

Software quality testing for calculation of outdoor noise

Ilya Tsukernikov, Igor Shubin, Leonid Tikhomirov

Research Institute of Building Physics, Russian Academy of Architecture and Building Science, Moscow, Russia.

Tatiana Nevenchannaya

Moscow State University of Printing Arts, Moscow, Russia.

Summary

Currently a wide range of software tools are used for calculations in different fields of building physics. This takes place for building acoustics as well. However such diversity in the absence of clearly defined requirements to software products leads to the fact that calculation results may differ significantly even in the programs that are using the same calculation methods and the same initial data. In this paper an attempt is made of compared analysis of three documents to be intended for testing of software quality for calculation of outdoor noise: Finish Standard NT ACOU 107-2001, German Standard DIN 45687:2006-05 and Draft International standard ISO/DIS 17534-1. The information of Russian Standard GOST R 56234-2014 stating quality requirements and test conditions for such software products is given also.

PACS no. 43.50.+y, 43.50.Rq

1. Introduction

With the growth of cities and increase of traffic flows the task of assessing noise impacts on residential areas became more serious. This becomes especially important when developing measures for protection against noise. At the same time calculation models can take in consideration vast areas and have a complicated configuration. In addition, during acoustic calculations it may be necessary to calculate several options in order to choose the most rational methods of noise reduction. Taking in consideration all these peculiarities, calculations of noise levels manually is becoming more complex and difficult to implement. To simplify and speed up calculations currently a wide range of software is used that implements almost all calculation methods. However, as practice shows, the same calculations using various software products with the same input data and calculation methods may differ significantly [1].

Currently, the software developers in most cases is not governed by the uniform criteria for assessing the quality of software products and the common ways of evaluating the accuracy and validating the calculations. Many software products that are

presented on the market do not allow their users to see exactly how the positions of calculation methods are implemented in them and what determines the final results of calculations.

With the increasing number of calculation methods and software tools that implement one or more methods the development of the documents regulating the requirements for software products is begun. Despite the fact that these documents have similar objectives (to ensure software quality control for outdoor noise calculation) and a similar approach to their achievement they vary considerably. This report offers a comparative analysis of the three documents that establish requirements for assessing the quality of software products: Finnish National Standard NT ACOU 107-2001 [2], the German National Standard DIN 45687:2006-05 [3] and the Draft International Standard ISO/DIS 17534-1.

Finnish Standard NT ACOU 107-2001, known as Nordtest method, is one of the first developed documents and is of a general nature essentially without specific software requirements but representing, as indicated in the title, a framework for the development of future documents.

It indicates that, the software developers must attach to their products declaration confirming the accuracy of the obtained results. To make it possible the document introduces the concept of

test cases - a set of simple scenarios of noise propagation for which calculation results can be easily obtained without use of software and therefore are considered as correct ones. Declaration of conformity of software should contain information about coinciding the test cases calculation results obtained using the software with the correct results within the accepted accuracy of the calculation. The document describes also procedures of test scenarios development and testing the quality of software products. As the Nordtest method provides only general requirements for software products related mainly to the accuracy of the results but ignoring the requirements of openness of software products description, and results output requirements of German Standard DIN 45687:2006-05 can be considered as a progressive step in the assessment of software quality.

German standard develops the ideas inherent in the Nordtest method and sets requirements, directly to the software and to its description. There are QSI forms introduced in the standard that allow the developer to describe the functionality of the developed software product. Listing the features of the software the developer at the same time must ensure its correct operation and for validation should provide the results of the test scenarios.

The list of requirements for the test scenarios has been significantly expanded, for example added the requirement of unambiguous definitions and of consistent initial data used in test scenarios is added. In addition to the accuracy of the results the Standard specifies requirements for software description, including a description of the used calculation methods, how they are implemented in the software, and detailed description of algorithms of data processing in the program. It is also important that the Standard establishes requirements for the output of information and calculation results, for example the user option for receiving a detailed report containing the algorithms and the results of intermediate calculations leading to the final results.

One of the main parts of the German Standard is the introduction of the concept of a common data format used in software tools. Currently each software tool for the calculation of outdoor noise uses a unique format for description of project and input data included in it. Due to the large number of software for noise calculation offered to the market there may be situations when, for example persons operating with one large project perform calculations using various software products.

Verification or exchange of results as well as exchange of the calculation models is practically impossible in such situation due to the incompatibility of used formats. The unified data format allows exchanging data regardless the software used to calculate provided that it meets the requirements of the Standard.

Described Standards are national documents required to apply only within the countries where they were implemented. Technical Committee TC 43 "Acoustics" of the International Organization for Standardization set in 2011 the theme of developing an International Standard for this subject. The drafts of International Standard ISO/DIS 17534-1 [4] and two technical reports DTR 17534-2 [5] and DTR 17534-3 [6] are available now.

The scope of the International Standard is to describe quality requirements and measures to ensure, to indicate and to verify the degree of conformity of a software program with a consistently implementable calculation method/procedure. According to the Standard new calculation methods should include a set of test scenarios that would allow verifying the accuracy of the obtained results. Often software developers make some simplifications at implementation of calculation methods to speed up calculations. The Standard sets out the requirements for developers that users might perform calculations with the simplifications and without them in order to compare the results and to determine the uncertainty caused by the use of the implemented simplifications. Moreover as outdoor noise calculation methods are developed by engineers and acousticians that may not be competent in programming the International Standard proposes to engage in the final stages of calculation method development representatives of software developers so that the developed methods and test cases have been correctly implemented in the software tools. As noted in the International Standard its implementation enables the manufacturer of this type of software to declare and to proof the correct implementation of a calculation method and the software user to verify it without the necessity of a third party certification. It takes into account that software developers and software users are members of the same scientific-technical community and offers means and measures for a transparent and open communication between them.

DTR 17534-2 contains general additional recommendations for the implementation of calculation methods in software, a general applicable set of test cases only described

geometrically and a description of the quality assurance interface (QAI) that allows the exchange of data between software programs quality assured according to ISO 17534. DTR 17534-3 DTR 17534-2 contains additional recommendations for the calculation method ISO 9613-2 that are agreed on if it should be implemented in software quality assured, test cases with detailed results that allow checking the correct implementation and forms to declare conformity with these requirements by a specified software product.

In conclusion, we note that on the territory of the Russian Federation enacted the national standard GOST R 56234-2014 [7] on the quality requirements of outdoor noise calculation software. The Standard development was based on the above German Standard DIN 45687:2006-05. As the German standard the main feature of Russian Standard is proposed common data format which enables sharing of results and calculation models for users of different software tools. During the public discussion it became clear when GIS format using as a common format it can still get formats not compatible with each other. This again confirms the need to attract software developers to develop calculation methods and test scenarios.

References

- [1] I. Tsukernikov, L. Tikhomirov Comparison of results of road noise calculation in a residential area of Moscow obtained using three software tools. Protection from excessive noise and vibration: Proceedings of the IV national scientific-practical conference with international participation, BG TU, St. Petersburg, 2013, p.409-419.
- [2] NT ACOU 107-2001. Framework for the Verification of Environmental Noise Calculation Software. Nordtest Method.
- [3] DIN 45687:2006-05. Acoustics - Software products for the calculation of the sound propagation outdoors - Quality requirements and test conditions.
- [4] ISO/DIS 17534-1 Acoustics - Software for the calculation of sound outdoors - Part 1: Quality requirements and quality assurance.
- [5] DTR 17534-2 "Acoustics – Software for the calculation of sound outdoors – Part 2: General recommendations for test cases and quality assurance interface.
- [6] DTR 17534-3 "Acoustics – Software for the calculation of sound outdoors – Part 3: Recommendations for quality assured implementation of ISO 9613-2 in software according to ISO 17534-1".
- [7] GOST R 56234-2014. Acoustics. Software products for the calculation of the noise level outdoors. Quality requirements and test conditions.