

Russian Regulatory and Technical Documents on Noise Protection Design

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Abstract. State of the art in the field of national rationing for designing of protection against noise is described. The scopes, substantive provisions and features of the normative and technical documents developed by Research Institute of Building Physics is given. These are two national standards: GOST R 56769-2015 and GOST R 56770-2015, which establish the methods for evaluation of single-number quantities of airborne and impact sound insulation in building and of building elements and were entered in 2016, and four codes of rules: SP 254.1325800.2016, SP 271.1325800.2016, SP 275.1325800.2016 and SP 276.1325800.2016, which set the rules for designing of industrial sound protection, the rules for designing of sound reduction of air heating, ventilating and air conditioning systems, the rules for designing of sound insulation of enclosing structures of residential and public buildings and the rules for designing of protection from traffic noise and were entered in 2017.

1. Introduction

Increased noise is one of the most dangerous and harmful factors influencing the person. The effect of noise not only creates discomfort, but also leads to serious diseases. Mental disorders, cardiovascular diseases, hearing impairment and auditory nerve neuritis, memory easing, and also so-called "noise illness" are far from a complete list of the effects of high noise on the body. Noise as harmful production factor, is responsible for 15 % of all occupational diseases on manufacture. Currently in various regions of the Russian Federation, 30 to 50% of the population is affected by excessive acoustic impact, which significantly affects the life expectancy of citizens. About 45% of the population is constantly experiencing a feeling of discomfort from the effects of increased noise [1]. As a result, the protection of residents of cities and populated areas against noise created by various sources of anthropogenic nature is a very acute problem.

Within the limits of the program of clever city creation normative and technical documents for designing of protection against noise on residential territories and in industrial, public and dwelling buildings were developed by Research Institute of Building Physics of Russian Academy of Architecture and Construction Science. The documents are two national standards (GOST R): GOST R 56769-2015 [2] and GOST R 56770-2015 [3], which establish the methods for evaluation of single-



number quantities of airborne and impact sound insulation in building and of building elements, and also four codes of rules (SP): SP 254.1325800.2016 [4], SP 271.1325800.2016 [5], SP 275.1325800.2016 [6] and SP 276.1325800.2016 [7], which set the rules for designing of industrial sound protection, the rules for designing of sound reduction of air heating, ventilating and air conditioning systems, the rules for designing of sound insulation of enclosing structures of residential and public buildings and the rules for designing of protection from traffic noise. The standards were entered in the Russian Federation by GOSSTANDARD of Russia in 2016; the codes of rules were entered by MINSTROY of Russia in 2017. The documents to be developed give rules and measures to ensure safe and comfortable conditions for working and living of residents and visitors arriving to relax and get acquainted with local sights, national monuments of heritage. SP 275.1325800 [6], GOST R 56769 [2] and GOST R 56770 [3] give also the possibility to select and, if necessary, design new contemporary technologies and construction materials for noise reduction. In the article the historical inquiry on national normative and technical documents operating since 1977 in the field of designing the protection against noise is given and scopes, substantive provisions and features of the developed documents are described.

2. Historical enquire

The first basic national normative and technical document establishing the mandatory requirements that should be observed when designing noise protection to ensure the standard noise levels at workplaces and in residential and public buildings was the building norms and rules (SNiP) SNiP II-12-77 [8]. Prior to its introduction, only isolated normative documents were in effect, in separate paragraphs of which there were established requirements for noise limitation only in various concrete objects. Examples are the Sanitarian Norms SN 245-71 [9] (paragraphs 13.3-13.7) and SNiP II-L.1-71 [10] (paragraphs 3.20, 3.24, annex 1).

In 2004, this document was replaced by SNiP 23-03-2003 [11] with the same title, which expanded the scope of the document by including not only design, but also the construction and operation of buildings for various purposes. In accordance with the accumulated practical experience, the list of construction and acoustic methods for providing noise standard parameters was supplemented and sound protection measures that should be provided in various sections of the project documentation were indicated. The requirement to perform acoustic calculation of expected sound pressure levels and, if necessary, evaluation and designing of construction and acoustic measures for noise protection have been introduced. The sequence of carrying out acoustic calculation was established; the requirements to noise characteristics of technological and engineering equipment were specified. The normalized values were supplemented by the limitations of the maximum sound pressure level at workplaces in rooms of different purposes. The category of high-standard conditions (category A) for offices, workplaces and offices of administrative buildings, design and research organizations with toughening of noise norms by 5 dB was introduced in comparison with the maximum permissible sound pressure levels regulated by federal Sanitarian Norms SN 2.2.2/2.1.8.562-96 [12]. The method of acoustic calculation of expected sound pressure levels at workplaces was included in SNiP 23-03-2003 [11] without changing except the evaluation of the room acoustic constant based on the mean sound absorption coefficient in the room and the introduction of the expression for the boundary radius in the case of a room with a single sound source. The graphical representation of the parameters included in the calculation formulas was replaced by their tabular task in order to simplify the implementation of calculations using software. It was excluded the cumbersome procedure for determining the total number of sound sources which should be taken into account. If necessary, it should be follow the recommendations given in the monograph [13]. The section containing methods for calculating the sound insulation of enclosing structures was excluded, since simultaneously with the implementation of SNiP 23-03-2003 [11], the code of rules SP 23-103-2003 [14] was introduced, in which these methods were contained. The section containing recommendations on designing of enclosing structures with the purpose of maintenance of their standard sound insulation, and also the section establishing requirements to sound-absorbing designs were actualized. At the same time,

recommendations for the evaluation of efficiency of acoustic screens and their appropriate selection were excluded. Relevant recommendations were contained in the textbook published in the same year [15]. Methods for calculating noise from ventilation, air conditioning and air heating systems, as well as gas-dynamic installations were also excluded. Appropriate methods were contained in the manual [16]. The structure of the SNIp [11] was brought into compliance with the requirements of the system of state standardization GOST R 1.5-2004 [17]. The designations of the values were brought into conformity with those used in International and European standards.

With the introduction in July 2003 of the Federal Law No. 184-FZ "On Technical Regulation", the status of SNIps turned out to be uncertain, since they were not included in the list of documents in the field of standardization used on the territory of the Russian Federation. Only in July 2010, with the enactment of Federal Law No. 384-FZ "On the Safety of Buildings and Structures", it was legislatively established that the SNIps approved before the entry into force of this Federal Law are recognized as codes of rules, which were registered in the Federal Information Fund of Technical Regulations and Standards in accordance with GOST R 1.5-2004 [17]. At the same time, the Government of the Russian Federation approved a list of SNIps to be updated and introduced in the form of codes of rules, as a result of which, compliance with the requirements of this Federal Law was ensured on a mandatory basis. In pursuance of this decision, in 2010 NIISF RAACS developed the updated version of SNIp 23-03-2003 [11], which was put into effect in May 2011 as code of rules SP 51.13330.2011 [18].

This code of rules has established mandatory requirements that must be met in the designing, construction and operation of buildings for various purposes, planning and construction of urban and rural settlements in order to protect against noise and ensure regulatory parameters of the acoustic environment in industrial, residential and public buildings, adjacent to them territories and in recreational areas. It regulates the sound pressure levels of penetrating noise in premises for various purposes and on the territory of residential buildings, the procedure for performing acoustic calculations to assess the noise regime in these rooms and territories, the procedure for selecting and applying various methods and means to reduce the calculated or actual noise levels to the requirements of sanitary norms. Requirements established in SP 51.13330.2011 [18] basically conform to the provisions of SNIp 23-03-2003 [11]. However, given the mandatory nature of the main provisions, it does not include the methods for acoustic calculation of expected sound pressure levels which were contained in SNIp 23-03-2003 [11] and also the methods for evaluating the effectiveness of recommended construction and acoustic measures to reduce noise. In paragraph 4.6 it is stated that acoustic calculations should be performed according to the methods set forth in the relevant code of rules. Such SPs were developed by NIISF RAACS in 2015-16 and put into operation in the first half of 2017. These documents are considered in this paper.

It should be noted that SP 51.13330.2011 [18] gives the norms of penetrating sound, which are assumed to be equal to the maximum permissible sound pressure levels at workplaces established by Sanitarian Norms SN 2.2.2/2.1.8.562-96 [12], and for production premises do not take into account that the sound penetrating into production rooms must be added together with the sound created by equipment operated in those rooms. As a result, in order to ensure the requirements of sanitary regulations, the maximum permissible levels of penetrating sound established in the code of rules should be reduced by 5 dB. The corresponding decrease is provided in the amendment 1 to SP 51.13330.2011 [18] prepared in 2016. Finally, the code of rules does not take into account the dependence of normative values on the severity and intensity of the labor process as it is provided for by the Sanitary Norms.

3. Normative and technical documents developed and implemented in 2016-17

Over the past three years, a number of documents developed within the framework of the provisions of paragraphs. 4.3-4.6, sections 5, 7-11 of the basic code of rules SP 51.13330.2011 [18]. We list them with the date of introduction, purpose and scope.

3.1. *National standards*

The first documents are the national standards GOST R 56769-2015 [2] and GOST R 56770-2015 [3]. The date of introduction of the standards is 2017-06-01. The both standards are a partial application to the Russian Federation of the international standards ISO 717-1: 2013 [19] and ISO 717-2: 2013 [20]. GOST R 56769-2015 [2] defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors, and windows; takes into consideration the different sound level spectra of various noise sources such as noise sources inside a building and traffic outside a building; gives rules for determining these quantities from the results of measurements carried out in one-third-octave or octave bands. The standard recommends the rating procedure for measurements carried out over an enlarged frequency range including the low frequency one-third-octave bands with central frequencies 50, 63, 80 Hz or octave band with central frequency 63 Hz and high frequency one-third-octave bands with central frequencies 4000, 5000 Hz or octave band with central frequency 4000 Hz.

GOST R 56770-2015 [3] defines single-number quantities for impact sound insulation in buildings and of floors; gives rules for determining these quantities from the results of measurements carried out in one-third-octave bands and in octave bands (for field measurements only); defines single-number quantities for the impact sound reduction of floor coverings and floating floors calculated from the results of measurements; specifies a procedure for evaluating the weighted reduction in impact sound pressure level by floor coverings on lightweight floors.

The single-number quantities in accordance with the both standards are intended for rating airborne and impact sound insulation and for simplifying the formulation of acoustical requirements in building codes. An additional single-number evaluation in steps of 0,1 dB is indicated for the expression of uncertainty (except for spectrum adaptation terms).

3.2. *Codes of rules*

The first of the developed code of rules is SP 254.1325800.2016 [4]. The date of its introduction is 2017-02-18. The code of rules set the rules for performance of acoustic calculations, for selection and placement of low-noise equipment, as well as for design of noise reduction measures at workplaces in premises and on the territory of industrial enterprises and organizations by means of construction acoustics (using sound-absorbing structures and facings, soundproofing structures, etc.).

In the code of rules concepts are introduced and provisions are made on the following issues included in the content of the document: indoor sound performances; procedure for calculating of the required noise reduction in the room; selection of measures to ensure the required noise reduction; determination of the required sound insulation of the enclosing structures of buildings and building elements; sound reduction by soundproofing cabins; sound reduction by soundproofing enclosures; sound reduction by sound absorbing linings and structures and sound reduction by acoustic screens.

The code of rules SP 271.1325800.2016 [5] (with the introduction date 2017-06-17) is applied to heating, ventilation and air conditioning (HVAC) systems used in buildings for various purposes and set the procedure for designing of sound attenuation systems for HVAC for optimal protection against noise and for ensuring acoustic parameters in the premises of production, residential and public buildings, as well as in the adjacent territories and in the recreational areas.

In the code the concepts are introduced and provisions are made on the following issues included in the content: rated noise parameters; sound sources and their acoustic characteristics; calculation of the reduction of sound power levels along the propagation path of noise; calculation of sound pressure levels in rooms and on adjacent territories; evaluation of structural noise; determination of the required sound reduction; basic sound reduction techniques and measures.

The code of rules SP 275.1325800.2016 [6] (with the date of introduction 2017-06-17) set the requirements for the calculation and design of enclosing structures of residential and public buildings. It is applied to methods for calculating the sound insulation of air and impact noise by internal and

external enclosing structures of residential and public buildings and their elements (windows, doors, gates, etc.), to methods for assessing the adequacy of soundproofing of building structures to the building standard values given in SP 51.13330.2011 [18]. The code of rules is also applied to methods for designing enclosing structures of buildings that provide the required sound insulation of air and impact noise and allow increasing the acoustic comfort of living, rest and work of the population in premises for various purposes. The code of rules does not apply to methods for calculating non-standard constructions, the sound insulation of which can be determined solely from the results of investigations in special acoustic chambers.

In the code the concepts are introduced and provisions are made on the following issues included in the content: normative requirements for sound insulation of air and impact noise by enclosing structures of buildings; methods for determining the airborne noise insulation index R_w and the index of reduced noise level L_{nw} by internal fences of buildings; method for determining the estimated parameter of sound insulation of external fences R_{Atran} ; methods for calculating the required sound insulation of walls, partitions and inter-floored floors of buildings; calculations of frequency characteristics of sound insulation of internal enclosing structures of residential and public buildings; design of enclosing structures that provide a standard soundproofing.

Code of rules SP 276.1325800.2016 [7] (with the introduction date 2017-06-04) set the rules for calculating the acoustic characteristics of motor and rail transport streams; the rules for assessing and forecasting the distribution of transport noise levels in the territories and in the premises of residential and public buildings, adjacent to transport roads; the rules for designing the measures to reduce the traffic noise levels on residential, public, business and recreational areas and in premises of buildings located on them; the rules for the development of operational noise maps of individual territories (build-up area in general). The code of rules is not applied to methods for evaluating and designing protection against aircraft noise, motorcycle noise, and noise from trains on high-speed highways.

In the code the concepts are introduced and provisions are made on the following issues included in the content: sanitary regulations of sound pressure levels in the premises of residential and public buildings and on the territories adjacent to them; methods for calculating the acoustic characteristics of transport streams of various types; methods for calculating expected sound pressure levels in residential, public-business and recreational areas and in residential and public buildings adjacent to transport highways; determination of the required reduction of transport noise levels; reduction of transport noise by organizational and planning activities and soundproof structures; roadside sound protection screens; calculation of parameters and acoustic efficiency of sound protection screens; calculation of the required reduction of traffic noise with soundproof windows in residential and public buildings and recommendations for their choice; technique of compilation of operational noise maps (zones of acoustic discomfort) of cities.

4. Conclusions

The developed documents are the basic normative and technical guidelines that establish the requirements and rules for designing noise protection from various noise sources of technogenic nature, corresponding to the current technological level.

Their application will provide an opportunity to determine, on an unified methodical basis, the expected sound pressure levels at designing, construction and operation of various urban development facilities and, if necessary, develop and apply effective construction acoustic measures for noise reduction to ensure the regulatory requirements in industrial, residential and public buildings and residential areas and comfortable conditions for living and cultural recreation for people.

5. References

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