

INFLUENCE OF FABRICATION MACHINES ON THE LEVEL OF NOISE DISTRIBUTION

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ABSTRACT

Research on noise is very important for the welding fabrication shop area which is a place where the welding fabrication process is carried out. This study aims to analysis the level of noise exposure and determine the results of the mapping of the distribution of noise intensity Leq (Equivalent Continuous Noise Level) at points T1 to T18. Data collection was carried out by conducting direct measurement observations on the research object and sound level mapping simulations. Noise level measurements were carried out at points where employees work close to the noise source. Noise level measurements were carried out for 5 min for each measurement point with recording of measurement results carried out every 5 second. The results of this study were then compared with the noise threshold value regulated in the decree of the minister of environment No.48 of 1996 which sets a maximum noise limit of 70 dB. The results showed that areas with higher elevation values tended to be around measurement points T4, T6, T8, T13, and T14. The highest noise intensity is in the T8 point area due to the presence of grinding machines and welding machines that have quite high noise intensity. The visualization results of the distribution of noise intensity show that the noise intensity is high or above the threshold value. so that workers who are there have a fairly high risk of health hazards and reducing the noise in the area requires sound dampening equipment.

Keywords: Noise, Sound Level, Intensity

1. INTRODUCTION

Noise can originate from various sources, including industrial machinery and equipment, motorized vehicle traffic, construction activities, or even other human activities. Noise levels are measured in decibels, and high levels or prolonged exposure can cause hearing loss, neurological disorders, sleep disturbances, and other health problems. Unwanted or excessive noise can interfere with or damage a person's hearing, physical, and mental health (Wang Z. et.al., 2023). Excessive, unwanted noise originating from production process equipment and/or work tools can, at certain levels, cause hearing loss (Dong C. et.al., 2023).

Welding fabrication shops employ various equipment, including welding machines, grinding machines, cutting machines, bending machines, and compressors, as well as transportation vehicles around the fabrication area (Waller S.T. et.al., 2021; FGSV, 2019). Welding processes use various methods, such as electric welding, gas welding, or laser welding, depending on the project's requirements. As a manufacturing company engaged in fabrication, we naturally use various tools and machines that generate varying levels of noise. The noise generated by welding machines, metal cutters, and other equipment can exceed safe limits set by occupational health and safety standards. Unwanted sounds from operational or business

activities at a certain volume and duration that can disrupt public health and the comfort of the surrounding environment are referred to as noise (Kuhnel et al., 2021).

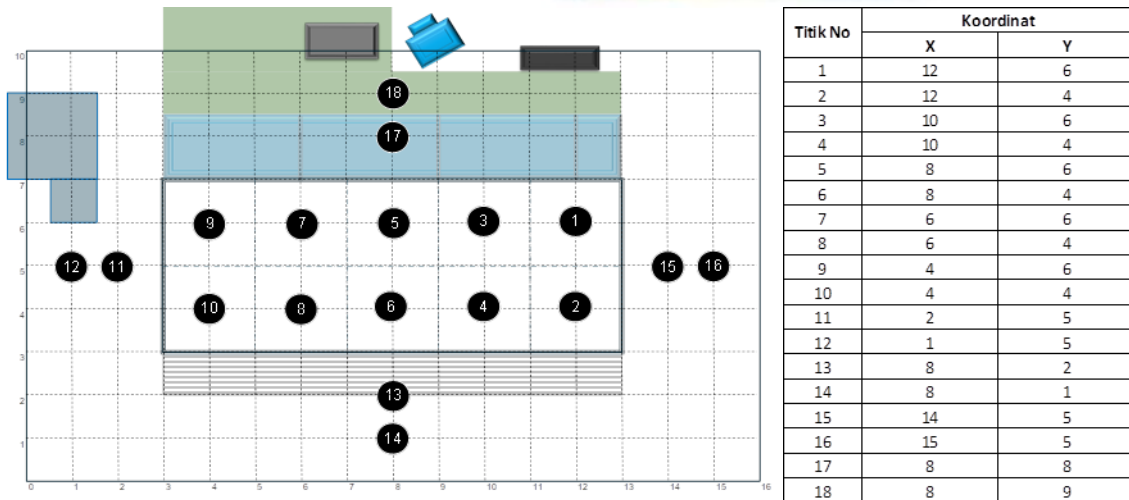
Welding is a critical process in various industries, including construction, manufacturing, and the automotive industry. However, this process is also a significant source of noise pollution, posing health risks to workers and environmental concerns. In this article, we will discuss the causes, impacts, and mitigation strategies for noise in welding, as well as provide a comprehensive guide to a safer work environment. Electrical discharges during welding are a major source of noise. The electric arc generated during welding produces high-frequency noise, often referred to as "arc noise." Arc noise intensity depends on the welding process, electric current, and voltage (Tong H., 2021).

During the welding process, hot metal sparks frequently occur and can produce quite loud noises when they strike adjacent surfaces. One of the physical elements that impact occupational safety is noise from machinery and the surrounding environment (Maison M., 2020). Therefore, research on noise intensity analysis is crucial for workshop areas. By conducting this analysis, companies can identify primary noise sources, evaluate the resulting noise levels, and implement measures to reduce worker exposure.

This research can also help comply with applicable occupational safety regulations and standards and improve the overall working environment. Furthermore, by knowing the appropriate noise intensity, companies can design effective mitigation strategies to protect the health and well-being of workers and increase overall operational efficiency and productivity. Therefore, analysis noise levels in fabrication area are necessary to create a safe, comfortable, and conducive work environment and mitigate the hazards caused by noise.

2. METHODOLOGY

The research stages begin with collecting data and information needed to support the analysis of conditions in the investigation area. Data collection is carried out by conducting direct observations and measurements on the research object, namely by using a sound level meter while simulations use Surfer 8. Noise level measurements are carried out at points where employees work close to the noise source by mapping the work area according to the distance of the plotting point where the noise will be measured as shown in Fig. 1. Noise level measurements are carried out for 5 minutes for each measurement point with recording the measurement results every 5 seconds. The noise levels include very high > 85 dB, high 73 dB-85 dB, moderate 62 dB - 73 dB, low 50 dB - 62 dB and very low < 50 dB. In the welding fabrication shops, there are various equipment including welding machines, grinding machines, cutting machines, bending machines and compressor machines that are used as well as vehicle transportation around the fabrication.



Picture 1. a. Grid Spot Area, b. Koordinate

3. RESULTS

Experiment

Noise mapping involves visually depicting the noise levels generated at each observation point, producing a noise contour map. The benefit of noise mapping is identifying areas with noise levels exceeding the noise level and enabling early prevention efforts by using ear protection devices, such as earplugs, based on the noise mapping results.

Using a sound level meter, the sound pressure level can be measured in dB over a 5-minute period. Each measurement takes 5 seconds, with a total of 60 data points. Calculations are then made for each point based on the measurement data, as shown in Table 1. The T1 frequency distribution at point 1 of the 60 measured data points is shown.

Table 1. Frequency distribution of T1 at point 1

No	Noise Interval	Mid Value	Frequency
1	77,50 - 78,21	77,86	5
2	78,21 - 78,93	78,57	8
3	78,93 - 79,64	79,29	13
4	79,64 - 80,36	80,00	4
5	80,36 - 81,07	80,71	5
6	81,07 - 81,79	81,43	7
7	81,79 - 82,50	82,14	18

Calculation of T1 at point 1 using the equation LTM5

$$\begin{aligned}
 & 10 \log \frac{1}{n} \sum T_n \cdot 10^{0,1L_n} \\
 & 10 \log \frac{1}{60} \sum T_n \cdot 10^{0,1L_n} \\
 & 10 \log \frac{1}{60} (5 \cdot 10^{0,177,86} + 8 \cdot 10^{0,178,57} + 13 \cdot 10^{0,179,29} + 4 \cdot 10^{0,180,00} + 5 \cdot 10^{0,180,71} + 7 \cdot 10^{0,181,43} + 18 \cdot 10^{0,182,14}) \\
 & 80,60 \text{ dBA}
 \end{aligned}$$

Therefore, the T1 value at point 1 is 80.60 dBA.

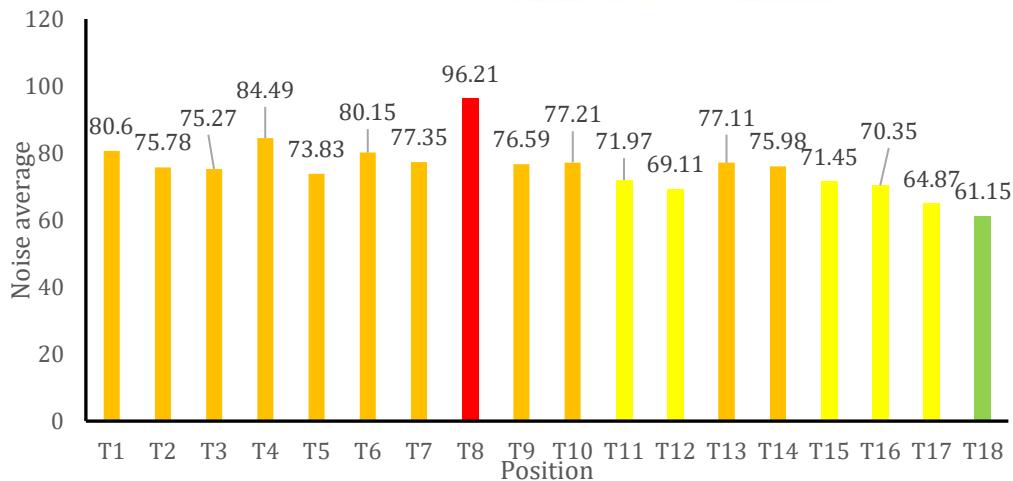
The next step is to perform calculations at points T2 through T18, using the Leq (noise level) calculations at each point as shown in table 2.

Table 2. Measurement of each plotting distance T1 – T18

No	Grid Coordinate		db	Leveling
	X	Y		
1	12	6	80.60	High
2	12	4	75.78	High
3	10	6	75.27	High
4	10	4	84.49	High
5	8	6	73.83	High
6	8	4	80.15	High
7	6	6	77.35	High
8	6	4	96.21	Very High
9	4	6	76.59	High
10	4	4	77.21	High
11	2	5	71.97	Moderate
12	1	5	69.11	Moderate
13	8	2	77.11	High
14	8	1	75.98	High
15	14	5	71.45	Moderate
16	15	5	70.35	Moderate
17	8	8	64.87	Moderate
18	8	9	61.15	Low

Using a sound level meter, the sound pressure level in dB can be measured over a 5 minute period. Each measurement data reading is taken for 5 seconds with a total of 60 data items. Based on the data calculation results above, there is one point with a very high Leq value, namely point T8 with a noise value greater than 85 dB. At this point, workers are only permitted to be exposed to noise for 8 hours per day in accordance with the provisions regarding the threshold values of physical and chemical factors in the workplace. At this point, there are employees who are carrying out pipe fabrication work. Meanwhile, the high-intensity noise area (range 73 dB-85 dB) is at 11 points (T1-T7, T9, T10, T13, T14).

At points T1 & T4, there are other employees who are also carrying out pipeline fabrication activities. The other measurement points are still below the threshold value. Fig. 2. shows the noise value that is on a very high scale at point T8 which is doing pipeline fabrication work due to grinding, cutting & chipping activities and the sound of the welding machine generator which is between 73 dB - 76 dB (Big Blue Generator data sheet). At points T1, T6, T13 & T14 are on a high scale of 80 dB - 85 dB while points T6, T13 & T14 are points that are between the crew who are working so that the noise value is high. At this point if the operator will work more than 8 hours it is necessary to use personal protective equipment (PPE) which can be in the form of ear plugs or ear muffs.

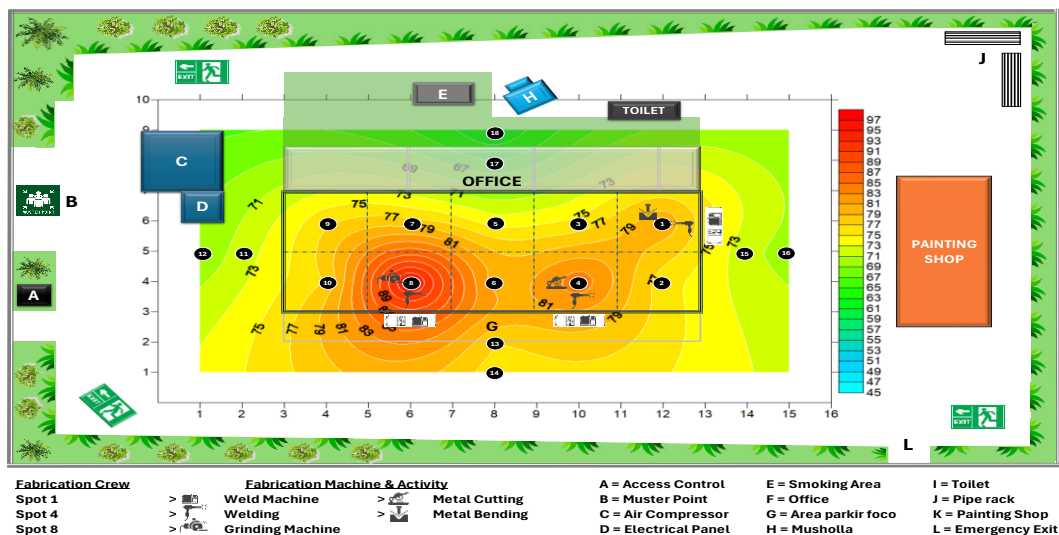


Picture 2. Graph noise level distribution T1 – T18

Areas T2, T3, T7, T9, T10 are on a medium scale, namely 75 dB - 80 dB. This point is outside the fabrication team's work area. So the influence of noise is still on a medium scale. For a low scale, namely between 70 dB - 75 dB, is at points T5, T11, T15 & T16. These points are the furthest from the welding team's working position. The noise scale is considered low. Points T17 & T18 are on a very low scale, namely below 70 dB. To be more specific, point T17 is inside the building, where the spread of sound is largely muffled by the office building located on the side of the welding fabrication shop area and point T18 is behind the office so that the noise has been largely muffled by the office.

Noise Distribution Contour

The contour map explains the distribution of noise at the measurement points in the fabrication shop area which is represented by the color spectrum of the different simulation results shown in Pic 3.



Picture 3. Contour Map of Noise Distribution Results T1 – T18

Based on the noise distribution from the image above, it can be analyzed that the red color indicates the highest noise value above 85 dB at point T8. The yellow to orange color around the center of point T4 indicates moderate noise, ranging from 75 dB to 85 dB. The green color indicates lower noise, between 70 dB to 75 dB, which begins to appear in the edge area of

the red and yellow noise zones. The blue color on the right edge and the top of the map indicates the lowest noise, which is below 70 dB, especially around points T11, T12, T15, T16, T17 & T18 where this area is relatively quieter.

4. CONCLUSION

Based on the results of the activity there are welding, grinding, cutting and fitting machines where the area with a higher elevation value is at the points where employees are working where the sound source comes from the work machines and ongoing fabrication activities. The highest noise intensity is in the T8 point area due to the presence of grinding machines and welding machines that have quite high noise intensity. The visualization results of the distribution of noise intensity show that the noise intensity is high or above the threshold value. so that workers who are there have a fairly high risk of health hazards and reducing the noise in the area requires sound dampening equipment.

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