ICTM integrated computer technologies in mechanical engineering - synergetic engineering

International Scientific and Technical Conference

INTEGRATED COMPUTER TECHNOLOGIES IN MECHANICAL ENGINEERING – SYNERGETIC ENGINEERING

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18 November, 2022, Kharkiv, Ukraine

GENERAL SCHEDULE (GMT+2)

November 18, 2022 (Friday)

9:25	TESTING SESSION : https://meet.google.com/xvk-xhzi-fis REGISTRATION OPENS	
9:45	OPENINGS CONFERENCE	
10:00	PLENARY SESSION	
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11:00	Session 1 – MECHANICAL ENGINEERING https://meet.google.com/xvk-xhzi-fis	Session 2 – SOFTWARE ENGINEERING AND PROJECT MANAGEMENT https://meet.google.com/cry-xyej-pkm
13:50	TECHNICAL BREAK	
14:10	Session 1 – MECHANICAL ENGINEERING https://meet.google.com/xvk-xhzi-fis	Session 2 – SOFTWARE ENGINEERING AND PROJECT MANAGEMENT https://meet.google.com/cry-xyej-pkm
15:40	CONCLUSIONS	
15:45	CLOSING OF THE CONFERENCE : LOOKING TO THE FUTURE	

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The official language of the ICTM-2022 is English

Time for presentations:

Presentation at the plenary session is 20 minutes.
Paper presentation and discussion at the regular session is 10 minutes.

November, 18, 2021, Friday

(GMT+2)	
9:25	TESTING SESSION : https://meet.google.com/xvk-xhzi-fis
9:30	REGISTRATION OPENS
09:45	OPENINGS CONFERENCE *Dr. Andrii Humennyi*, Acting Vice–Rector National Aerospace University "KhAI", Ukraine
10:00 10:30	PLENARY SESSION *Prof. Piotr Lipiński* – Keynote Speaker 1 Institute of Information Technology, Lodz University of Technology, Poland *Dr. István Biró* – Keynote Speaker 2 Budapest University of Technology and Economics, Hungary
10:50	TECHNICAL BREAK

11:00	SESSION 1 – MECHANICAL ENGINEERING https://meet.google.com/xvk-xhzi-fis Dr. Olga Shypul – Chairman
11:00	Borys Lupkin, Kateryna Maiorova, Iurii Vorobiov, Viacheslav Nikichanov and Valeriy Sikulskyi. **Study of Drilling Cutting Modes Impact on Shrinkage and Surface Roughness of Holes in Composite Materials**
11:10	Oleh Pihnastyi and Olha Ivanovska. **A model of a transport multi-section conveyor based on a neural network**
11:20	Yevhen Nemanezhyn, Gennadiy Lvov and Yuriy Torba. **Numerical Simulation of the Steady Creep of Single-Crystal Alloys**
11:30	Oleksandr Tarasov, Liudmyla Vasylieva, Alexander Altukhov, Dmytro Pavlenko and Daria Tkach. **Development of integrated CAD / CAE systems based on parameterization of the simulated process**
11:40	Andrii Kondratiev, Viktor Kovalenko, Tetyana Nabokina and Igor Taranenko. **Influence of Physico-Mechanical Factors on Residual Technological Stresses and Strains of Composite Panels**

11:50	Nasr A.Jabbar, Ihsan Y. Hussain and Oday I. Abdullah. **Thermal analysis of Functionally Graded dry clutch disc subjected to characteristic parameters effects**
12:00	Vitalii Voronko, Yuri Dyachenko, Iryna Voronko, Oleksandr Zastela and Svitlana Myronova. **Technology of Holes Strengthening by Pneumo-Impulse Hole Mandrelling**
12:10	Olga Shypul, Oleksiy Pavlenko, Yevgen Aksonov and Sergiy Zaklinskyy. **Experimental Setup with Stand-Alone Automatic Modular Logger of Parameters of Thermal Pulse Processing**
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12:30	Andrii Breus, Sergey Abashin and Oleksii Serdiuk. **Control of stress conditions in growth of copper oxide nanostructures**
12:40	Oleksandr Shorinov, Serhii Polyvianyi and Anatolii Dolmatov. **Calculation of Velocity and Temperature of Nickel Powder Particles in a Supersonic Nozzle During Low-Pressure Cold Spraying**
12:50	Olena Sierikova, Elena Strelnikova and Kyryl Degtyariov. **Numerical Simulation of Strength and Aerodynamic Characteristics of Small Wind Turbine Blades**
13:00	Vasyl Ruzaikin. **Pump assistant ground-source two-phase thermosiphon for the heating and cooling of households**
13:10	Gennadii Martynenko and Lyudmyla Rozova. **Integrated Computer Modeling of Dynamic Processes in Rotor Machines and Systems with Elastic-Damper and Magnetic Bearings**
13:20	Oleg Baranov. **Substrate thickness as a control factor in growth of copper oxide nanostructures**
13:30	Valeriy Sikulskyi, Kateryna Maiorova, Ihor Bychkov, Svitlana Myronova and Stanislav Sikulskyi. **Shape of Part Edges with the Various Surface Finish of the Adjacent Surfaces**
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14:10	Vitaliy Gaidachuk, Tetyana Nabokina, Igor Taranenko, Oleksandr Gaidachuk and Andrii Kondratiev. **Analysis of Gluing Assembly Defects of Ultra-Thin Composite Face Sheets with Honeycomb Core**

14:20	Sergey Filipkovskij, Valentin Chigrin, Alexander Sobolev and Evgeny Vasilevskij. **Simulation of Aircraft Engine Dynamic Effect on Aircraft Wing Caused by a Fan Blade-Off**
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11:00	SESSION 2 – SOFTWARE ENGINEERING AND PROJECT MANAGEMENT https://meet.google.com/cry-xyej-pkm Dr. Dmytro Chumachenko – Chairman
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11:20	Victoriya Abramova, Sergii Kryvenko, Sergey Abramov, Viktor Makarichev and Vladimir Lukin. **A Fast Procedure for Image Lossy Compression by ADCTC Using Prediction of Distortions' MSE**

11:30	Valeriyi Kuzmin, Maksym Zaliskyi, Yulia Petrova and Alexei Holubnychyi. **Research of Mathematical Models Based on Optimization Paraboloid and Alternative Method of Regression**
11:40	Oleksii Lytvynov, Mykola Nechyporuk and Hanna Spitsyna. **Synergetic Approach and Issues of Criminological Science Methodology**
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12:00	Nataliia Filipenko, Gabriele JuodkaitĖ-GranskienĖ, Aleksandar Ivanovic, Valeriia Turska, Yurii Myroshnichenko and Serhii Lukashevych. **Particular Aspects of International Cooperation of Ukrainian Forensic Science Institutions with Foreign Specialists in Collecting, Studying and Processing Human Genomic Information and Conducting Molecular Genetic Analysis**
12:10	Oksana Yurchenko, Oleh Strelko, Halyna Vasilova, Maryna Rudiuk and Oleksii Goretskyi. **Analysis of the Possibility of Using Analytical Methods to Model the Risks and Consequences of Transport Events in the Transport of Dangerous Goods by Railway Transport**
12:20	Victoriia Naumenko, Vladimir Lukin and Sergey Krivenko. **Comparison of noisy medical image lossy compression by BPG and AGU**
12:30	Olha Pohudina, Mykhailo Kovalevskyi, David Naso and Rossella Bartolo. **Analysis of the Architecture of Perceiving a Dynamic Environment for an Unmanned Aerial Vehicle**
12:40	Fangfang Li, Sergey Krivenko and Vladimir Lukin. **Lossy Compression of Three-channel Remote Sensing Images Based on Controlled Visual Quality**
12:50	Olena Savchuk, Anastasiia Matvieieva and Dmytro Kritskiy. **Legal Support of Economic Activity in The Conditions of the Pandemic**
13:00	Dmytro Chumachenko, Adam Wojciechowski and Sergiy Yakovlev. **Simulation of the Impact of Migration Caused by the Russian War in Ukraine on the Dynamics of COVID-19 in Poland**
13:10	Galyna Mygal, Olga Protasenko and Natalia Kobrina. **Research of human-machine interaction on the example of the "operator-UAV" system**
13:20	Natalia Teliura, Alona Reshetchenko, Nataliia Tsapko, Oksana Myrgorod and Oleksandr Pirohov. **Methods of Organizing Measures Directed to Environmental Safety and Noise Protection Management in Urban Areas**
13:30	Ivan Ostroumov and Nataliia Kuzmenko. **An air traffic safety management based on probabilities**
13:40	Tetiana Podzolkova, Ihor Shynkarenko and Sergii Perepelytsia. **Use of Information Systems in Disclosure of Criminal Offenses**
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14:50	Oleh Pihnastyi and Olha Ivanovska. **Using multilayer neural networks to predict the output flow parameters of multi-section conveyor**
15:00	Oleh Uhrovetskyi, Oleg Kurdes and Dariia Topal. **Scientific Approaches to Reforming Staff Management of State Forensic Science Institutions of the Ministry of Justice of Ukraine**
15:10	Ievgen Meniailov, Serhii Krivtsov and Tetyana Chumachenko. **Clustering of Patients with Diabetes Mellitus using Expectation-Maximization Algorithm**
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Methods of Organizing Measures Directed to Environmental Safety and Noise Protection Management in Urban Areas

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Abstract. In order to implement ecologically safe noise protection practical solutions, it is necessary to improve the method of environmental safety management, which aims to implement the algorithm proposed in this article for monitoring the acoustic space in terms of noise pollution and making decisions regarding the protection of agricultural zones of urban systems from above-standard noise levels. The environmental safety management mechanism consists of groups of functional and environmental mechanisms, which in turn function through environmental audits, environmental programs, environmental impact assessment, and environmental monitoring. Among the popular urban planning solutions to reduce noise levels, the maximum greening of agricultural zones and dividing strips of main streets is singled out as an economically profitable and ecologically safe justified noise protection method, taking into account the prevention of the occurrence of unplanned road construction and other types of public utility works, which entails a change in general plans of built-up cities and significant reconstructions of the infrastructure network.

Keywords: Physical Pollution, Monitoring, Innovative Solutions, Regulatory Framework.

1 Introduction

An urgent problem of the urban systems functioning is the anthropogenic influence of the transport infrastructure. With rapid urbanization, the number of private vehicles is increasing, which leads to environmental pollution. In addition to the introduction of polluting substances with emissions into the atmospheric air, the operation of vehicles creates a noise load.

Recently, the impact of urban noise on the environment and public health has increased by almost 25 percent. According to the "Future Noise Policy" (Publications Office of the EU), more than 80% of the noise load in residential areas of urban systems is caused by road traffic. In European countries, this has led to the development and implementation of legislation to reduce the impact of excessive noise levels on the territory of urban systems. The EU Directive [1] calls for the harmonization of standards governing the procedures for determining noise levels and exposure in Europe in order to provide free and accessible information about noise regimes in densely populated cities and leaves free space to choose the requirements regarding the scope, form and means of providing the community with relevant cartographic information. materials for each EU member state. Among the factors that negatively affect and complicate the environment in the process of environmental safety management of noise protection in urbanized areas, the following should be highlighted: lack of monitoring data on the results of noise exposure and scientific solutions for noise protection; multi-factorial parameters of the noise generation process. The lack of systematic surveys and the necessary equipment for conducting observations or the ineffectiveness of existing technical solutions can lead to an increase in the noise level due to unplanned construction of roads and other types of public works. This is due to the imperfection of the existing regulatory and methodological approaches, in particular, the lack of guidelines regarding the principles of placement of monitoring sites, frequency and procedure for determining noise levels in the territories of agricultural zones within the influence of the road network.

The aim of the paper is to substantiate the expediency of the organization of noise pollution level monitoring and to improve the system of scientific and methodical approaches to the organization of experimental studies on the determination of noise levels in the monitoring system in order to reduce man-made transport and linear load on the environment.

2 Formulation of the problem for the development of architectural and planning solutions to reduce noise pollution at the level of urban systems

Since January 2020, the Law "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine for the Period Until 2030" entered into force, which specifies the existing problems and the current state of the environment in Ukraine. Among the root causes of Ukraine's environmental problems are the inefficient state management system in the field of environmental protection and the unsatisfactory state of the state environmental monitoring system, in particular from noise impact, which requires the introduction of a system and ecological approach to industry policy and improvement of the environmental management system.

Analyzing the state regulatory legal framework [2-4], we can come to the conclusion that the organization of experimental studies of the noise characteristics of traffic flows passing along residential buildings is not fixed at the legislative level.

A large number of scientific works are devoted to the problems of researching the noise characteristics of vehicles [5-10]. So, for example, in the article [5], the author conducted a number of experimental measurements of noise levels, during which special attention was paid to highways near residential buildings, a total of 165 points in the territory of Ivano-Frankivsk were studied. Based on the results of the study, individual zones with the highest noise load were identified in the City of Ivano-Frankivsk, acoustic load distribution profiles were constructed along the main streets, taking into account the equivalent sound level in the green areas of the city, which are located nearby. A noise map for the territory of Ivano-Frankivsk was built using the Surfer software.

The experimental studies analyzed above can be attributed to the monitoring of acoustic load levels, but the lack of a regulated legislative framework for the organization of such studies makes it impossible to carry out similar observations of noise load levels in areas of residential construction located in the zone of influence of urban transport infrastructure.

The generalized approaches proposed in the author's research [11] are aimed at solving the problems of pollution of the roadside space by traffic noise and can be implemented in the programs of greening the territories of Ukraine. But none of them can be 100% effective until a system is developed in the country that will constantly monitor the noise regime of urban systems and record noise levels exceeding the maximum permissible levels.

In order to achieve the specified goal of the research, it is necessary to solve a number of tasks: to create a structure, methodological and mathematical means of researching agricultural areas affected by linear sources of noise, to minimize the man-made load on the environment, and to improve the system of scientific and methodological approaches to the organization of experimental research on the determination of noise levels pollution in the territories of agricultural zones of urban systems, taking into account architectural and planning solutions of built-up areas.

Monitoring the noise levels of the street and road network of populated cities can be presented as a cyclical observation procedure that will ensure the creation and accumulation of a data bank of street noise observations. Figure 1 shows the proposed annual monitoring scheme.

To implement a noise monitoring system, first of all, it is necessary to select control points for field measurements. In compliance with the requirements of Directive 2002/49/EU, these points within urban areas of residential development should be chosen taking into account:

possibilities of recording noise characteristics in the noisiest positions at the boundaries of territories and near the facades of residential buildings;

the representativeness of the measurement data regarding the reflection of the acoustic situation in urban areas of residential buildings in general [12].

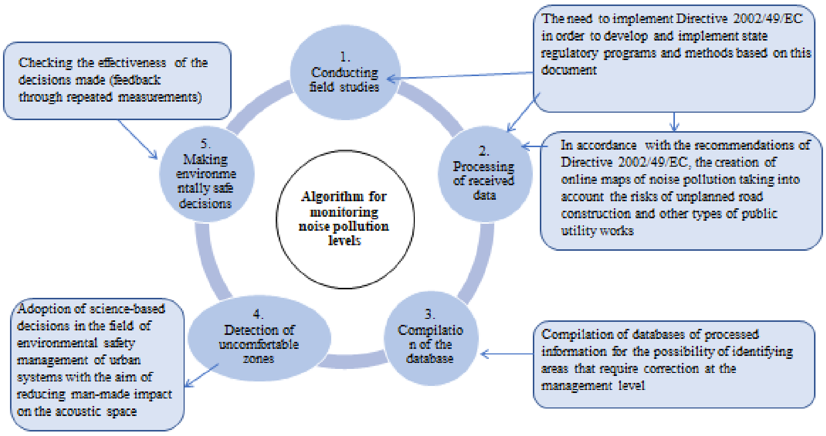

Fig. 1. Algorithm for organizing monitoring of noise pollution levels [6].

The step-by-step organization and implementation of the algorithm for monitoring the levels of noise pollution caused by the operation of vehicles is presented in the Table. 1.

Table 1. Algorithm for the step-by-step organization of noise level monitoring/

Stage name	Description	Normative base	Recommendations
1. Conducting field studies	Conducting noise measurements on each street of the road network of the settlement, with a fixed speed of traffic and at a distance of at least 50 meters from intersections and public transport stops, during a time interval covering the passage of 200 vehicles in both directions. For each existing category of roads, one street with steady traffic is selected and	Classification of transport highways based on the received noise level data in accordance with SBS B.2.3.-4:2015 "Automotive roads". Location of control points in accordance with recommendations (Fig. 2-3).	The control street must be made of asphalt concrete, the width of one lane is not less than 3 meters. The distance from the edge of the carriageway to the line of residential buildings is at least 10 meters. Special attention should be paid to the fact that there should be no enclosing structures, noise protection screens, green spaces and other factors that can shield the sound during field studies. The recommended distance for the location of the measuring device is 7.5 meters. Monitoring of

	control points are determined at which measuring devices should be located to determine the sound characteristics of the traffic flow.		noise levels should be carried out at least at three points on the selected control street to regulate the noise load on urban landscapes using measuring devices-noise meters. Noise meters used in noise monitoring must have frequency characteristic "A" with a frequency range of measurements of classes 1 and 2.
2. Processing of data obtained	The measured noise parameters are equivalent $L_{A\ eq}$ noise levels and maximum $L_{A\ max}$ noise levels.	Directive 2002/49/ EU	Measurements of the specified values should be carried out at least three times a day: during the day from 7:00 AM to 7:00 PM, in the evening from 7:00 PM to 11:00 PM and at night from 11:00 PM to 7:00 AM
3. Compilation of the database	Creating a data bank based on Microsoft Access	Not regulated	The main tables in the noise monitoring database should highlight the following information: Streets (names and codes of streets on which noise monitoring is carried out); Point_Location (location of monitoring points, taking into account addresses and type of territory); Traffic_Flow (characteristics of the studied traffic flows); Monitoring_Data (calculation data of equivalent L_{Aeq} and maximum L_{Amax} levels of noise with indication of date and time of measurements); Normative_Value (maximum permissible noise levels depending on the time of day and type of territory).

4. Detection of discomfort zones	Compare the calculated equivalent (L_{Aeq}) and maximum (L_{Amax}) noise levels with the specified permissible noise levels	On the approval of the State sanitary norms of permissible noise levels in the premises of residential and public buildings and on the territory of residential buildings	To identify the dynamics of noise pollution of urban systems, the obtained results should be compared with data from previous years. For each control point, the deviations of the obtained values are determined according to the following recommended formula: A_i=L_1 n_1 - L_1 n_2, where A_i is the deviation at the *i*-th control point, dBA; L_1 n_1 – equivalent noise levels at the *i*-th point in the current year, dBA; L_1 n_2 – equivalent noise levels at the *i*-th point for the past year, dBA.
5. Decision taking	Implementation of generalized methods of protection of agricultural zones of urban systems from increased noise levels	1. SBS B.1.1-31:2013. Protection of the territories of buildings and structures from noise. 2. DSTU-H Б B.1.1-33:2013. Guidelines for the calculation and design of noise protection in rural areas.	Use of combinatorial noise protection practical solutions [6]

Taking into account the level of detail of each of the stages of monitoring noise levels, at the last stage of decision-making of monitoring, specific measures are implemented to select constructive solutions to reduce man-made pollution from noise, and the degree of environmental safety, at the same time, is ensured by the choice of rational combinatorial practical solutions for local greening of agricultural areas of urban systems.

3 Results of experimental data on the influence of infrastructure networks at the level of urban systems

In order to improve scientific and methodological approaches to the organization of the first stage of monitoring studies, the methodology of GOST 23337-78, valid in Ukraine until 01.01.2019, was improved for conducting experimental studies to determine the levels of noise pollution caused by the operation of motor vehicles, taking into account dense urban buildings and landscape greening of primary highway sections of urban systems.

During the long-term period of conducting experimental studies on the determination of noise levels published in [6, 13] and analysis of the obtained data, the most representative control points for measuring noise levels in the territories of agricultural zones of urban systems were identified. Taking into account the distance from the noise source to the measuring device regulated in GOST 23337-78 of 7.5 meters; types of street and road profiles and the width of red lines for main streets of 50-80 meters, and 15-25 meters for streets and roads of local importance; location of roadways, sidewalks, and landscaping strips, in order to take into account all the above recommendations and requirements regarding the distances between highways and agricultural areas, unified schemes (Fig. 2-3) are proposed for the organization of experimental studies to determine the noise levels of agricultural areas located in the zone of influence of highways, for the organization of the first stage of the system of monitoring observations.

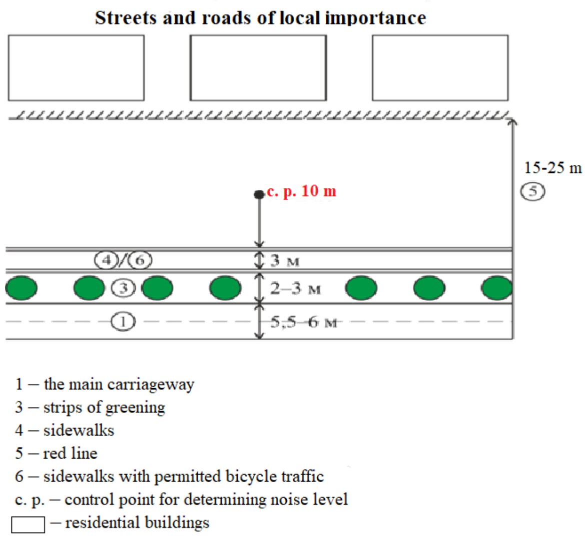

Fig. 2. Scheme of the location of the control point for conducting experimental studies on the determination of noise levels in the agricultural area adjacent to streets and roads of local importance.

Taking into account the architectural and planning conditions of the development of the agricultural zone bordering the streets and roads of local importance, during experimental studies, it was found that the most representative control point demonstrating the estimated levels of noise pollution of the studied area is a distance of 10 meters from the line of the carriageway. Such a distance covers a strip of greening that serves as a noise barrier in the way of sound wave propagation and is located at a sufficient distance from residential buildings that can serve as an additional source of noise (for example, with open windows, household noise can spread to the territory of the agricultural zone, and the standardization and conducting of experimental research in the middle of the premises has different normative documents and the nature of research), which in turn can lead to obtaining incorrect experimental data.

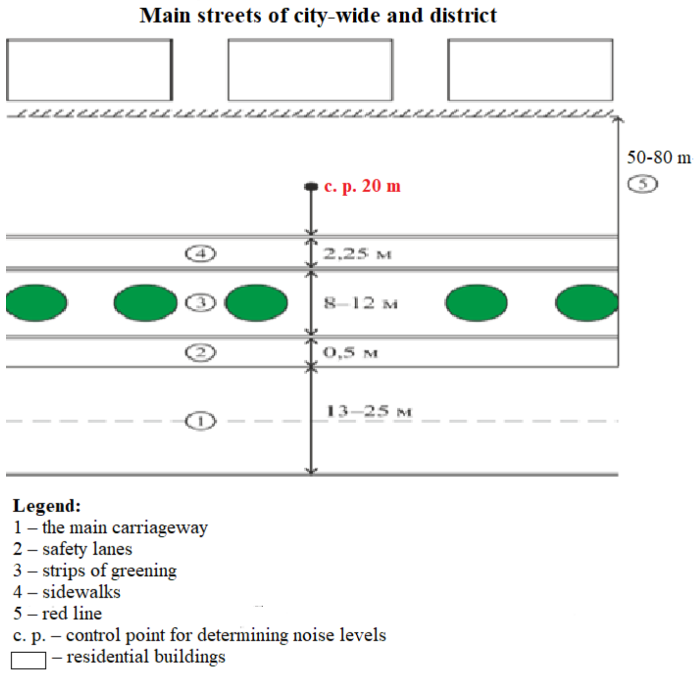

Fig. 3. Scheme of the location of the control point for conducting experimental studies on the determination of noise levels in the rural area adjacent to main streets of city-wide and district significance.

The location of the control point at a distance of 20 meters from the carriageway of main streets of city-wide and district importance is justified by the fact that such streets have a greater number of traffic lanes and a higher traffic intensity. The diagram also shows that the typical placement of residential buildings in the zone of influence of this type of street is at a greater distance from the highway. Therefore, in order to obtain correct data from measurements of noise levels, it is advisable to conduct experimental studies at a distance of 20 meters from a linear noise source covering a strip of protective green spaces and located at a sufficient distance from residential buildings.

Four full-scale objects of the City of Kharkiv were chosen to test the proposed schemes. Two objects are residential buildings bordering streets of local significance (No. 1, No. 2), and the other two objects (No. 3, No. 4) are residential buildings adjacent to main streets of city-wide importance. Experimental studies were conducted in the spring period (April-May) of 2021. The averaged results of equivalent noise levels in the selected areas are presented graphically in Fig. 4.

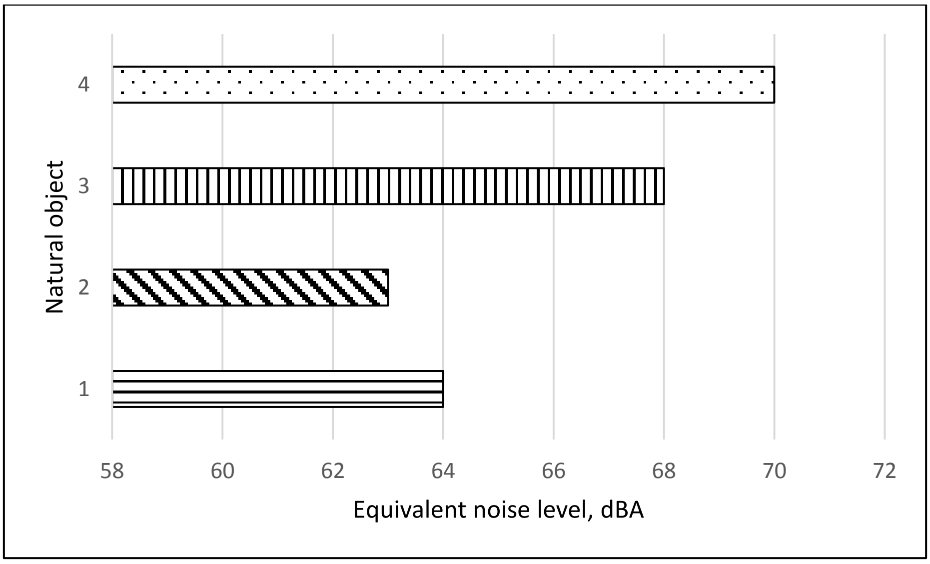

Fig. 4. Results of experimental measurements according to unified schemes for the location of control points.

To implement the fifth stage of the proposed algorithm for monitoring noise, development of conductive coatings for monitoring information systems [15], pollution levels in the decision taking part, it is recommended to be guided by the following known methods of reducing traffic noise in urbanized areas:

1. Reduction of the noise level of the source itself or its localization.
2. Direct isolation of the object of protection.
3. Reduction of the sound level on the path of its propagation.

The first two proposed methods of reducing noise levels in agricultural areas are impossible to implement due to the complex infrastructure of urban systems.

Important urban planning solutions that are used as anti-noise include:

1. Increasing the distance between the noise source and the protected object.
2. Application of acoustic screens, walls or screen buildings.
3. Various planning techniques that allow rational placement of "noisy" objects in micro-districts.

4. Use of terrain relief.
5. Maximum greening of agricultural zones and dividing lanes of main streets.

The first four solutions given above are difficult to implement in modern conditions due to the established architectural, planning, logistical ensemble of cities [14, 16], which was compiled more than 100 years later. In order to implement the above rational techniques for the construction of rural areas and main streets, it is necessary to make changes to the general plans of cities and carry out significant reconstructions. This is a very complicated, time- and money-consuming process. Especially if attention is paid to noise reduction in residential areas, it is necessary to take into account the fact that during the reconstruction of highways or any other construction works, additional noise pollution occurs due to the operation of construction machinery and other equipment.

The use of one or another method or their combination depends on the degree of noise reduction required, taking into account economic and operational constraints. The above allows us to come to the conclusion that the most effective noise-reducing solutions are the introduction of additional local greening as rational and effective solutions for ensuring the ecological safety of urban systems in case of man-made noise pollution and to prevent the occurrence of unscheduled road construction and other types of public utility works.

4 Conclusion

Based on the conducted analysis, the absence of correlations between the regulatory legislative and normative and methodological documents in the field of noise pollution and impacts on urbanized areas was highlighted.

It is proposed to improve the atmospheric air monitoring system in terms of noise pollution, taking into account the requirements of EU Directive No. 49 and the nationwide procedure for the implementation of European standards.

On the basis of generalized experimental studies conducted by the author and covered in scientific publications, recommendations were developed for the organization of experimental studies in the first part of noise monitoring, taking into account modern architectural planning, dense urban development and the growth of transport infrastructure of urban systems.

With the use of experimental research approval data on the basis of the proposed schemes for the location of control points, it was established that the exceed of the maximum permissible noise level in the territories of agricultural zones of the Kharkiv urban system reaches about 15%, and in order to ensure the ecological safety of the acoustic space, the latest directions of noise protection of agricultural zones should be implemented in the context of sustainable development bridge.

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