Analysis of noise levels caused by various types of trains

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Abstract. A passing train is a source of the noise. Noisy is an unwanted sound from a business or activity at a certain level and time that can cause public health problems and environmental comfort. Noise is one of the problems for environmental health. According to the World Health Organization (WHO), in 2000 there were 250 million (4.2%) of the world population experiencing hearing loss due to noise and around 140 million (50%) were in Asia. A passing train is a source of the noise. In this study the measurement of daytime noise level (Lsm) and momentary noise level (Lek) at several points along the Cirebon-Cepu railway. The daytime noise level (Lsm) is measured for 24 hours for each point while the instantaneous noise level is measured from 5 meters, 10 meters, 15 meters and 20 meters from the rail. Noise level at night (Lsm) and momentary noise level (Lek) which is measured is the noise level caused by various types of trains that are passing. From the research that has been done, the noise level in some places has exceeded the Threshold Value. The highest noise level of Nighttime at Cirebon Pruaskan Station is 78 dBA for Special areas, while the biggest increase in momentary noise is caused by a freight train of 30 dBA in Pulosaren Settlement.

1. Introduction
Railway noise is categorized as a discrete noise type that creates spikes in time-dependent noise diagrams. The continuity of this type of noise is low. Hence it causes less sleep disturbance, but makes communication rather difficult due to its high magnitude [1]. When the waves of acoustic noise reach human tissues, especially the organs of hearing, they periodically press them and make them vibrate. The nervous system transfers these vibrations to respective centers in the brain. When exposed to a longlasting, even if not very intensive, noise the hearing gets tired [2]. Several studies show the old conventional diesel locomotive train produces a higher noise level [3]. From previous research, researchers obtained noise levels in several areas along the railroad that exceeded the noise quality standards set by the Ministry of Environment in 48/MENLH/11/1996 even though the existing conditions are single rails. Even in Brebes, Some residents who live on the edge of the Brebes-Cirebon railway line claim they are worried about the impact of noise and vibration from the construction of a double track on the section. They asked for the construction of the line to pay attention to the Environmental Impact Analysis. Residents also asked for clarity regarding the threshold of noise and vibration that was safe from the functioning of the lane [4]. For this reason, research on Noise Modeling along the Railroad is important and meaningful, because this research has never been conducted in Indonesia and by modeling the noise there will be many benefits including; Noise Level Mapping in the Area Around the Railroad, Noise Level Mapping of Community Health / Comfort in the Area Around the Railway Road, Reference to deal with noise problems in the area along the railway, Reference for decision makers to determine the area along the railway line, according to its designation, Reference to the transportation department, so that the operation of the Railway is environmentally sound. Actually, research on Noise Modeling along the Railroad has been carried out...
abroad and tends to be a reference for analysis in the country. This tendency results in the calculation of the noise level not in accordance with the actual noise level due to differences in climate / weather, so that it has the potential to cause problems with residents living in areas along the railroad tracks. Therefore this study intends to develop a model of Noise in the Area along the Railway in Indonesia [5].

2. Experimental Details
Retrieval Location Field data for this study in the area around the railroad along Prujakan Station to Kanci, Astanajapura District, Cirebon Regency at 3 locations. The reason for choosing the location is because the route is the busiest line so that it has a high noise level, as shown in figure 1.

![Figure 1. Location of Field Data Collection for Research](image)

Data obtained from measurements during the time interval are equivalent both during the day (\(L_S\)), and at night (\(L_{M}\)), [6] with equations (1);

\[
L_{ek} = 10 \log \frac{\sum_{i=1}^{n} 10^{Li/10}}{N}
\]

(1)

with Lek: Equivalent Noise Level N: Number of Total Measurements this: Amount of data recorded at time interval to Li: Noise Level at time interval I can be calculated noise level at night (\(L_{sm}\)) [6] using equation (2).

\[
L_{sm} = 10 \log \left( \frac{\sum_{i=1}^{16} 10^{Lek_i/10} + \sum_{j=1}^{8} 10^{(Lek_j + 10)/10}}{24} \right)
\]

(2)

The value of daytime noise is calculated, compared to the standard value of the noise level set with a tolerance of +3 dB (A) (KEP-48 / MENLH / 11/1996). Tools used: Survey form, Used to record momentary noise, ie when the train is passing for 10 minutes with recording time every 5 seconds. Stationery To record all the data needed. Stopwatch. Measuring the length of time needed when a train passes at one point. Sound Level Meter (SLM) Measures the momentary noise level, that is when the train passes. Meter Measure the noise source distance (train) with the measurement point. Surveyor As a note taker of the required data at the direction of the researcher. Preliminary survey The preliminary survey is intended to estimate the accuracy in sampling related to the location of the study, the accuracy of the method chosen, the estimated cost and time of the survey, the determination of the type and number of tools to be used and the efficiency of the surveyor personnel to be used.
3. Results and Discussion

The statement of day-night noise level is an equivalent noise level statement model that is used to express the noise level especially in residential areas. The measurement is carried out for 24 hours, which is divided into night time intervals (22.00-06.00) and daytime intervals (6:00 to 22:00). The results of the noise level measurements at the Prujakan Nighttime Noise Level were obtained at 78 dBA while the noise quality standards set by the Ministry of Environment in Kep-48 / MENLH / 11/1996 for a special area of 70dBA. High noise levels at the Prujakan Station caused by the high activity of the train at the station. The high activity of the train at the Prujakan station, also increased the economic activity at the station. This can be seen in the measurement of momentary noise even though it is measured when there is no train. The instant noise at Prujakan station is completely presented in Table 1.

| Table 1. Prujakan Station |
|---------------------------|
| Noise Level (dBA)         | Distance (m)  |
|                          | 5   | 10   | 15   | 20   |
| There is no train         | 80  | 80   | 80   | 80   |
| Freight train             | 104 | 98   | 95   | 92   |
| Train Economy             | 104 | 98   | 95   | 92   |
| Executive Train           | 103 | 97   | 94   | 91   |

The results of noise measurements in Pulosaren settlement show, the noise level at night is 59 dBA, while the quality standard is 55 dBA. The high level of noise in the area is due to the economic activities of the population in the area. This can also be seen from the results of instantaneous noise measurements when there is no train that shows the noise level has reached 61dBA as shown in table. The biggest increase in momentary noise was donated from freight trains of 42dBA at a distance of 20m. Observation in the field shows, the closest house to the railroad is 20m, so they will feel a noise increase of 30dBA.

| Table 2. Pulosaren Settlement |
|-------------------------------|
| Noise Level (dBA)             | Distance (m)  |
|                               | 5   | 10   | 15   | 20   |
| There is no train             | 60  | 61   | 61   | 60   |
| Freight train                 | 102 | 96   | 93   | 90   |
| Train Economy                 | 100 | 94   | 91   | 88   |
| Executive Train               | 101 | 95   | 92   | 89   |

In Kanci, Astanajapura Subdistrict, Cirebon Regency, with the designation of the Open Green Lsm area exceeding the quality standard, which is 71 dBA, while the quality standard is 55 dBA. The result of measuring the instantaneous noise level in the area when there is no train is 71dA. The high level of noise in the area is because the area is located on the north coast of Java (Pantura), which is the busiest road in Indonesia.

| Table 3. Kanci District of Astanajapura Cirebon Regency |
| Noise Level (dBA) | Distance (m) |
|-------------------|--------------|
|                   | 5  | 10 | 15 | 20 |
| There is no train | 60 | 61 | 61 | 60 |
| Freight train     | 102| 96 | 93 | 90 |
| Train Economy     | 100| 94 | 91 | 88 |
| Executive Train   | 101| 95 | 92 | 89 |

4. Conclusion
The results of measurement and calculation of the noise level day and night in the area along the railroad from Prujakan Station to Astanajapura District, Cirebon Regency showed that it exceeded the noise level threshold as contained in the Minister of Environment Decree Number 48/MENLH/11/1996. The highest day and night noise in the Kanci area of Astanajapura Subdistrict, Cirebon Regency was 71dBA, while the biggest momentary increase was in the Pulosaren Settlement, which was caused by a Goods Train of 30 dBA. The highest instantaneous noise is caused by freight trains and economic trains totaling 104dBA at a distance of 5m at Prujakan Station.

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