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The Effect Of Variation Of Welding Camp On The Strength Of The Arc Joint Welding Sheltered Metal Arc Welding (SMAW) On Steel St 37

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Abstract

In this study will discuss the extent to which the strength of the st37 steel or low carbon steel arch test after welding Shielded Metal Arc Welding (SMAW). ST37 steel or low carbon steel is formed into specimens with three models of kampuh, namely Double V kampuh 60°, single V kampuh 60° and single slope kampuh 30° as many as 9 (nine) specimens. Furthermore, welding with a current of 90 A and electrode e 6013 then performed a curved test to determine its mechanical properties through the test Universal Testing Machine (UTM) type Tarno Test UPH 100 kN at the State Polytechnic Laboratory Medan. From the data obtained after the analysis can be concluded that the specimen of Type V double camber has the highest value of curved strength is the value of the average curved strength of 1063.96 MPa, of Type V single and single slope camber. This is possible because there are two sides of welding and a large angle of 60° which makes the Weld strong. While the type of single slope welding camp has the lowest arch strength value due to the small welding angle of 30° which makes the welding process difficult and the electrode is not completely filled at the root of the Weld.

Keywords: Welding Camp, Welding Sheltered Metal Arc Welding, Steel St 37

INTRODUCTION

With the development of industrial technology today, it cannot be ruled out the importance of the use of metal as the main component of the production of an item, ranging from the simplest needs such as household appliances to building construction and machinery construction. This causes the use of metal materials such as cast, steel, aluminum and others to increase. The metal gives rise to the need for assembly or connection technology. One of these connection technologies is by welding (welding). Metal splicing techniques are actually divided into two large groups, namely: temporary joint and permanent joint.

Welding is the connection of two or more materials in a plastic or liquid state by using heat or pressure or both. The most widely used welding method today is welding with a shielded electric arc. Shielded electric arc welding or SMAW welding (Shielded Metal Arc Welding) is a welding process that uses heat to Melt base materials and electrodes. The strength of the welding results cannot be separated from several factors, namely the strength of the current used, the position and the weld joint so that the determination of the position and the right type of Joint must be considered to produce a good welding connection. The current strength that is often used in welding is adjusted to the thickness of the material and the diameter of the electrode.

To determine the quality of the results of the welding connection of the SMAW process, it is necessary mechanical test including bending test. Bending testing is used to measure the strength of the material due to loading. Bending strength or bending strength is the largest bending stress that can be received as a result of external loading without experiencing large deformation or failure. Therefore, to overcome these problems in need of a study of the variation of the type of welding camp in order to determine which campuh variation is appropriate to use in the welding process of the bending strength of the results of low carbon steel SMAW welding joints.

a. Steel ST 37

St 37 steel is a low carbon steel equivalent to AISI 1045 with a chemical composition of carbon: 0.5%, manganese: 0.8%, Silicon: 0.3% ditajmbah other elements. With a hardness of ± 170 HB and a tensile strength of 650-800 N/mm2. In general, St 37 steel can be used directly without

heat treatment, unless special use is required. This steel is widely used for the manufacture of tooling equipment, gears and general construction because it has weldability and can be done in the machining process well.

b. Shielded metal Arc Welding (SMAW)

Umata's Focus in this study is welding using electric arc welding or SMAW (Shielded Metal Arc Welding), in this discussion the author will discuss about SMAW welding. According to Suharto (1991: 77) electric arc welding or better known as Shielded Metal Arc Welding is a welding process with an electric arc where heat is obtained from the arc that radiates between the electrode (with Flux sheath) and the workpiece. The parent metal in this welding undergoes melting due to heating from an electric arc that arises between the tip of the electrode and the surface of the workpiece. Bususr electricity generated from a welding machine.

Some things that need to be considered in the welding process of Shielded Metal Arc Welding (SMAW) include:

1. Current Source

The electric current that has a large current is causing sparks on the welding electrode associated with the part to be joined (welded) so that there is high heat to melt the metal. The current source in the electric welding machine is alternating current (AC), direct current (DC) or can also be AC-DC. AC welding machine the machine needed is electric current from PLN. The advantages of using an AC welding machine are relatively cheaper equipment, a small arc flame that reduces the incidence of porous on the welding holes. The disadvantage is that it cannot be used for all types of electrodes, in addition, it cannot be used to weld all types of metals.

DC current machine its main advantages electric arc flame is stable,all kinds of electrodes can be used in DC welding machine, low noise level, flexible welding machine can be changed alternating or direct current. This welding there are 2 kinds of DC welding, namely stationary welding that can not be moved and portable welding can be moved as well as mobile welding machines where the machine is rotated by a gasoline motor or diesel installed with the welding machine to produce electric current that is not reached by the electrical network.

2. Arc Voltage

In general, it can be said that the welding current determines the penetration of the Weld because it is directly proportional, or at least exponentially. The arc current also affects the voltage. If the voltage is constant then if the current goes up then the arc length increases, while the current goes down then the arc length will decrease. The voltage required to weld is roughly between 20 to 30 volts. So to maintain the arc length at a certain length, the electrical voltage needs to be considered.

3. Electrical Polarity

Exposure to the theory below is very helpful for researchers in determining good polaristas for this study because if wrong in determining the polarity will be fatal in the welding process. According to Wiryosumarto, electric arc welding with wrapped electrodes can use straight polarity and reverse polarity. Welding on SMAW machines DC current has two polarities, namely polarity DCEN (Direct current negative electrode) and DCEP (Direct Current Straight Polarity) and DCRP (Direct Current reverse Polarity).

4. Electrode

Welding using electric arc welding required welding wire (electrode) consisting of one core made of metal coated with a layer of chemical mixture. The electrode consists of two parts, namely the webbed part (flux) and not webbed which is the base for clamping welding pliers. The function of the flux is to protect the molten metal from the air environment, generate a protective gas, and stabilize the arc.

5. Current

The magnitude of the required welding current depends on the diameter of the electrode, the thickness of the material being welded, the type of electrode used, the geometry of the joint, the welding position. Welding area has a high heat capacity then a high current is required. Welding

current is a welding parameter that directly affects the penetration and melting speed of the parent metal. The higher the welding current, the greater the penetration and melting speed. Large currents in welding affect welding results when the current is too low, the displacement of fluid from the tip of the electrode used is very difficult and the electric arc that occurs is unstable. The heat is not enough to melt the base metal, resulting in small, uneven Weld holes and less penetration. If the current is too large, it will result in widened bead, small spark grain, deep penetration as well as high welding Matrix reinforcement.

a. Types Of Welding Campers

The type of weld seam is also one of the causes that affect the strength of the welded joint. Kampuh las is part of the parent metal that will be filled by welding metal. Basically, in choosing The Shape of the camp, it should lead to a decrease in weld metal to the lowest metal price and not reduce the quality of the connection. For welding camps at the time of combustion can fill in the entire thickness of the plate. Before welding is carried out, the welding camp must go through a preliminary process, rust, oil, paint must be removed to obtain good combustion.

b. Bending Test

Bending test is a destructive test. Destructive testing is a test used to determine the strength of metals in construction. According to Syahrani, to determine the bending strength of a material can be done by testing the bending of the specimen. The bending strength or bending strength is the largest bending stress that can be received as a result of external loading without experiencing large deformation or failure. The amount of bending strength depends on the type of specimen and loading. As a result of arcing testing, part of the specimen is subjected to stress, while the lower part is subjected to tensile stress.

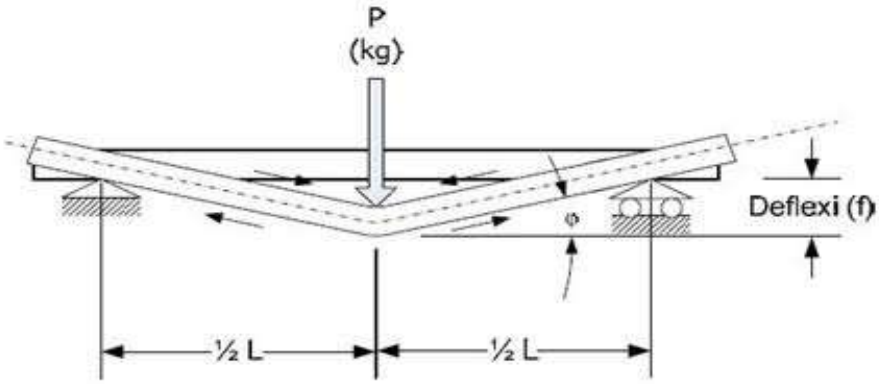


Figure 1. Bending Test

The moment of inertia of the material of such a beam can be found using the following equation:

$$I = \frac{bh^3}{12}$$

The bending moment that occurs in the specimen can be found using the equation:

$$M = \frac{1}{4} P.L$$

The value of the maximum stress / bending strength on the beam-shaped specimens that are supported by two points and given the loading at the center point can be found using the following formula:

$$\sigma b = \frac{3PL}{2bh^2} \text{ [MPa]}$$

Where: σb = Max bending tension/strength (Mpa), P = working load (N), L = distance between points (mm), b = specimen width (mm) and h = specimen thickness (mm).

RESEARCH METHODS

1. Tools and materials

Tools and materials used in this study are :

- Cutting Torch (Blender)
- Greinda Manual
- SMAW welding machine
- Electrode
- Caliper
- ST37 steel plate
- Bending Testing Machine

2. Specimen Formation

Test specimen Material with size 195 mm x 45 mm x 10 mm. Camp in use is a single V camp 60°, Double V camp 60° and single slope Camp 30°.

3. Welding Process

After the specimen is formed as many as 9 specimens, then cleaned of dirt to avoid weld defects. Specimens that have been in the form of angular contact and then welded with an upright position and horizontal electrode movement (horizontal). Welding electrode E6013 with welding current 90 A.

RESULTS AND DISCUSSION

1. Curve Test Result

Arch testing is performed to determine the mechanical properties of the material specimen under test. Arch test equipment used in this study is a Universal Testing Machine (UTM) type Tarno test UPH 100kn Medan State Polytechnic Laboratory. The results of bending test for ST37 steel material with variations of single V, Double V and single slope can be seen in table 1 and 2.

Table 1. Data on Bending test results on St37 steel welded joints

Specimen Code	Methods	Load (P) (N)	σ (MPa)	E (%)	E (MPa)	Defleksi (δ)	Angle
A I	Double V	18200	1002,63	5,64	177,77	44,17	45°
A II	Double V	19500	1103,58	3,59	307,4	48,26	46°
A III	Double V	19100	1085,67	6,15	176,53	46,13	44°
B I	Single V	14500	778,07	5,64	137,96	35,19	64°
B II	Single V	13900	767,49	4,62	166,12	34	57,5°
B III	Single V	10200	544,22	4,10	132,74	25,12	65,5°
C I	Single Slope	9400	512,84	2,56	200,33	23,50	69°
C II	Single Slope	7200	392,49	6,15	63,82	17,39	60,5°
C III	Single Slope	11400	640,11	5,64	113,49	27,66	68,5°

Table 2. Bending Test Result Data

Specimen Code	Methods	Initial length (Lo) (mm)	Width (b) (mm)	Thick (h) (mm)	Arm Style (L) (mm)	Length end (L1) (mm)
A I	V Ganda	195	46,88	9,64	160	206
A II	V Ganda	195	46,89	9,51	160	202
A III	V Ganda	195	46,49	9,53	160	207
B I	V Tunggal	195	47,34	972	160	206
B II	V Tunggal	195	47,46	9,57	160	204
B III	V Tunggal	195	47,55	9,71	160	203
C I	Lereng Tunggal	195	46,18	9,76	160	200
C II	Lereng Tunggal	195	47,18	9,66	160	207
C III	Lereng Tunggal	195	46,06	9,63	160	206

1. Discussion

a. Bending Tension

The stress value on the beam-shaped specimen that is overwritten by two points and given a load on the middle point can be calculated using the following equation :

$$\sigma b = \frac{3PL}{2bh^2} \text{ [MPa]}$$

From the above equation, the bending stress values of the three types of kembuh can be found in the table below :

Table 3. Rated Voltage Of Each Specimen

Types Of Camp	Specimen	Voltage (MPa)	Average voltage (MPa)
Double V	A I	1.085,67	1.063,96
	A II	1.002,63	
	A III	1.103,58	
Single V	B I	544,22	696,59
	B II	778,07	
	B III	767,49	
Single Slope	C I	392,49	515,14
	C II	512,84	
	C III	640,11	

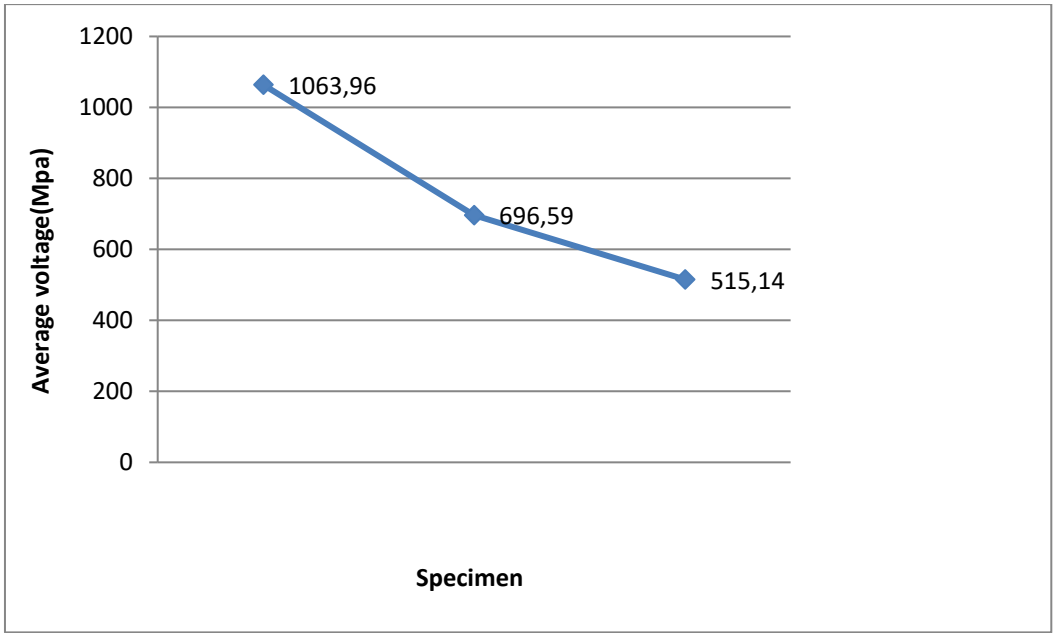


Figure.1 Graphicsof average arcing stress

Seen from figure 1. that ST 37 steel with Double V camphor variation has the highest average arch stress value of 1063.96 MPa. While the lowest average arch stress value is equal to 515.14 MPa. This shows the influence of variation of welding kembuh las to Welding Steel ST 37 for curved test. In Double V kampuh there are two sides of welding and also a large angle of 60°. This makes the welded joint have a high bending stress. While in the single slope welding camp there is only one side of the welding and the angle formed is only 30°, so that the welding process becomes difficult which can cause the strength /stress of the curve to be low.

b. Stretching

Calculating the elongation value to determine the strain value is:

$$\varepsilon = \frac{\Delta L}{L} x100\%$$

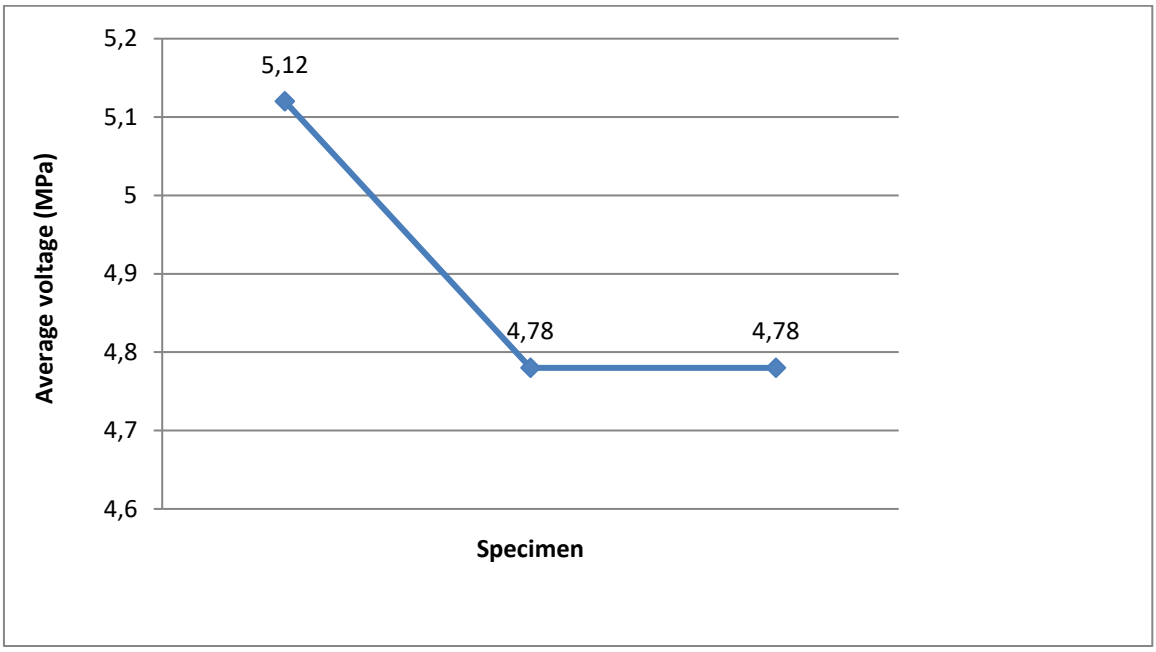
Description:

ε = Stretching (%)
ΔL = Length increase (mm)
L = Initial length (mm)

From the above equation, the results of strain values in each test can be as follows:

Table 4. Strain Value Per Specimen

Types Of Camp	Specimen	Stretching (ε) (%)	Average stretch (ε) (%)
Double V	A I	5,64	5,12
	A II	3,59	
	A III	6,15	
Single V	B I	5,64	4,78
	B II	4,62	
	B III	4,10	
Single Slope	C I	2,15	4,78
	C II	6,15	
	C III	5,64	



Pictures. 2 Graph Of Campane Type Relationship With Average Strain

From Figure 2.it can be seen that the highest strain is found in the type of Double V camp with a strain value of 5.12 %, while single V camp and single slope have the same average strain value of 4.78%.

c. Elastic Modulus

Elastic Modulus (E) on the test curve is a voltage (σ) divided by strain (ε) on the specimen. Can be calculated by the following equation.

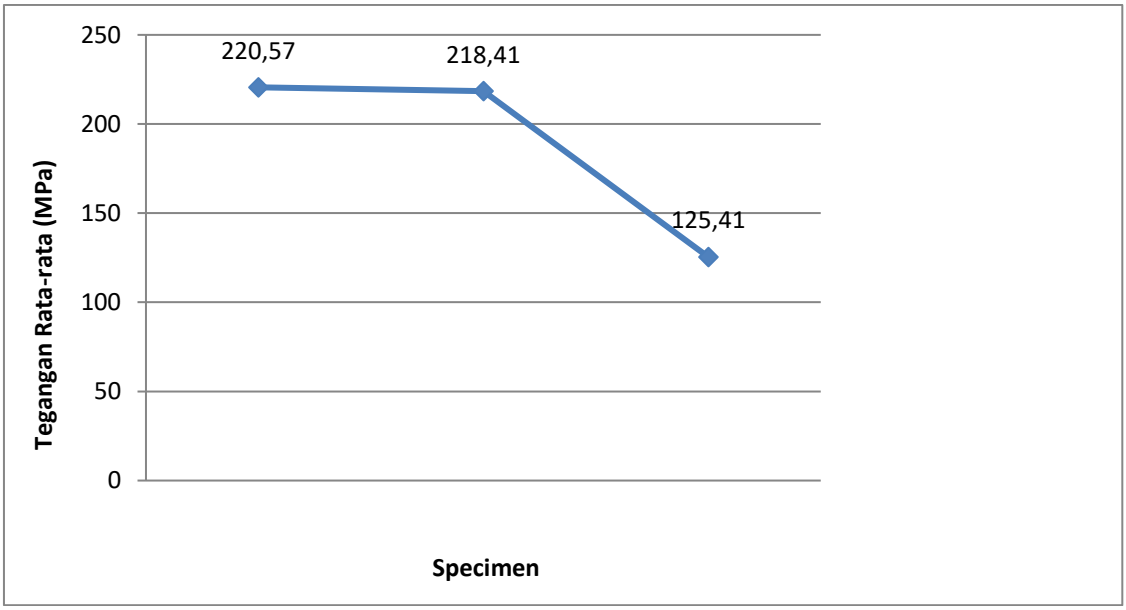
$$E = \frac{\sigma}{\varepsilon} \text{ [MPa]}$$

Description :

E = modulus of elesticity (MPa)
σ = Voltage (MPa)
ε = stretching

Table 5. Modulus Of Elasticity Of Each Specimen

Types Of Camp	Specimen	Modulus Of Elasticity (E) (MPa)	Modulus Of Elasticity Average (E) (MPa)
Double V	A I	177,77	220,57
	A II	307,4	
	A III	176,53	
Single V	B I	200,33	218,41
	B II	63,82	
	B III	113,49	
Single Slope	C I	137,96	125,41
	C II	166,12	
	C III	132,74	



Pictures.3. Graph of the relationship of the type of Campuh with the average modulus of elasticity

From the picture.3 it can be seen that the highest elastic modulus value is found in the Double V kampuh welding type of 220.57 MPa. While the lowest modulus of elasticity is found in the welding type of single slope camp of 125.88 MPa. This shows the influence of variation of welding kembuh las to Welding Steel ST 37 for curved test. In the Double V kampuh there are two sides of welding and also a large angle of 60°. This is what makes the welded joint have a greater modulus of elasticity.

CONCLUSION

Based on the results of research that has been conducted on the three types of welding camps, namely Double V, single V and single slope welding camps, the following conclusions can be obtained: From the data obtained on the strength value of the St 37 steel or low carbon steel arch test is that there is an influence of the type of Camber used during the welding process. Thus the type of Double V kampuh has the highest arch strength value of the average arch strength value of 1063.96 MPa, from the type of single V and single slope kampuh. This is due to double V kampuh there are two sides of welding and a large angle of 60° which makes the Weld strong.

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