# Simulation and Experimental Study on Mechanical Properties of Aluminium Alloys Welded by TIG Process

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***Abstract:*** *Aluminium alloys are widely utilised in the aerospace and automobile industries due to their low density and mechanical qualities, as well as their resistance to corrosion. Joining of Dissimilar and similar Aluminium alloys are required in many engineering applications. TIG welding is mostly used to weld thin sections for high surface finish. The heat-affected zone and other properties of a welded joint depends on the welding parameters. This study gives a basic understanding on change in mechanical properties and behavior of materials after welding process. In addition, this paper gives a detailed study of welding technique with an experimental detail. Aluminium alloys are becoming increasingly popular as the aerospace, marine engineering, and other industries develop. The future scope of this study will help in developments in Aluminum alloy welding. In this study microstructure analysis were employed. This analysis gave an idea about weld quality and how mechanical properties are varied with the weld. On a process of combining various weld parameters, The current study used tensile and microhardness experiments to evaluate and investigate the effect of various welding conditions on the ultimate tensile strength and hardness of welded specimens.The objective of this work is to simulate and study the mechanical properties of dissimilar and similar assemblies of Al alloys. The two dissimilar and similar aluminum alloys AA6061 and AA7075 were joined using TIG welding technique.*

***Keywords: Aluminium alloys; Welding technique; Mechanical properties***

## 1. Introduction

One of the most effective welding methods now in use, TIG welding can join almost any metal or metal alloy. Aluminum alloys are used in practically every industry since they are a lightweight metal, including aerospace production, defense, cars, food processing, structural, and cryogenic applications [1]. In the same light time, aluminum alloys will typically have excellent strength and flexibility. Aluminium alloys have a strong combination of great wear resistance and good corrosion resistance [2]. Steel, stainless steel, chromoly, aluminum, nickel alloys, magnesium, copper, brass, bronze, and even gold can all be joined together using TIG welding. TIG welding is helpful for welding wagons, bike frames, lawn mowers, door handles, fenders, and other items. Aluminum alloy 6061 is a heat-treatable medium to high-strength alloy with a higher strength level than alloy 6005A. It has a mild fatigue strength [3]. Even though its strength is reduced in the weld zone, it possesses excellent weldability and corrosion resistance. It has good cold formability. For the production of airplane parts like wings and fuselages, 7075 is frequently employed. In other industries, its strength and small weight are also advantageous. 7075 aluminum alloy is extensively used to make rock climbing equipment and bicycle components. Aluminium alloys 7005 and 6061 are also used in the bicycle industry[2,3]. Many researches recommended Tungsten Inert Gas (TIG) welding to achieve high-quality welds. It can also aid in faster welding speeds, reduced distortion, and the ability to weld thin welding sheets with less skill [4]. Tungsten inert gas welding TIG welding, which is also recognized as gas tungsten arc welding (GTAW), achieves fusion by applying heat to the workpiece through an electric arc formed between the tungsten electrode and the workpiece [3,4]. The most traditional method of welding aluminum alloys was TIG welding using a direct electric current source. When this electrode is linked to the negative pole of the battery [5]. It is known, that welding at this polarity is not effectively remove the oxide film from the aluminum Surface. Moreover, in this method of arc welding in an inert gas atmosphere a large amount of heat at the positive pole [6]. TIG welding method with an electrode, connected to the positive pole, leads to overheating and melting of the electrode. A shielding gas, such as argon or helium, is used to shield the molten weld pool from exposure to air contaminants. Argon is the more commonly used choice compared to helium due to its higher density, which offers superior protection even at lower flow rates. This shielding gas displaces the air around the welding arc and weld pool [2,7], ensuring a contamination-free environment.

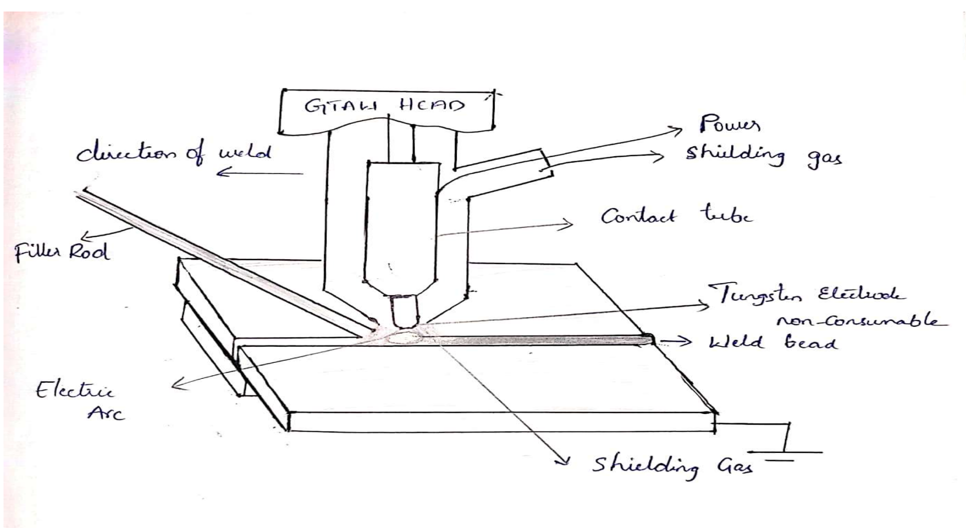



**Figure1. Schematic diagram of TIG welding**

The widespread use of aluminum alloys in the automotive and aerospace industries sparked research into the metals' tensile strength at weld joints. In this work, the impact of welding settings on 6 mm thick AA6061-AA7075,AA6061-AA6061,AA7075-AA7075 is investigated [7]. Tungsten inert gas welding was used to join the samples. By shielding argon gas, two passes of welding were performed to test the strength of the junction using ER4043 filler metal. To assess the strength of the welded joint, the microstructure, hardness, and tensile strength were assessed. A solid state joining can be employed for welding of AL6061 in large constructions [8]. During the welding process, the microstructure diversity will occur between the weld essence (WM) and the base essence (BM), resulting in mechanical parcel disparities. As a result, an appropriate welding system must be used to produce and design a good welded product. Due to its versatility and low cost, tungsten inert gas (TIG) welding is the most extensive gas shielded bow-welding procedure that may be used in connecting Al mixes [8,9]. TIG welding can create a high-quality, reliable procedure with lesser spatter and a better weld bead appearance.

**Table 1**

**Chemical composition of ER4043 filler wire**

| Base metal | Cu | Mg | Si | Mn | Fe | Zn | Ti | Cr | Al |
|---|---|---|---|---|---|---|---|---|---|
| ER 4043 | 0.3 | 0.05 | 5.1 | 0.05 | 0.8 | 0.1 | 0.2 | - | Bal |

## 2. Experimental procedure:

The materials utilized in this investigation were 7075 aluminum alloy and 6061 aluminum alloy. Test specimens were made in the dimension of 125x60x6 mm, using a power hack saw and filing operations . V butt joints of 45° were prepared for TIG welded joints for each plate, as shown in Fig. 1.Two different series of aluminium materials are used in this work. As the name includes two dissimilar alloys, aluminium 6061 and 7075 alloys are used [10]. Here both alloys are in a pure/base stage which means the alloys are taken without tempering. The chemical composition and physical properties are tabulated in the table 2

**Table 2**

**Chemical and physical properties of aluminium alloys**

In AA6061 we can observe magnesium (Mg) in higher weight percentage, which can build

| Chemical composition of Aluminium 6061 and Aluminium 7075 alloys | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Alloy** | **Magnesium** | **Silicon** | **Copper** | **Chromium** | **Mn** | **Iron** | **Zinc** | **Titanium** | **Al** |
| AA6061 | 0.80-1.20 | 0.40-0.80 | 0.15-0.4 | 0.04-0.35 | 0.15 | 0.7 | 0.25 | 0.15 | Rem |
| AA7075 | 2.10-2.90 | 0.40 | 1.2-2.0 | 0.18-0.28 | 0.30 | 0.5 | 5.10-6.10 | 0.20 | Rem |

| Physical properties of Aluminium 6061 and Aluminium 7075 alloys | | | | | |
|---|---|---|---|---|---|
| **Properties** | **Tensile strength Mpa** | **Yield strength Mpa** | **Thermal conductivity (W/m-K)** | **Melting point $^{o}C$** | **Hardness Hv** |
| AA6061 | 311.15 | 274.51 | 151-202 | 585 | 96 |
| AA7075 | 539.42 | 485.72 | 130-150 | 477 | 175 |

good strength in alloys as well as weldability and works as a corrosive resistance. Basically, by adding this to an alloy tensile strength of a material increased [11]. In AA7075, Zinc (Zn) is added almost 6% of overall alloy. Which means apart from Aluminium it holds a highest weightage. It is used for enhancing the heat treatable nature of the material and the chromium (Cr) provides high-temperature strength, increase the tensile strength.

Some of the major applications for this alloy are, AA6061 alloys are aluminum alloys that are known for their excellent combination of high strength, resistance to corrosion, lightweight properties, along with good ductility and toughness . On the other hand, AA7075 exhibits remarkable strength and has found extensive use in components for aircraft and other applications subjected to significant stress [12]. Both AA6061 and AA7075 materials are commonly employed in maritime fittings, vehicles, and aerospace applications .

### 2.1 Selection of filler rod for experimentation:

The study is about joining of dissimilar and similar aluminium alloy, from the literature and sources this series of alloys can be joined by TIG welding process. For the joining purpose we use a filler material, these are fed into the weld joint and add material for building the weld [13]. Here we have two types of TIG welding filler materials. They are

1. ER4043
2. ER5356

1.ER4043: ER4043 TIG welding rods have a higher tensile strength than ER5356 TIG welded rods. They are most used for 6 series alloys and are heat treatable. It is used in Flat, horizontal, Overhead, Vertical-Down and Vertical-Up weld positions [14].

2.ER5356: It is used for 5 series aluminium and is generally preferred if the finished price will be anodized.Based on the selected material ER4043 taken as a filler material for welding. Generally, filler material/filler rod will be in a circular shape. Chemical composition of ER4043 is tabulated in table 1 and the mechanical properties are as

**Table 3**
**Mechanical properties of ER4043**

| Parameter | Value |
|---|---|
| Tensile strength | 154-228 Mpa |
| Yield strength | 60-190 Mpa |
| Elongation | 5-12 % |
| Melting point | 573- 631 C |

### 2.2 Selection of gas flow and power range for tig welding:

Selection of a filler material is fully based on the thickness of the base metal. Here the thickness of both AA6061 and AA7075 was 6mm. According to the thickness the required flow rate and size of the filler rod was configured. Specifically, the material thickness and amperage required to make a proper weld [15]. Thicker materials will necessitate more current and, as a result, larger tungsten.Based on the on the diameter of the filler material the current range was consider from the data. The table 4 shows the specifications for electrode size and filler size

### 2.3 tig weld set up

In the current study, a DC argon arc welding machine is used for TIG welding of aluminum. The entire welding setup consists of an argon cylinder, primary power supply cable, [1,16] grounding cable, welding torch, Tig welding machine, and work piece.

**Table 2**
**Specifications for electrode and tungsten size**

| Metal guage | Joint type | Tungsten size | Filler size |
|---|---|---|---|
| ¼"(6.4mm) | Butt | 2.4mm | 2.4mm |

### 2.4 weld parameters

The welding parameters used in the operation were mentioned in the following table.The most important influencing factors that affect the weld quality or mechanical properties of TIG welded joints were identified by a thorough analysis of the literature and earlier work [1,17].

| Type | parameter |
|---|---|
| Gas Flow | 6,7,8 |
| Power | 150,170,190 |

Tig welding parameters were used for this study: current, voltage, and gas flow rate. Many pre-experiment runs were performed to find the appropriate range of parameters. The welding parameters that have been identified are listed in

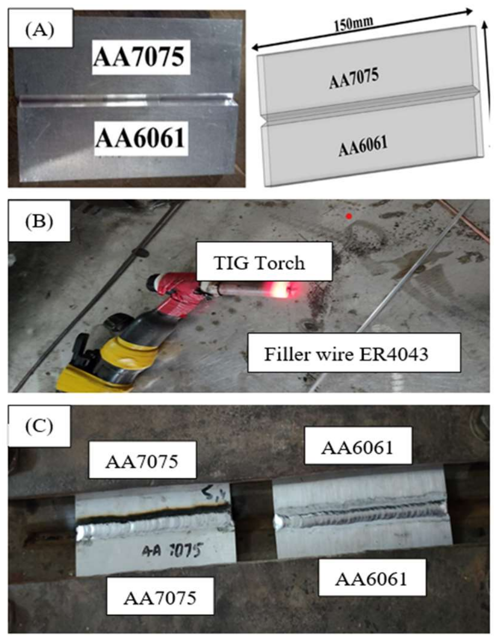
**Table 5**
**Weld parameters values**

| parameter | Specimen name | Gas flow (L/min) | Current (Amp) |
|---|---|---|---|
| 150A/6L | A | 6 | 150 |
| 170A/6L | B | 6 | 170 |
| 190A/6L | C | 6 | 190 |
| 150A/7L | D | 7 | 150 |
| 170A/7L | E | 7 | 170 |
| 190A/7L | F | 7 | 190 |
| 150A/8L | G | 8 | 150 |
| 170A/8L | H | 8 | 170 |
| 190A/8L | I | 8 | 190 |

### 2.5 Experimentation

The experimentation was carried out at Patel welding works, a private welding institute in Vishakhapatnam. Due to the availability of weld setup experimentation was carried out there. And specimens were purchased at Andhra steel distributers Hyderabad. To carry out the testing's specimens were cut down into required dimensions using wire cut EDM machine at Ganapati CNC bala nagar Hyderabad .Pre welding operations were done at department of mechanical engineering, JNTUK. The raw specimens were cut down into 250mm x 60mm x 6mm. Both AA6061 & AA7075 plates were taken for edge preparation. A single 'V' butt joints are considered for preparing weld joints. At first the workpiece should be cleaned properly. By using file the edges of the specimens are prepared an angle of 45º at each end. The edge preparation is shown in Figure 2

2

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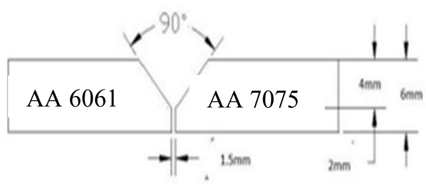



**Figure 2. Edge preparation for the sample , Figure 3. V ($90^0$) edge for the butt welding ,Figure 4. Images showing (a) weld plates (b) tig torch and filler wire (c) welded specimens**

The 9 different welded pieces were gone through the cutting processes for various testings After that the results were evaluated.

### 2.6 determination of mechanical characteristics

The mechanical and metallurgical properties of the prepared joints need to be tested and analysed. These analyses are done to figure out how strong the welded joints are. The yield strength, ultimate tensile strength (where the stress-strain relationships are drawn), and microstructures were tested and analysed. Micro- Vickers hardness is also recorded along with these measurements**.**

#### 2.6.1 Tensile test

Sample preparation for evaluation of tensile strength
The extension and Ultimate Tensile Strength (UTS) of all weld joints were evaluated using a universal tensile testing machine (UTES- 40HGFL). At room temperature, all of the samples were evaluated. Tensile samples were cut perpendicular to the weld ing direction, with the welded zone [1] deposited within the gauge length. The ASTM E8 standard was employed in the specification's creation

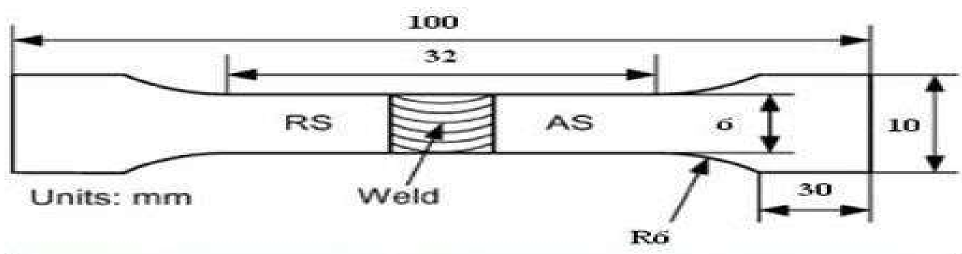



**Figure 5. Astm E8 standard tensile specimen dimensions**

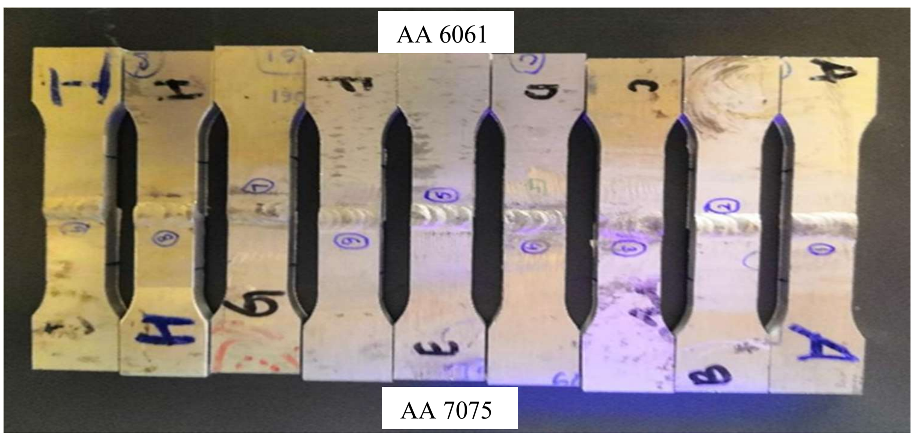



**Figure 6. Welded specimens with 9 different parameters**

The tensile test specimens were cut from the welded plate sample as per the ASTM E8 standards using wire cut EDM

### 2.6.2 evaluation of micro hardness

Following ASTM E3 standards, the sample from the welded joints is considered which is defect/ void free and sectioned into required dimensions. The samples were sectioned using hand cutting machine, as per the dimensions. Later the specimens should be grinded in order to avoid sharpe edges using grinding wheel. The specimens must be thoroughly cleaned and the surface should be flat along the cross-section at both sides of the specimen. The sample having dimensions of 20mm X 10mm X 6mm was utilized for the evaluating micro hardness. Microhardness tester for determining the hardness of various locations such as weld beads, HAZs, and base material. For each indentation, the dwell period was set to 10 seconds and a force of 500 gm was applied [1]. Hardness tests were performed on two separate locations to obtain a complete response of hardness variation due to the

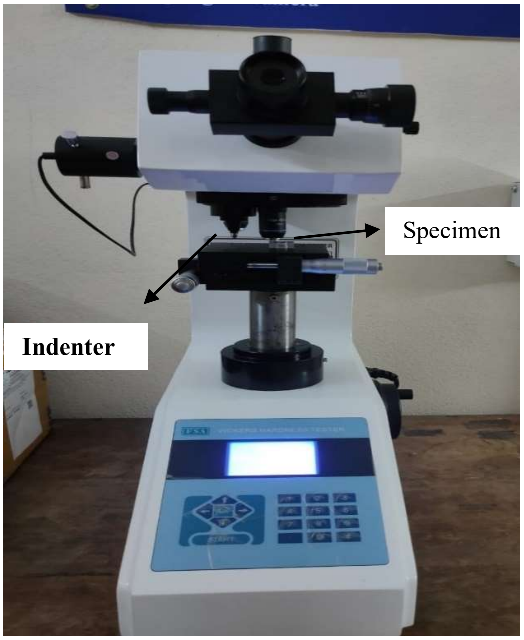



**Figure 7. Micro Vickers Hardness Apparatus**

conformation of different characteristic zones[10]. Beginning at the weld center.

### 2.6.3 Microstructural characterization

A Dewinter Technologies optical microscope is used for microscopic investigation. The welded plates were sectioned into test specimens for metallography in a transverse manner perpendicular to the welding direction so that the test specimen included different zones including base metal [5], weld zone, and heat affected zone. The metallurgical microscope's image-processing image recognising camera was used to take pictures of the microstructures, The test was conductued at IRC,JNTUK Typical specifications of optical microscope was shown in the below table

**Table 6**
**Specifications of an Optical microscope**

| Parameter | Value |
|---|---|
| Product | Metallurgical microscope |
| Maker | Dewinter Technologies |
| Eye piece | 10x |
| Resolution | 1000X |
| Magnification | 50X,100X,200X,500X,1000 X |

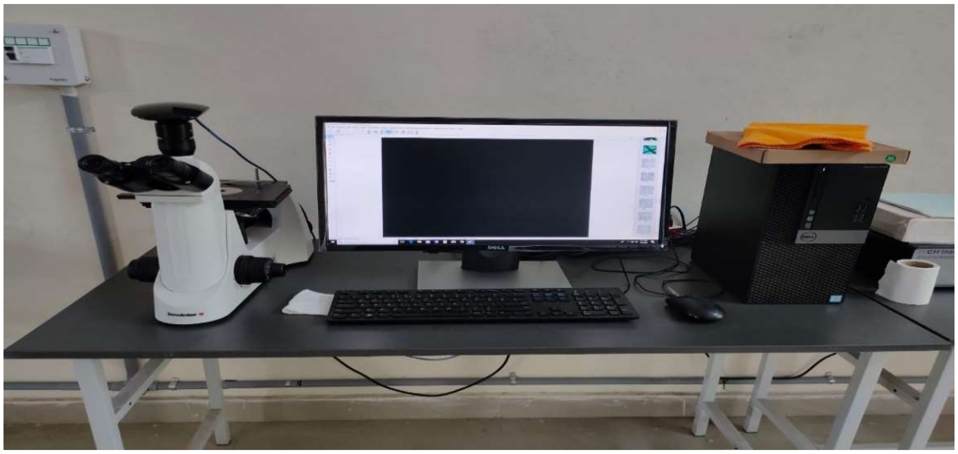


**Figure 8. Optical microscope apparatus**

### 2.6.4 Sample preparation for evaluation of micro structure

The sample from the welded joints sectioned into the requisite dimensions is taken into consideration in accordance with ASTM E3 standards. Using a hand cutting machine, the samples were divided into sections based on their dimensions. The specimens should then be ground using a grinding wheel to prevent sharp edges. The specimens must be carefully cleaned, and both sides of the cross-section should have a level surface. Here the sample dimensions was 20mm X 10mm X 6mm

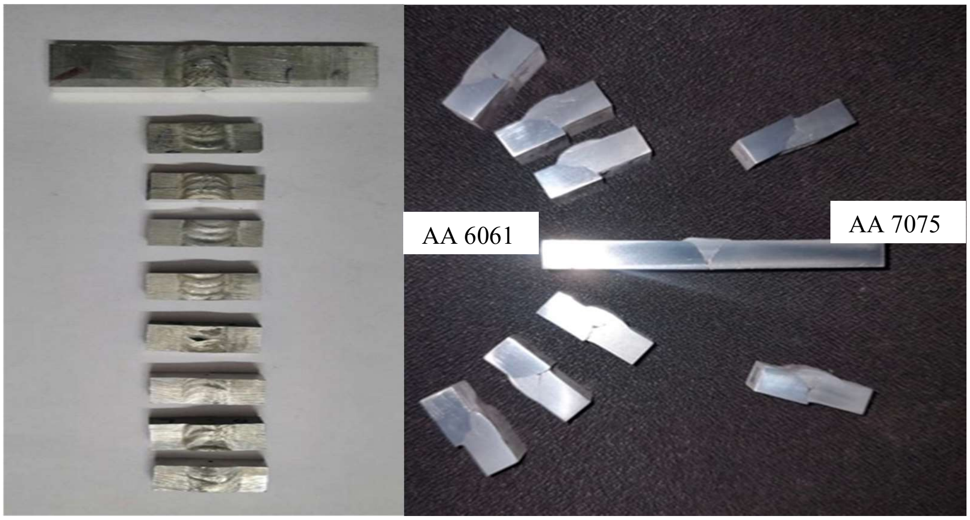



**Figure 9. Samples prepared for microstructure analysis,Figure 10. Polished samples**

## 3. Results and discussion

### 3.1 tensile result

From the tabulated results we can observe that specimen at 190 amperes 10 litre per minute gas flow rate has higher tensile strength as 51.630,63.7,57.63 Mpa. And almost all specimens show a good percentage elongation Among all these 150 amperes 6 litre per minute gas flow rate shows less tensile strength value, and on increasing the gas flow rate along with ampere range the tensile strength is increased

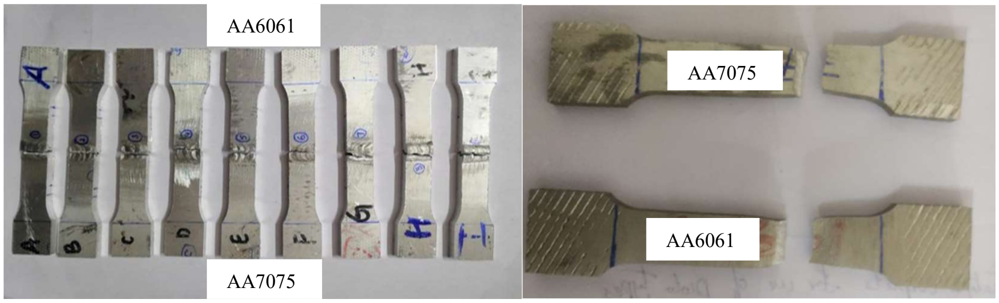



**Figure 11.Tensile specimens after test**

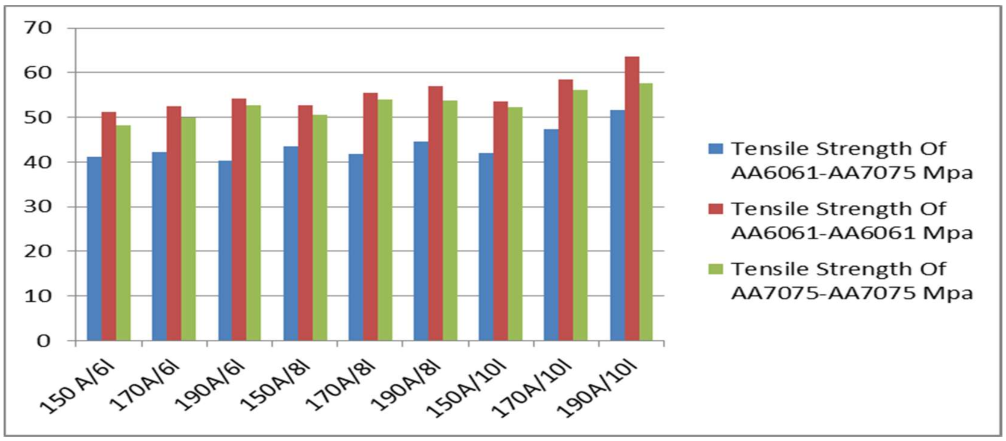



**Figure 12. Bar graph showing the comparison of tensile strength of three weld combinations at 9 parameters**

**Table 7**
**Tensile strength result for the weld combinations for different weld parameters**

| Parameters | Tensile Strength of AA6061-AA7075 Mpa | Tensile Strength of AA6061-AA6061 Mpa | Tensile strength of AA7075-AA7075 Mpa |
|---|---|---|---|
| 150 A/6l | 41.148 | 51.2 | 48.3 |
| 170A/6l | 42.160 | 52.5 | 50 |
| 190A/6l | 40.198 | 54.2 | 52.61 |
| 150A/8l | 43.599 | 52.6 | 50.529 |
| 170A/8l | 41.741 | 55.4 | 54 |
| 190A/8l | 44.673 | 56.9 | 53.72 |
| 150A/10l | 41.926 | 53.6 | 52.31 |
| 170A/10l | 47.445 | 58.5 | 56.129 |
| 190A/10l | 51.63 | 63.7 | 57.63 |

According to the aforesaid results, the greatest tensile strength was observed at 190 amp 10 litres gas flow . for further mechanical characteristics we have chosen specimens welded at 190 amps 10 litres per minute gas flow.

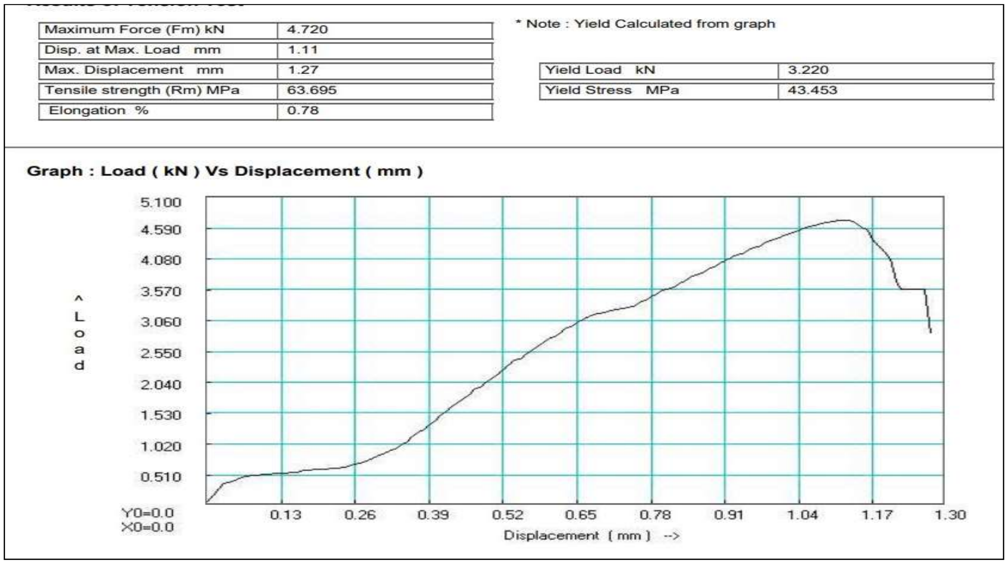



**Figure 13. Graph of AL6061-AL6061 welded at 190 Amps/10L per minute gas flow**


**Figure 14. Graph of AL7075-AL7075 welded at 190 Amps/10L per minute gas flow**

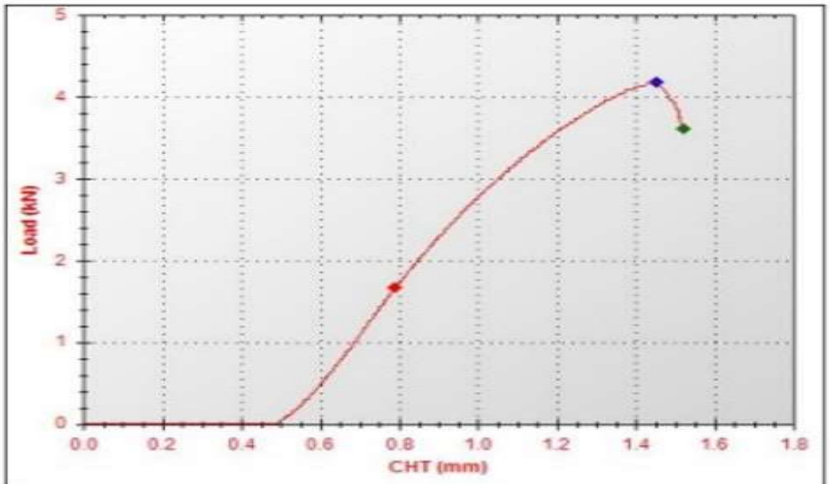



**Figure 15. Graph of AL7075-AL7075 welded at 190Amps/10L per minute gas flow**

### 3.2 micro hardness result

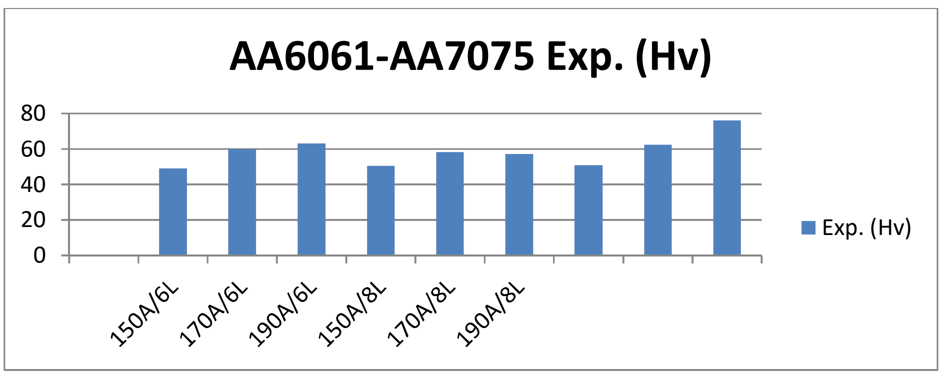



**Figure 16. Bar graph for AL 6061-7075 hardness**

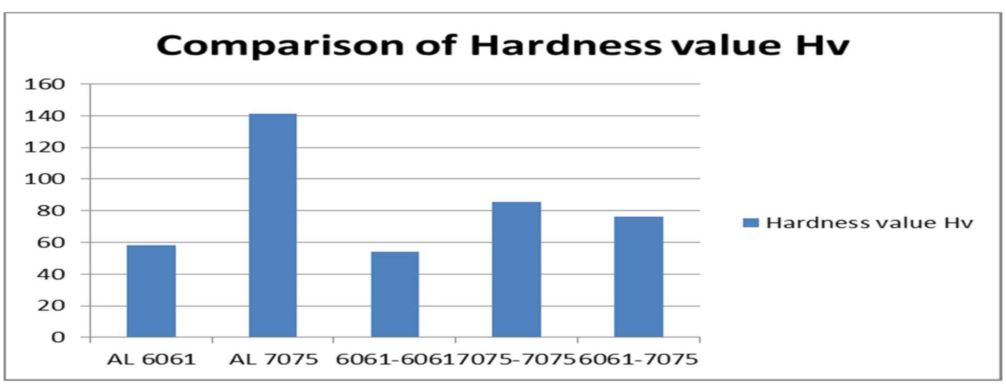



**Figure 17. optimum hardness values for all welds**

The table gives the detailed hardness values for each parameter.

**Table8**

**Vickers hardness values for AL6061-7075 weld**

| AL 6061-AL7075 | Exp. (Hv) |
|---|---|
| 150A/6L | 49.04 |
| 170A/6L | 59.69 |
| 190A/6L | 63.06 |
| 150A/8L | 50.5 |
| 170A/8L | 58.28 |
| 190A/8L | 57.14 |
| 150A/10L | 50.87 |
| 170A/10L | 62.29 |
| 190A/10L | 76.015 |

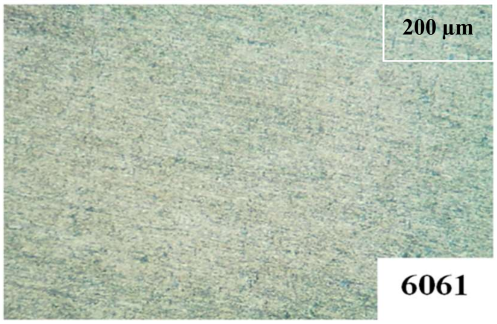
These all values are compared with base material hardness value. As the base material 6061 has 58.36 Hv and 7075 has 141.3 Hv. In the 9 different parameters was shows an effective result. In these values also at 190 amps and 10lit/min the specimen shows a peak value of 76.015Hv and low value as 49.92Hv at 150amps 6lit/min gas flow. The result itself indicates 190A/10L good hardness values microstructure reveals the 190 amps 10lit/min has good coarse grain structure

**Table 9**
**Hardness values for three combinations of welds at 190amps current and 10L/min gas flow**

| S.No. | Alloy Material | Hardness value Hv |
|---|---|---|
| 1. | AL 6061 | 58.36 |
| 2. | AL 7075 | 141.3 |
| 3. | 6061-6061 | 54.12 |
| 4. | 7075-7075 | 85.34 |
| 5. | 6061-7075 | 76.015 |

### 3.3 micro structure

The micro-structural characterisation of the TIG welded Al- 6061-7075, Al- 6061-6061, and Al- 7075-7075 samples of 6 mm thickness was done. reduced exaggeration of the optical microstructure of the weld zone The HAZ is primarily made up of fine grains. Additionally, the impact of welding speed on grain size has been observed [4] and extensively researched. demonstrates the optic microstructure of the emulsion zone under advanced exaggeration at different welding speeds. Additionally, it has been noticed that as welding speed is increased, the grain size in the emulsion zone decreases. This may be because heat input changes as welding speed is increased [4].



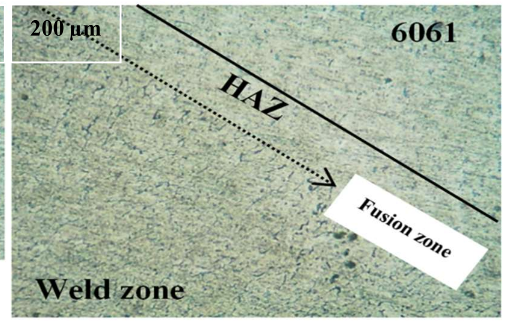




**Figure 18. Microstructure of AA6061 metal, Figure 19. Microstructure of AA6061 metal and weld zone**

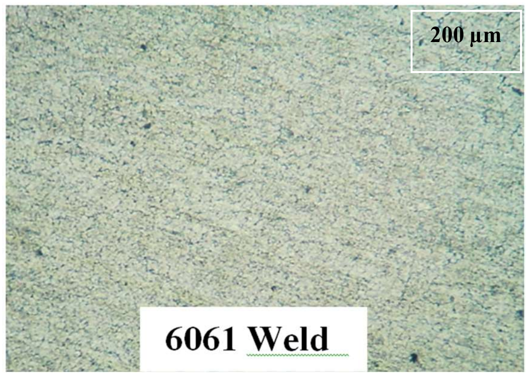
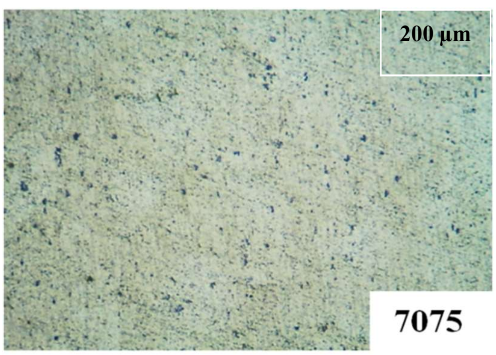



**Figure 20. Microstructure of AA6061-AA6061 weld zone**



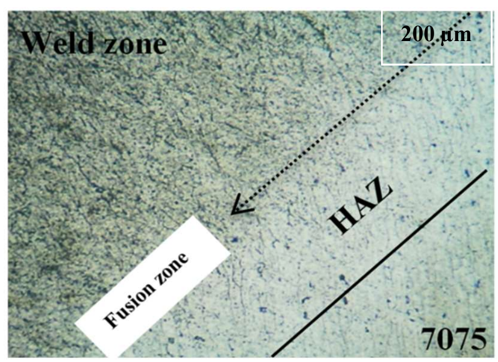
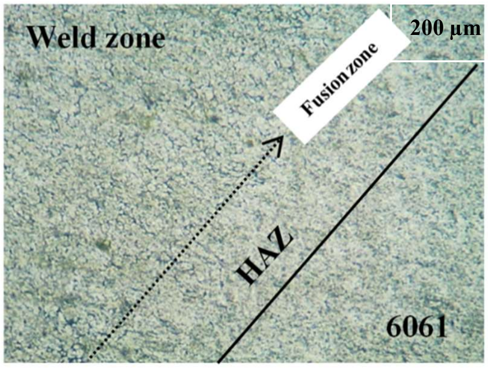




**Figure 21. Microstructure of AA7075 metal, Figure 22. Microstructure of AA7075 metal and weld zone**

**Figure 23. Microstructure of AA7075-AA7075 weld zone**



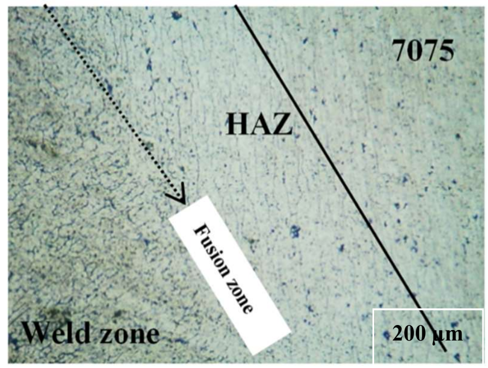




**Figure 24. Microstructure of AA6061-AA7075 ,Figure 25. Microstructure of AA6061-AA7075**

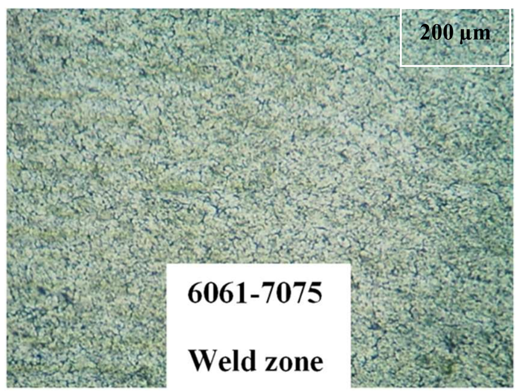



**Figure 26. Microstructure of AA6061-AA7075 zone**

Microstructure of 6061,7075 and their combination welds are analysed , from the analysis it is observed that the fine grains are formed in the weld zone it is clearly observed in 7075-7075 weld zone. The all images represent the microstructure of at 10 lit/min gas flow. But here even on increasing the power range we couldn’t fine the dark shaded part at heat affected zones and grain alignment and flow is good in nature. At 190 amps pure weld shows a good bonding between grains and we can see some connectivity also gaps. By comparing all these it came to know that the power range of 190amps shows a good bondage between weld 6061 as well as weld 7075. It recommended in a metallurgical point of view.

### 3.4 simulation of structural and thermal anlaysis using ansys

Ansys process

Step 1: Create the Geometry

1.Launch ANSYS Workbench and create a new project.

2.Import the geometry.

Step 2: Define Materials

1. In the Engineering Data workspace, define the material properties for Aluminium Alloy Al6061: Aluminium Alloy Al7075: ER 4043

2.Input the Young's Modulus, Poisson's Ratio, and Density for each material.

3.Assign these materials to appropriate sections of the geometry.

Material properties
Aluminium Alloy Al6061:
Young's Modulus: 68.9 GPa, Density: 2700 kg/m³, Poisson's Ratio: 0.33, Yield Strength: 240 MPa, Thermal Conductivity: 167 W/(m·K),
Aluminium Alloy Al7075:
Young's Modulus: 72 GPa, Density: 2810 kg/m³, Poisson's Ratio: 0.33, Yield Strength: 460 MPa, Thermal Conductivity: 130 W/(m·K),
ER 4043:
Young's Modulus: 70 GPa, Density: 2690 kg/m³, Poisson's Ratio: 0.33, Yield Strength: 120 MPa, Thermal Conductivity: 130 W/(m·K)

### 3.4.1 Material assignment

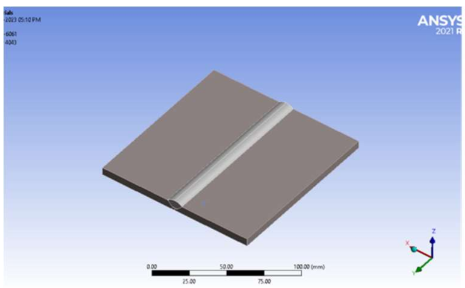
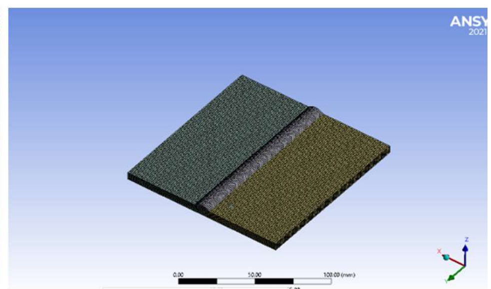



**Figure 27. material assignment for plates , Figure 28. Meshing of plates**

Step 3: Meshing
1.Go to the Meshing workspace.
2.Generate a suitable mesh for your chassis geometry. A fine mesh is usually
Preferred for accurate results
3.Ensure that the mesh is refined at critical areas, such as stress concentration points.Here, after the material selection is complete, we must develop meshing for each object. Mesh signifies breaking up a single part into a number of pieces. This mesh will also transfer applied loads for the entire object. Only once meshing is complete can we solve our problem. Without mesh, we are unable to resolve our issue. Additionally, the model displayed below is created using tetra meshing.

### 3.4.2 Boundary conditions

Step 4: Apply Boundary Conditions
1.Return to the Engineering Data workspace and set up the boundary conditions.
2.Apply the 4321N force as a distributed load on the relevant locations of the object.
3.Fixtheappropriate faces to simulateconstraints.
4.Later apply convection on areas 27*c as bulk temperature, and film coefficient value is 5e-6w/mm^2*C,
5.Conduction 300*C
6.Solve results like deformation and von misses stress and strain and total temperature and heat flux values.

### 3.4.3 Structural and thermal boundary conditions

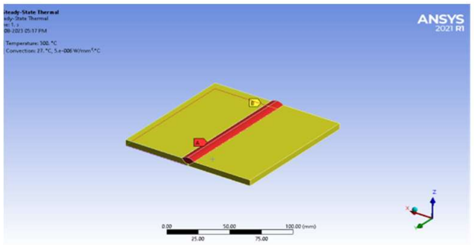
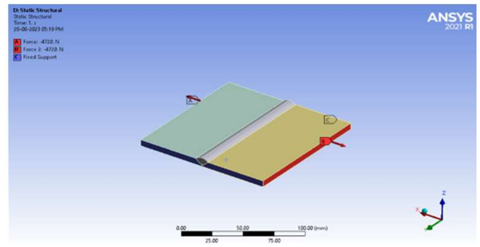



**Figure 29. Thermal boundary conditions , Figure 30. Structural boundary conditions**

## Results

### Al 6061-Al 6061

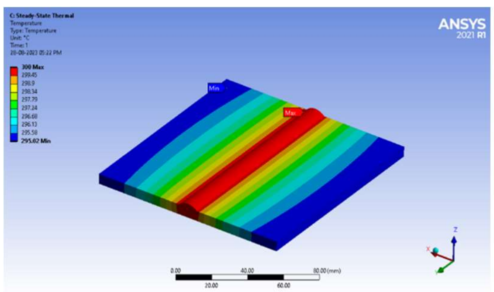
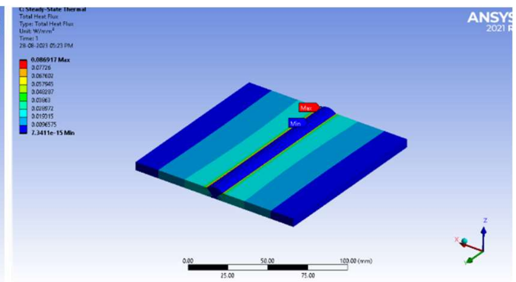



**Figure 31. Total temperature , Figure 32. Total heat flux**

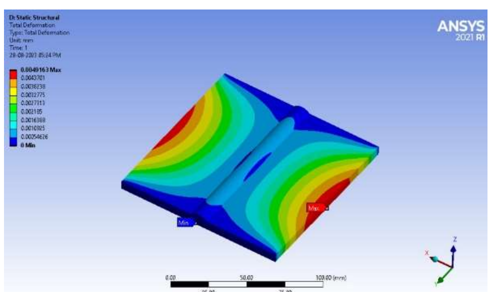
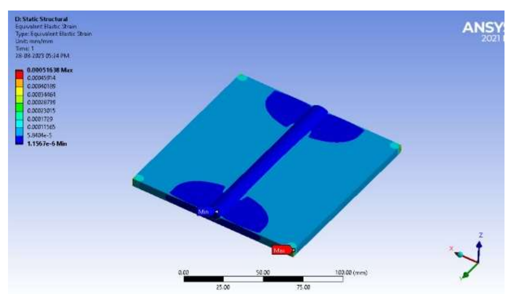



**Figure 33. Total Deformation , Figure 34. Total Strain**

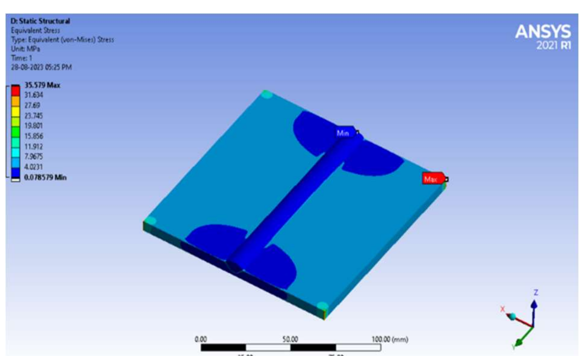
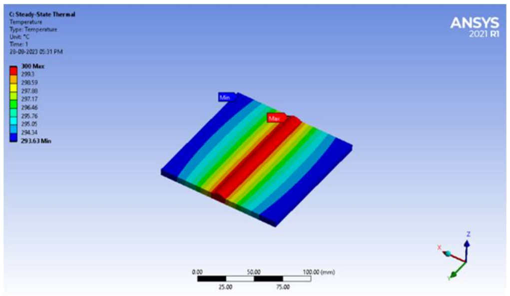


**Fig. 35. Equivalent Von mises stress**

**Al7075-Al 7075**



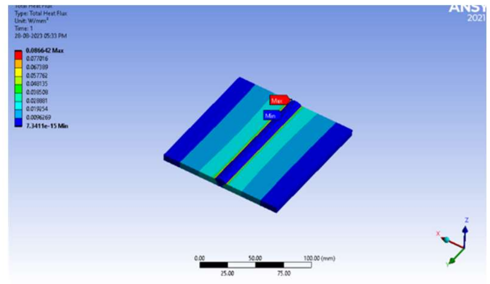
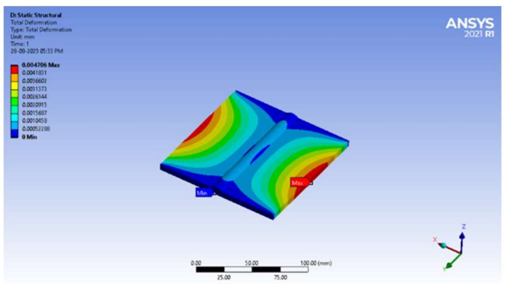


**Figure 36. Total temperature , Figure 37. Total heat flux**



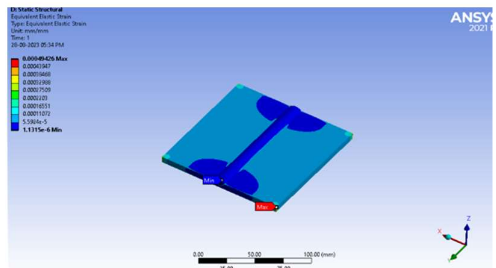


**Figure 38. Total Deformation , Figure 39. Total Strain**

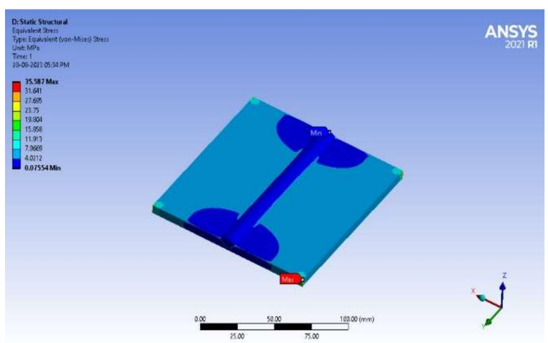
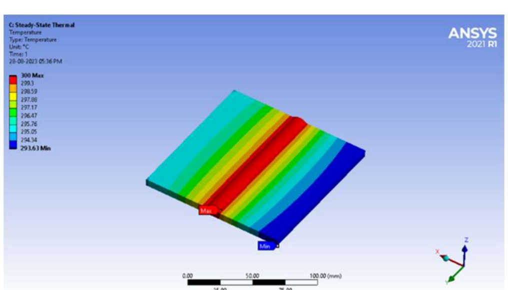



**Figure 40. Equivalent Von mises stress**

**Al6061 & Al 7075**



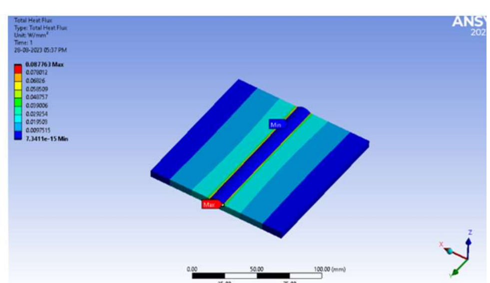


**Figure 41. Total temperature , Figure 42. Total heat flux**

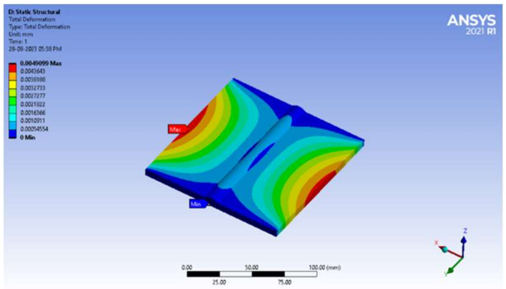
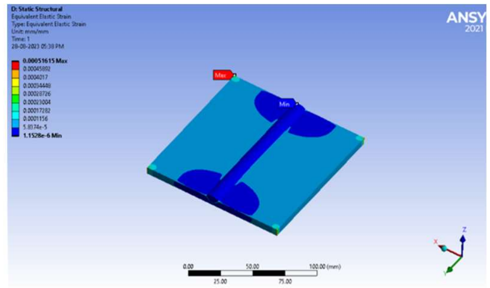



**Figure 43. Total Deformation , Figure 44. Total Strain**

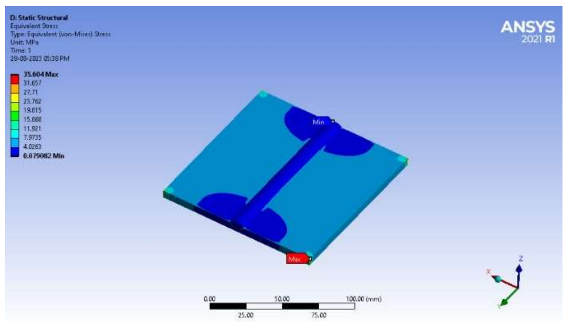


**Figure 45. Equivalent Von mises stress**

## 4. Conclusion

The purpose of this research is to investigate the tungsten inert gas (TIG) welding of Al-6061, Al-7075, and Al-6061-Al-7075 alloys of 6 mm thickness in butt welded. The effect of welding current and gas flow rate on the microstructure and mechanical properties of the weld zone has been investigated. This experimental inquiry yielded a significant conclusion summary.

- Some pores were identified in Weld microstructure which is due to oxidation.
- The grain size was gradually decreased on increasing the current flow at 190A/10L –6061/weld (ER4043)/7075 it shows a good metallurgical behavior compared to other specimens. And there it behaves like a good heat absorber.
- At constant welding voltage and current, the tensile strength of the welded joint falls as welding speed increases.
- The micro-hardness of the weld zone in the weldment is less than that of the base materials as received.
- With an increase in welding speed, the fusion zone's average micro-hardness rises.

**Table 10**
**Simulation results**

| Material | Total heat flux W/mm$^2$ | Total deformation Mm | Stress Mpa | Strain mm/mm |
|---|---|---|---|---|
| A6061-A6061 | 0.086917 | 0.0049163 | 35.579 | 0.00051638 |
| A7075-A7075 | 0.086642 | 0.004706 | 35.587 | 0.00049426 |
| A6061-A7075 | 0.087763 | 0.0049099 | 35.604 | 0.00051615 |

The other part of this study is thermal and structural analysis of tig welding by using ansys in this study at we achieved equivalent von mises stress,total deformation,strain,total heat flux ,as mentioned above.


## 5. Acknowledgement

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