# Noise Pollution Analysis in External Masonries of Heavy Traffic Roads, Case Study Tirana, Albania.

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**ABSTRACT***: This paper determines the acoustic properties of external walls building materials composition. Noise pollution is one of the main pollutants nowadays but it is not considered of great importance in the construction field, despite some studies showing that greater acoustic pollution is produced by buildings under construction. The study consists on analysing two different types of buildings equipped with different type of external masonry composition in terms of building materials. The buildings are located at "21 Dhjetori" street, Tirana, Albania. Furthermore, the case study area is treated as an area that consistently harvests noise. The impact of noise pollution on the existing building materials is going to be analysed.*
*Those mile stones will provide information regarding the noise levels, comparison of the actual level of noise production (outdoor and indoor area), sound transmission and sound diminution, as well as the implementation of acoustic materials in order to improve the quality of life of the inhabitance.*
*The selected area has the highest norms of acoustic pollution in the city according to the studies implemented by Determination of acoustic properties of building materials is an important task gaining higher importance due to the demand for suitable construction materials, located in places with high level of noise and places with heavy traffic, such as urban areas.*
*The aim of this paper is displaying a comparative study on the actual noise levels generated by this area. It indicates the acoustic properties of the current building materials followed by a more suitable soundproof insulation.*

**KEYWORDS-***building materials, external masonry composition, noise levels, sound transmission, sound insulation*

## I. Introduction

Throughout recorded history Tirana has constantly been highly ranked on the overall charts regarding noise pollution levels in EU. World Health Organization (WHO) recommends that throughout the day the noise levels should stay under 55 decibels, while during the night, continuous background noise should stay below 30 decibels and individual noises should not exceed 45 decibels. However, in Tirana daytime and nighttime register respectively the average noise levels of 73.8 dB and 69.9 dB, yet there are certain areas that reach almost the double of these values. [1]

During communism (1946-1990) there was no high level of acoustic pollution, the absence of private cars, entertainment, commercial services as well as the peripherical location of industrial activities generally preserved minimal noise levels to the city. The constructive pattern during this period displays buildings of different purposes. The use of silicate bricks masonry was massive. [1]

Furthermore, by the mid-1990s noise levels in Tirana were beyond the norms of WHO recommendations considering that Tirana was a city that until 1990s had yet no private cars and a few buses. As a result, it is indicated that the majority of Tirana's noise is due to motorized traffic. [1]

The 90s (post communism era) were also characterized by an estimated population rate that was dedicated to the mass migration toward the city, due to the fact that Tirana was the main

industrial and economic district of Albania. Privatization of land and buildings opened the city to rapid development, heavy traffic, and booming construction of shops, houses, and squatter settlements. Tirana's metropolitan population grew to more than 600,000; city size increased fivefold. [5]

Nowadays Tirana is home to different architectural styles that represent both periods. Many of the buildings constructed during communism are still functional nowadays.

This paper synthesizes two buildings, each representative of its own period, to ensure information on how these building react to the contemporary noise pollution in order to raise awareness regarding the poor quality of the building materials and techniques of implementation as far as the acoustic isolation is concerned.

## II. Sound and noise

2.1 Definition of sound and noise.

Sound is a form of energy that is transmitted by pressure variations which the human ear can detect. Most sounds are made up of a complex mix of many different frequencies. Frequency refers to the number of vibrations per second of the air in which the sound is propagating and it is measured in Hertz (Hz). Waves of the frequency that range from 20–20,000 Hertz (Hz) can affect the human hearing aid and cause a sense of sound in it. However, a person can hear sounds even up to 20 Hz. Sound can also travel through other media, such as water or steel. Noise can be defined as unwanted sound. [2, 3]

2.2 Sound measurements

All measures consider the frequency content of the sounds, the over all sound pressure levels and the variation of these levels in a specific time frame. Sound pressure is a basic measure of the vibrations of air that make up sound. Because the range of sound pressures that human listeners can detect is very wide, these levels are measured on a logarithmic scale with units of decibels (dB). [4]

2.3 Noise levels

While certain sounds may not affect us, others may prove to be damaging. In general, sounds above 85 are harmful, depending on how long and how often you are exposed to them and whether you wear hearing protection. [4] The following chart explains the decibel level of a number of sounds.
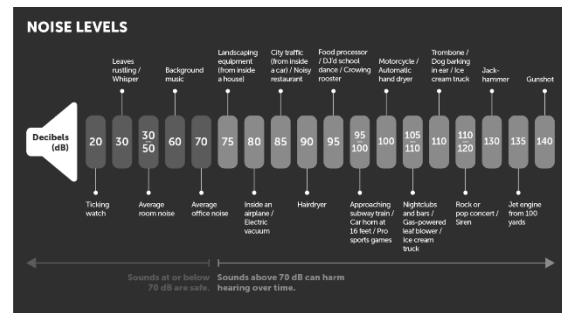


Fig. 1 – Noise level, source: Hearing health Foundation/ Prevention/ Keep Listening Campaign/ What are safe decibels?

## III. Noise pollution

3.1 Definition of noise pollution

Noise pollution is an unwanted sound created by sound-generating human activities that is considered harmful or detrimental to human health degrading the quality of life, while `noise` is identified as being a sound that is ``out of place``. [7]There are many adverse effects associated with exposure to noise pollution. This can range from hearing impairment, to sleep disturbance, to annoyance and even cardiovascular disorders.[7, 4]
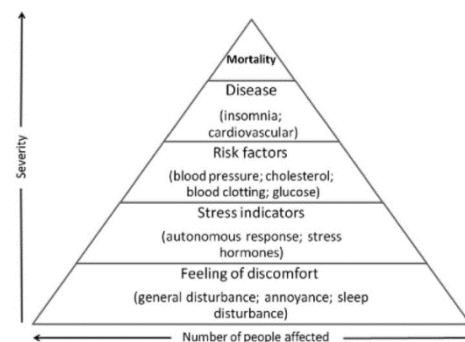


Fig.2 – Pyramid of health effects of noise [7]

## IV.     Soundproofing

### 4.1 Acoustic materials

Acoustic is the science of sound and deals with the origin of sound and its propagation, either in free space, in pipes and channels or in closed spaces. Acoustic materials eliminate sound reflections and are generally porous, with many pathways that redirect sound and cause it to lose energy. [9]

### 4.2 Sound Insulation

The sound insulation or sound transmission loss of a wall is that property which enables it to resist the passage of noise or sound from one side to the other. This should not be confused with sound absorption which is that property of a material which permits sound waves to be absorbed, thus reducing the noise level within a given space and eliminating echoes or reverberations. It is desirable to have a single number rating as a means for describing the performance of building elements when exposed to an "average" noise. One method which has been recently proposed is the sound transmission class (STC). The rating is determined by measuring the transmission loss (TL).If the rating is higher, the sound penetrating through the material is blocked. The easiest way to improve the rating is by adding mass to the walls in order to increase the overall thickness of the walls, adding insulation or air space inside walls.  [2,10]

## V.     21 DHJETORI

21 Dhjetori is one of the busiest and loudest intersection in the city of Tirana. This area is very close to the city center and it incorporates within itself a wide domain of institutions such as: kindergartens, primary schools, universities, hotels, banks, restaurants, bars, hospitals etc. Moreover, the intersection of 21 Dhjetori is connected to many main areas which leads to heavy traffic and therefore high level of noise.

### 5.1   Noise levels in 21 Dhjetori

During the monitoring over the years 21Dhjetori has been listed as an area with relatively high noise level, especially at night. In 2018 the noise level in this area exceeded by 33% over the standard values. [6,8]]According to recent survey results, due to the citizens perception, the main source of noise pollution is transport (70%), construction (20%) and entertainment (10%). The average value of noise levels reaches up to 72.8 dB while studies over the years show a maximum value of 97.5 db.

### 5.2   Experimental Procedure

The experiment consists on analyzing the noise transmission on two buildings (building A and B) each having a different masonry from the other, located at 21 Dhjetori. Building A is positioned 30 m across building B. The procedure is performed by 3 people, two of whom measure noise from the interior while the other is placed in between these two buildings. Measurements are taken on the third floor in five different moments throughout the day, precisely at 9:00 am, 12:00 pm, 3:00 pm, 6:00 pm and 9:00 pm. The duration of each measurement is 60 s. It is important to be mentioned that this paper does not take into account the noise generated by the floor, ceiling or windows. The focus is only on the external masonry.



Fig.3 – Building location, Tirana, Albania, Source: Google Map

The equipment used for the measurements is Decibel X – iPhone Application: Using a decibel meter we can measure the sound level in (db.) performance for each building material in the experiment.

Fig. 4 – Decibel X app. layout
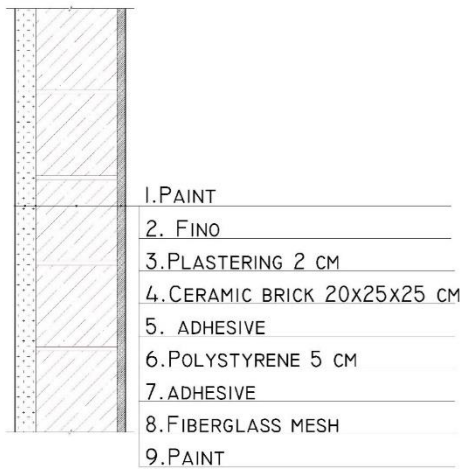
5.3 Masonry



Fig. 5 – Building A masonry, CAD, Source: Authors.



Fig. 6 – Building B masonry, CAD, Source: Authors.

1. Paint is used as a protective and decorative coating on cement-based surfaces, such as: concrete, plaster, etc.

2.It is a powder material which prevents mold creation and allows the airing of cement-based, hydrated lime, marble carbonate sand and marble of selected granulometry, synthetic resins and special additives walls.

3.Basic filling material for brick or block walls for indoor and outdoor environments. It is used as a basic mortar to stucco all types of supports, such as: brick or block walls, etc.

4. This Brick has the maximum capacity to bind with cement. Uniformity in color, size, and shape. The ceramic brick is free from cracks and other flaws such as air bubbles, stone nodules, etc.

5. Calcium silicate bricks are made of (silica) sand and lime and popularly known as sand lime bricks. These bricks are used for several purposes in construction industries such as ornamental works in buildings, masonry works etc.

6. Wall adhesive is an essential product. It's used to securely fixate an element to either the wall, or floor by using a trowel to spread the adhesive in meter square sections.

7. The wire mesh is used to strengthen the facades that are going to be repaired or plastered.

5.4 Experimental Results

| Noise levels | | | | | | |
|---|---|---|---|---|---|---|
| **Time** | **Outdoor** | | **Building A** | | **Building B** | |
| | **Avg** | **Max** | **Avg** | **Max** | **Avg** | **Max** |
| **9:00 am** | 61.6 db | 73.6 db | 49.1 db | 55.1 db | 56.7 db | 63.8 db |
| **12:00 pm** | 71.5 db | 89.6 db | 57.9 db | 71.4 db | 52.9 db | 73.3 db |
| **3:00 pm** | 85.1 db | 96.1 db | 73.5 db | 88.0 db | 77.2 db | 90.9 db |
| **6:00 pm** | 72.1 db | 85.8 db | 59.8 db | 66.3 db | 63.3 db | 71.5 db |
| **9:00 pm** | 71.4 db | 86.1 db | 59.8 db | 66.8 db | 63.0 db | 69.9 db |

Table 1 – Noise measurements at 21 Dhjetori , Tirane, Albania. 26 January 2022, Source: Authors
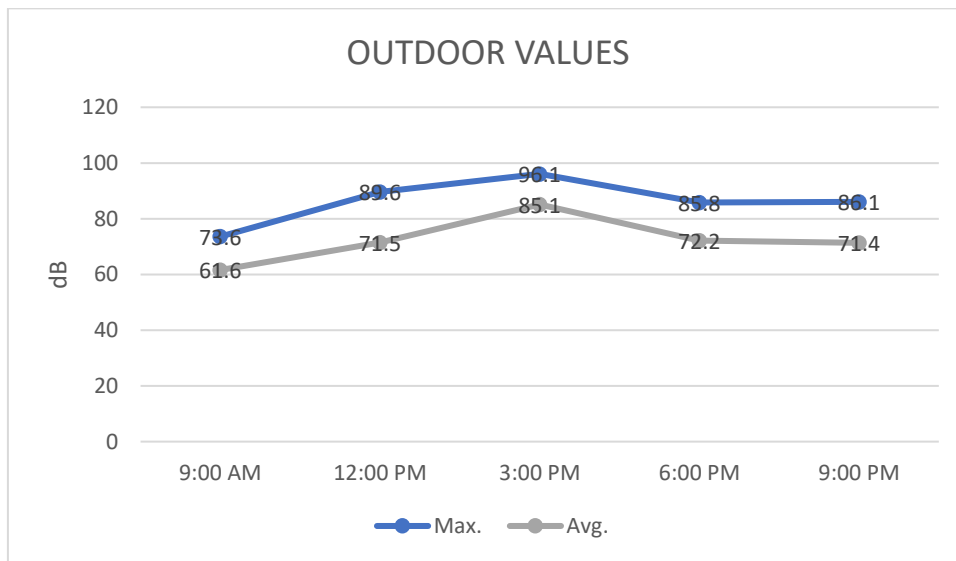
5.6 Charts



Chart 1 – External noise level measurements at 21 Dhjetori , Tirane, Albania. 26 January 2022, Source: Authors
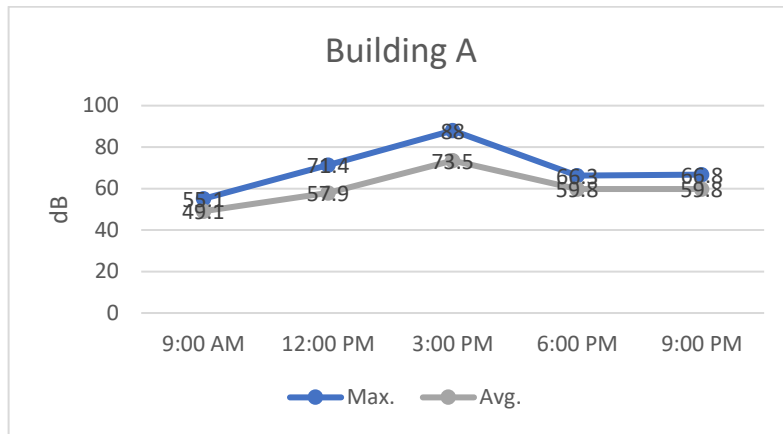
Chart 2 – Building A masonry noise level measurements at 21 Dhjetori , Tirane, Albania. 26 January 2022, Source: Authors
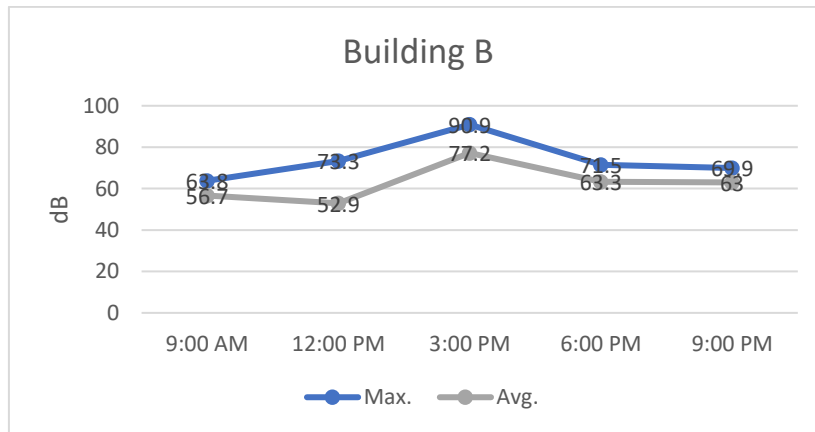


Chart 3 – Building B masonry noise level measurements at 21 Dhjetori , Tirane, Albania. 26 January 2022, Source: Authors
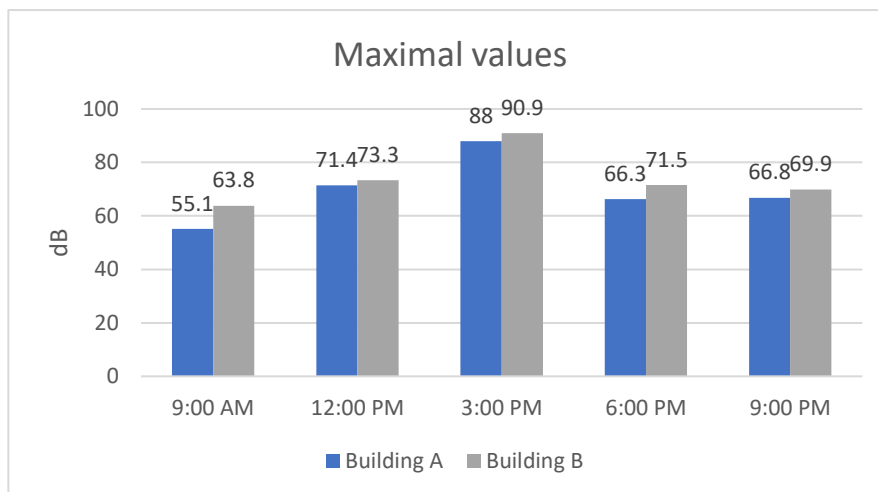


Chart 4 – Maximal noise levels at 21 Dhjetori , Tirane, Albania. 26 January 2022,Source: Authors

## VI.    Conclusion

According to field observations, this paper concludes as followed:

The noise level difference between the buildings inner and outer space is relatively small, which indicates poor layers performance of masonry composition.

Building "A" due to its (ceramic brick) masonry displays a better reaction to the noise as opposed to Building "B" (silicate brick masonry), nonetheless its level of noise transmission is yet very high compared to the standard values.

Building A (ceramic brick masonry) reduces the noise level by nearly 20 dB while building B (silicate brick masonry) reduces the noise level by nearly 10 dB.

In addition, besides the poor quality of construction, the area is very much so in need of immediate noise reduction.

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