Increase of Investment Appeal of Projects for Noise Control Measures in Urban Environment

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Abstract. The authors analyzed the contemporary noise pollution level in the large cities of the Russian Federation. The article identifies the factors causing the reduction of acoustically comfortable urban territories. It states the task for the increase of investment appeal of the projects aimed at noise control measures adoption.

1. Introduction

Today, under a high rate of housing construction, it is vitally important to find an understandable way of stating and communicating of the information concerning the negative influence noise has on a human as well as on its propagation principles and efficient noise control measures. This information will be especially useful for people participating in real estate transactions. Virtually all citizens can be included in the category: citizens living in organized microdistricts (potential retail market participants) where the housing price will reduce due to compromised acoustic comfort; investors wishing to increase their capital by means of housing construction; architects who are directly involved in the development of the spaces intended for human work and leisure; officials inspecting the quality of future residential environment and approving the related documents; real consumers improving their living conditions. The quality of the provided product - in our case, it is acoustically comfortable urban environment - is set by requirements, claims and ignoring of the offered goods.

2. Relevance

Today Russian consumers pay little attention to the effect noise has on them and their houses while choosing the place to live in. Obviously, such situation is caused by the urban population growth because of healthy young people coming from city environs or villages, as it is believed that a healthy young man may not notice noise impact. That is why the investors don't pay due attention to this problem when setting tasks for architects limiting their activity to formal requirements. As a result of the absence of proper technical solutions applied during designing and construction to protect the population from noise impact in the best possible way, one can observe a wide-scale implementation of wrong solutions causing a growing damage to the population health and, consequently, to the economy as well. It explains the fact why the authorities in the large Russian cities perform infill
construction in already formed districts or construct houses in the sanitary control areas. Infill construction may deteriorate various hygienic indicators of the adjacent buildings (illumination intensity, noise, space limits, number of parking places, etc.) [1]. In this case it is impossible to correct the situation and reach some satisfactory results even applying special complex and expensive noise control systems. As a result of a high and inadequate consumer demand, when a potential buyer cares only of a limited number of criteria (convenient layout, proximity to transport joints, walking accessibility of necessary objects, high profile of living in the downtown, etc.), corresponding offers arise at the market [2]. An indirect proof of such high demand is provided by the survey conducted for the USUAA during several years (2009-2016). The results showed that in 80% of cases the students are ready to buy houses in a priory unfavorable districts providing they have available funds. Such phenomena demonstrate not only the consumer unawareness but also short sight or weakness typical for other real estate market participants: "hard-core investors longing for "quick" money; opportunistic architects ready to implement everything their investor wants; weak authorities allowing for approval and issue of construction permits for ugly and obstructing buildings" [3]. Indeed, there are cases advocating public bodies and architects and protecting them from such claims; as a rule, such projects stipulate for noise control measures (vibration insulating seal gaskets in a foundation, noise control floor and glazing designs, ventilation valves, special layout, noise source shielding, etc.) that make such construction possible. However, their implementation can be of the same nature as famous "Potemkin Villages" [4,5] due to their high price and poor construction culture (poor qualification or low interest of the workers).

Development of noise control measures within the formed city building system, especially in its historical part, shall be individual as most likely, many standard solutions will be unacceptable:

- Noise barrier asphalt laying is not efficient over the vast part of the Russian Federation [4; 6-8]. In summer, coating pore spaces will be clogged with mud while in winter - with ice and salt solution, besides, multiple transition over 0°C during the winter period will reduce the service life of such pore coating;
- Asphalt unevenness reduction is limited by traffic safety considerations (tire scrubbing) [8];
- Noise control shields will spoil historical views and lead to constraining of the urban environment spaces or will be inefficient for people living on upper floors in case of high-rise block construction;

Besides, it is a rather spread phenomenon when designers "don't know the physical laws of noise propagation or the measures for efficient elimination of its impact on the residential area" [9]. As a result, a priori useless or impractical solutions are implemented. For example:

- Upon determination of the acoustic shield effective height, locations of a reference point and sound source are taken as being in close vicinity to a shield. Application of a wrong calculation pattern provides wrong impression in terms of the high efficiency of proposed measures [10].
- Such pattern does not take into account the interaction between designated materials and aggressive environment in which the product will be exploited (corrosion, cloudiness, destruction, short life, "failing" of a sound-proof material due to soaking, exposure to vandal actions) [11];
- Wrong design of AS compatibility with road furnishing (water discharge apertures, disconnections of the road for outdoor lightning posts, ATCS supports, etc.) [11].

3. Task setting
Apart from comfortable housing, a modern city needs a well-developed transport infrastructure represented by the noisiest objects [6,12]. Due to enhancement of the transport infrastructure a growing number of citizens will have two types of houses: a city flat for work and country house as a place of permanent residence [13]. Daily (weekly) migration between these two houses will contribute to the traffic noise increase. This means the problem of transport noise control will be relevant until a new transport system organization is in place in the economy.
4. Theoretical part
Cooperation and a due approach to the project of the investor and (or) developer, architect and approving bodies provide for comfortable residential property in the urban areas with elevated noise pollution [14]. The efficiency of solutions for noise control in residential and public buildings influences their final cost. However, one shall remember that such costs will be accounted at the design solution stage, thus, they will be initially included in the project price which makes it possible to assess its profitability.

It is possible to develop investment appeal of the urban territories located in the vicinity of transport communications by means of inclusion of various noise control measures into design solutions [15-19]. In this case the architecture of a new building with its spatial arrangement, specific form shaping, etc., shall be considered as a tool for building noise control. During the design process it is necessary to use appropriate software products to determine the efficiency and to test the decisions taken. However, yard territory fencing off from outdoor noise may cause the background noise problem inside the yard space [20-21]. Background noise occurs due to high-rise construction and a growing vehicle-to-population ratio as well as the practice of separate sale of parking places and flats; it leads to a lack of space in yards and growth of the inner-block noise (signaling noise, ICEs of powerful cars, activity of a large number of people).

When developing the offers for the implementation of noise control activities, one shall take into account their compliance with aesthetic, economical, functional and operation requirements. The officials responsible for approval of the suggested design solutions shall have appropriate competences and take regular advanced training to properly assess submitted design projects.

5. Practical relevance
The number of people living under unfavorable acoustic conditions keeps growing [22,23]. This fact proves the promising nature of the theoretical and practical activity for noise impact reduction in residential areas that are being formed or already exist. Supposedly, to foster an active position of citizens in relation to elevated noise impact and noise control, it is reasonable to introduce social advertisement explaining a high value of acoustic comfort as the guarantee of health in the future. Further, the urban consumers will be more demanding to their living conditions and ready to pay for the implementation of full-scale measures intended for noise reduction.

One of the ways to combat with the population acoustic unawareness can become development of the information base allowing one to determine one's territory acoustic pollution. Thus, many researchers (N I Ivanov, M V Butorina, N K Kiryushina, D A Kuklin and others) offer to develop noise maps for large cities with the help of appropriate software products that will contribute to the development of strategic plans intended for noise pollution combat and building up of an active position shared by the citizens who live in noisy areas (see Figure 1). However, there is a number of reasons preventing the implementation of this idea:

- There is no a single method providing for exact reflection and forecast of noise pollution. The reason is not only in the various calculation algorithms used by various software products but also in the influence of various noise propagation peculiarities characteristic of a particular place and time [24]. Besides, one shall take into account that real and objective noise propagation may be shown only in space;
- There is no a developed algorithm for assessment of the created noise map that provides for the substantiated identification and determination of noise sources and their nature as well as for agreement of the conditions in the place of noise propagation;
- There is no a developed algorithm for identification of funding sources to make a noise map; apparently, it shall be a city service working with the real estate market participants (real estate brokers, owners of industrial enterprises, property owners association, railway, etc.);
- The place for the noise map location is not determined. Most likely, it will be some electronic interactive (changing over time) space organized similarly to such platforms as 2GIS, Yandex
traffic jams, etc., allowing for tracing of the history of noise pollution change inside a city space.

Figure 1. Example of a planar noise map made with SoundPLAN [25].

Taking into account the aforementioned, the map introduction shall be regulated by the laws of the Russian Federation. Such noise map shall be placed in the digital spaces of city administrations while at the legislative level all the participants of a real estate transaction shall be obliged to familiarize themselves with an area noise level ("noisy" and "quiet" city areas) where a house is located. Such amendment will help to influence the housing prices forcing investors and (or) developers to create competitive advantages.

6. Conclusion
People living in large cities in the territory of the Russian Federation are exposed to the impact of elevated noise pollution. Noise can be considered to be a by-product of a human activity. Most urban people suffer from noise impact, nevertheless, they don't have an active civic position on the issue. Large Russian cities have various noise control solutions (mostly, acoustic shields), however, their efficiency and aesthetics can be initially flawed or they fail within a very short time period (due to design mistakes, poor construction culture, etc.).

Introduction of digital interactive spatial city noise maps as well as establishing of the conditions for their essential and profitable use during real estate transactions and activities (lease, purchase, sale, construction, demolition, etc.) will allow for keeping the public informed in terms of noise localization and damage and, over time, will significantly influence real estate prices thus contributing to the reduction of urban territories exposed to noise pollution.
References
[1] Kolmakov A V and Gorodetskaya N N 2011 Protection of Population against Elevated Noise: Book of Conf. Repp Infill Construction Influence on Urban Districts Noise Conditions (St.-Petersburg) p 454
[2] Kolmakov A V, Gorodetskaya N N and Chigirinskikh E V 2012 Acoustic Comfort as Criterion for Housing Choice Urban Culture as Social Safety Factor: Problems, Trends, Prospects: Proc. Interdiscipp Int. Appp Res. Conf. (Yekaterinburg: Institute of Urban Studies) pp 130–3
[3] Kolmakov A V and Ignatyeva V O 2016 Foresight Technologies in Urban Space Organization Theory of Modern City: Past, Present, Future: Proc. Rus. Sci. Conf. with Int. Part (Yekaterinburg: Arkhitekton) pp 77–9
[4] Ivanov N I 2015 Elevated Noise Problem in the Russian Federation: Who is to Blame and What to Do? Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 14–35
[5] Butorina M V 2015 Evaluation of Sound Insulation of Fence Structures Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 570–9
[6] Zakharova P V, Savinova E V and Arsanov A S 2015 Noise in Cities: Inevitability or Growth Area? Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 113–6
[7] Ivanov N I, Shapurin A E and Butorina M V 2017 Noise Level Legislative Regulation in the Russian Federation: Problems and Ways for Situation Improvement Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 15–24
[8] Shubin I L and Nikolskiy A I 2015 Experience of Noise Control in Moscow Protection of Population against Elevated Noise: Book of Conf. Repp (St.-Petersburg) pp 58–65
[9] Kolmakov A V 2013 Use of Fold Structures to Increase Acoustic Shield Functionality and Aesthetics Arkhitekton: Izvestiya Vuzov 42 (Yekaterinburg: Arkhitekton)
[10] Kalashnikova N K, Rudneva E A, Klimenkova O I, Goncharenko I A and Ponofedin I A 2015 Mistakes of Acoustic Design of Transport Facilities with Noise Sources Protection against Elevated Noise: Book of Conf. Repp (St.-Petersburg) pp 424–9
[11] Tyurina N V 2015 Relevant Problems of Acoustic Transport Shields Design Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 685–93
[12] Ivanov N I 2015 Noise Control Concept in the Russian Federation Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg), (Electronic source) pp 12–24
[13] Ziyatdinov Z Z 2017 City Planning Reasons for Development of Second House Academic Bulletin UNIIP RAACS 1 (Yekaterinburg) pp 13–8
[14] Zakharov Yu I, Zakharov V Yu and Sankov P N 2015 Location of Urban Area Facilities with Account of Negative Noise Impact of Transport Sources Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 455–63
[15] Kochnev A P 2015 City Planning Residential Complexes with Noise Control Functions. Urban Areas Rehabilitation in terms of Noise Pollution. Roadmap Protection of Population against Elevated Noise: Book of Conf. Repp (St.-Petersburg) pp 160–79
[16] Kolmakov A V 2015 Acoustic Viscous Surfaces in Urban Environment Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 321–7
[17] Kolmakov A V 2017 Acoustic Structures as Means for Improving of Standard Housing Aesthetic Appeal FIFA 2018: Prospects, Expectations and Sports Mega Event Heritage Effect: Proc. Int. Appp Res. Conf. (Yekaterinburg: UrFU Publishing House)
[18] Kolmakov A V 2017 Sound Insulation Structures of Yard Passages Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 389–96
[19] Kolmakov A V 2017 City Noise Control with Architectural Means Academic Bulletin UNIIP RAACS 1 (Yekaterinburg) pp 51–6
[20] Osipov G L, Yudin Ye Ya and Khyubner G 1987 Noise Control in Buildings and Residential Areas ed G L Osipova and Ye Ya Yudin (Moscow:Stroiizdat) p 558
[21] Spiridonov P Yu 2015 Main Noise Load Sources in Metropolitan Cities Exemplified by Nizhniy Novgorod and Problems of Communal Noises Shaping and Evaluation Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 311–8

[22] Koshurnikov D N 2015 Dynamic Evaluation of Public Health Risk in Large City Caused by Noise Impact Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 246–55

[23] Koshurnikov D N 2013 Experience of 3D Visualization of Acoustic Calculations Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 306–9

[24] Tsukernikov I Ye and Tikhomirov L A 2013 Comparison of Results of Road Noise Calculations in Moscow Residential Area Obtained with Three Software Products Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 409–19

[25] Shabarova A V, Kulin D A and Butorina M V 2017 Evaluation of Rail Transport Impact on Residential Housing Areas Protection against Elevated Noise and Vibration: Book of Conf. Repp (St.-Petersburg) pp 441–6