Acoustic Barriers to Reduce Sound Pressure and Environmental Noise in the Ica Fencing

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Abstract. The objective was to determine the reduction of sound pressure through acoustic barriers, knowing the factors that affect the propagation of its acoustic emission, the methodology was the quantitative design, explanatory level, pre-experimental type, pre and post-test, based on studies of behaviors of other barriers such as noise mitigating measures; Two sound level meters were used to measure noise, one of which served as a reference since the sound spectrum due to traffic has a varied behavior. The results obtained in the tests carried out in the field and office work, allowed us to corroborate the Equivalent Continuous Sound Pressure Level (LAeqT). We conclude that Calle Lima 1ra. block and 1st. block Av. Grau, exceeds the standard limits established in the S.D. N° 085-2003-PCM Words.

1. Introduction

Due to the imminent growth of traffic noise [1]. In recent years and with the increase in inhabited areas on city avenues, it is necessary to generate acoustic screening in areas where the noise level exceeds what is allowed. Environmental noise has become one of the most annoying pollutants in modern society that directly affects the well-being of the population [2]. People subjected to great noise continuously, experience physiological disorders, such as loss of hearing capacity, alteration of brain, cardiac and respiratory activity, gastrointestinal disorders, among others [3]. In addition, behavioral alterations such as sleep and rest disturbance, communication difficulties, irritability, aggressiveness, developmental problems occur attention and mental concentration [4]. Of the sources of urban noise, motorized vehicles are responsible for approximately 70% of the noise present in cities, and of this, the greatest contribution is made by motorcycle taxis. A second group is made up of "stationary sources", that is to say, street vendors, music, etc. [5]. The installation of acoustic barriers in developed countries has been widely used as a form of noise control in the propagation stage. This need has led research centers or government entities to develop the subject with a view to optimizing these devices and standardizing their use. The authorities stand out in this area by creating requirements for both acoustic efficiency and construction, and the scientific community in the development of new designs.

On the other hand, the creation of mitigation measures according to the environmental environment, plays a very important role in the decision to install an acoustic barrier [6]. Therefore, the complement of the different physical and landscape variables involved in This problem will enable the integration of an optimal solution to control traffic noise levels [7], to finally improve the quality of life. Acoustic screens or barriers installed in the vicinity of high-noise traffic lanes are the most effective and widespread means for reducing the effects that intrinsic noise to these sources produces in their environment. But, the arrangement of new elements in the surroundings of an avenue generates a series of added effects, both on the landscape itself and on the people who perceive it. In other words, an acoustic screen can be considered as a corrective measure of the sound impact, but its construction introduces new impacts on the environment.
1.1. Speed of sound
The speed of sound is the speed of propagation of sound waves, a type of longitudinal mechanical waves produced by pressure variations in the medium. [8].

\[ V_s = V_0 + \beta T \]  

(1)

Where:
\[ V_0 = 331.3 \text{ [m/s]} \]
\[ \beta = 0.606 \text{ [m/(s °C)]} \]
\[ T \text{ [°C]}, \text{is the temperature in degrees Celsius.} \]

1.2. Intensity.
The intensity of a sound is determined by the amplitude of the oscillatory movement.

\[ I = 2\pi f^2 A^2 \rho v \]  

(2)

\[ f = \text{Frequency} \]
\[ v = \text{Speed of sound in a density medium (} \rho \text{)} \]
\[ A = \text{Amplitude} \]

1.2.1. Sound intensity level unit.
The decibel is the main unit of measurement used for the power level or intensity level of sound [8].
Decibel (dB) is defined by the following expression:

\[ L_{dB} = 20 \log_{10} \frac{L_1}{L_{ref}} \]  

(3)

\[ L_{dB} = \text{Signal level in dB} \]
\[ L_1 = \text{Vibration level, in acceleration, speed or displacement.} \]
\[ L_{ref} = \text{Reference level, equivalent to 0 dB} \]

1.3. Sound meter
Figure 1 shows the Equipment that transforms the Sound Energy that is perceived through the pick-up element or microphone that is generally found at the end of the Electrical Energy Measurement Instrument that passes to an Analogue or Digital recorder. When we move away from the emitting source, the noise gradually decreases [9]. Table 1 shows the allowable tolerances in dB.

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| Class | Calibrators | Sound level meters |
|-------|-------------|--------------------|
| 0     | +/- 0.15    | +/- 0.40           |
| 1     | +/- 0.30    | +/- 0.70           |

**Figure 1.** Sound level meter.
Figure 2. Some noises and their loudness levels.

Table 2. Some noises and their sound levels

| Noise Description              | Sound Level |
|--------------------------------|-------------|
| Chirping birds                 | 10 dB       |
| Car horn                       | 90 dB       |
| Tree leaf rustle               | 20 dB       |
| Bus horn                       | 100 dB      |
| Residential areas              | 40 dB       |
| Interior discotheques          | 110 dB      |
| Normal conversation            | 50 dB       |
| Motorcycles without muffler    | 115 dB      |
| Office environment             | 70 dB       |
| Drills                         | 120 dB      |
| Factory interior               | 80 dB       |
| Avión sobre ciudad             | 130 dB      |
| Road Traffic                   | 85 dB       |
| Umbral de dolor                | 140 dB      |

Source: Pan American Health Organization. "Environmental Health Criteria: El Ruido", Mexico 1980.

2. Material and method

2.1 Study area
Noise was evaluated in places that affect the routine of the common citizen, regardless of their profession: main streets, habitual urban transport. Measurements were made with an integrating sound level meter, as established by the norm of the National Environmental Commission (CONAMA), during the months of July to September 2019. The study was carried out on Avenida Grau due to poor planning and construction of its buildings. The effects of noise and its long-term consequences on the health of your patients are becoming widespread. Therefore, it is essential to take action to limit and control exposure to environmental noise. These actions supported by an adequate scientific evaluation of the available data on the effects of noise, in particular the dose-response relationship. This relationship forms the basis of the risk assessment and management process.

2.2 Methodology.
A descriptive, cross-sectional study was carried out during June-September 2019. Measurements were made between 5:00 p.m. and 8:00 p.m. [12].
Measuring instrument
A type 2 integrating sound level meter (margin of error ± 1 dB) was used, duly calibrated, which complied with the requirements established in the standards of the International Electro-technical Commission (IEC Standard), publications Ns 651 Sound Level meters (Sound Level Meters), first edition 1979; and Ns 804 Integrating-averaging Sound Level Meters, first edition of 1985 [13]. The A-weighting filter and the slow response of the Measuring Instrument were used. The results of the measurements were expressed in dB (A) slow.

Measurement conditions
They were carried out according to what is established by the noise measurement standard [14]. The measurement points were located between 1.2 and 1.5 meters above the ground, and if possible, about 3.5 meters or more from walls, buildings or other reflective structures. At least three measurements of 1 minute duration will be made, at points separated from each other by approximately 0.5 meters, and from them the arithmetic average was obtained [15]. Measurements that included occasional noises were discarded.

Measured noise sources
The environmental noise emitted in areas that affect the routine of the common citizen Independent of their profession was evaluated, therefore the measurement places have been chosen arbitrarily:
- The existing noise emission in the streets with the highest noise emission in the Ica fencing was evaluated.
- The record of noise emitted by public transport was carried out in taxis and motorcycle taxis.

3. Results

• LDN or Day-Night Equivalent Level
The LDN measures the level of noise Leq that is produced in 24 hours. When calculating the noise at night, as there should not be, a 10 dB (A) is penalized for those that occur between 10 at night and 7 in the morning. Figures 3 and 4. indicate the monitoring measured in Grau Avenue and Ayacucho Street. Table 3 shows the monitoring points in the Ica fence.

![Figure 3. Noise monitoring Av. Grau and Calle Ayacucho- Ica.](Image)

![Figure 4. Noise monitoring Av. Graù and Calle La Mar- Ica.](Image)
Table 3. Monitoring points in the Ica fence

| LOCATION (MONITORING POINT) | TURN       | 07/09/2004 | 15/09/2004 | 21/09/2004 | 22/09/2004 | AVERAGE PER SHIFT | AVERAGE PER POINT |
|-----------------------------|------------|------------|------------|------------|------------|-------------------|-----------------|
| A                           | MIDDAY 12 - 14 Hr. | 74.40      | 73.20      | 79.00      | 73.90      | 78.00             | 78.22           |
| B                           | MIDDAY 12 - 14 Hr. | 74.30      | 80.70      | 83.90      | 81.30      | 82.80             | 81.35           |
| C                           | MIDDAY 12 - 14 Hr. | 72.10      | 85.80      | 77.90      | 80.00      | 80.40             | 80.20           |
| D                           | MIDDAY 12 - 14 Hr. | 79.00      | 76.60      | 79.00      | 77.70      | 80.10             | 79.22           |
| E                           | MIDDAY 12 - 14 Hr. | 70.00      | 80.00      | 73.20      | 80.10      | 80.40             | 80.13           |
| F                           | MIDDAY 12 - 14 Hr. | 71.00      | 78.60      | 77.90      | 79.60      | 81.35             | 83.23           |
| G                           | MIDDAY 12 - 14 Hr. | 72.10      | 79.90      | 77.70      | 77.50      | 80.10             | 79.22           |
| H                           | MIDDAY 12 - 14 Hr. | 70.00      | 80.00      | 73.20      | 80.10      | 80.40             | 80.13           |
| I                           | MIDDAY 12 - 14 Hr. | 71.00      | 78.60      | 77.90      | 77.70      | 80.10             | 79.22           |
| J                           | MIDDAY 12 - 14 Hr. | 70.00      | 80.00      | 73.20      | 80.10      | 80.40             | 80.13           |
| K                           | MIDDAY 12 - 14 Hr. | 71.00      | 78.60      | 77.90      | 77.70      | 80.10             | 79.22           |

4. Conclusions
- It has been determined that the Equivalent Continuous Sound Pressure Level (L_AeqT) for Calle Lima 1ra. block and Av. Grau 1ra. block, exceeds the standard limits established in the S.D. N° 085-2003-PCM.
- It has been determined that the Equivalent Continuous Sound Pressure Level (L_AeqT) for Calle San Carlos and Av. Grau 5ta. block, east side, exceeds the standard limits established in the S.D. N° 085-2003-PCM

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