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ESTIMATION OF WELDING WIRE (ELECTORDE) REQUIREMENTS FOR INSTALLATION OF 300 FEET BARGE SIDEBOARD ASSEMBLY

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ABSTRACT

Installation of the sideboard assemblies on a 300 feet barge requires an estimate of the need for welding wire, besides that an estimate of the need for oxygen and LPG gas is also required for the work of cutting the old sideboard. This is so that the repair work does not experience errors in estimating the amount of consumables used so as not to result in losses for the shipyard company. The objectives obtained during the research were to determine the need for welding wire in the welding process of the 300 feet barge sideboard. The design of this study uses a quantitative approach and there are several variables used including independent variables such as the thickness of the material, the length of the welding, and cutting areas. Dependent variables such as the number of electrodes, oxygen, and LPG gas used. Control variables such as the SMAW welding process using AWS A5.1 E6013 electrodes and cutting using an oxygen and LPG gas cutting blender. The data collection techniques in this study were literature study, observation, and interviews. Based on the calculation, the total need for welding wire for the installation of the 300 feet sideboard assembly is 95.87 kg total oxygen requirement of 241.51 kg and LPG gas of 177.35 kg for cutting the old sideboard.

Keywords: *barge; oxygen; sideboard; welding wire*

INTRODUCTION

The transportation system is important in connecting regions and ships play a role in national economic development because it can accelerate the economic development of regional communities (Hasbullah, 2016). A barge is a type of ship with a flat hull or large box that floats. There are parts of barges that other types of ships do not have, such as sideboards. Sideboard is a plate structure to support the load on the deck. Barges do not have engines (propelled) so they must be towed by tugboats (Lee et al., 2022; Tran et al., 2018). Because in its construction, barges are different from ships in general (Mey Krisselni Sitompul et al., 2022). One of the ship components that is often replaced is the hull plate, with a replacement process usually called replating (Amalia et al., 2021). *R* Plating is carried out because the plate does not meet standards, which will result in deformation, cracking and corrosion (Mey Krisselni Sitompul et al., 2022; Dev & Saha, 2017). The replating process on the ship's hull is carried out during docking, where one type of work is welding (Okumoto et al., 2009).

Welding on the ships must meet the requirements of the classification board which supervises and determines the feasibility of ship construction (Marsudi, 2021; Feng et al., 2020; Azwinur Azwinur, 2019). The replating process begins with determining the area to be cut. Manually cutting plates using oxygen and LPG gas is included in the field of welding technology where the principle is to melt the metal (Aditya & Kristiyono, 2022). Therefore, gas settings and distance are very necessary to automate steel plate cutting (Ascione et al., 2022; Kurniawan, 2018; Nugroho & Pambudi, 2016; ; Smith et al., 1988).

Each work element has been given material requirements that will be used in carrying out the work (Tarore et al., 2012). The most important part of the welding process is the welding wire. The

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selection of welding wire is an important factor because it determines the welding results, so knowing the types of welding wire and their properties is very important, because it is used as a basic reference in selecting welding wire.

The aspect that must be planned in installing the 300 feet barge sideboard assembly is the need for welding wire. Apart from that, determining the area to be cut on the old sideboard, the aim is to ensure that repair work does not experience errors in estimating the number of consumables used so that it does not result in losses for the shipbuilding company. Therefore, it is necessary to estimate the need for welding wire using the method used: 1. determine the type of welding process (SMAW); 2. volume and length of the area to be welded and 3. grove/joint preparation. So with this estimate the project does not experience losses in time or costs (Dian et al., 2022).

METODE

This research uses a quantitative approach (Sugiyono, 2015), the data collection and analysis process is accompanied by pictures, tables and other displays, while the type of research uses descriptive research which aims to determine the need for welding wire in the installation process of the 300 feet barge sideboard assembly and the need for oxygen and LPG gas in the process. cutting old sideboards. The research procedure as figure 1.

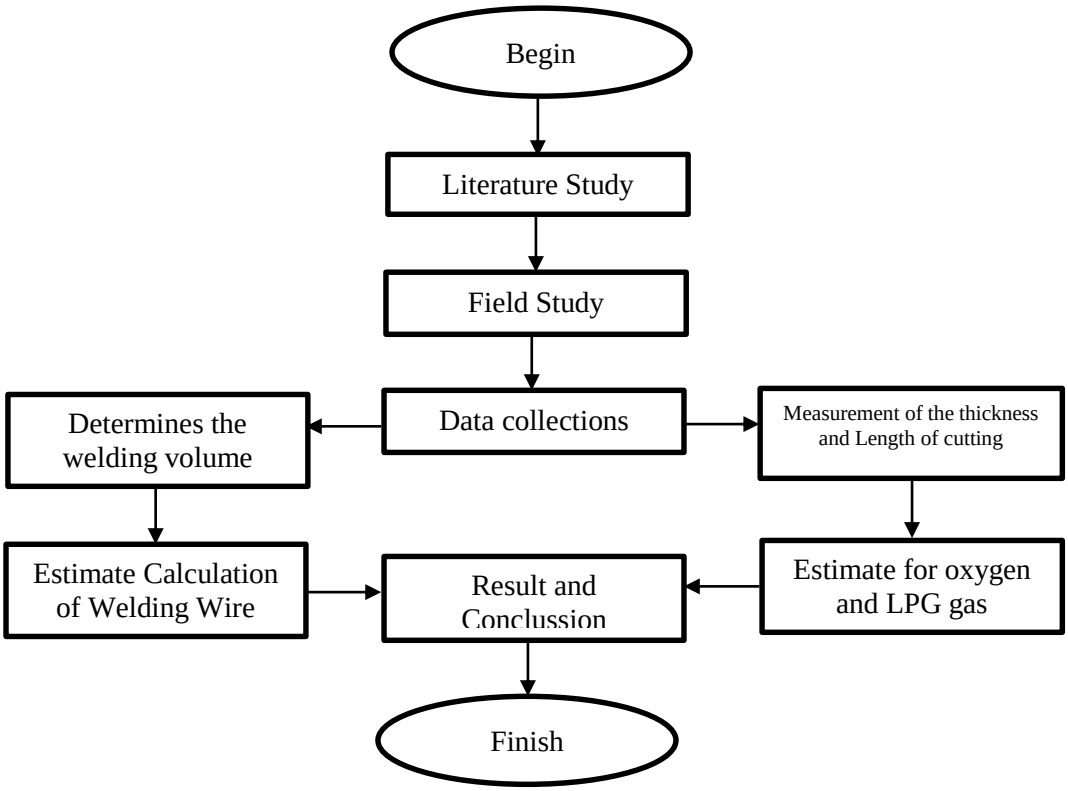

Figure 1. Research Procedure for Estimating Welding Wire Needs

RESULT AND DISCUSSION

Welding Wire Consumption Needs

1. Welding Volume Calculation

Welding volume calculations are used to calculate the need for welding wire that is removed in the welding process for assembling the sideboard assembly as in figure 2. With this estimate, the need for welding wire in the warehouse can be provided earlier before the project is carried out.

Figure 2. Sideboard Assembly Results

a. Determines the welding volume on the plate as figure 3

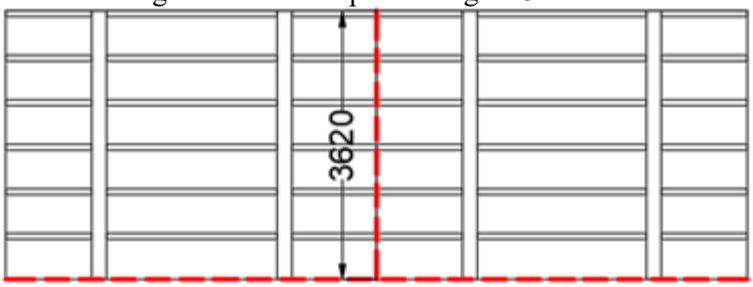

Figure 3. Welding Joints on Plates

1) Butt Joint

V1 = Gap x Material Thickness x Weld Length

Where:

Gap = 2 mm

Material Thickness = 8 mm

Weld Length = 3620 mm x 18 *line*

= 65.160 mm

The result:

V1 = 2 x 8 x 65.160 mm^3

= 1.042.560 mm^3

= 1042,56 cm^3

2) T Joint

V2 = 0,5 x α1 x α2 x Weld Length

Where :

α_1 = 5 mm

α_2 = 5 mm

Overall length of welds = 191.200 mm

The result:

V_2 = 0,5 x 5 x 5 x 191.200 mm^3

= 2.390.000 mm^3

V_{total} = 2.390.000 mm^3 x 2 sisi

= 4.780.000 mm^3

= 4780 cm^3

V_{plate} = 1042,56 + 4780

= 5822,56 cm^3

b. Determine the welding volume in the longitudinal elbow as figure 4.

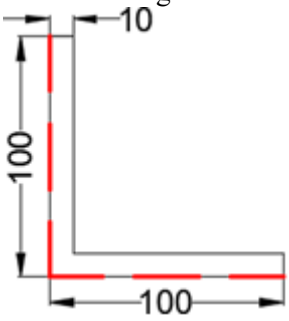

Figure 4. L/M Elbow Profile Size

V_{elbow} = Gap x Material Thickness x Weld Length
Where:
Gap = 2 mm
Material Thickness = 10 mm
Weld Length = 200 mm x 108 Pcs
= 21.600 mm

The result:
V_{elbow} = 2 x 10 x 21.600
= 432.000 mm^3
= 432 cm^3

c. Determining the welding volume on the H-Beam (Stanchion) as figure 5.

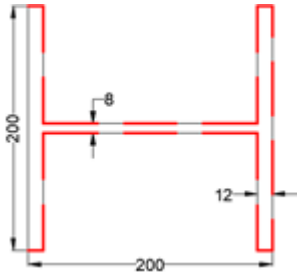

Figure 5. Size of H-Beam on Stanchion

Corner joint (Fillet Joint)
V_{h1} = 0,5 x α1 x α2 x Weld Length
Where:
α_1 = 5 mm
α_2 = 5 mm
Weld Length = 984 x 71 Pcs
= 69.864 mm

The result:
V_{h1} = 0,5 x 5 x 5 x 69.864 mm^3
= 873.300 mm^3
= 873,3 cm^3

d. Determining the welding volume on the H-Beam (Support Stanchion) as figure 6.

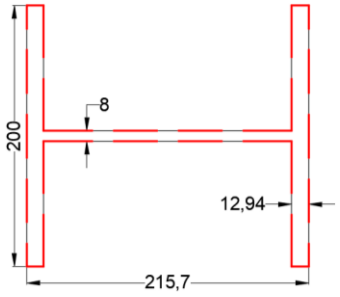

Figure 6. H-Beam Size on Stanchion Support

Corner joint (Fillet Joint)
V = 0,5 x α1 x α2 x Weld Length
Where:
α_1 = 5 mm
α_2 = 5 mm
Weld Length = 1215,4 x 71 Pcs
= 86.293,4 mm

The result:
V_{h2} = 0,5 x 5 x 5 x 86.293,4 mm3
= 1.078.6667,5 mm3
= 1078,67 cm^3

e. Determines the welding volume on the doubling plate as figure 7.

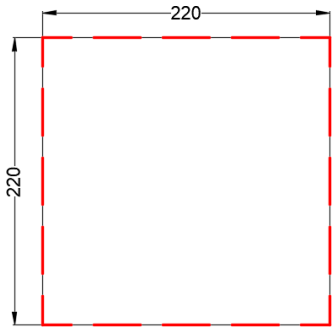

Figure 7. Doubling Plate Size

V = 0,5 x α1 x α2 x Weld Length
Where:
α_1 = 5 mm
α_2 = 5 mm
Weld Length = 880 x 140 Pcs
= 124.960 mm

The result:
V_{PD} = 0,5 x 5 x 5 x 124.960 mm^3
= 1.564.000 mm^3
= 1564 cm^3

2. Calculation of Welding Wire Consumption

The data from the calculation of the welding volume above is then processed to obtain the consumption requirements for the welding wire used.

M = $\sum$Vx ρ

Where :

$\sum$V = V_{plate} + V_{elbow} + V_{h1} +V_{h2} +V_{PD}
= 5822,56 + 432 + 873,3 + 1078,67 + 1564
= 9770,53 cm^3

ρ = 7,85 gr/cm^3

The result:

M = 9770,53 x 7,85
= 76.698,66 gr
= 76,70 kg

The efficiency of welding wire (SMAW) is 80%, so the need for welding wire is::

X = m / 0,8
= 76,70 / 0,8
= 95,87 kg

So the electrodes needed in the installation process of the sideboard assembly are 95.87 kg or 20 packs (1 pack of electrodes weighs 5 kg).

Oxygen and LPG Gas Consumption Needs

Installation of the sideboard assembly was previously done by cutting the old sideboard as shown in figure 8, therefore it is necessary to calculate the need for oxygen and LPG gas consumption (Kusuma Aditya et al., 2023). Based on research conducted in the field, the average thickness of each old sideboard component is approximately 6 mm. (See table. 1)

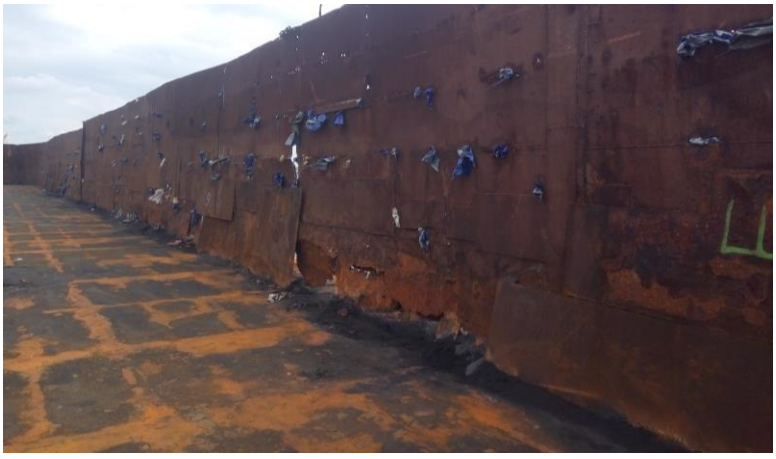

Figure 8. Initial conditions before cutting

X = cutting length x α
Y = cutting length x β
Where:
X = oxygen consumption requirements
Y = LPG gas consumption requirements

Table 1. Consumption of Oxygen-LPG Cutting Gas

No	Thick (mm)	Oxygen (α) kg	LPG (β) kg
1	6	0,347	0,159
2	8	0,601	0,193
3	10	0,855	0,227
4	12	1,109	0,261
5	14	1,363	0,295

α = value based on table 1, plate thickness 6 mm
= 0,347 kg
β = value based on table 1, plate thickness 6 mm
= 0,159 kg/m

1. Determine the consumption of oxygen and LPG gas on the plate
   a. Vertical
   X = (54 line x 3,62 m) x 0,347 kg/m
   = 67,83 kg
   Y = (54 line x 3,62 m) x 0,159 kg/m
   = 31,08 kg
   b. Horizontal
   X = 191,2 m x 0,347 kg/m
   = 66,35 kg

   Y = 191,2 m x 0,159 kg/m
   = 30,4 kg

   So the total consumption requirement on the plate is:
   Total Xplate = 67,83 + 66,35
   = 147,29 kg
   Total Yplate = 31,08 + 30,4
   = 134,18 kg

2. Determine the consumption of oxygen and LPG gas at the extended elbow
   X_{elbow} = (54 line x 6 Pcs x 0,2 m) 0,347 kg/m
   = 22,48 kg
   Y_{elbow} = (54 line x 6 Pcs x 0,2 m) x 0,159 kg/m
   = 10,30 kg
3. Determine the consumption of oxygen and LPG gas on the H-Beam
   $X_{H\text{-}Beam}$ = (142 Pcs x 0,576 m) x 0,347 kg/m
   = 28,38 kg
   $Y_{H\text{-}Beam}$ = (142 Pcs x 0,576 m) x 0,159 kg/m
   = 13 kg
4. Determine the consumption of oxygen and LPG gas on the doubling plate
   X_{PD} = (12 Pcs x 0,88 m) x 0,347 kg/m
   = 43,36 kg
   Y_{PD} = (142 Pcs x 0,88 m) x 0,159 kg/m
   = 19,87 kg

   Based on the calculations above, the total demand for oxygen and LPG gas consumption is:
   X_{total} = $X_{plate} + X_{elbow} + X_{H\text{-}Beam} + X_{PD}$
   = 147,29 + 22,48 + 28,38 + 43,36
   = 241,51 kg

$$Y_{total} = Y_{pelat} + Y_{elbow} + Y_{H\text{-}Beam} + Y_{PD}$$
$$= 134{,}18 + 10{,}30 + 13 + 19{,}87$$
$$= 177{,}35 \text{ kg}$$

CONCLUSION

The welding wire (electrode) used in welding corresponds to the AWS A5.1 series type E6013. Based on calculations for installing the sideboard assembly on a 300 feet barge, it has a volume of 9770.53 cm3, while 95.87 kg of welding wire is needed or around 20 packs of which (1 pack of electrodes weighing 5 kg) and the total oxygen requirement is 241.51 kg and gas. LPG of 177.35 kg for cutting old sideboards. In order to minimize errors in calculating the volume and length of welding, ensure that the shape of the welding grove matches the shape of the grove being welded. The type of electrode used must be suitable for the plate used so that the welding connection results in a good and strong connection.

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