Evaluation of noise level in architecture department building in University of Sumatera Utara

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Abstract. Noise is one the comfort factors that need to be noticed, particularly in an educational environment. Hearing a high noise in a period can affect students’ learning performance. The aims of this study were to know the noise level and get an appropriate design to reduce noise in Architecture Department building in the University of Sumatera Utara, considering that architecture students often spend most of their time inside the room. The measurement was conducted in four rooms for two days each from 09:00 – 12:00 and from 13:00 – 16:00 by using Sound Level Meter that placed near the noise source of the room. The result indicated that the average of noise level exceeded the 55 dB(A) so it still needs the appropriate design to reduce the noise that occurs in the building.

1. Introduction
Every activity produce noise in different intensity. According to World Health Organization, noise pollution is one of the main forms of urban environmental pollution and is responsible for negative impacts that are harmful to the environment and the quality of life of the population [1]. The noise from transportations, traffic, civil construction, siren and fireworks [2], lawn mowing, communication between class break, and music [3] and other noises are the examples of noise pollution that can affect students’ concentration and learning performance [4][5][6], psychological and physiological disorder [7]. Every building differs from its noise level allowance according to its function, particularly in educational building, the noise limit is 55 dB(A) inside the classroom [8].

The University of Sumatera Utara is located near commercial area, Soewondo Air Force Base, and densely populated settlements. It makes a contribution in noise sources in the University of Sumatera Utara. Architecture Department, Faculty of Engineering, USU has two operating-buildings. Students spend most of their time inside to learn and work on their projects. In this case, they need audial comfort while working and learning.

This paper was to evaluate the noise level in one building of Architecture Department (the new one) whether the noise level is exceeded the allowance or not, identify the noise source and find the solution to reduce the noise level.

2. Method
This study used the descriptive and evaluative method by using Sound Level Meter to measure the noise level. The measurement was conducted in four rooms inside the building for each point was measured
for two days. The point of measurements was put near the noise source between the operating time, 09:00 WIB – 12:00 WIB and 13:00 WIB – 16:00 WIB in 1-hour interval using the average value of the noise level and observed the noise source around the points during the measurement. The specification of the SLM showed in the table below:

| No | Parameter                  | Value                                      |
|----|----------------------------|--------------------------------------------|
| 1  | Name                       | Sound Level Meter Hong Yan HY1361I          |
| 2  | Measuring range            | 30 – 130 dBA or 35 – 130 dBC              |
| 3  | Accuracy                   | ±1.5 dB                                    |
| 4  | Frequency weighting        | A/C                                        |
| 5  | AC output                  | 0.707 Vrms                                 |
| 6  | DC output                  | 10 mV/dB                                   |
| 7  | Time weigh                 | Fast/slow                                  |
| 8  | Microphone                 | ½ inch electric condenser microphone       |
| 9  | Power                      | 1.5V AA alkaline or USB 5V 100mA           |

3. Results and Discussions
The results will be discussed in 4 subsections; they are the average of the noise level in each point, noise limit, noise source that occurred at each point, and the solution that can be applied in the building to reduce the building.

3.1. The Average of Noise Level in Each Point
Table 2. shows that the range of noise level occurred in Point A was between 55.7 dBA – 64.3 dBA, for Point B, was between 56.3 dBA – 63.8 dBA, for Point C was between 54.6 dBA – 57.7 dBA, and for Point D was between 60.7 dBA – 67.9 dBA. The highest average noise level range was in Point D. The most low average noise level range was in Point C. Even in Point C, the range still exceeded the noise limit allowance for an educational building.

| Time          | Point A | Point B | Point C | Point D | Point A | Point B | Point C | Point D |
|---------------|---------|---------|---------|---------|---------|---------|---------|---------|
| 09:00 - 10:00 | 55.8    | 58.1    | 55.9    | 60.7    | 55.7    | 61.5    | 55.2    | 61.8    |
| 10:00 - 11:00 | 57.8    | 57.9    | 55.4    | 60.7    | 57.7    | 57.3    | 56.3    | 62.7    |
| 11:00 - 12:00 | 61.6    | 58.5    | 54.7    | 66.9    | 64.3    | 60.8    | 56.2    | 67.9    |
| 13:00 - 14:00 | 58.2    | 63.8    | 55.0    | 67.6    | 59.9    | 57.3    | 57.3    | 67.8    |
| 14:00 - 15:00 | 56.5    | 56.3    | 54.6    | 64.2    | 61.3    | 58.1    | 56.2    | 61.3    |
| 15:00 - 16:00 | 59.7    | 59.9    | 57.7    | 61.6    | 62.9    | 57.0    | 56.3    | 62.7    |

3.2. Noise Limit
According to Indonesia Ministry of Environment and World Health Organization (WHO), the maximum of the noise level in educational building is 55 dBA. Figure 1 shows that noise level in almost every point exceeded the noise limit of 55 dBA.
3.3. **Noise Sources**

According to researcher observation, the noise sources mainly came from the activities inside the four rooms, and sometimes came from outside activities and vehicles. Activities that produce noise are communication between people, class break, music, and vehicles. The most exceeded noise level was in Point D, the noise source mainly came from outside the room, the communication between students in the corridor.

3.4. **Solution**

Because the average noise level exceeded more than 55 dBA, the building needs appropriate design solution to reduce the noise level to fulfill the noise limit as an educational building.

Here are some solutions that could be applied in the building, (1) adding vegetation buffer outside the building to decrease the noise from outside, (2) applying sound isolation layer on outside walls. To reduce the inside noise, the solutions are: (3) applying the absorbent panel on the walls, (4) adding furniture which can absorb noise (in order to not create an echo), (5) changing the building functions into another room function that does not really need tranquillity, for example staff room, administration office, etc. In regulation side, rules could be applied by forbidding the students to make noise near the building, and creating an appropriate room to discuss.

4. **Conclusions**

The noise level in Architecture Department building was exceeded the noise limit allowance, so it needs appropriate design solution to reduce the noise level.

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