
Calculation Ultimate Strength on Media Use Backing Ceramic Against ASTM A36 Steel by SMAW Process

Sabaruddin Rahman

Department of Ocean Engineering, Hasanuddin University, Indonesia
sabaruddin-r@eng.unhas.ac.id; Tel.: +62-811-4338-864

Abstract

Metal welding of large structures often requires alternating welding on both sides, which can be costly and time-consuming. However, welding results are only sometimes perfect, and gaps often require solutions to maximize welding results. One solution is using media backing ceramic as a support that can give better results. This study aims to evaluate the effect of backing ceramic and non-backing ceramics on the strength of the tensile test results on ASTM A36 steel using SMAW welding. The results of the tensile test show that there is an effect of strength on ASTM A36 steel. Mark Ultimate Tensile Strength, the highest, was obtained on specimens that did not use backing ceramics, equal to 451.893 Mpa. In contrast, the lowest value of Ultimate Tensile Strength was obtained on the specimen using backing ceramics, equal to 428.736 MPa.

Keywords: SMAW; ASTM A36 Steel, Backing ceramics, Ultimate Tensile Strength

1. Introduction

The growth of construction technology is very rapid and the need for the creation of raw materials cannot be separated from welding technology [1]. In this ever-growing era, much construction uses steel to make it more sturdy. In the use of steel raw materials in construction, welding has a very important position in the field of metal engineering and revision. Welding is a method of joining metals by melting them, resulting in a metallurgical bond between the metals being joined [2]. In the welding process, many aspects must be observed, starting from module knowledge to suitable procedures for joining metals so that maximum results are obtained [3].

Metal welding processes for large structures such as ships often require the welder to weld back and forth on both sides of the ship, thus wasting a lot of processing costs and time [3]. Therefore, the media backing ceramic acts as a support and is made in the form of a ceramic base which prints better results [4]. Thus, costs can be reduced, and the hull welding process can be accelerated.

Not all will get perfect results in the welding process, so there are always gaps. This matter will require finding solutions to maximize welding yields. Therefore, this study aims to identify the "effect of using Backing ceramics against the tensile strength test on ASTM A36 using the SMAW process". It is hoped that good and optimal results will be obtained so that they can become a reference for improving the industrial world in the future.

2. Materials and Methods

2.1 The material used in this research is ASTM A36 steel with a thickness of 10 mm. The chemical composition of these materials is shown in Table 1.

Table 1. ASTM A36 Steel Chemical Composition [5]

No	Element	Content
1	Carbon (C)	0.25%-0.290%(Depends on thickness)
2	Copper	0,20%
3	Iron (Fe)	98%
4	Manganese (Mn)	1,03%
5	Phosphorous (P)	0,040 %
6	Silicon (Si)	0,280 % (max 0,4%)
7	Sulfur (S)	0,050%

2.2 The welding machine used for the steel welding process is the SMAW welding machine, as shown in Figure 1.



Figure 1. The welding machine used in the SMAW process [5]

2.3 AWS E7018 Welding Wire Type

2.4 Tensile Test Equipment

The tools used in the tensile test (tensile strength) can be seen in Figure 2.



Figure 2. Tensile test equipment

This research was conducted using an experimental method. ASTM A36 steel specimens are divided into two groups, namely the group that uses backing ceramics and the group that does not use backing ceramics. Then, the specimen was welded using the SMAW process. After that, a tensile test was carried out on the specimen to evaluate the strength of the weld results.

3. Results

This chapter describes the information obtained from the testing process according to research procedures. This information is analyzed and processed to obtain material test results, both physically and mechanically, from the SMAW welding process with and without modification using backing ceramics.

These tests are divided into two groups:

1. Group 1: SMAW welding results using backing ceramics, tested by tensile test.
2. Group 2: SMAW welding results without using backing ceramics, tested by tensile test.

3.1 Tensile Testing

Tensile testing aims to determine the toughness of a material under a given stress and strain. The tensile test is one way to know the properties of a material by pulling it and observing how the material reacts to the pulling force and how far the material can be stretched.

This study only focuses on the tensile strength value of each specimen. The value of ductility in the tensile test specimens can be calculated using the following formula:

$$\sigma_{Ult} = \frac{F_{Ult}}{A_0} \text{ N / mm}^2 \quad (1)$$

3.1.1 Tensile Strength Value

After the tensile test, the tensile strength value can be calculated from the test results. The calculation results can be seen in Table 2 below:

Table 2. Value Ultimate Strength from the Tensile test

No	Variation	Code Material	CSA (mm ²)	F. Ultimate (N)	Ultimate Strength (Mpa)
1	Non Backing Ceramics	A1	201,7	89,000	441,24
		A2	202,46	90,000	444,13
		A3	191,36	90,000	470,893
		Average	198,50	89,666	451,893
2	With Backing Ceramics	B1	209,80	91,000	433,74
		B2	212,60	91,000	430,38
		B3	213,22	90,000	422,09
		Average	211,87	90,666	428,736

Table 2 shows the average tensile strength values for each group. The average value of SMAW welding on ASTM A36 steel without backing ceramics is 451.893 MPa. Whereas for SMAW welding on ASTM A36 steel with backing ceramics, the average value is 428.736 MPa.

This tensile strength value can also be depicted in graphic form as shown in Figure 3 below:

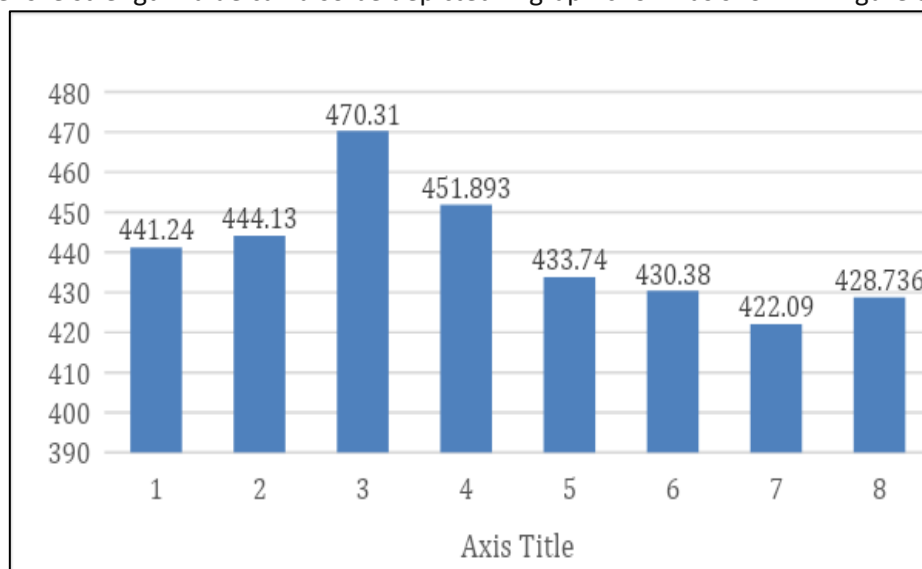


Figure 3. Strength Graph (Ultimate Tensile Strength)

Based on the results of the tests that have been carried out, it can be seen that the highest tensile strength values are found in specimens that do not use backing ceramics, equal to 451.893

MPa. While the lowest tensile strength value is found in the test using backing ceramics of 428.736 MPa.

4. Discussion

Information is obtained from the results of the tensile test that has been carried out, which is then analyzed and processed to obtain material test result, both physically and mechanically, from the SMAW welding process with and without modification using backing ceramics.

This test is divided into two groups: Group 1 is the result of SMAW welding using backing ceramics tested by tensile test, while Group 2 is the result of SMAW welding without using backing ceramics which are also tested by a tensile test.

Tensile testing aims to determine the toughness of a material under a given stress and strain. This is one way to know the properties of a material by pulling it and observing how the material reacts to the pulling force and how far the material can be stretched. This research only focuses on the tensile strength value of each specimen.

After the tensile test is carried out, the tensile strength value can be calculated from the test results. The calculation results can be seen in Table 2 which shows the average tensile strength value for each group. For SMAW welding on ASTM A36 steel without backing ceramics, the average value is 451.893 MPa. Whereas for SMAW welding on ASTM A36 steel with backing ceramics, the average value is 428.736 MPa.

Based on the results of the tests that have been carried out, it can be seen that the highest tensile strength values are found in specimens that do not use Backing ceramics that are equal to 451.893 MPa. While the lowest tensile strength value is found in the test using Backing ceramics of 428.736 MPa.

This indicates that the use of backing ceramics in the SMAW welding process can affect the material's tensile strength value. Use Backing ceramics decreased the tensile strength value by 5.13% compared to without backing ceramics. This can be caused by several factors, including:

- Backing ceramics can inhibit the flow of heat from the metal to the weld Backing, thus causing faster cooling. Faster cooling can increase the residual stress and decrease the ductility of the weld metal.
- Backing ceramics can cause differences in the coefficient of thermal expansion between the metal and the weld backing, causing deformation and cracking in the joint area.
- Backing ceramics can contain unwanted elements, such as oxygen, nitrogen, or hydrogen, which can react with the weld metal and cause porosity, inclusions, or embrittlement.

Therefore, the use of backing ceramics in SMAW welding on ASTM A36 steel must be carried out with care and attention to factors that can affect the quality of the joint. Backing ceramics can provide advantages in terms of time and cost efficiencies, but can also pose risks regarding reduced tensile strength. However, further research is needed to determine how it affects backing ceramics on the value of the material's tensile strength.

5. Conclusions

Based on the results of the tensile test that has been carried out. It can be concluded that the use of backing ceramics in the SMAW welding process on ASTM A36 steel can affect the tensile strength value of the material. The test results show that the highest tensile strength value is found in the specimens that do not use backing ceramic which is equal to 451.893 MPa, while the lowest tensile strength value is found in the test using Backing ceramics of 428.736 MPa.

Usage backing ceramics decreased the tensile strength value by 5.13% compared to without backing ceramics. The use of backing ceramics in SMAW welding on ASTM A36 steel must be carried out with care and attention to factors that can affect the quality of the joint. Backing Ceramics can provide advantages in terms of time and cost efficiencies but can also pose risks regarding reduced tensile strength. However, further research is needed to determine how it affects backing ceramics on the value of the material's tensile strength.

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