

# **Laporan AKHIR (KP801)**

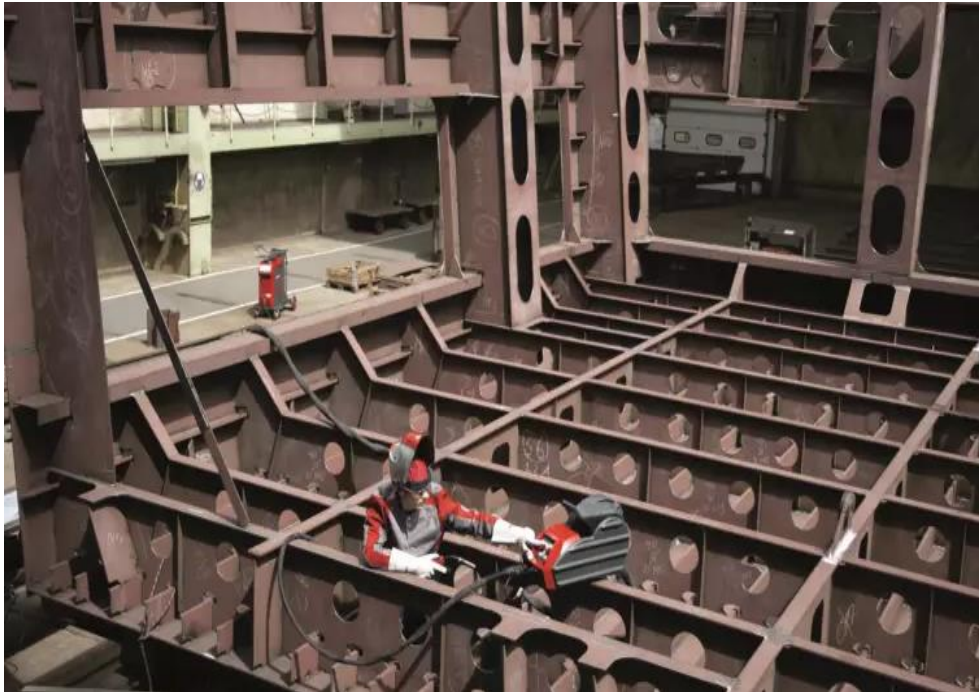
## **WELDING DISTORTION ANALYSIS ON WELDING JIG/FIXTURE USING FINITE ELEMENT METHOD**

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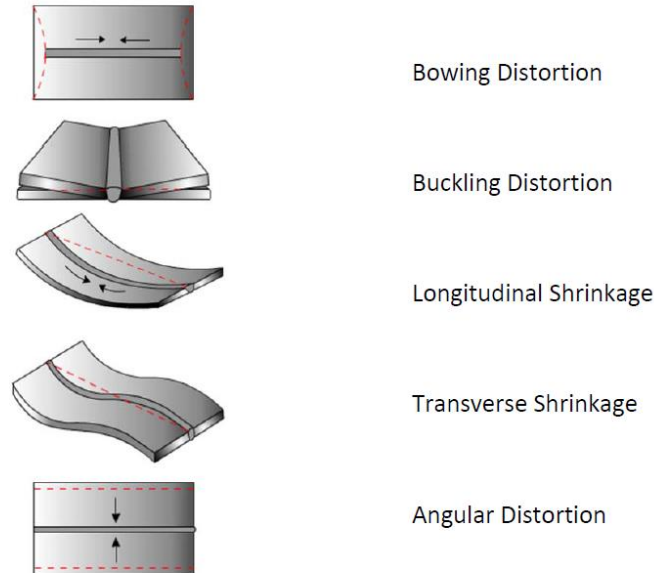
**Jurusan Teknik Mesin  
Program Studi Teknologi Rekayasa Konstruksi Perkapalan  
Politeknik Negeri Batam**

## 1.0. Introduction



- In the fabrication processes associated with the marine and oil/gas industries the most frequent of which is SMAW (Shield Metal Arc Welding). The primary disadvantage of this joining process, however, is that all of these techniques require a high heat to melt the components together and cause distortion

FIGURE 1 FABRICATION PROCESS



- This creates opposing forces, or stresses within the metal this imbalance of stresses leads to distortion in the welded component. If these stresses exceed the material's yield strength, it can cause permanent deformation the components together making a distortion

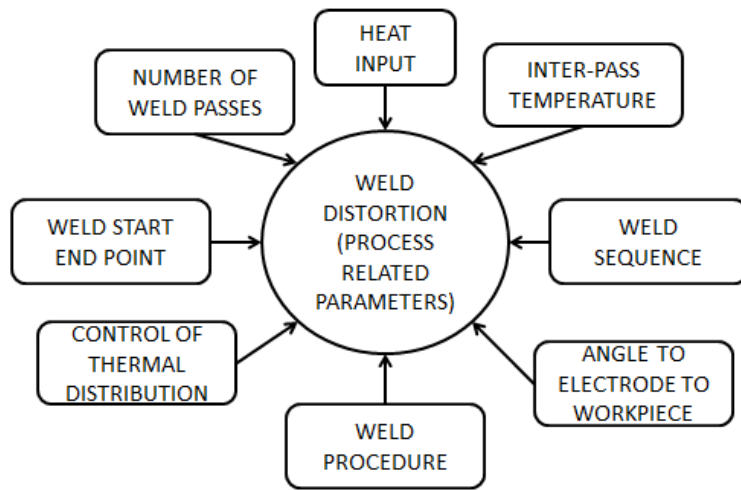
FIGURE 2 DISTORTION ILLUSTRATION



**FIGURE 3 JIG/FIXTURE ON  
FABRICATION PROCESS**

Because these distortions need to be repaired, they also result in financial losses, to counter this problem is making a support to adjust the material prior welding that called Jig/Fixture. since welding distortion occur when welding process it made with the purpose to maintain the material to be adjust in a fixed position so that even after weld it still maintain its designated position

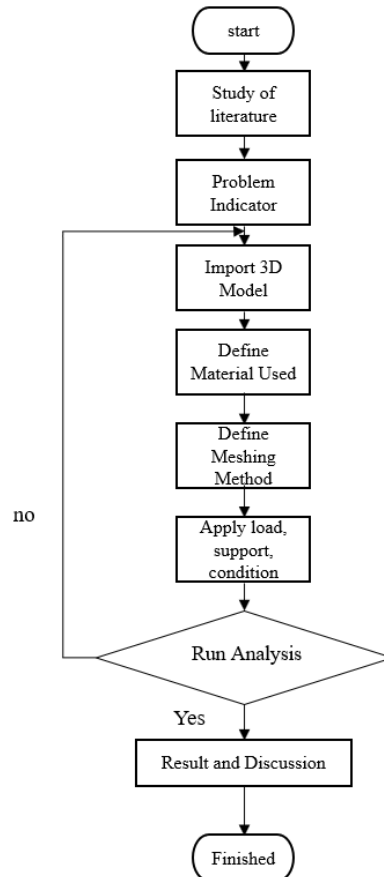
## 2.0. Basic Theory



**FIGURE 4 WELDING  
DISTORTION PARAMETER**

Involving phases that range from identifying the problem to analysis and assessing the product. The process of problem identification involves gathering and analyzing all information pertaining to the design of jigs and fixtures. There are many factors that a welding distortion can occur from heat input, material properties, welder skill, equipment failure, human error, etc. because of these factors the residual stress remains on the heat when welding and after welding making a deformation that can't be prevented only can be controlled.

## 3.0. Research Methodology



- Welding distortion occur by uneven heat on the welded area of parent metal causing a product deviation, Fixture purpose is to maintain its fixed position on a material, so it need more study for consideration during the tool design phase. as its first step to studying the frame which the jig and fixture will be attached by using pertinent and acceptable references in the problem-solving process.

FIGURE 5 FLOWCHART

- weld size will be 5 mm and sized of plate for joint are 200 mm x 200 mm x 8 mm preparation method follows EN ISO 15614- 1:2012 [9].

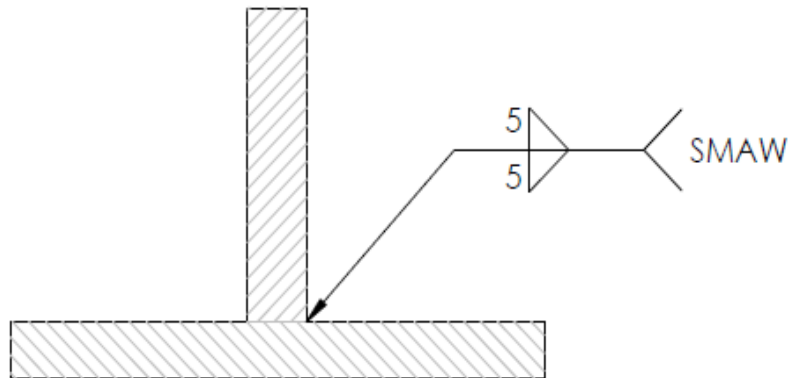


FIGURE 6 T-JOINT

**Table 1 Mechanical Properties of ASTM A36**

Material Grade	ASTM A36
Density	<u>7.80</u> g/cc
Elongation	20-23%
Yield Strength	250 Mpa
Tensile Strength	400 Mpa
Coefficient of Thermal Expansion	$11.7 \times 10^{-6}$ (°C)

# RESEARCH SKETCH

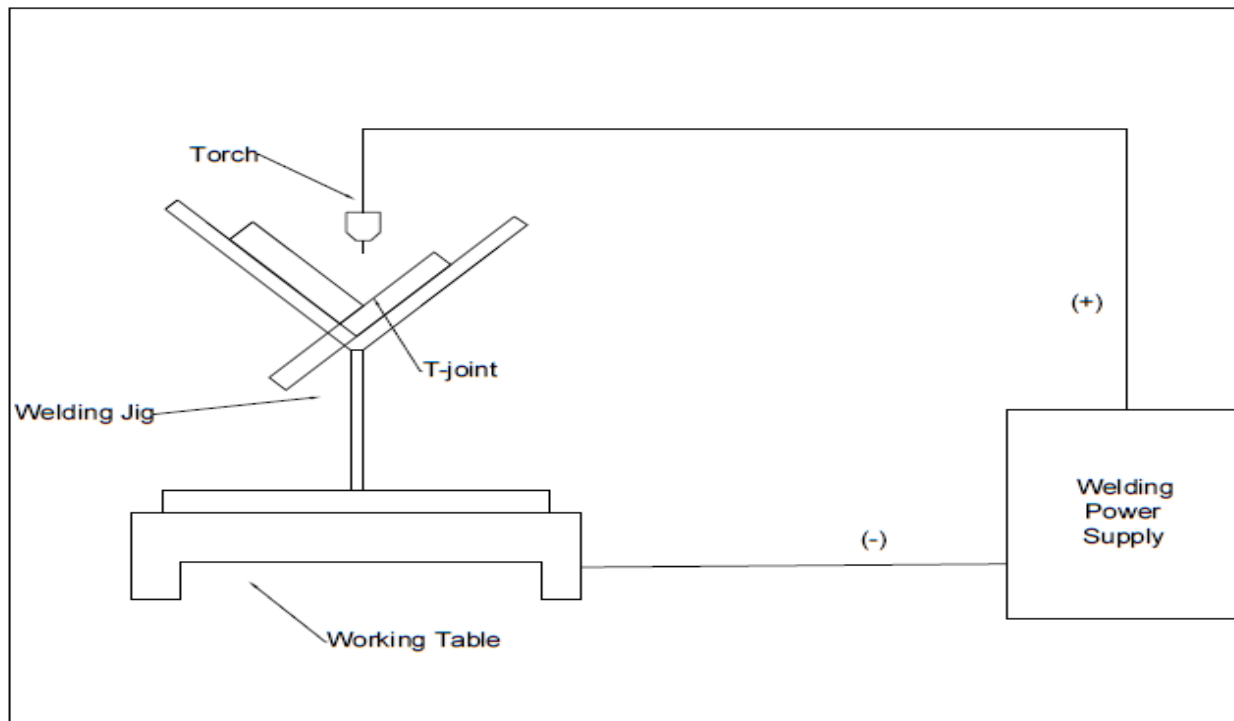


FIGURE 7 FIXTURE SKETCH

## 4.0 Hasil dan Pembahasan

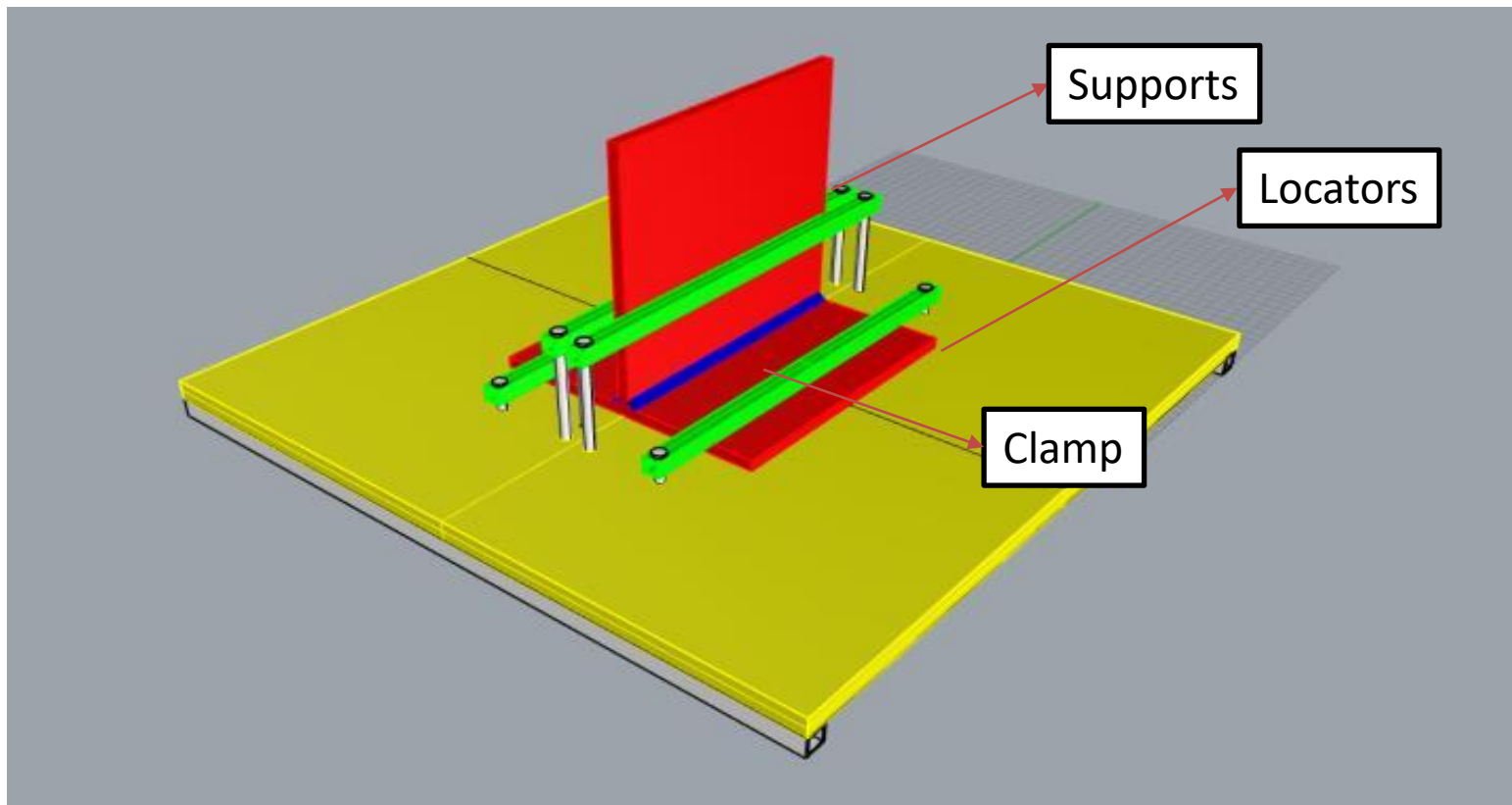


FIGURE 8 FIXTURE DESIGN

TABLE 2 FIXTURE DESIGN MATERIAL

No	Component Name	Material	Dimension
1	Base Plate	MS	236 mm x 200 mm x 15 mm
2	Bolt	Grade 8.8	Diameter 4 mm, Length 15 mm
3	Nut	Grade 8.8	4 mm
4	SHS	MS	12 mm
5	SHS	MS	13 mm

## Transient Thermal Analysis

- 700 °C reference often pertains to the average temperature around the weld area visualization resulting maximum temperature of 716.11 °C , and the minimum is 22 °C

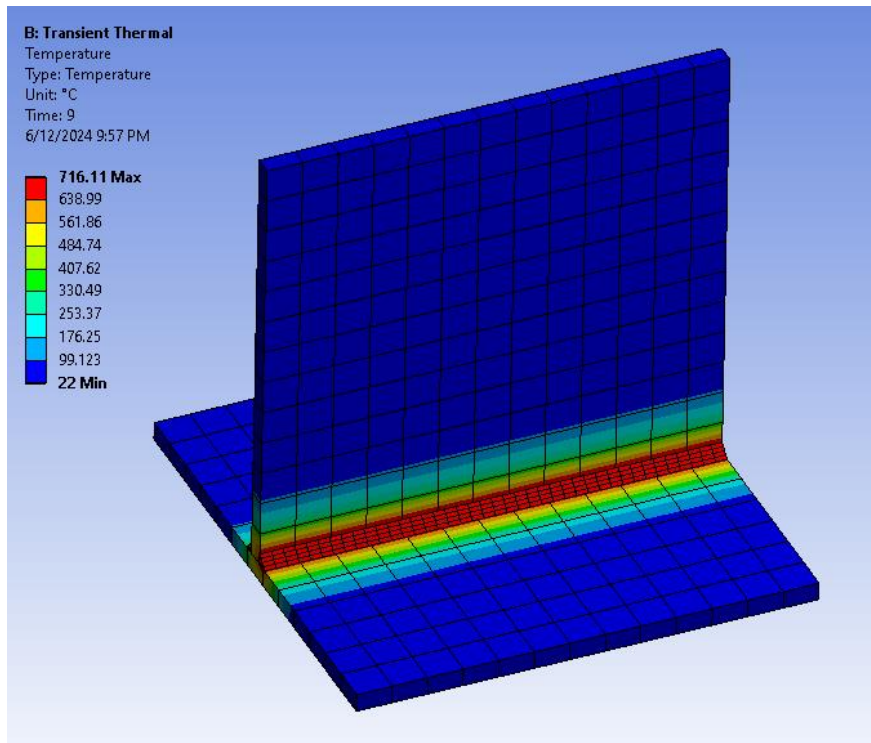


FIGURE 9 TRANSIENT THERMAL VISUALIZATION

# Static Structural Analysis

- indicate that the deformation is located in start and end weld point with the maximum deformation of T-Joint with designated boundaries are 0.77 mm on the fillet weld and maximum equivalent stress with designated boundaries are 277.41 Mpa

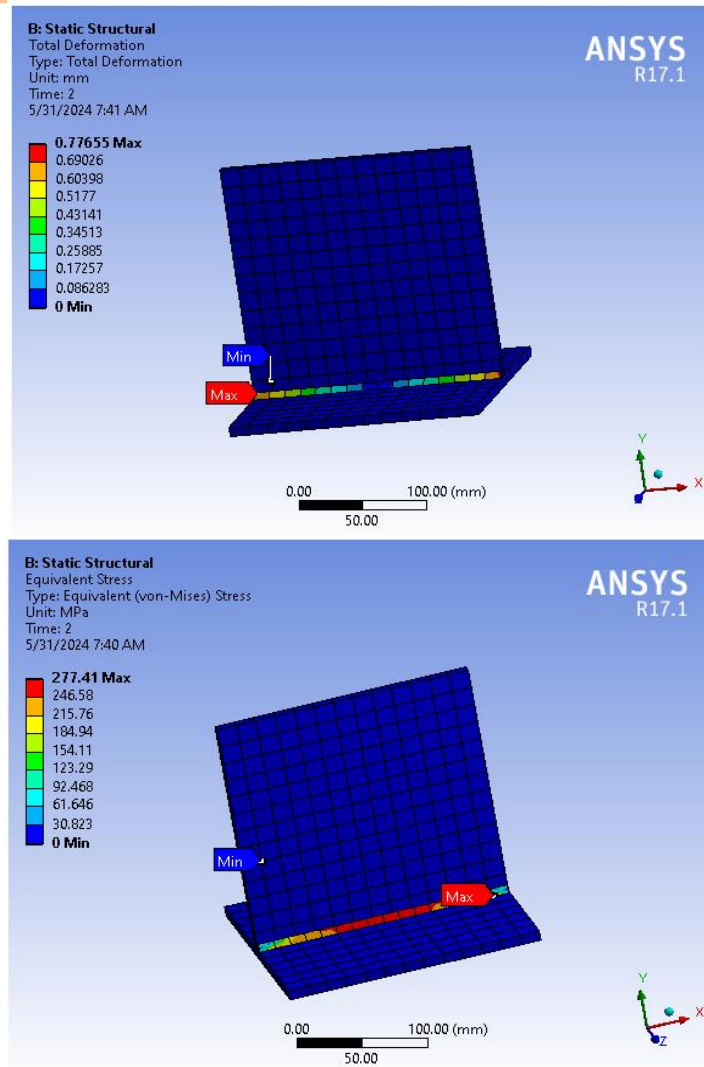


FIGURE 10 DEFORMATION AND EQUIVALENT STRESS VISUALIZATION

## Factor of Safety

- Jig factor of safety is conducted with setting boundary and the load that the jig will withstand maximum 500N, the result of the factor of safety using FEM Analysis are 15

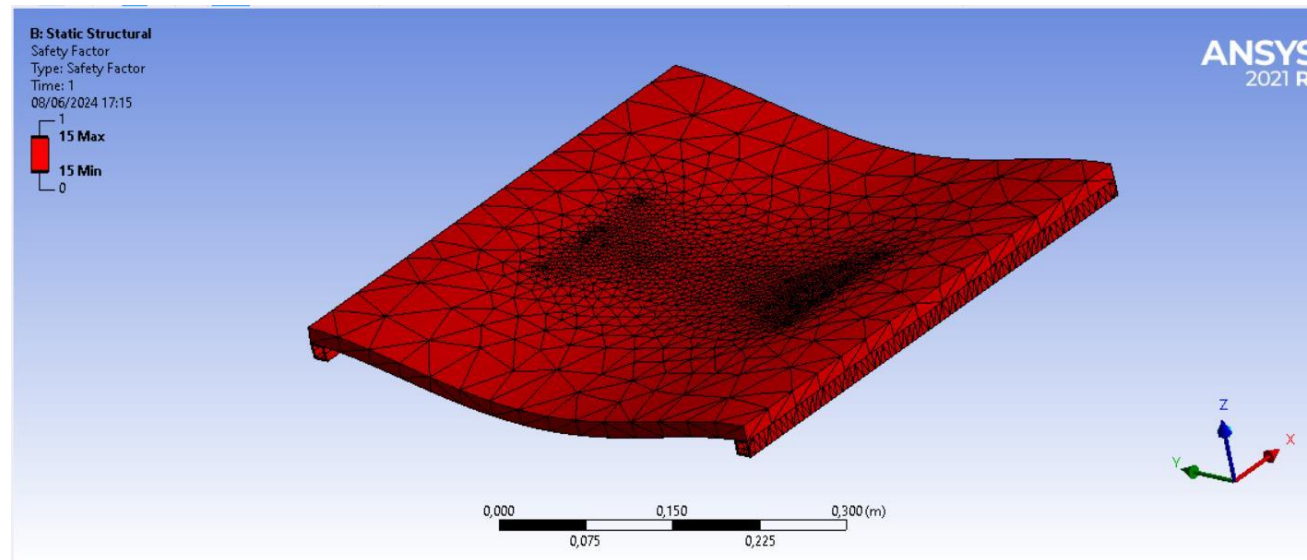


FIGURE 11 FACTOR OF SAFETY VISUALIZATION

## 5.0 Conclusion

- In order to joint materials together, welding often includes heating the connection. Both contraction and expansion are caused by heat. Distortion may arise from unequal heating and cooling. The distortion is a result of residual stress that is created while welding. Because of it one solution that is necessary is to control the distortion using Jig/Fixture Method, this method use to maintain its designated position of the parent material prior, during, and after welding in a fixed position. this study shown and develop a 3D FEM analysis on how the T-Joint weld set on design fixture make it a fixed position with the result of :
  - Total deformation on the T-Joint on the Fixture/Jig of minimum value is 0 mm and maximum 0.77 mm with the visualization the maximum total deformation area in the start and end point of fillet weld
  - Stress Analysis visualize the point of the maximum stress are with the value of 277.41 Mpa
  - Result of thermal analysis pointing that the temperature of maximum 716.11°C on the fillet weld being transfer to the parent material thoroughly
  - Factor of safety result of the Jig of the value of 15 with 500N Applied load that confirm the Jig/Fixture are safe.
- In Conclusion, welding fixture are a valuable investment for any company involved in production welding. Their ability to improve accuracy, quality, productivity, and safety. And hoping with this study can be a better reference into making a better welding fixture.

## Daftar Pustaka

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# THANK YOU

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