=0.4sec



Temp. distribution alog the weld line at time t=0.8sec



Temp. distribution alog the weld line at time t=1.8sec



Thermal Flux at t=1.8 sec

VI. CONCLUSION

This project started as an initial step at TIG welding process. We determined the temperature distribution and thermal flux at all time of welding.

A. By conducting experiments with weld parameters the heat flux is calculated and is used as input for the finite element analysis in butt-welding of plates.

B. Analysis of this weld joint gives useful information for the modeling of the process under different process conditions without carrying out real experiments on the machine, this saves money, time and resources.

C. Coupled field analysis is carried out to estimate the residual stresses. The maximum induced stress observed due to the temperature distribution of 548o C is 145 MPa.

D. The resultant distortion observed in the weld plate is 0.050mm

REFERENCES

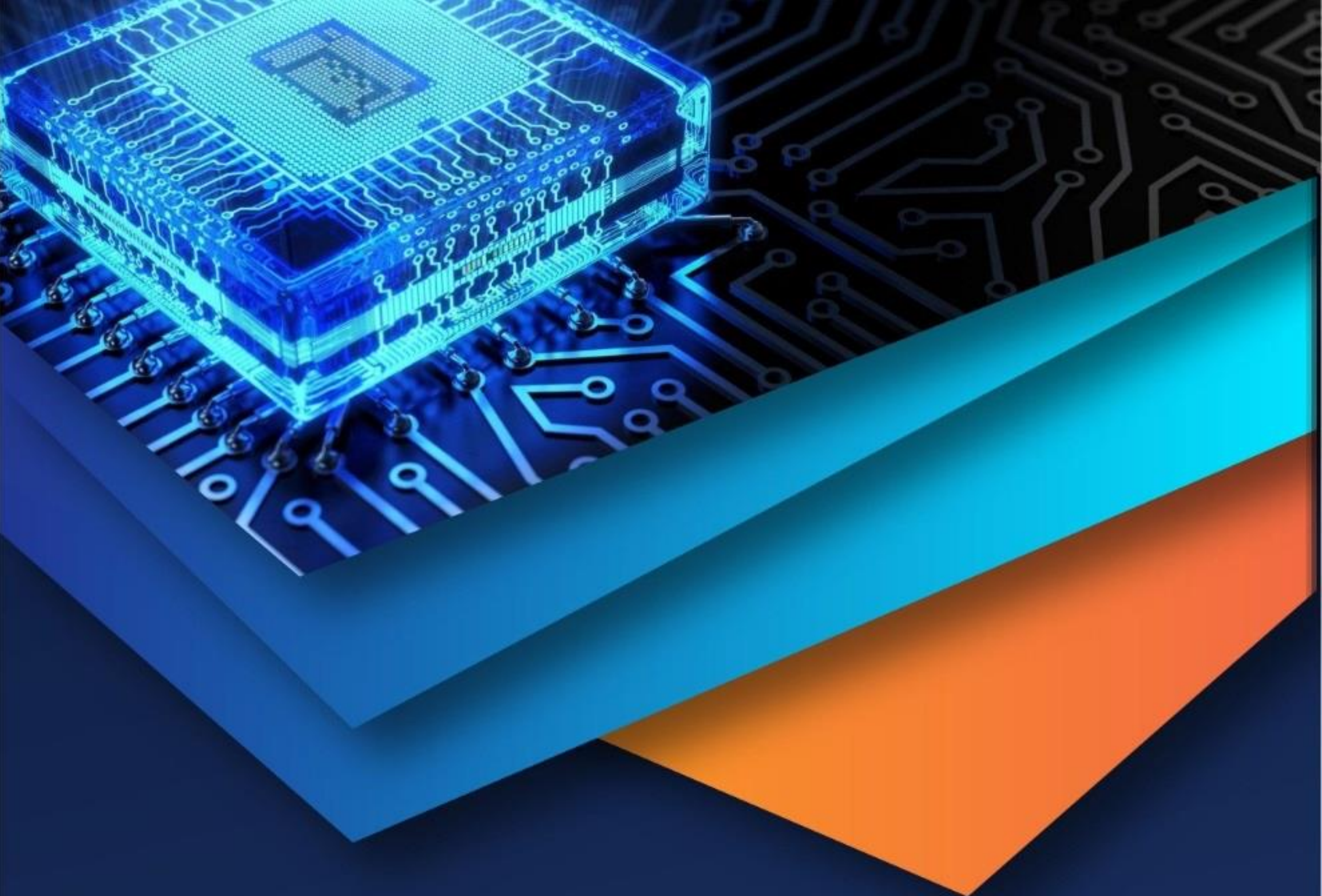
[1] Izhar Sabari , Dr S S Chouhan , Ranjeet Kumar [2017] " Strength analysis and optimization of orbital welding parameters " International Journal of Engineering Technology and Applied Science ,vol.3 May .

[2] N.I.S Hussein, M.N.Ayof, S.Nordin [2016] " Tensile Strength of Orbital Welded Mild Steel Tubes With Dissimilar Thickness " International Journal of Materials, Mechanics and Manufacturing, Vol.4, February.

[3] Abhishek B P,Anil Kumar G, Madhusudhan .T [2015] " Experimental And Finite Element Analysis of Thermally Induced Residual Stresses For Stainless Steel 303 Grade Using Gmaw Process ". International Research Journal Of Engineering and Technology , vol:2 May.

[4] Vishnu V.S, Nadeera M, Joy Varghese V.M [2014] " Numerical Analysis of Effect of Process Parameters on Residual Stress in Double Side TIG Welded Low Carbon Steel Plate" , International Conference on Advances in Engineering and Technology – 2014.

[5] Shankar Sehgal, Harmesh Kumar [2014] "Structural Dynamic Finite Element Model Updating using Derringer's Function : A Novel Technique



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR: 7.129

SJIFactor — TOGETHER WE REACH THE GOAL
IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY