

Elena Prokofieva, Sean Smith
METHODS OF QUALITY CONTROL OF AIRBORNE AND IMPACT SOUND
INSULATION IN NEWLY BUILT RESIDENTIAL BUILDINGS

Napier University Edinburgh, Building Performance Centre
 42, Colinton Rd, Edinburgh,
 EH10 5BT, UK
 Tel: +44 131 4552569; e.prokofieva@napier.ac.uk, se.smith@napier.ac.uk

The standard method of sound insulation testing in dwellings is pre-completion testing of separating walls and floors during the building process. The main disadvantage of this method is that if these structures fail to comply with building standards requirements, the remedial works should be conducted which may require additional costs and time spent. In 2004 the Robust Details Scheme as an alternative method to pre-completion testing was introduced in England and Wales. Robust Details scheme guarantees the performance complying with Building Standards and includes the description of the building process of the constructions, their flanking details, recommended materials and so on. Each construction is tested on real sites by RD inspectors, which are appointed acoustic measurement contractors. The scheme RD is also included within the Code for Sustainable Homes introduced in UK in 2007.

In various countries across the world the process of residential developments construction is controlled by the Building Standards or equivalent approved by the Government, which are applicable to all new and converted buildings. The Acoustical Regulations, as part of the Building Standards, which prescribe the acceptable airborne and impact sound insulation of walls and floors between the dwellings, vary for different countries not only in terms of values, but also in criteria, which are chosen to specify the sound insulation of the partitions.

The sound insulation characteristics can be measured in the laboratory or tested on site during the end of the building process. The laboratory tests demonstrate purely the sound insulation characteristics of the type of tested construction, without any additional flanking or workmanship effects. On-site testing shows how the tested construction performs in the real conditions, including any existing flanking through the junctions and the influence of workmanship on the site.

The following characteristics are mainly used to describe the sound performance of the partitions [1]:
 For airborne:

- R_w – weighted insulation index, evaluated in the laboratory;
 - R'_w – weighted insulation index, evaluated on site so it includes possible flanking transmission;
 - D_w – weighted sound level difference between source and receiver rooms,
 - $D_{nT,w}$ – weighted sound level difference with effect of reverberation time, both measured on site.
- Sometimes the negative coefficient C_{tr} is added to characterise the low frequency sound insulation.

The relation between D and R is as follows:

$$D = R + 10 \log (0.16 V/TA),$$

where V – total volume of the receiving room (m^3), T – reverberation time of the receiving room (seconds), A – total area of the separating wall between the emission and the receiving rooms (m^2).

For impact:

- L_{nw} – weighted sound level, measured in laboratory,
- $L'_{nA,w}$ or $L'_{nT,w}$ – weighted sound levels with effect of partition area (A) or reverberation time (T) respectively, both measured on site.

Building Standards in Russia

In Russia, currently the sound insulation for newly built residential buildings is regulated by the Sanitary Standards and Rules, introduced by Government, and the City Council requirements for building companies (i.e. City of Moscow Building Requirements). According to Sanitary Standards and Rules SNiP 23-03-2003, the requirements for newly built party walls and floors are as follows:

Sound insulation	Airborne (R_w , dB)	Impact (L_{nw} , dB)
For buildings of category A (the highest)	54	55
For buildings of category B	52	58
For buildings of category C (the lowest)	50	60

Building Standards in Great Britain. Pre-completion testing

In England and Wales the acoustic regulations are included into Building Regulations dated by 2000. The latest revision of Part E. Resistance to passage of Sound (Approved Document E) was introduced in 2003. Approved Document E regulates not only the performance standards, but also types of rooms for testing and approved manner of recording pre-completion test results. According to the Approved Document E the compliance with the Building Regulations for party walls and floors must be demonstrated through a programme of pre-completion testing. The number of tests required for flats is defined within the Regulations as “at least one set of tests for every ten dwelling houses, flats or rooms for residential purposes”. If different construction or flanking details are used in the building, the sub-group is created and should be tested as described in the standards.

Sound insulation	Airborne ($D_{nT,w} + C_{tr}$, dB)	Impact ($L'_{nT,w}$, dB)
For floors or walls in new built dwellings	45	62 (floors only)
For floors or walls in converted dwellings	43	64 (floors only)

In Scotland the acoustic regulations are included into Building (Scotland) Regulations dated by 2001. The latest revision of Section 5: Resisting Sound Transmission to Dwellings was introduced in 2003. A sample of partitions should be tested to confirm the compliance with regulations' requirements.

Sound insulation	Airborne ($D_{nT,w}$, dB)	Impact ($L'_{nT,w}$, dB)
	Mean value (individual value)	Mean value (individual value)
For walls in any dwellings	53 (49)	–
For floors in any dwellings	52 (48)	61 (65)

Way to Robust Details Scheme

The pre-completion testing is usually conducted after the major building works are completed. If the sound insulation of the constructions tested exceeds the regulation standards, the remedial works or replacement of the construction would increase the costs of the project, and sometime cannot be conducted without partial or full destruction of the faulty partition. One of the ways for architects to avoid the increases of cost and building time in the future, is to improve design and build the constructions of party walls and floors to make sure that they are more robust and the standards will be obtained during the final testing.

In July 2002, new measures were outlined for new Part E revision (for England and Wales), which included the opportunity for house-building industry to put forward a possible alternative to pre-completion testing. The proposal was to create a list of constructions, which are consistently meeting the Building Regulations requirements. The construction description should also include the flanking details, junctions with external walls and other recommendations to achieve the required standards. The Building Performance Centre at Napier University was chosen to project manage the Robust Standard Details (RSD) project.

Each candidate scheme should satisfy the following requirements:

- meet the required performance standards:

	Mean value	Individual value
Airborne $D_{nT,w} + C_{tr}$	Not less than 50 dB	Not less than 47 dB
Impact $L'_{nT,w}$	Not more than 57 dB	Not more than 60 dB

- be repeatable and reproducible – can be built at any site with the same performance results.
- be systematised relative to the importance of flanking details, junctions, component variations etc.

After the intensive programme of identifying and assessing a number of potential designs, proposals were submitted in May 2003 and published for public consultation. These proposals included 13 Robust Details which met the stringent performance criteria established by the project. After the public approval the Minister responsible for Building Regulations announced in January 2004 that he would allow Robust Details to be used as an alternative to pre-completion sound testing as a means of satisfying Part E of the Building Regulations. This took effect from 1st July 2004 in England and Wales to coincide with the introduction of pre-completion sound testing.

Dwelling plot registration process

Applicants wishing to use the RD route towards Part E1 compliance are required to register each plot with Robust Details Ltd by paying an allocated fee of £30 (per plot, any number of RD schemes can be used in one plot). Once plots are registered, the applicants are provided with registration documentation, which is accepted by building control bodies as evidence of the entitlement to use RD instead of pre-completion sound testing.

The construction should be conducted using the recommendations given by RD. Site checklists are supplied with the registration documentation to allow site managers to check that the building work is carried out in accordance with the relevant RD scheme. RD inspectors may visit the site during the construction works to check that the building is built to the required standards and to test the completed structures to confirm the compliance with the requirements.

Once the separating wall(s) and/or floor(s) in each home are completed, the site manager is required to fill in the compliance certificate for the plot and make it and the completed checklist available to the building control body and warranty provider. During the construction works the RD inspectors can visit the site to confirm that the works are conducted by the rule.

Principles of Robust Details design structure submission

Trade associations, manufacturers or other interested parties who wish to submit proposals for new Robust Details, proceed through the following stages:

Stage A: Registration, including any pre-application testing. This requires undertaking an initial set of eight sound tests on site before the application is submitted. If the application is accepted, the test results will count towards the assessment.

Stage B: Sound testing on nominated sites where the proposed 'detail' is being used. In this stage, you are required to carry out a further 22 on site test sets. RD may witness a proportion of the tests as part of the audit process. At the end of this stage, full details of all test results are submitted to the RD that the Assessment and Approval Committee can review them and make a recommendation to the Board of Directors.

Stage C: Approval, publication and promotion of the new Robust Detail. At this stage the new Robust Detail is made available for use by builders as an alternative to pre-completion sound testing. This includes publishing the new Robust Detail in the Robust Details Handbook.

Everywhere where testing is required, the tests on site should be conducted by the appointed by RD acoustic measurement contractor. The maximum number of tests of any one scheme from any one site is eight. Each batch of 30 CRSD tests required spreading over a minimum of three different appointed measurement contractors.

Summary

RD scheme, applied in England and Wales, allows the builders to build the constructions with high quality sound insulation and reduce the time and costs of the projects by providing the certificates of compliance with current Building Regulations to the constructions built according to the RD recommendations.

These certificates also allow to gain the credit points for Code for Sustainable Homes, introduced in UK in 2006. This Code develops this all-round measure of the sustainability of new homes, ensuring that sustainable homes deliver real improvements for all society and reduce carbon dioxide emissions, water use, waste, and improve sound insulation.

REFERENCES

1. Acoustics - Rating of sound insulation in buildings and of building elements. ISO 717. Part 1. Airborne Sound Insulation. Part 2. Impact sound insulation. British Standards, 2006.
2. *Protection from noise. SNIIP 23-03-2003 (Защита от шума. СНиП 23-03-2003).* State Committee of Russian Federation on building and housing, Moscow, 2004.
3. Approved Document E: Resistance to Passage of Sound. Building Regulations, 2003.
4. Section 5: Resisting Sound Transmission to Dwellings. Building (Scotland) Regulations, 2003.
5. www.robustdetails.com