Journal of Applied Science, Engineering, Technology, and Education *ISSN: 2685-0591 (online)*
Vol. 4 No. 1 (2022)
https://doi.org/10.35877/454RI.asci843

The Effect of Current and Time on Nut Spot Welding Process Towards Torque Test in Export Crate Construction

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Abstract

The problem of loose spot-welding nuts during knockdown is a problem, from the cost of replacing the loose spot-welding nut and additional time to repair damage that can reduce productivity. To increase the strength of spot welding, it is necessary to test with certain variables, namely the spot-welding process with five variables 25A, 30A, 40A, 50A, and 60A, five-time variables 0.5 seconds, 1.0 seconds, 1.5 seconds, 2.0 seconds and 2.5 seconds. Each of 30 samples of each variable were tested for destructive torque with a digital torque wrench to get a precise torque value and SEM photos to determine the HAZ of the spot-welding process. The results obtained from this study are to determine the effective value of each variable so as to increase the efficiency of repair costs in terms of goods and time due to the release of nut spot welding. Tests are carried out to increase productivity in terms of time and cost efficiency as well as to find out the science in examining the effect of current and time variables in the spot-welding process.

Keywords: nut spot welding, torque, bolt, spot welding.

Received: 15 January 2022 Revised: 29 March 2022 Accepted: 2 June 2022

1. Introduction

The development of engineering in this era makes a process now easier, so that processing a component into a sub-assembly part or assembly part does not require a lot of time and processing.

One of them is the process of connecting the nut/bolt component with angle iron (base metal) using a spot-welding machine, this process does not require additional materials as usual because it only heats the material from the nut/bolt to be connected to the base metal.

In the tightening process, if the nut spot comes off it will interfere with the production process and other processes so that the daily production target is not achieved, there are additional costs for repairing parts, replacing parts or adding time to make repairs. Obviously, this is a problem that must be addressed to avoid wasting time and money.

SPCC270D and SCGA Steel Materials with a thickness of 0.65 mm. The results of the research on optimal parameter variations for welding the two types of materials are using 5.8 kA, Welding Time 17 cycles and a Compressive Force of 2.4 kN (Ir, DW Karmiadji, 2020).

The Taguchi method with optimal parameters to be applied in the DP-290 steel point welding process, metallographic characterization, microhardness and Peel test were also carried out on each specimen. The result is low intensity and medium pressure for a longer time, better tearing resistance, due to changes in the microstructure of the specimen (Reyes-Calderón et al., 2018).

The best quality spot welding using a PDN 10-10 type welding machine and aluminum plate material with a thickness of 0.8 mm; 1 mm and 1.2 mm, with overlap connection, welding current 26 A and output voltage 1.75 volt pressing time of 1 second; 1.5 seconds and 2 seconds. The test of chemical composition, microstructure, hardness and tensile strength of the test specimens refers to the JIS Z 3139 standard (Waluyo, 2013).

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The time variables are 1 second, 2 seconds and 3 seconds with the material SPCEN JIS G 3141, the hardness test standard uses DIN 50103 and the shear test standard uses ASTM D 1002 (Rasyid & Drastiawati, 2020).

The plate is made of low carbon steel with ferrite and martensite phases. Welding currents used are 0.9 kA, 1.6 kA, and 1.85 kA with welding times of 0.25, 0.5, 0.75 and 1 second. Mechanical properties testing carried out includes tensile strength to determine the shear strength of the welded joint (L. Agustriyana, YS Irawan, 2011).

The parameters used in this welding are pressing time, press time of 10 seconds, 15 seconds, and 20 seconds. From the results of the tensile/shear test that has been carried out, the greatest tensile/shear strength occurs at a time of 20 seconds, namely 45,073 Kgf/mm2. From the hardness test that has been carried out, the highest hardness occurs in welding with a pressing time of 20 seconds, namely 356.8 HV (Taufik, 2020).

Spot weld between low carbon steel and austenitic CrNi stainless steel. The thickness of the different materials being welded is 2 mm. The DeltaSpot welding gun with the tape process is used to weld different steels. Spot welds are manufactured with various welding parameters (welding currents range from 7 to 8 kA) (Kolařík et al., 2012).

The results of the experiments are tensile tested to ensure that the components are up to standard for their tensile stresses. From the tensile uii data with a standard of 9.8 kN, the results obtained reach 10.45-13.5 kN. Parameter settings are then used as operational standards as a reference for carrying out the production process (Prayogi, 2019).

Six variables including electrode force, electric current, and quadrilateral time (squeeze, up-slope, welding time, and hold) at three different levels were considered as inputs to Taguchi's algorithm. The results of the Taguchi sensitivity analysis showed that the parameters of electric current (22%) and welding time (17%) were the most effective factors on the diameter of the nugget. Furthermore, Multiple Regression Technique (MRT) is used to present a new equation to calculate the point diameter through the parameter process (Reza Kashyzadeh et al., 2022).

The results of this study indicate that the nugget on the Vickers hardness test has a higher value than the base, namely 172.78 for a current of 8.6 A and a welding time of 20 seconds, 191.58 for a current of 6 A and a welding time of 10 seconds, and a base metal value of 165. 7, then the percentage with increasing force with a current value of 8.6 A is 7.1% and for a current of 6 A 25.8% (Al, 2013).

2. Research Methods

This research examines the effect of current and time on torque in the tightening process on construction with M8x16 bolts. So the current and time are varied with the aim of knowing how far the optimal point in the nut point welding process is.

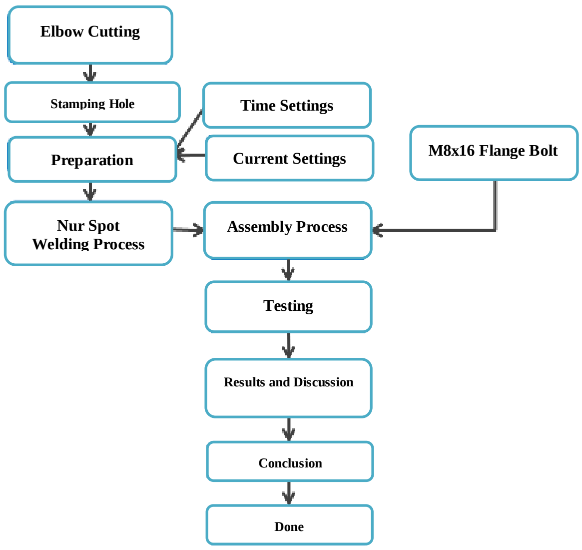

Figure 1. Flowchart of the research process

This study conducted tests with fixed variables: angled iron material, nut point welding material and variable current and time variable in the nut point welding process, in this test 5 (five) currents and 5 (five) variables were made. This test method aims to determine the appropriate heat input for elbow material 30x30x2.4 mm and nut spot M8 material to determine the maximum torsional strength of nut spot welding and elbow iron.

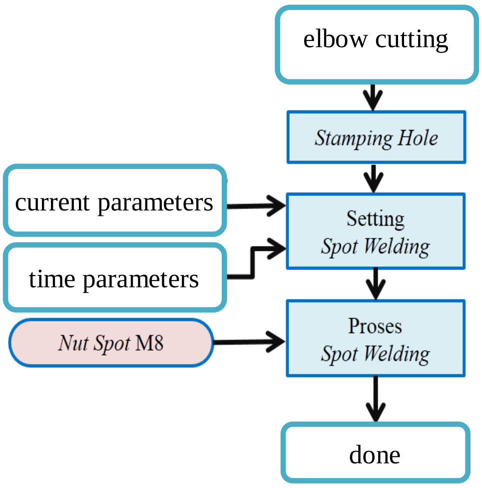

Figure 2. Schematic Explanation

Figure 3. Machine Las Spot/Stationary Spot Welding

Figure 4. Process Nut Spot

Table 1. Chemical test results of elbow iron

No.	Element	Mass%	Error%	Atom%
1.	C	0:54	0:36	1.85
2.	F	8:19	0:25	21:57
3.	Si	0:53	0:45	0.62
4.	Fe	90.74	0.92	75.95
Total		100.00		100.00

Table 2. Results of testing the chemical composition of beans where

No.	Element	Percentage %	Error %	Atom%
1.	F	9.71	0.25	24.03
2.	Fe	90.29	0.96	75.97
	Total	100.00		100.00

Table 3. Test results for chemical composition Mixture of materials

No.	Elements	Percentage %	Error %	Atom%
1.	C	0.47	0.37	2.12
2.	F	8.73	0.25	20.35
3.	Si	0.37	0.45	0.89
4.	Fe	90.42	0.93	76.64
	Total	100.00		100.00

3. Results and Discussion

In the nut spot welding process the heat input variable (time and current) each sample was made of 5 (five) variables with a time variable specification of 0.5, 1.0, 1.5, 2.0, and 2.5 seconds and a current variable of 25, 30, 40, 50, and 60 amperes so as to give 25 (two twenty five) variables for the heat input process and specimen samples that will be carried out to determine the strength of nut spot welding on motor export crate construction. The testing of this research was carried out destructively to determine the maximum strength of spot welding, the composition of the material using SEM to determine the composition of the material.

In the figure 5 to figure 15, it can be seen that changes in current at the same time variable show different welding results, with low yields, small welding results and large increases in welding results. It can also be said that an increase in current does not necessarily result in good welding results. It can be seen that the difference in the welding results of the 50 Ampere variable has better results than the 60 Ampere variable.

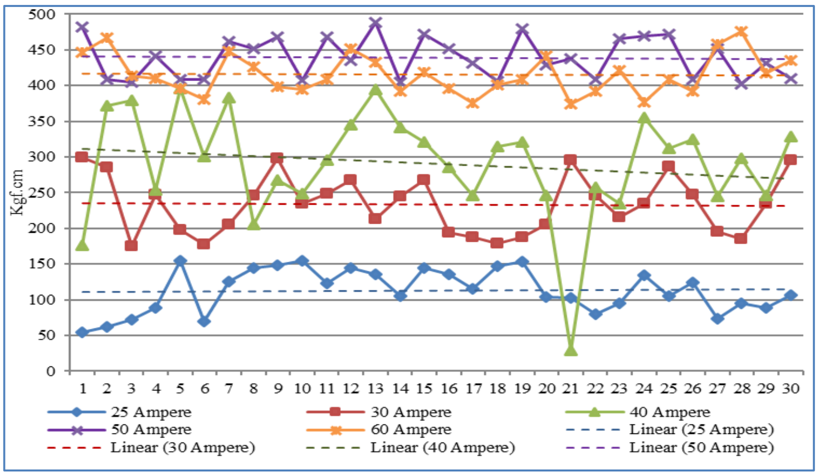

Figure 5. Torque test results with a time of 0.5 seconds

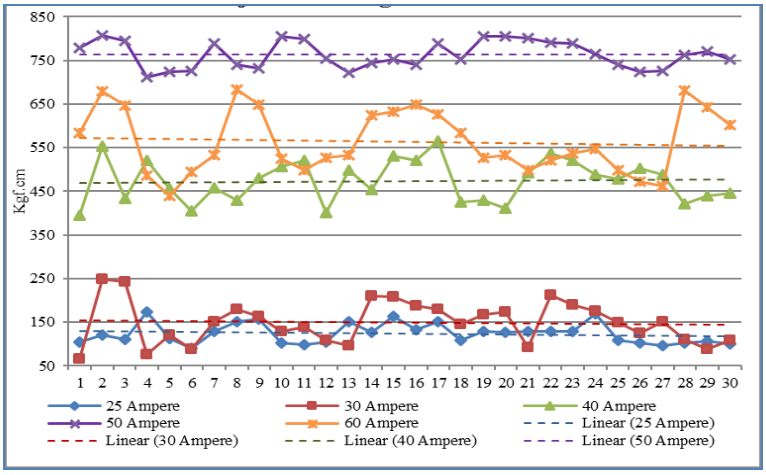

Figure 6. Torque test results with 1.0 second time

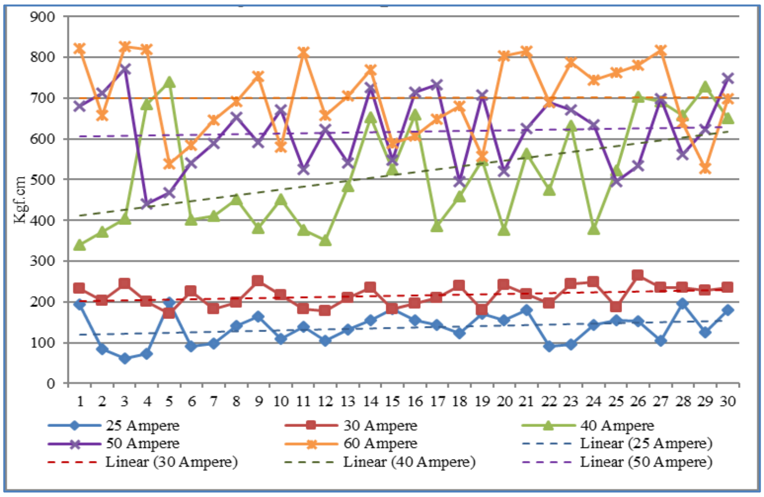

Figure 7. Torque test results with 1.5 second time

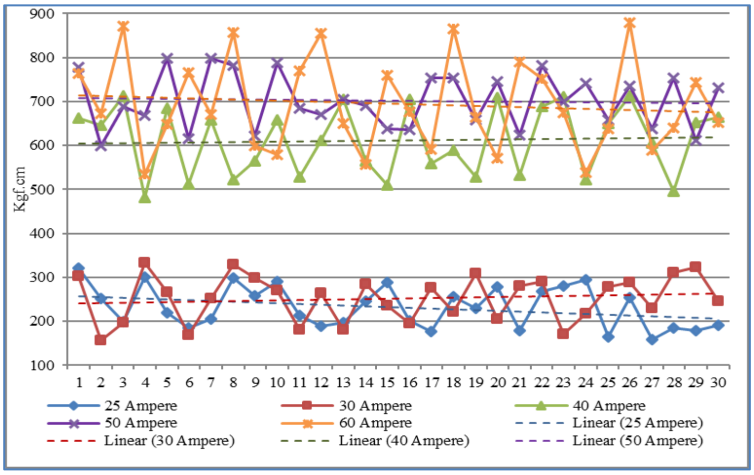

Figure 8. Torque test results with 2.0 second time

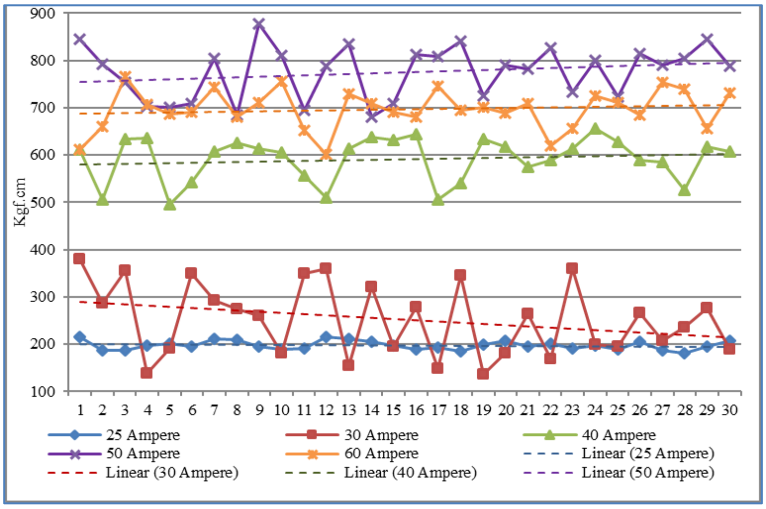

Figure 9. Torque test results with 2,5 second time

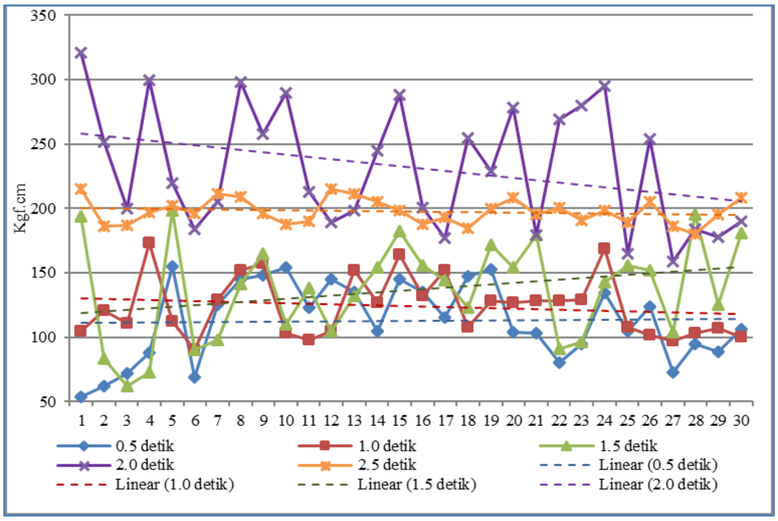

Figure 10. Torsion Test Results with a current of 25 amperes

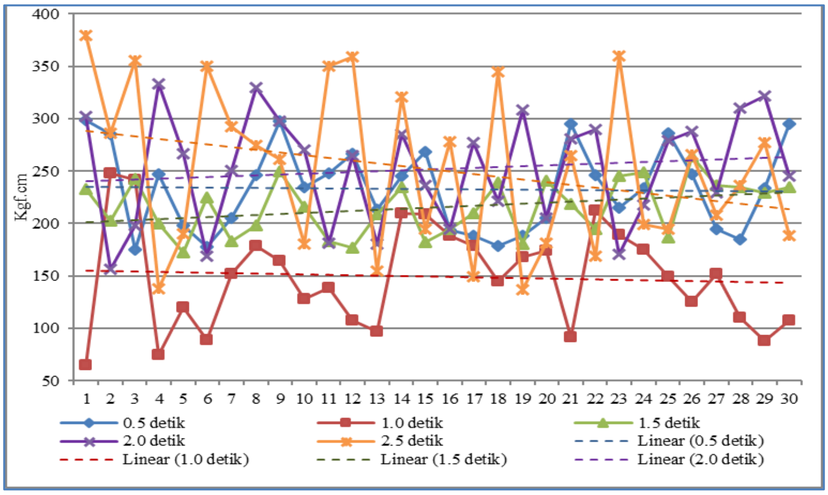

Figure 11. Torsion Test Results with a current of 30 amperes

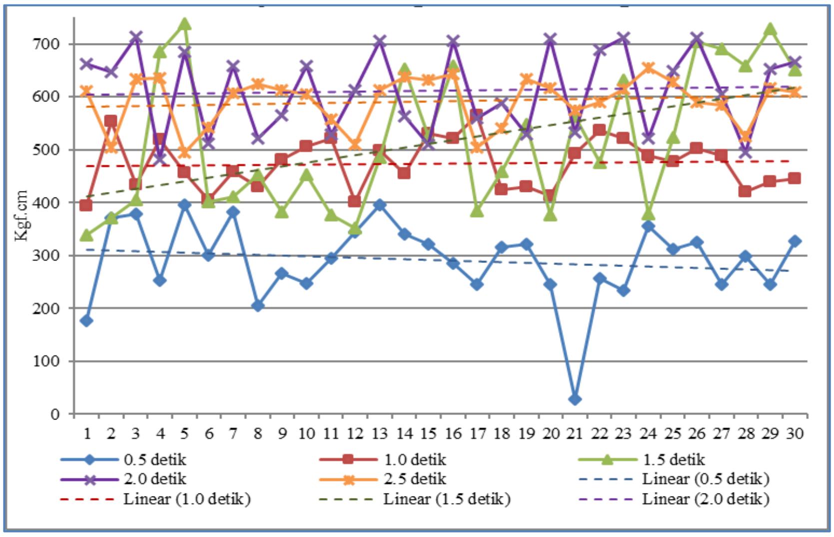

Figure 12. Torsion Test Results with a current of 40 amperes

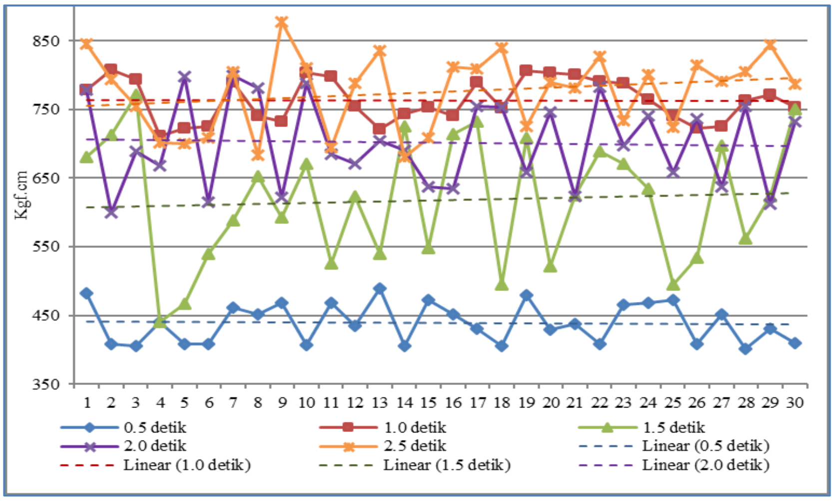

Figure 13. Torsion Test Results with a current of 50 amperes

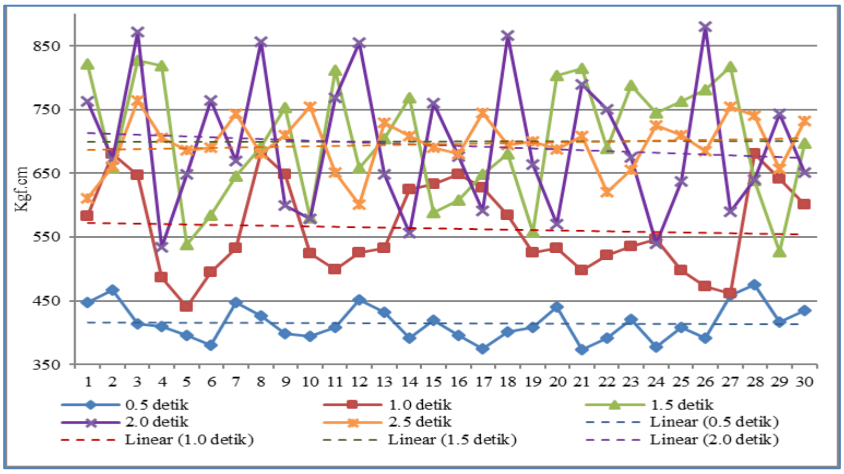

Figure 14. Torsion Test Results with a current of 60 amperes

Figure 15. Welding results

4. Conclussion

The conclusions from the results of this study are:

1. In the current variable, the data obtained are:

No.	Flow variable (A)	Time variable (seconds)	Average torque (Kgf.cm)
1.	25	2.0	323
2.	30	2.0	252
3.	40	2.0	612
4.	50	2.5	776
5.	60	1.5	700

ON the Time variable Then the data obtained are:

No	Time variable (seconds)	Current variable (A)	Average torque (Kgf.cm)
1.	0.5	50	439
2.	1.0	50	763
3.	1.5	60	700
4.	2.0	50	702
5.	2.5	50	776

2. The best results in the nut spot welding process between Nut Spot M8 and Elbow 30x30 thick 2.4 mm with a current setting of 50 Ampere and time 2.5 seconds.
3. The basic material has a carbon content of > 0.35%. The nut spot welding process must be preheated but in the nut spot welding process for nut spot welding, the pointed part works for heat concentration and this part will blend with the base material.
4. The higher the current and time in the welding process the results obtained are not necessarily the better

References

Al, D. B. et. (2013). Analysis of Microstructure and Mechanical Properties of Spot Welding and Brazing Results for Home Industry. *J. Tek. Undip Engine*, *1*(2), 1–8,.

Ir, DW Karmiadji, and M. H. (2020). *Spot Welding Analysis of Mpv Vehicle SPC and SCGA Materials*.

Kolařík, L., Sahul, M., Kolaříková, M., Sahul, M., Turňa, M., & Felix, M. (2012). Resistance spot welding of dissimilar steels. *Acta Polytechnica*, *52*(3).

L. Agustriyana, YS Irawan, and S. (2011). The Effect of Welding Current and Welding Time in Spot Welding Processes on Tensile Strength and Welding Microstructure. *J. Mechanical Engineering*, *2*(3), pp.175–181.

Prayogi, D. P. and E. (2019). *Analysis of Spot Welding Machine Parameters on the Strength of Welded Connections on K59J Stay Mirror Components*.

Rasyid, R., & Drastiawati, N. S. (2020). Pengaruh Waktu Pengelasan Titik (Spot Welding) Terhadap Kekerasan, Kekuatan Geser Dan Diameter Nugget Pada Baja Spcen 1, 6 mm. *Otopro*, *16*(1), 1–6.

Reyes-Calderón, F., Vences-Hernández, R., Salazar-Torres, J. A., Vergara-Hernández, H. J., Aguilera-Navarrete, I., & Pérez-González, V. (2018). Parameter optimization: force (F), time (T) and current intensity (I), in the RSW welding process of DP-290 steel plates using the Taguchi method. *Soldagem & Inspeção*, *23*, 157–167.

Reza Kashyzadeh, K., Amiri, N., Ghorbani, S., & Souri, K. (2022). Prediction of Concrete Compressive Strength Using a Back-Propagation Neural Network Optimized by a Genetic Algorithm and Response Surface Analysis Considering the Appearance of Aggregates and Curing Conditions. *Buildings*, *12*(4), 438.

Taufik, A. P. and A. (2020). Analysis of the Effect of Welding Time Variations on Mechanical Characteristics and Physical Properties in Resistance Spot Welding (Rsw) Galvanized Plate Materials. *J. Flywheel*, *11*(1), 27–32.

Waluyo. (2013). The Effect of Aluminum Plate Thickness and Length of Stress on Spot Welding on Physical, Mechanical and Thermal Efficiency Properties. *J. Tek. Engine*, *6*(9).