

Analysis of acoustic pollution in buildings near high traffic streets. Case study Zogu Zi crossroad, Tirane, Albania.

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ABSTRACT:: Acoustic 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 most of acoustic pollution is produced by buildings under construction and roads with high traffic. The aim of the paper is to compare the noise levels at different time of the day in two different buildings which have different characteristics and different construction materials. The goal is to understand how well sound isolated civil buildings are and how engineers have calculated the noise levels based on the specific area. The buildings are located at "Zogu Zi", Tirana, Albania. The case study area is an area that consistently harvests noise from heavy traffic. The impact of the noise and the sound insulation materials in the wellbeing of the inhabitation is going to be analyzed too. 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, environmental noise, public health

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I. INTRODUCTION

According to a survey by the National Environment Agency, Tirana is the noisiest and loudest city in Albania, with noise pollution frightening and beyond any EU criteria. According to Numbeo's analysis of 98 nations, Albania is positioned 23rd for noise pollution. The increase of the noise pollution throughout the past years (2010–2017) in Tirana, Albania's capital, results in noticeably increased numbers[1]. In the most recent report, the organization also discussed how noise pollution, or noise levels beyond the prescribed limits of 70 dB during the day and 55 dB at night, can lead to aggression, hypertension, hearing loss, tinnitus, and sleep disturbances. According to these data, Tirana violates safe noise levels to a greater extent than those specified by the European Union.

According to some researches, motorized traffic is the main source of Tirana's daily noise. Traffic signal issues, frustrated horn honking by drivers in gridlock, and truck traffic in urban areas causes vehicle noise. High noise levels are caused by additional, unrelated elements during the day and by music from bars and clubs at night.

However, there have been very few public noise reduction initiatives to underline. Noise pollution protection measures sometimes have been implemented. Instead of being created through an accountable administrative structure that provides ongoing monitoring and enforcement, they have mostly been the product of the will of important public leaders[2]. Recommended guideline values based on the health effects of noise, other than occupationally-induced effects, are often not taken into account. There is no doubt that society would benefit from being reorganized to promote healthy transportation. Understanding the various types of noise, how it is measured, how it originates, and how it affects people is necessary to comprehend noise. Active noise reduction, including noise control, must be implemented, and the effectiveness of the policy implications in each situation must be assessed[3]. During the 90s (post communism era) some of the areas 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[4].

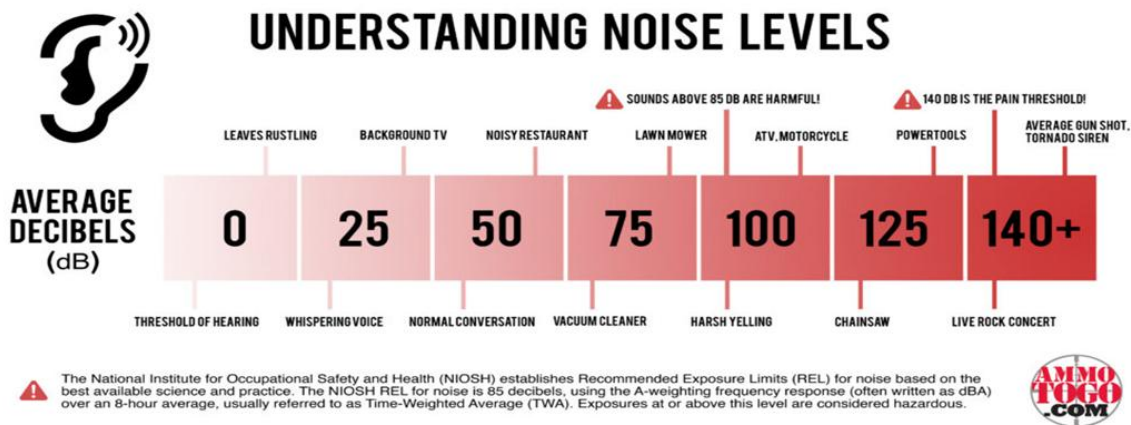


Fig. 1 -Noise level, Hearing health [8].

II. NOISE POLLUTION

2.1 Definition of noise pollution

Environmental noise pollution is one of the most significant environmental stressors influencing public health globally and is now a recognized topic in environmental and public policy. As one of the most significant environmental stressors influencing human health globally, environmental noise pollution is now a recognized topic in environmental and public policy.

2.2 Environmental Noise and Health

There is currently a large body of research correlating environmental noise exposure to a variety of detrimental health impacts. A variety of cardiovascular consequences, including hypertension and ischemic heart disease, as well as annoyance, sleep disturbance, and others rank among the most significant of these. Other newly discovered impacts include myocardial infarction (heart attack), stroke, unfavorable pregnancy outcomes, infertility problems, and possible associations with certain malignancies. Additionally, the impacts of noise-induced sleep disruption are linked to a host of health issues, including as exhaustion, decreased cognitive and physical performance, increased anxiety, and unfavorable emotional states like anger and depression[5].

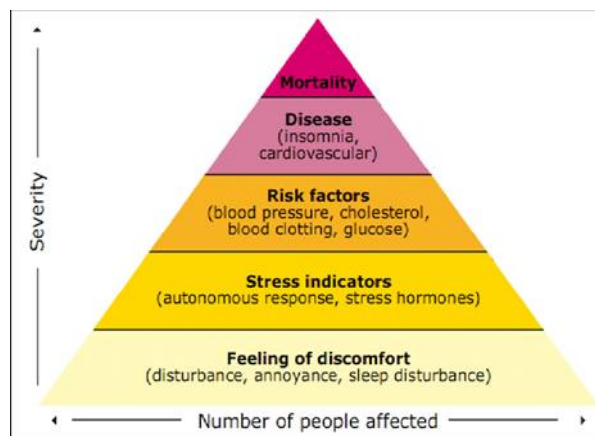


Fig. 2 -Pyramid of health effects of noise [9].

2.3 Sources of Noise Pollution

- Road Traffic Noise. Noise from the motors and exhaust systems of large trucks are common sources of noise pollution.
- Noise from Aircraft.
- Noise from Railroads.
- Construction Noise.
- Noise from Industrial Activity.
- Noise in Buildings.

- Noise from Consumer Products.
- Fireworks [6].

III. SOUND INSULATION

Sound insulation is a kind of measure to prevent the sound waves from permeating. The sound transmission loss, which is represented by the decibel difference between incident sound and penetrated sound, serves as an example. The sound-insulating property improves with increasing numbers.

3.1 Sound Absorption

The ability of a surface or construction material to absorb sound rather than reflect it is known as sound absorption. If a room has a large percentage of reflective surfaces, sound waves will bounce about the space once they are produced. Gypsum board, wood, concrete, brick, and tile are some common building materials that are relatively reflective and do not absorb much sound. Sound is much better absorbed by softer materials like carpet, foam cushioning, and fiberglass insulation. For usage in locations where sound is a major concern, acoustical baffles with absorptive materials are available and most are designed to be unobtrusive and visually nondescript so as to allow for installation without drastically altering the aesthetics of a room[7].

IV. ZOGU ZI



One of the busiest and noisiest intersections in Tirana is located in the so called Zogu Zi. This neighborhood is quite close to the city's core and contains a variety of establishments, including hospitals, universities, hotels, banks, restaurants, and pubs. Additionally, there is a lot of traffic and noise at the Zogu Zi crossroads because it is connected to several major places. During monitoring throughout the years, Zogu Zi has been identified as having a high noise level, especially at night, which is higher than the standards of the European Union. The permitted European rate of 35 to 50 decibels is exceeded, increasing the pollution level to 80 dB.

Fig.4 The are under study. Source: Google Earth

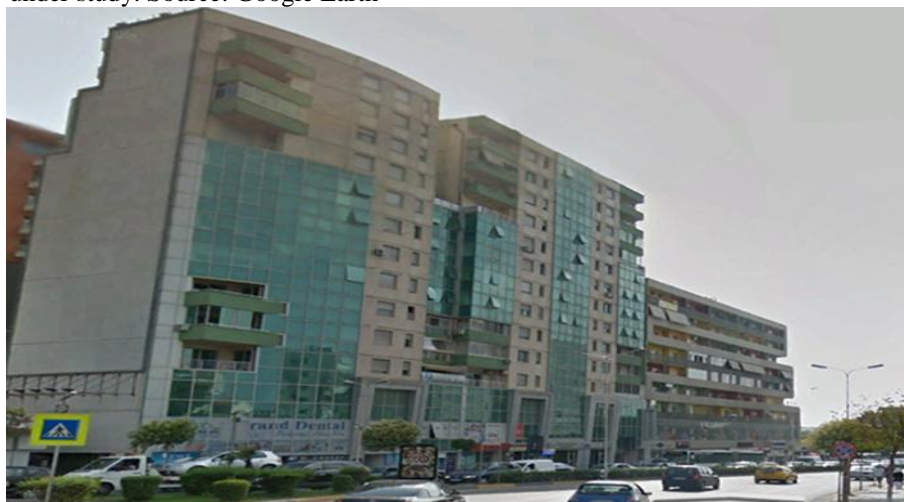


Fig. 5 -Building location 3D View, Tirana, Albania.(Building A- Left ; Building B- Right) source: authors

V. EXPERIMENTAL PROCEDURE



The experiment consists on analyzing the noise transmission on two buildings (building A and B). Each building has a different masonry from the other, and they are both located at Zogu Zi crossroad. Building A is positioned next to building B. The experiment 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. The duration of each measurement is 45s. It is important to underline that the measurement have not be done close the doors or windows. The focus is only on the external masonry. The equipment used for the measurements is Decibel X – iPhone Application: Using a decibel meter can measured the sound level in (db.) performance for each. Building.

Fig. 6 -Building location, Tirana, Albania. Source: Google Earth



Fig.7 – Decibel X app. Layout source: iPhone Application

5.1 Masonry Composition

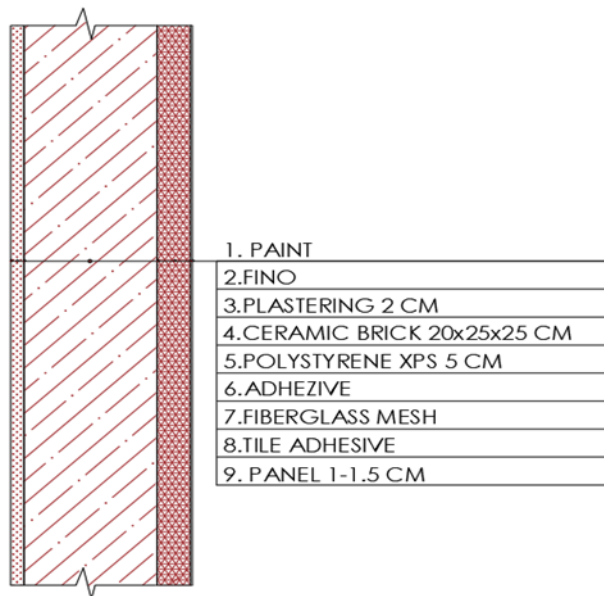


Fig. 8 – Building A masonry composition, CAD,
Source: Authors.

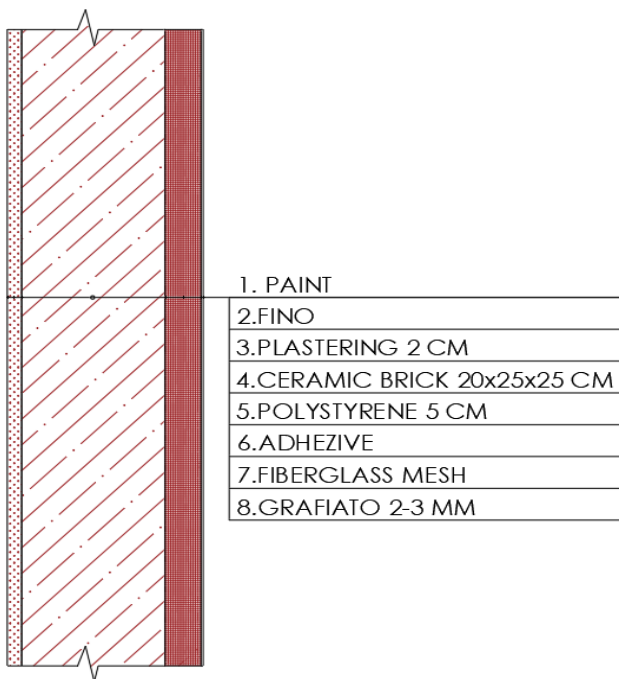


Fig. 9 – Building B masonry composition, CAD,
Source: Authors.

1. *Paint is used as a protective and decorative*
2. *It is a substance in the form of powder that, when mixed with marble, carbonaceous stone sand, hydrated lime, cement, and other additives, prevents the growth of mold and permits the wall to breathe.*
3. *Plaster, a pasty material made of lime, water, and sand that is used to cover partitions, ceilings, and walls. It is one of the oldest methods of construction.*
4. *This Brick can be joined with cement the most. They come in a wide range of colors and can be manufactured from a variety of materials, including clay. There are no cracks or other faults in the ceramic brick, such as air bubbles or stone nodules.*
5. *The relevance of outside divisions in a structure cannot be overstated. In addition to its aesthetic value, polystyrene performs the fundamental function of assisting in the creation of high performance thermal and acoustic insulation.*
6. *A necessary item is wall adhesive. Use it to firmly affix a piece to either the wall or another surface.*
7. *Concrete is strengthened structurally and water loss is minimized by using fiber mesh. Additionally, this kind of mesh is used to strengthen concrete and give it a stronger impact resistance while also preventing melting.*
8. *Facade panels are utilized to create aesthetically pleasing buildings and improve noise and temperature insulation.*
9. *Decorative coating that serves for the treatment of facades and interior surfaces. High resistance to atmospheric conditions. It forms a stable and long lasting structure.*

VI. RESULTS AND DISCUSSION

| Noise levels | | | | | | |
|--------------|----------|---------|------------|---------|------------|---------|
| Time | Outdoors | | Building A | | Building B | |
| | Avg. | Max. | Avg. | Max. | Avg. | Max. |
| 9:00 AM | 62.1 db | 71.4 db | 48.6 db | 55.1 db | 50.4 db | 55.2 db |
| 12:00 PM | 70.5 db | 76.7 db | 51.2 db | 57.6 db | 52.4 db | 59.5 db |
| 7:00 PM | 72.5 db | 86.9 db | 59.3 db | 65.9 db | 61.6 db | 66.8 db |

Table of measurements, Source: authors.

According to the measurements as seen in table 1. It is observed that the noise level outside reaches high and disturbing values. While comparing buildings, Building B has higher values than Building A.

6.1 Charts

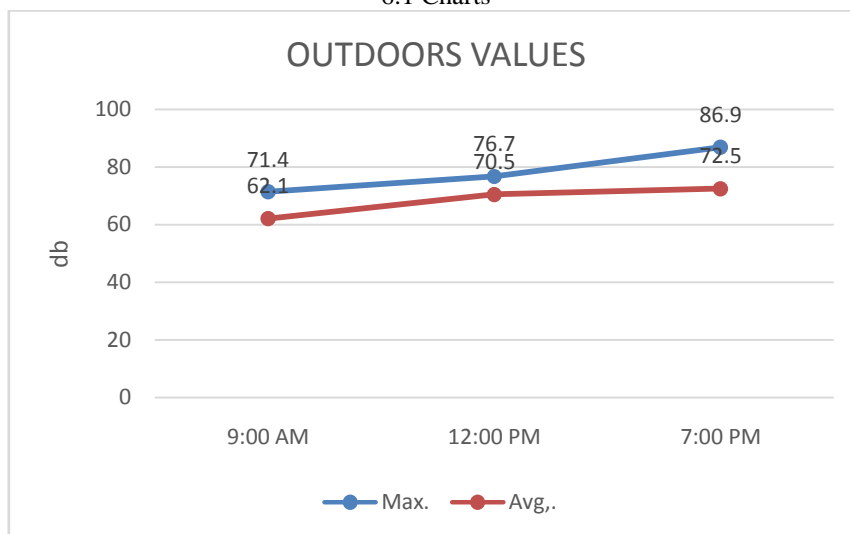


Chart 1 – External noise level measurements at Zogu Zi , Tirane, Albania. 28 January 2022: source:authors
According to the chart 1. It is observed that the noise level has high values throughout day.

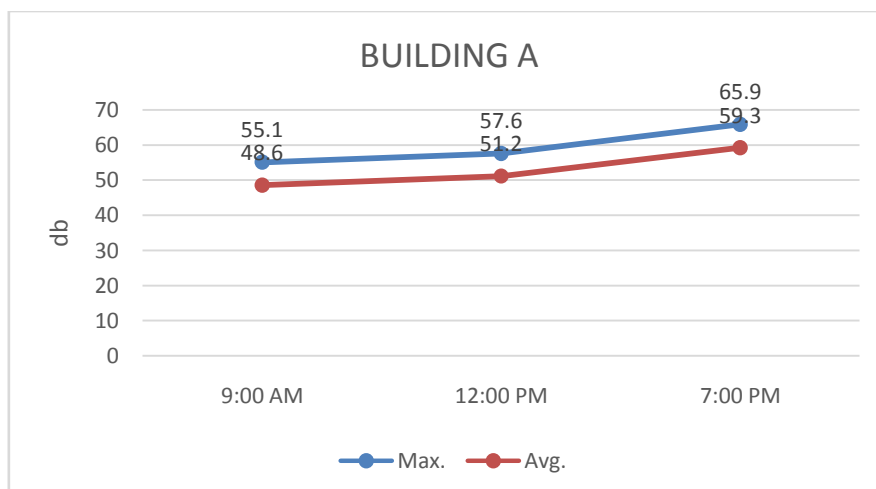


Chart 2 – Building A masonry noise level measurements at Zogu Zi , Tirane, Albania. 28 January 2022, source:authors

According to the chart 2. It is observed that the highest noise level is reached at 7:00 PM

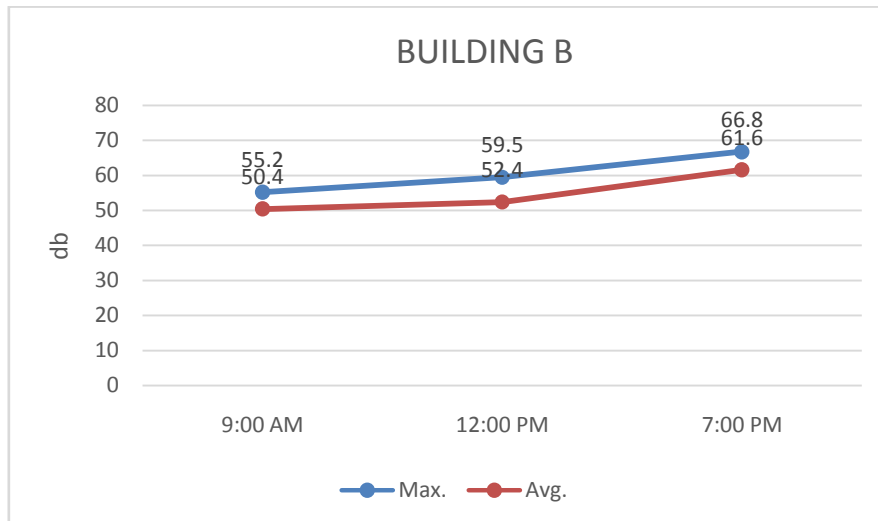


Chart 3 – Building B masonry noise level measurements at Zogu Zi , Tirane. 28 January 2022, source:authors
According to the chart 3. It is observed that the highest noise level is reached at 7:00 PM

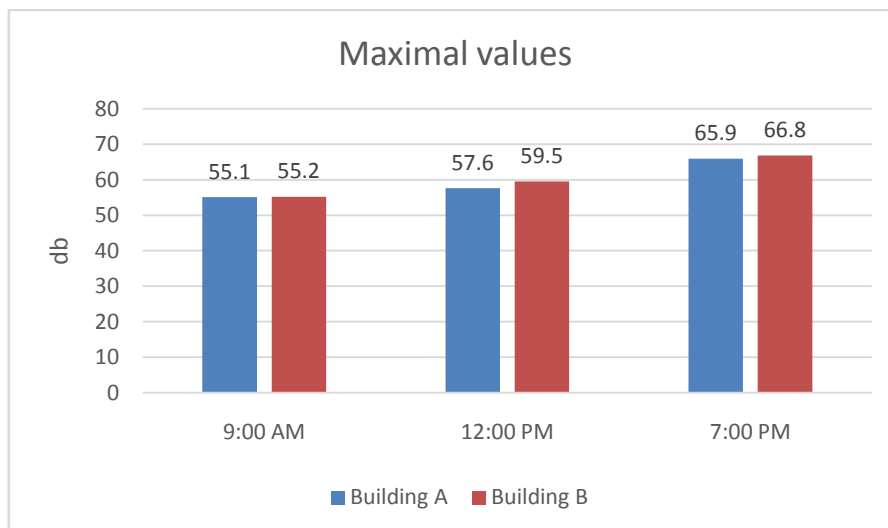


Chart 4 – Maximal noise levels at Zogu Zi , Tirane, Albania. 28 January 2022, source:authors
According to the chart 4. It is observed that Building B has higher noise values than Building A.

VII. CONCLUSION

According to field observations, this paper concludes as followed:

- I. The noise level difference between the buildings inner and outer space is relatively small.
- II. Both buildings A and B display a good reaction to the noises. Building A isolates noises better, with a very small difference compared to building B, because in the layers of the facade, the ceramic panel have a greater impact on reducing noise than grafiato.
- III. Buildings reduce the noise level by nearly 20 dB. They are well insulated, but they can perform even better.
- IV. In addition, the area is poor in terms of noise protection so it is needed an immediate strategy for noise reduction.

REFERENCES

- [1]. Ndotja akustike, Shqipëria e 23-a mes 98 vendeve, një projekt kundër “borive”. Marrë nga adresa: <https://www.monitor.al/ndotjaakustike-shqiperia-e-23-mes-98-vendeve-nje-projekt-kunder-borive/>, 06/03/2018. Aksesuar më (consulted on 30.07.2019).
- [2]. D Pojani, Noise Pollution Management Issues in Tirana, the Capital of Albania. REAL CORP 2012 17th International Conference on Urban Planning and Regional Development in the Information Society GeoMultimedia, Schwechat, Austria. 2012. 14-16 MAY 2012 .
- [3]. Dr Richard Helmer Director, Department of Protection of the Human Environment ,Cluster Sustainable Development and Healthy Environments, guidelines for community noise. April 1999/World Health Organization, Stocholm University and Karolinska Institute 1995.

- [4]. H Felstehausen. Urban Growth and Land Use Changes in Tirana, Albania: With Cases Describing Urban Land Claims. Land Tenure Center University of Wisconsin–Madison, Working paper. Ag Econ Aug 1999 ; (31). doi: 10.22
- [5]. Environmental Noise Pollution, Noise Mapping, Public Health, and Policy. 2nd Edition - april 9, 2002
- [6]. <https://nyaaya.org/legal-explainer/sources-of-noise-pollution/>
- [7]. Construction Methods and Materials for Noise Control by Nick Gromicko, International Association of Certified Home Inspectors <https://www.nachi.org/noise-control.htm>
- [8]. <http://www.ballistics101.com/silencer-guide.php>
- [9]. https://www.researchgate.net/figure/WHO-pyramid-of-health-effects-of-noise_fig1_271561532