IMPROVEMENT OF NOISE IMPACT MEASUREMENT METHODS ON CITY STREETS

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Abstract

Noise pollution presents a significant environmental challenge in Uzbekistan, particularly in urban areas adjacent to major transportation infrastructure. This study investigates the effectiveness of noise management strategies in Tashkent, focusing on a specific street segment. While existing noise assessment and management programs are implemented, they often exhibit limited effectiveness due to a lack of integration with other environmental and policy initiatives. This research examines the efficacy of selected noise mitigation measures, analyzing their combined impact on improving the acoustic environment. Through a combination of research and analysis, the study provides recommendations for noise abatement plans tailored to the specific characteristics of the chosen street segment in Tashkent. The findings contribute to a deeper understanding of the complexities of urban noise management in Uzbekistan and offer valuable insights for the development of more comprehensive and effective solutions.

Keywords: Noise pollution, Urban noise, Noise measurement, Environmental health, Public health, Quality of life, Transportation noise, Acoustic environment, Urban planning, Territorial planning, Noise mitigation strategies, Noise mapping, Traffic noise, Environmental factors, Sound propagation, Noise regulation, Noise standards.

1. Introduction

Noise pollution is a pervasive environmental problem in urban areas, significantly impacting public health, well-being, and quality of life. While existing noise measurement methods provide valuable data, they often struggle to capture the intricate and dynamic nature of urban noise. This includes variations in traffic volume, types of vehicles, and environmental factors like weather and building structures. Consequently, there is a need for improved methods that more accurately assess noise impact on city streets. This study aims to address this challenge by developing more comprehensive and nuanced approaches to measuring urban noise.

It is said that the section "Protection against noise" must be included in the territorial planning documents of the territories of the Republic of Uzbekistan, settlements, and in the master plans of cities, districts, micro districts, and districts, so I started with the summary.

In the first stage, I studied foreign experiences and the main ones are as follows

noise exposure not only reduces lifespan but also impacts the quality of life by hindering everyday activities, disturbing sleep patterns, and triggering psychological and physiological effects This exposure results in annoyance, learning difficulties, and health problems, ranging from temporary to permanent hearing loss. [1]

The detrimental effects of noise from vehicles and industrial machinery on physical and mental well-being are well documented [2]

In India, the railway is the major transportation mode for carrying goods and people. The tracks for the movement of the rail were initially constructed in the city for the pre-eminence and expediency of the vantage of the people. Rapid modernization and increasing population in the city crammed the area around the railway tracks. Moving rail on the tracks passing through the city is not compatible, which is creating problems for the nearby [3]

Noise measurements were carried out at these 28 locations two times a day for a period of one hour during the early morning and early evening rush hours, in the presence and absence of a barrier. The Calculation of Road Traffic Noise (CRTN) prediction model was employed to predict noise levels at the locations chosen for the study. Data required for the model include traffic volume, speed, percentage of heavy vehicles, road surface, gradient, obstructions, distance, noise path, intervening ground, effect of shielding, and angle of view. The results of the investigation showed that the minimum and the maximum noise levels are 46 dB(A) and 81 dB(A) during the daytime and 58 dB(A) and 71 dB(A) during nighttime. The measured noise level exceeded the 62 dB(A) acceptable limit at most of the locations. [4, 5]

Things to be done before noise measurement and assessment and primary data collection

Geographic information. Exact geographic boundaries of the area to be mapped, including street networks, buildings, and important land features (parks, water bodies, etc.). The topography of the area includes changes in elevation, hills, and valleys that affect sound propagation. Detailed information on existing land use in the area (residential, commercial, industrial, recreational, etc.).

Traffic information: Comprehensive road network information on road types (motorways, arterial roads, local roads), traffic lanes, and speed limits. Average daily traffic flow volume, including hourly or peak hourly variations, on major roads in the region. Distribution of vehicle types (cars, trucks, buses) on different roads, as each type produces different noise levels. [8, 9]

Available noise information Existing noise measurements, if available, are collected based on previous studies or monitoring programs. Noise levels were determined and noise complaint surveys or public opinion surveys were conducted. Appropriate noise standards or regulations are established for the area, including noise limits for specific land uses.

Collect information about the population and the level of sensitivity of existing facilities. The distribution of population density in an area indicates areas with high concentrations of people potentially affected by noise. Noise-sensitive areas such as schools, hospitals, residential areas, or parks are identified. The elderly or any vulnerable populations with poor health that may be more susceptible to noise exposure have been studied.

Below is a list of suggested programs for creating noise maps:

CadnaA: One of the most powerful and widely used programs is the Noise Modeling package. It offers many features such as modeling noise propagation in complex environments, analyzing the effects of screens, and predicting noise levels in buildings.[9]

SoundPLAN: Another popular package type known for its intuitive environment and flexibility in simulating different scenarios. It is an ideal software for designing noise barriers and analyzing the impact of noise on transport infrastructure.[10]

NoiseMAP: A special program for modeling traffic noise. One type of software that provides very accurate noise level prediction based on traffic parameters, road surface, and field geometry.[11]
Inoise: a new type of intuitive and quality-assured software for the calculation of industrial noise in the environment.[12]
INSUL: A program for modeling sound insulation of buildings and noise protection in urban environments.[13]
Odeon (Acoular): Open-source software used for indoor sound simulation. Provides high accuracy of calculations and the ability to create detailed models. Free open-source software.[14]

2. Materials and Methods

Oscillating noise is non-constant noise in which the sound level changes continuously over time and the changes in A-corrected sound level exceed 5 dBA when measured on the time characteristic of the "slow" sound during the measurement period. [10]
Intermittent noise is non-continuous A-corrected noise, the sound level of which changes gradually by more than 5 dBA during the measurement time, and the duration of the intervals during which the sound level remains constant is at least 1 s.
The equivalent sound level is calculated according to the formula.

$$L_{AeqT} = 10\lg \left(\frac{1^{t}}{T}\int_{t1}^{2} \frac{p^2 A(t)}{p_0^2} dt\right.$$

T= $t_2 - t_1$ fixed time interval, c; t_1 – the beginning of the time interval, c; t_2 – the end of the time interval, c; $p_0 = 2 * 10^{-5}$ — reference sound pressure
Sound effect - the time integral of the square of the sound pressure during the observation time interval or the measurement time interval

$$E = \int_0^T p^2(t)dt$$

$$p(t) - \text{sound pressure, Pa}$$

Sound exposure level - a value equal to decimal logarithms of the ratio of sound exposure in a certain time interval or the duration of the sound event in an interval equal to the reference sound exposure; is calculated according to the formula.
When calculating the distance coefficient, the minimum distance between the object of noise and the object where the noise meter is installed should be 3.5 m, and the maximum distance should be 6 m. The minimum height of the meter installation should not be less than 1.2 m, and the maximum should not exceed 2.5 m. The formula for calculating the noise difference between the noise center and the summer according to the location coefficient is as follows [11, 12, 13]

$$L_{jk} = 10\ \mathrm{Log}_{10}\ C/10$$

Where C is the actual distance between Shumomer and the noise center

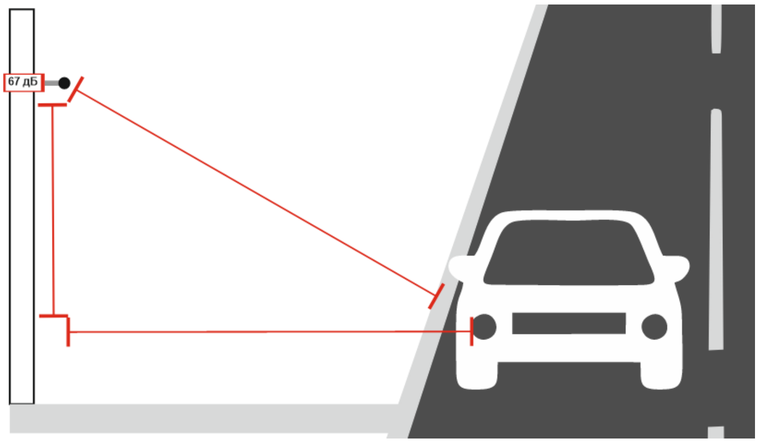

Figure 1. When calculating the distance coefficient, the distance between the noise object and the object on which the noise meter is installed

It should be placed at a distance of at least 10 m from other buildings and structures so that noise diffraction does not affect the accuracy of the measurement during measurement. [12,14]

To assess the daily noise background, it is necessary to perform measurements at different times of the day. In the morning (6-10 a.m.) it is often characterized by an increase in noise levels from traffic, during the day (10-6 p.m.) noise from traffic and other sources reaches its highest level, in the evening (6-10 p.m.) the noise level comes from traffic in entertainment areas, it is recommended to carry out measurements during this period to assess the night noise background at night (6:00 p.m.).

An interval of 1-5 minutes per 24-hour measurement time is ideal for assessing the overall noise level throughout the day. It covers changes caused by traffic, industrial activity, and even social events.

An interval of 1-5 seconds per 1 hour of measurement time is considered sufficient to characterize the noise from a particular source or to analyze short-term changes in the noise level. [15, 16, 17, 18]

Criteria for maximum sound levels

Table 1. Pin names and functions of the JSN SR-04T sensor

Blocking of rooms or areas	Hour of the day	Sound pressure levels (equivalent sound pressure levels) in octave bands with geometric mean frequency (Hz), dB									Sound level La (equivalent sound level	Maximum sound level Lamikc, dBA
		31,5	63	125	250	500	1000	2000	4000	8000		
1. Offices of administrative and maintenance staff of production enterprises, laboratories, and rooms intended for measuring and measuring.	-	93	79	70	63	58	55	52	50	49	60	75
2. Offices of dispatching services, observation and remote monitoring cabins with telephone connection, collection sites, telephone and telegraph stations	-	96	83	74	68	63	60	57	55	54	65	80

Z. Laboratory rooms designed for the transmission of experimental work, observation, and remote control cabins that do not have a telephone connection.	-	10 3	91	83	77	73	70	68	66	64	75	90
4. Rooms of production rooms with permanent workplaces, areas of enterprises with permanent workplaces (except for the works listed in positions 1-3)	-	10 7	95	87	82	78	75	73	71	69	80	95
5. Wards of hospitals and sanatoriums		76	59	48	40	34	30	27	25	23	35	50
		69	51	39	31	24	20	17	14	13	25	40
6. Surgical rooms of hospitals, doctors' offices	-	76	59	48	40	34	30	27	25	23	35	50
7. Classrooms, study rooms, auditoriums of educational institutions, conference halls, study halls of libraries, auditoriums of clubs, halls of court sessions, worship buildings, and auditoriums of clubs with the usual equipment.	-	79	63	52	45	39	35	32	30	28	40	55
8. Music classes	-	76	59	48	40	34	30	27	25	23	35	50

3. Conclusions

In certain areas/locations, noise levels may exceed certain times of the day/week.
It is important to list the most important sources of noise and their contribution to noise levels.
The following recommendations are proposed to address the noise issues identified in this assessment:
Develop the most urgent mitigation strategies, focusing on the highest noise levels and most affected sources.
Propose long-term strategies to manage noise levels and promote a quieter environment, including potential land-use changes, transport improvements, and community-based solutions.
Recommend ongoing noise monitoring to track the effectiveness of noise abatement measures, assess the impact of changes over time, and ensure continued compliance with noise standards.
For this purpose, the installation of permanent noise measuring devices on street sections throughout the city and regular analysis.

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