Noise Level Analysis of KM. Sabuk Nusantara 71 to Increase Ship Passengers Comfort Based on BKI Rules

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Noise Level Analysis of KM. Sabuk Nusantara 71 to Increase Ship Passengers Comfort Based on BKI Rules

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Abstract

Noise is a sound or sound source that is unwanted and can interfere with or have an impact on health and comfort, according to sound experts that exceed the level of the senses of the human listener can cause deafness. The method used in this research is to compare the calculation of noising in the conditions before the addition of construction and after the addition of construction. The purpose of this study is to obtain the carateristic noising value in the conditions after the addiion of the gorger construction before the addition of the side deck girder construction as a means of evaluating the side deck girder construction planning in the ship engine room ship 2000 DWT. The consideration of adding construction is one of the alternatives in providing reinforcement so that it can reduce the noise wave signal that occurs. From analyze results after addition of a sized T profile FB 180 x 8 mm FP 75 x 10 mm, maximum value at intervals of 0 - 30 seconds, at a value of 62 dB. there is a decrease in value of 0.47% in engine room. At a value of 57 dB, there is a decrease in value of 0.41% in accommodation. At a value of 37 dB, there is a decrease in value of 0.56% in navigation room. Able to reduce range curve of nosing on before the addition of the construction is on an average between 40-80 dB, after the addition of the construction has an average area of 55-20 dB.

Keywords: *Noising, Side Deck Girder, Engine Room, Profil T, Construction*

1. Introduction

Noise is a sound or sound source that is unwanted and can interfere with or have an impact on health and comfort, according to sound experts that exceed the level of the senses of the human listener can cause deafness (Cianferra, Petronio, and Armenio 2019; Soares, Antunes, and Debut 2021). In an operational tool, noise is a problem that is quite important, especially in relation to comfort (Learn 2021; G. Zhang 2020).An excessive level of noise can have a negative impact on the performance of the human body (D.-Q. Li, Hallander, and Johansson 2018).Some of these impacts are from a health perspective as well as from a psychological and technical perspective (Kurt et al. 2017).Damage to hearing devices is one of the health and psychological impacts that can be caused, namely emotional disturbances, while from a technical point of view noise can be an indication of a problem with existing equipment(Carter, Tregenza, and Stevens 2020).

Noise intensity has a major impact on human health and if exposed for too long it will cause health problems.As for the sound that is generated when operating, it affects the environment and the system around it (Williams 2019; G. Zhang 2020). The types and numbers of sound sources (noise) in the workplace vary widely, including machine sounds, collisions between work tools and workpieces, flows, materials (gas flow, water or liquid materials in pipes), and humans (Guo 2020; Learn 2021). To be able to control the noise that occurs on a ship, it is necessary to first learn how to spread the noise(Xue 2020). The spread and propagation of noise from various spaces on the ship can go through two routes, namely: through the air and becoming a noise starting from the air so that it is called air borne noise, and through parts of the hull construction where the noise occurs is called structure borne noise(Viola 2017). Air borne noise that is spread by a noise source after arriving in a walled room can cause vibrations and can cause noise coming from the vibrating wall(L. Zhang, Meng, and Zhang 2020). Thus the air borne noise can be transformed into a structure borne noise. In contrast, structure borne noise originating

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from a noise source after propagating and arriving at a wall in another room can deliver air in the room and can cause noise so that it turns into air borne noise (B. Zhang 2019). From the phenomenon that occurs, corrective steps can be taken to reduce the noise that occurs in the ship's engine room. KM ship noise measurement process. Belt Nusantara 71 is carried out in several parts, and to show an indication of the considerable noise in the engine room of the ship, see figure 1.

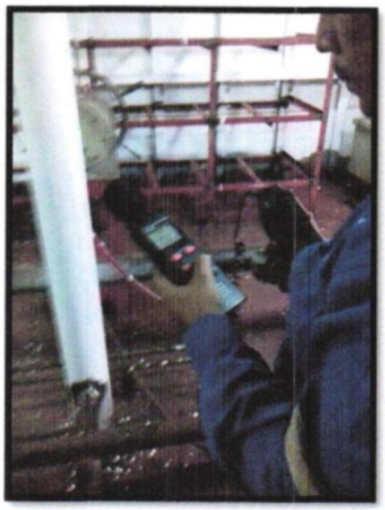

Figure 1. Ship noise measurement

Previous research has shown, the Refined Composite Multi-Scale Depersion entropy (RCMDE) method shows the new effectiveness of the dynamic non-linear method used in diagnosing signal processing. In an article entitled *"A Comparative study of four nonlinear dynamic methods and their application is a classification of ship-radiated noise"*, it shows the compatibility of ship noise radiation. Performance classification is described in a scale where the basis of the method is to compare the multi scale permutation entropy (MPE) and k-nearest neighbor (KNN) methods. The results of the classification show the effectiveness of the calculation method of noise radiation generated from the ship (Yu-xing Li 2020). On the other side in the reserch with the title *"A denoising method for ship radiated noise based on spearman variational mode decomposition, spatial-dependence recurrence sample entropy, improved wavelet threshold denoising, and Savitzky-Golay filter."* Explain if this method can reduce the noise in the real series of the signal generated by the ship. The noise reconstruction process can be described based on empirical data and a variety of decomposition modes. The purpose of the decomposition is to show the noise level of the signal that is obtained. In addition, the dominance of the Spearman method results in Intrinsic mode function (IMF) which can improve the ratio from 2 dB to 4 dB or otherwise(Yang, Cheng, and Li 2021). Meanwhile in research with the title *"Onboard ship noise: Acoustic comfort in cabins."* explain the need for an analysis discussion of noise in the passenger room of a passenger ship. Evaluations are presented in the form of criteria, type of sound sources that may be produced. such as the effect of using HVAC (Heating, ventilation and Air Conditioning) as well as noise from the canteen, recreation room, and so on. This effect is different from the operation of the engine, the propulsion and the generator have different indicators. The results of the study show that the normative results are limited result, the effectiveness based on the noise source component is the critical component(Borelli 2021). On the other side in the reserch with the title *"Research on feature extraction of ship-radiated noise based on multi-scale reverse dispersion entropy"*. Shows the results of an experimental model that extracts noise based on two scale parameters. So that the results of the extraction of these methods can be used as an archive for the comparative classification of the noise radiation generated by the ship(Yuxing Li 2021). Nevertheless in each of these studies the application is carried out on passenger ships, considering that this passenger ship has a level of comfort that must be considered. The concept of noising calculation is only centered on the simulation and not correlated with field measurements. So that it can make an opportunity for this research to have a correlation where both the calculation of noising that occur either before or after the addition of a construction is carried out. What is more of concern is that in this section the measurement in the engine room construction, so that it affects the noising the part of ship.

The method used in this research is to compare the calculation of noising in the conditions before the addition of construction and after the addition of construction. For later comparison with numerical calculation data. The purpose of this study is to obtain the carateristic noising value in the conditions after the addition of the gorger construction before the addition of the side deck girder construction as a means of evaluating the side deck girder construction planning in the ship engine room ship 2000 DWT ,what can effected in a recommended part of ship .

2. Materials and Methods

In this study, the ship used was KM. Sabuk Nusantara 71 with the main sizes, as can be seen in table 1.

Table 1. Main Size of the Ship

Description	Score	Unit
LOA (Length of Over All)	68.5	meter

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LBP (Length between Perpendicular)	63.00	meter
B (Bearth)	14.00	meter
H (Hight)	6.20	meter
T (Draught)	3.50	meter
DWT	2000	Ton

The flow of the method used is based on the measurement of the noise level and then compared with the BKI rules, then after an unsuitable result is obtained, an evaluation of the factors that can reduce the occurrence of noise can be carried out. The results of the evaluation are then compared with the analysis of the results of noise measurements, as shown in Figure 2.

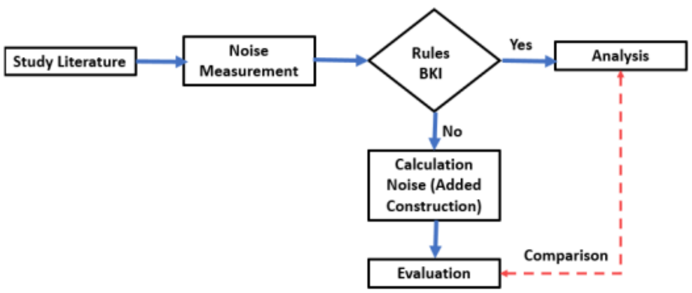

Figure 2. Flow methodology

From the ship construction, the engine room section was previously seen from the need for additional construction. Very complex engine room construction design, the reinforcement system uses T profile.. The method used is the calculation according to the numerical approach assisted by computational software. The approximation to the calculation of the formula decomposition noising signal, itself is outlined in the equation :

$$u_k(t) = A_k(t) cos\,[\varphi_k(t)] \quad (1)$$

Where $A_k(t)$ is the amplitude of $u_k(t)$, and $A_k(t) > 0$; $\varphi_k(t)$ is phase of $u_k(t)$. After get equation 1 to get instantiated frequency of $u_k(t)$ as follows :

$$\omega_k(t) = \frac{d\varphi_k(t)}{dt} \quad (2)$$

But in the equation 2 is assumed $\omega_k(t) > 0$. After than in the analytical signal calculation responding in the $u_k(t)$ as follows :

$$\left(\delta(t) + \frac{j}{\pi t}\right) * u_k(t) \quad (3)$$

where $\delta(t)$ is impulse function on equation number 3. depiction of the sound signal at the sound source in the ship's engine room is presented in figure 3.

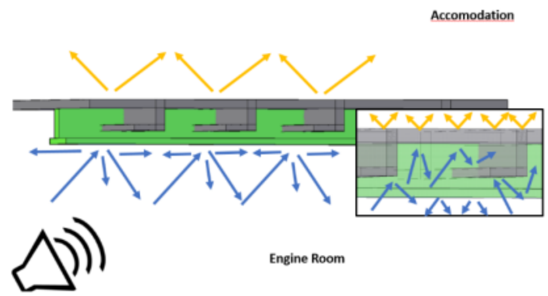

Figure 3. Noise Signal distribution

After the calculation values are obtained, they are grouped to be analyzed and compared. From equation number 1 the comparison uses a combined graph to determine the maximum value of noising after and before the addition of the side girder construction.

3.Results and Discussion

Based on the measurement results, it is reviewed into several points that represent the noising that occur on the ship while operating. The measurement results can be seen in Figure 4.

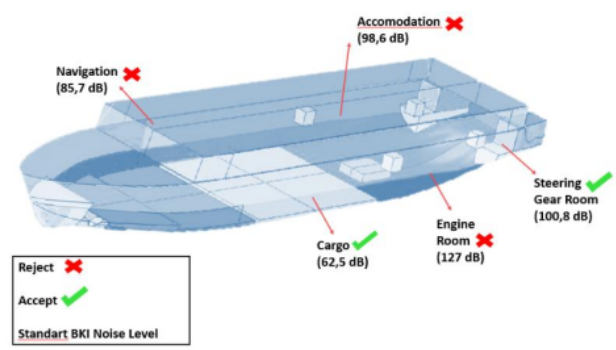

Figure 4. Result Noising Test

From the figure 4 show the most critical noise conditions are found in the accommodation pour, navigation room and engine room. the three sections do not meet the standards of BKI rules. The engine room is the part that is most affected by the noise level which is quite high, then after the addition of the T-profile side deck girder construction with the size of FB 180 x 8 mm FP 75 x 10 mm. depicted in Figure 3 in the section shown in green color is an additional construction of the side deck girder.

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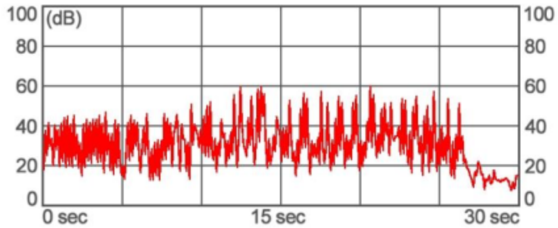

Figure 5. Noising calculation in Engine room

Then the calculation is carried out according to equation 1, in the engine room showing the maximum value at intervals of 0 - 30 seconds, at a value of 62 dB. there is a decrease in value of 0.47% show in figure 5.

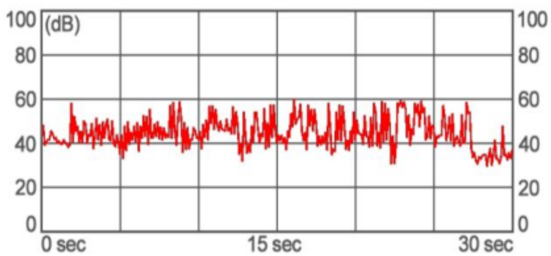

Figure 6. Noising calculation in accommodation

In the accommodation showing the maximum value at intervals of 0 - 30 seconds, at a value of 57 dB. there is a decrease in value of 0.41% show in figure 6.

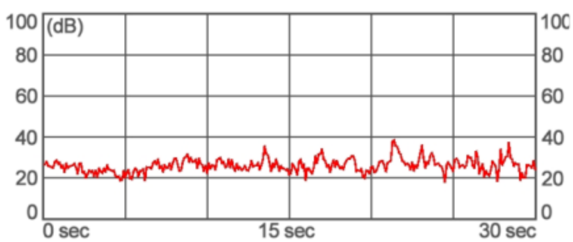

Figure 7. Noising calculation in navigation room

In the accommodation showing the maximum value at intervals of 0 - 30 seconds, at a value of 37 dB. there is a decrease in value of 0.56% show in figure 7. Then after comparing the noise calculations in the engine room before and after the addition of the side deck girder construction in the ship engine room, the results are obtained at intervals of 0 - 30 seconds, at a maximum value of 83 dB become maximum value 62 dB . There is a decrease in value of 0.25% show in figure 8.

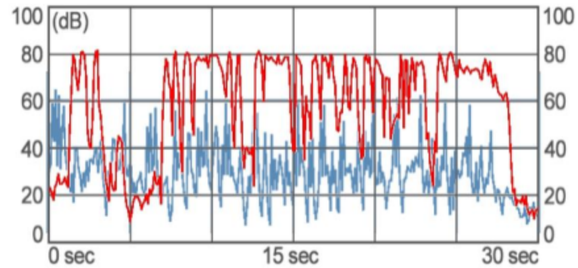

Figure 8. Comparation noising calculation

From figure 8, on the graph, it can be seen that the chart of the peaks and valleys in the section before the addition of the construction is on an average between 40-80 dB. Then in the scheme of peaks and valleys the graph in the section after the addition of the construction has an average area of 55-20 dB. This shows that the effect resulting from the addition and planning of the modulus profile is able to have an influence on the propagation of the sound wave signal in the vicinity. So that from the results of the comparison of these calculations it can be analyzed together, that the application of the addition of the side deck girder construction is quite appropriate.

4. Conclusion

Noise becomes something that reduces the level of comfort. Therefore we need an additional construction that can reduce the vibrations that occur. The construction planning modulus of calculation succeeds in making noise from the results shown at the beginning of the measurement. The consideration of adding construction is one of the alternatives in providing reinforcement so that it can reduce the noise wave signal that occurs.

Based on the results of noising analyze, it was found that the noising value decreased after adding the construction of the side deck girder to the engine room. From calculation results, maximum value at intervals of 0 - 30 seconds, at a value of 62 dB. there is a decrease in value of 0.47% in engine room. At a value of 57 dB, there is a decrease in value of 0.41% in accommodation. At a value of 37 dB, there is a decrease in value of 0.56% in navigation room.

Evaluation results from the addition of a sized T profile FB 180 x 8 mm FP 75 x 10 mm , able to reduce range curve of nosing on before the addition of the construction is on an average between 40-80 dB. after the addition of the construction has an average area of 55-20 dB. This shows that the effect resulting from the addition and planning of the modulus profile is able to have an influence on the propagation of the sound wave signal in the vicinity. So that from the results of the

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