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Noise exposure impact zone hue modeling using LISA FEA V.8

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ABSTRACT

This study aims to obtain data on the impact of noise pollution by conducting a noise test from the operation of the PLTD and modeling it to get the noise impact hue.
Finite element software modeling the impact of noise generated from the operation of PLTD to determine the hue of the noise impact. LISA, a popular finite element analysis application, was used to estimate and complete this study using the finite element model.
Noise data retrieval, some data is carried out according to the engine power load during production and the machine stops with a certain distance reference to the affected area, namely residential areas, with a zone radius of up to 100 m from the machine point.
The condition of the impact of noise exposure that occurs, where in general the area that has a major impact on settlements is a linear area of openings at the noise source because noise waste is free to come out of building openings without any obstacles. , so that the nominal sound impact that occurs without these obstacles, the average noise value is above the 70 dB.A threshold with the category of very disturbing.
Keywords: Effect, Hue, Impact, LISA FEA, Noise

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Abstrak
Penelitian ini bertujuan untuk mendapatkan data dampak pencemaran suara dengan melakukan uji kebisingan dari pengoperasian PLTD dan melakukan permodelan untuk mendapatkan rona imbas kebisingan.

Pemodelan perangkat lunak elemen hingga dampak kebisingan yang ditimbulkan dari pengoperasian PLTD untuk menentukan rona dampak kebisingan. LISA, aplikasi analisis elemen hingga yang populer, digunakan untuk memperkirakan dan menyelesaikan studi ini menggunakan model elemen hingga.

Pengambilan data kebisingan, beberapa data dilakukan sesuai dengan beban daya mesin selama produksi dan mesin berhenti dengan referensi jarak tertentu ke daerah yang terkena yaitu daerah pemukiman, dengan radius zona hingga 100 m dari titik mesin.

Kondisi dampak paparan kebisingan yang terjadi, dimana secara umum daerah yang berdampak besar terhadap permukiman adalah daerah linier bukaan pada sumber kebisingan karena limbah kebisingan bebas keluar dari bukaan gedung tanpa adanya hambatan. , sehingga nominal dampak bunyi yang terjadi tanpa hambatan tersebut, nilai kebisingan rata-rata berada di atas ambang batas 70 dB.A dengan kategori sangat mengganggu..

Kata kunci: Efek, Dampak, Kebisingan, Limbah, LISA FEA.

1. Introduction

In the development of the PLTD Senayan 101 MW infrastructure, in the planning process to the operational phase of the PLTD activities, environmental conditions for the occurrence of important impacts, namely the impact of noise occurring due to machine operation, must be taken into account. Whereas, as part of this effort, PLTD Senayan is conducting a noise study to determine the environmental impact of the operation of PLTD Senayan 101MW.

The work area of PLTD Senayan's Noise and Vibration Study Service Activity is located on Jalan Soldier Pelajar, RT. 7/RW. 7 Grogol Village, Kebayoran Lama District, Special Capital Region of Jakarta.

This study aims to obtain data on the impact of noise pollution by conducting a noise test from the operation of the PLTD Senayan to obtain information on the environmental impact of the PLTD Senayan during the operation of the PLTD Senayan 101 MW in terms of noise. With this activity, it is hoped to obtain a noise abatement management to obtain a method and to minimize it according to the regulations set/applicable by the government or the set Standard Threshold Values (NAV).

Finite element software modeling of the acoustic impact of noise arising from the operation of PLTD Senayan 101 MW to determine the impact of noise exposure

Figure 1 Research site layout

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2. Research Methods

2.1 Collection of topographical data

Topographic surveying is a method of determining the position of man-made and natural signs (features) on the ground surface. Topographic surveys are also used to determine the configuration of the terrain (terrain). The purpose of a topographic survey is to gather the data needed to draw a topographic map. The map image from the combined data forms a topographic map. Topography shows the character of vegetation using an equals sign with the horizontal distance between multiple features and their respective elevations during a given date. The topographic mapping process itself is a mapping process that uses terrestrial survey equipment to measure directly on the earth's surface. Mapping techniques have evolved in accordance with the development of science and technology. With the development of ground electronic measuring instruments, the measuring process with high accuracy is becoming increasingly faster, and with the support of GIS technology, the calculation steps and processes are becoming simpler and faster, and drawing can be done automatically. Surveys are usually carried out on the flat plane, i.e. without taking into account the curvature of the earth. For surveying projects, the curvature of the earth is small, so the effect can be neglected in simplified calculations. On the other hand, with long-distance projects, the curvature of the earth cannot be neglected, since these are geodetic surveys..

Figure 2 Topographic survey at the research site

2.2 Noise data retrieval

According to Suma'mur [2], the most common types of noise encountered are the following:

1. Stable broadband noise. For example machines, fans, kitchens with lightbulbs.
3. Continuous noise with a narrow frequency spectrum (stationary narrow-band noise). For example circular saws, gas valves.
4. Intermittent noise (intermittent). For example traffic, the sound of ships flying past the airport.
5. Impulse noise (throb or pulse). For example, gunshots or firearms, explosions.
6. Repeated impulsive noise. For example the forging machine in the company

According to Sihar, noise in the workplace is divided into two main types, namely:

1. Fixed noise is divided into two parts, namely:
   a. Discrete frequency noise in the form of pure "tones" at different frequencies;
   b. Broadband noise, noise that occurs with more variable intermittent frequencies (not pure "tone").
2. Transient noise is divided into three parts, namely:
   a. noise fluctuations, noise that constantly changes over a period of time;
   b. Intermittent noise, intermittent noise and can vary in strength, e.g. B. traffic noise;
3. Impulse noise generated by high-intensity noise (hearing) in a relatively short time, e.g. B. The sound of a gun exploding.[1], [2].

The threshold is a standard workplace factor that workers can accept without causing illness or health problems in their daily work for a maximum of 8 hours a day or 40 hours a week (KEPMENAKER No.Kep-51 MEN/1999). The NAV of noise at work is the highest sound intensity, i. H. The average level that is acceptable for workers who work no more than 8 continuous hours per day and 40 hours per week without causing permanent hearing loss. The acceptable noise limit is 85 dBA for 8 consecutive hours of exposure[3]–[5].

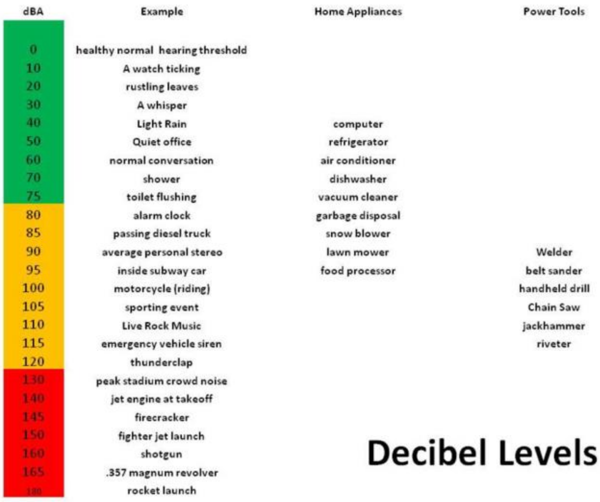

Figure 3 Decibel levels

Figure 4 Noise tester, sound level meters

The following are the noise exposure (NAB-Noise) guidelines based on Appendix II to the Minister of Labor Order No. Kep-51/MEN/1999 on Limit Values for Physical Factors at Work and the Department of Labor Environment Order No 48 of 1996 on noise level standards [6]–[8] .

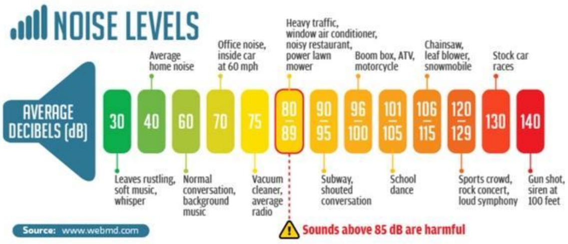

Figure 5 Noise levels

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Table 1. NAV of noise according to Decree of the Minister of Labor No. Kep-51/MEN/1999 on threshold values for physical factors at work.

Waktu pemajanan / Hari	Intensitas kebisingan (dB.A)	Waktu pemajanan / hari	Intensitas Kebisingan (dB.A)
8 jam	85	28,12 detik	115
4 jam	88	14,06 detik	118
2 jam	91	7,03 detik	121
1 jam	94	3,52 detik	124
30 menit	97	1,76 detik	127
15 menit	100	0,88 detik	130
7,5 menit	103	0,44 detik	133
3,75 menit	106	0,22 detik	136
1,88 menit	109	0,11 detik	139
0,94 menit	112	Tidak boleh	*140

Catatan: (*) Tidak boleh terpajan lebih dari 140 dB.A, walaupun sesaat.
Sumber: Kep-51/MEN/1999 tentang Nilai Ambang Batas Faktor Fisika Di Tempat Kerja.

Table 2. Noise NAV according to the Decree of the State Minister of the Environment No. 48 of 1996 concerning Noise Level Standards

Peruntukan Kawasan / Lingkungan Kesehatan	Tingkat Kebisingan dB (A)
a. Peruntukan Kawasan.	
Perumahan dan Pemukiman	55
Perdagangan dan Jasa	70
3. Perkantoran dan Perdangan	65
4. Ruang Terbuka Hijau	50
5. Industri	70
6. Pemerintahan dan Fasilitas Umum	60
7. Rekreasi	70
8. Khusus:	
– Bandar Udara	
– Stasiun Kereta Api	60
– Pelabuhan Laut	70
– Cagar Budaya	
b. Lingkungan Kegiatan	
1. Rumah Sakit atau sejenisnya	55
2. Sekolah atau sejenisnya	55
3. Tempat Ibadah atau sejenisnya	55

The method of collecting noise data uses a sound level meter with analysis of the results using the LISA FEA V. 8 application.

Noise measurement methods, which usually serve a purpose rather than the measurement itself, include:

1. Measurements are only for checking the working environment
2. Measurements aimed at determining the impact on the affected workforce

The instrument used to measure noise is a sound level meter (SLM) and the unit of noise measured is decibels (dB).

In addition, the sound level meter can also be equipped with a frequency analyzer in octave, half octave and third octave levels. Any time you use a sound level meter, you must first calibrate it every three months to get measurement results with maximum accuracy.

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Figure 6. Noise survey at the research site

2.3 Finite Element Method

The finite element method (FEM) is a numerical method for solving technical analysis problems. The finite element method combines several mathematical concepts to generate equations of a linear or nonlinear system. The number of equations generated is usually very large, reaching more than 20,000 equations. Therefore, this method is of little practical value unless a suitable computer is used[9]–[11].

When a structure is subjected to forces such as stress, pressure, temperature, flow rate, and heat, the result is strain (deformation), stress, temperature, pressure, and flow rate. The nature of the distribution of the resulting action (deformation) on a body depends on the properties of the force and stress system itself. In the finite element method you can find the distribution of this effect, expressed as displacement. The finite element method uses an element discretization approach to solve the problem of finding displacements of vertices/connections/lattices and structural forces. The discrete element equations are related to the matrix method for structural analysis and the results obtained are identical to those of classical analysis for structures. The discretization can be done with one-dimensional elements (line elements), two-dimensional (plane elements) or three-dimensional (volume/continuum elements). This approach uses a continuum element to determine a solution that is closer to the truth.

2.4 LISA FEA

LISA, a popular finite element analysis application, was used to estimate and complete this study using the finite element model. researchers have developed a very detailed approach in the LISA software. The frequency is predicted assuming that the walls are rigid. Assuming that LISA correctly predicts the frequency for the rigid cavity. The three types of models are, in order of their simplicity and ease of construction, the line element model, the shell model, and the solid model.

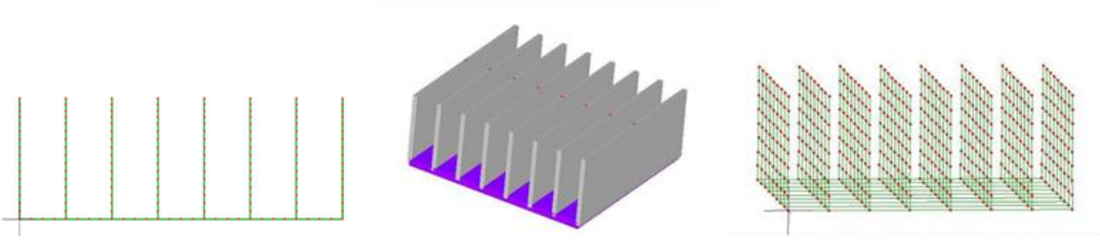

Figure 7. Element model on LISA FEA

Figure 7 explains for line element models only, the convection coefficient of the baseplate surface needs to be determined as half the value used elsewhere since we cannot exclude convection from assembling the baseplate surface with the face selection tool. It's just a matter of common sense.

And for the other two models, it's easy to exclude the mounting surface from convection - we just don't select that surface. An internal heat generator is used in each case, and the volume of the entire floor slab is assumed to be the heat source. Care should be taken when applying boundary conditions to a line element model. LISA selects all faces of the line elements when the "face" selection is made (i.e. both "ends" of the line and all "sides" of the line)[9], [12].

3. Results and discussion

In general, polygon calculations consist of two stages, namely the first stage is the calculation of temporary coordinates and the second stage is the calculation of definitive coordinates. The map projection system used is the Universal Transfer Mercator (UTM) projection system.

When collecting noise data, some data are carried out according to the engine power load during production and engine stop with a certain distance reference to the affected area, namely residential areas, with a zone radius of 100 m from the machine point. As for the first zoning, which is linear with the residential path, as shown in Figure 3.

Figure 8. Element model on LISA FEA

Figure 8 shows the visual topographical results of the study area represented in the sound propagation color results, where in the analysis the study area elevation has an impact on the sound propagation rate of the surrounding environmental conditions. The topographic hue obtained is plotted at the test area points and the identified test points to obtain excellent and detailed data in this noise exposure study, the graph is shown in Figure 9.

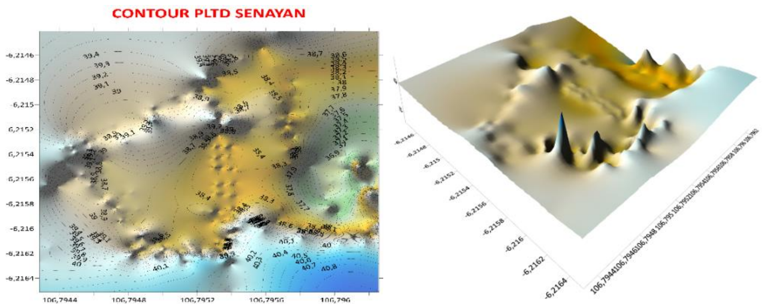

Figure 9. Topographic results at the research site

3.1 Zone noise analysis 1

In order to control noise at its source, it is first necessary to identify the cause of the noise and secondly to decide what can be done to reduce it. Modifying the power source to reduce the noise generated is often the best way to control noise. For example, if an impact occurs such. a compression stroke, reducing the peak impact force (even at the cost of longer time the force acts) will dramatically reduce the noise generated.

In noise control by design, the terms direct and indirect are sometimes used to describe the path of sound from generation to propagation through the air. As a result, the air noise inside the fan is directly radiated, but the noise carried by the structure inside the gearbox is transmitted to the casing wall and indirectly radiated as air noise.

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When collecting noise data, some data are recorded according to the current load of the machine during production and when the machine is stopped with a certain distance reference to the affected area, e.g. B. residential area performed.

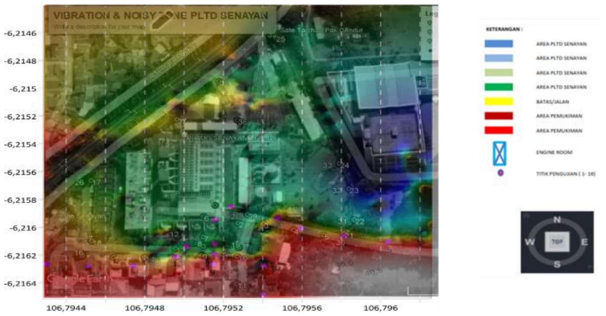

Figure 10. Plotting reasearce pont

Table 3. Zone 1 noise data

Research Point	POWER LOAD (%)			
	100	75	50	0
	NOISE RATE (dB.A)			
1	95.10	93.33	89.10	77.23
2	91.07	86.17	81.33	68.20
10	86.13	83.67	82.43	66.40
11	86.28	75.73	74.93	64.90
Threshold	70.00	70.00	70.00	70.00

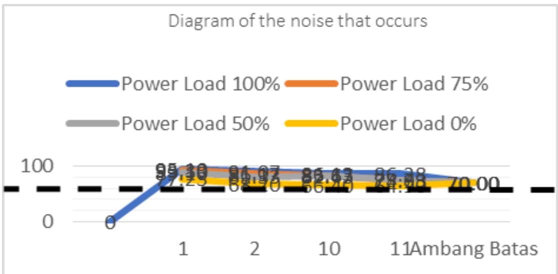

Figure 11. Diagram of the noise that occurs

From Figure 11, 12 it can be seen that there is a noise effect in zoning 1, the study provides information that with a load power of 50% to 100%, it shows a noise value of more than 70 dB.A, namely with a nominal value of 74.93 dB.A to 95.10 dB.A. the condition of the machine with 0% load power only at a distance of 25 m has a value below the threshold.

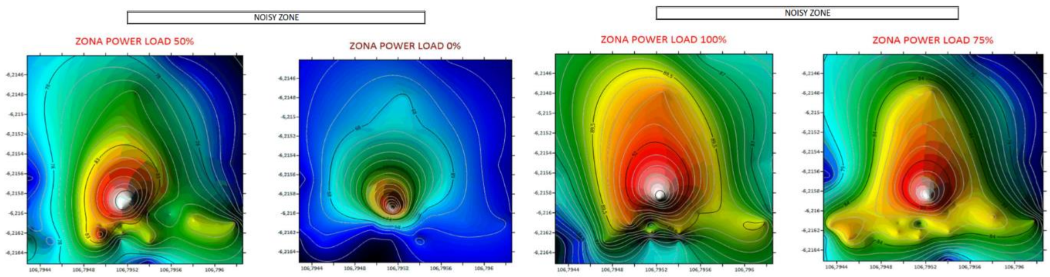

Figure 12. Diagram of the noise that occurs

After the noise test data has been collected and analyzed and entered into the LISA FEA V.8 program to identify the effects occurring, it can be seen in Figure 13,14, which explains that the central point of the noise source comes from the engine building and has a significant impact on the residential area of the surrounding residents when the engine is on until the engine is on. 100% load.

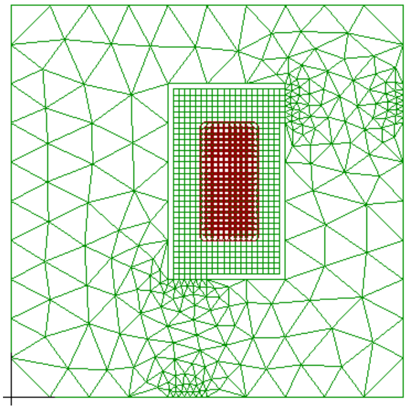

Figure 13. Modeling the research area using LISA FEA

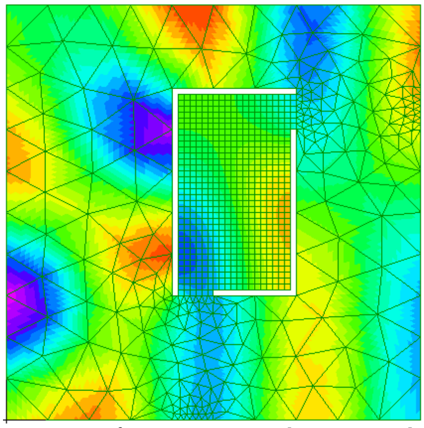

Figure 14. Modeling the impact area of noise exposure in the area around the study using LISA FEA

Figure 14 is a modeling of the area affected by noise exposure using LISA FEA V. 8 software, where in this modeling the building is modeled according to the conditions in the field and given an open space as a flow of noise exposure according to the condition of the building from the source of the impact of the noise exposure. It is seen that several dark blue hues are the source of the noise exposure and reach several segments of the population zone and have an impact due to the exposure as noise waste. And several blue to purple dots on the outside of the building are indicated as sound sources from outside the environment at the location under review. Dealing with noise through barriers In Figure 8, it can be seen that the noise area reaches residential areas with a noise level above 70 db, but after a 6 meter high barrier is installed, the noise-induced area in residential areas drops below 70 db, which As can be seen in Fig. 9, the color tone in the residential area is already green and the value is below the threshold, it can be seen that the noise effect is distorted laterally by the installation of the barrier, where previously the noise effect in the environment was still at the upper limit was. However, the noise impact is greatly reduced if the barrier is installed around the noise source area or the engine area.

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4. Conclusion

From the results of this study, it was obtained the hue of the condition of the impact of noise exposure that occurred, where in general the area that had a major impact on settlements was the linear area of the opening at the noise source because the noise waste freely came out of the opening of the building without any obstacles, so the nominal sound impact that occurs without this obstacle, the average noise value is above the threshold of 70 dB.A with the category of very disturbing. Continuous noise type with a wide frequency spectrum. Therefore, it is necessary to handle it by constructing a barrier to prevent the sound resonance from echoing into settlements, or planting lush trees around the noise source building to reduce the impact of noise exposure in densely populated settlements so that it does not interfere with the health and daily activities of the surrounding environment.

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