Minimising Risks

Sound Insulation Testing and Test Risk Management

Sound Insulation Testing of Residential Developments - A Guide to the Implications of the Building Standards and Test Risk Management

(Scottish Building Standards 2011 - Section 5 – Noise)

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Summary:

The 2010 version of the Scottish Building Standards included new requirements for pre-completion testing of sound insulation performance.

The changes to Section 5 - on Noise - significantly increased levels of sound insulation and extended the scope of the regulations to all residential buildings, not just attached domestic dwellings, as was formerly the case. In addition, through the 'Example' constructions, they also introduced new, extensive and detailed construction guidance.

The introduction of pre-completion testing means that designers, inspecting agents and constructors need to take particular care to ensure that designs and the constructed work comply with requirements and are capable of demonstrating compliance with the sound insulation standards when tested, at completion. Without a successful Test Certificate Local Authority Completion Certificates will not be issued.

The increased sound insulation standards mean that new constructions need to be introduced or developed for standard designs of, for example, attached dwellings, flats, hotels and every building that is divided into more than one area of different occupation and the construction of residential buildings, such as hotels and care homes, need to be carefully controlled to ensure conformance with the new required standards and guidance.

There are now also performance standards for internal walls and floors protecting rooms used for sleeping within residential accommodation and revised requirements for properties that are converted to dwellings or other types of residential accommodation.

Strategies and tactics to deal with these issues therefore need to be considered and adopted before *designs and warrant applications are completed so that the resultant completed projects can be tested with a high degree of confidence that these tests will be successful.*

*To minimise the risk of failure at testing, in our view, a **Test Risk Management Strategy** and process should be adopted - from project inception through to completion and testing - so that the risks of test failure are minimised (see section 1.0 below). A number of project teams have already adopted this management strategy and a number of our projects have already demonstrated the effectiveness of this process.*

1.0 TEST RISK MANAGEMENT - Strategy and Recommendations

For most clients and constructors the risk of pre-completion sound insulation test failure will be a matter of considerable concern given that release dates and cash flow could all be seriously jeopardised. Clients, designers, and constructors will also be concerned that the costs and time to remedy any causes of test failure could be considerable - even if it were readily possible to identify, and subsequently rectify the causes of such failures.

There will also be concern about where the costs of any failure might fall – with clients probably looking for the costs to be met by others. However demonstrating who or what has caused a test failure may be difficult and lead to extensive wrangling, argument and even litigation with all the attendant costs and delays that these can involve. Accordingly it will be in everyone's interest to ensure that during design, construction and testing all that can be (reasonably and practically) done to minimise risk of test failure will be done and so reduce the exposure of all parties to this risk and its consequences.

In our view a Test Risk Management strategy should be considered and adopted by all involved at the inception of a project and this strategy then implemented from start to finish of the design and construction process.

The essential elements of this strategy are given below:

1.1 Client and Project Team at Project Inception:

All involved need to recognise that test failure could be a major problem, bearing in mind that:

- It could be difficult to identify cause(s) of failure
- How much of the project is affected could be difficult to assess
- It could be very difficult to remedy the failure(s)
- There could be significant (unbudgeted) cost, disruption and delay implications
- There could be considerable direct and consequential additional costs
- Further testing will be required, perhaps over more of the project, with further costs
- There could be considerable fallout in terms of determination of liability for costs and delays

1.2 Essential Early Steps:

- Advise Clients of the changes and discuss and agree strategies to minimise test failure risks
- Agree to develop, adopt and implement a project Test Risk Management strategy
- Review existing / standard constructions and amend / replace with designs that will meet the new standards
- Integrate requirements under BREEAM and CfSH
- Discuss best "buildability / costs" options with supply chain partners / teams

1.3 Consider What Could Go Wrong:

Recognise that briefing, concept designs, detailed designs, construction and workmanship issues could all affect outcomes. There will be a need therefore to consider the implications of:

- Structural choices and their possible impacts on test risks
- Use of 'Example', 'Other' or 'Bespoke' constructions
- Potential flanking transmission paths with non-standard details
- Service routes, ducts and constructions
- Inadvertent changes to critical specifications
- Effects on sound insulation performance of construction elements of some traditional

workmanship practices
- Poor workmanship on sound insulation performance of construction elements

Agree with the Client and Project Team how each risk will be identified, assessed, minimised and managed, and by whom, for each project.

1.4 Implement a Test Risk Management Strategy during Construction, including:

- Planning for careful checks on developing and finalised designs (especially where details vary from Example Constructions)
- Developing remedial construction strategy(ies) to be incorporated into designs (for use in the event of test failure)
- Agreeing on-site checking procedures at an early stage
- Considering bringing in a consultant acoustician, especially if designs are “Other” or vary from “Example Constructions”

1.5 Consider critical design issues:

- Give early and careful consideration to requirements for, and use of, recessed down-lighters and laminate floor finishes
- Think carefully about routing of services and locations of sockets sets
- Consider implications of sprinkler systems in terms of services, access and routing
- Advise Housing Association (et alia) Clients about banning the use of laminate flooring and fixing of loudspeakers to party walls / ceilings (in leasing conditions)
- Consider use of absorptive materials in common areas to reduce intrusive noise levels

1.6 Before Construction Work Commences:

- Arrange for tool-box talks to tradesmen before critical work commences so that they understand the impact on sound insulation performance of some aspects of construction
- Arrange critical stage inspections of separating walls, floors and adjacent constructions
- Prepare a check-list of checks (if you are doing them)
- Make sure the checks will happen (if someone else is doing them)
- Make sure reports on checks are included in regular project team meeting agendae
- Beware design / specification changes that could affect sound insulation / performance
- Contact Building Control and agree testing programme(s), if required

1.7 Make Early Arrangements for Testing:

- Agree with Client / Project Team when testing should take place – for example, of early completions to test and avoid repetition of construction defects, or
- Testing of late completions to keep construction standards on track
- Early and late testing (with consequent increased costs, in some instances)
- Include testing period(s) in project programme requirements and review regularly
- Advise Contractors and Clients of testing requirements
- Provide a check list of what has to be complete so that testing can be carried out
- Make clear that noise making construction work cannot take place nearby during tests
- Arrange tests well in advance - availability and release programmes need to be matched
- Keep testing organisations up-to-date on availability changes

1.8 Provide Contractor with Testing Checklist:

- Separating walls and floors as well as flanking walls and floors must be complete
- Walls, floors and all wall /ceiling finishes must be complete
- Skirtings must be complete and fixed
- No carpets to floors
- Where a concrete floor with bonded resilient cover is to be fitted with wood based flooring the test sample resilient floor cover should be tested with a wood based floor covering laid over the test sample area
- Doors should be in place and fully fitted, with external and internal doors fitted, as required, with seals and drop bars fitted and active
- All door/window ironmongery must be fitted and all windows and doors closed during the tests
- Trickle-vents to windows must be fitted, working and closed
- Services should be complete and any voids around ducts sealed up
- Electrical sockets should be fitted
- An electricity supply should be available for the test units (110v, or, preferably 240v)
- Test units and adjacent areas within and outwith the building should be quiet for the duration of the tests
- No noise should be made in or around the buildings being tested, during the tests
- No site workers should enter, or be working in the units, during the tests
- All involved in the testing, or verification of tests, should use suitable hearing protection

1.9 In the Event of Test Failure(s)

- Try to establish the cause(s) of failure(s)
- Consider the extent of the problem(s) – is remedial action required to all, or just part, of the project?
- Deploy agreed remedial strategy (see 1.4 above) to all or part, as agreed
- Consider and agree the extent of re-testing required
- Carry out tests in accordance with the standards and prepare report on findings

2.0 Contract Administration

2.1 Test Risk Management Strategy:

A Practice Note issued by the RIAS advises that where the Architect is the Contract Administrator, *he/she should ensure that the contractor takes steps to seek implementation of a Test Risk Management strategy for a project that requires testing and advise the Client as to the appropriateness of this strategy*.

2.2 Knowledge and Skill:

Architects as Contract Administrators should be aware that making appropriate checks in relation to on-going design and construction will require a good knowledge of the implications of the standards and of the Example Constructions so that they can take reasonable steps to ensure that they are not found liable with respect to this aspect of their work in the event of test failure.

2.3 Appointment of Consultant Acoustician:

The Practice Note issued by the RIAS also advises that where the Architect as Contract Administrator or under a Design and Build appointment is aware that design advice and requirements for testing are outwith his / her expertise, the appointment of a consultant experienced in this field should be recommended. [Ref. Consultants appointments in SCA/2000 Clause 1.03, DBE/2000 and DBC/2000.]

3.0 Overview of the Requirements of the Technical Standards:

The re-written section new Part 5 (Noise) sections to the Technical Handbooks, provide for different requirements for domestic and non-domestic testing and for conversions as detailed below as well as with increased scope of application (to all domestic and non-domestic residential buildings).

The following summaries of the basic requirements of the Standards should be supplemented by reading the full text of the standards and guidance all of which can be found at: <www.scotland.gov.uk/bsd>.

3.1 Domestic:

The re-written Standard 5.1 has introduced significantly higher sound insulation standards for separating floors and walls to “new build" and “converted" domestic dwellings (with consequential changes to constructions and details of construction):

***New* Design performance levels in dB**		
	New *build and conversions* - not including *traditional buildings*	***Conversions* of *traditional buildings***
Minimum airborne sound insulation	56 DnT,w	53 DnT,w
Maximum impact sound transmission	56 L'nT,w	58 L'nT,w
***Old* Design performance levels in dB**		
	Walls	***Floors***
Mean airborne sound insulation	53 DnT,w	52 DnT,w
Individual airborne sound insulation	49 DnT,w	48 DnT,w
Mean impact sound transmission		61 L'nT,w
Individual impact sound transmission		65 L'nT,w

A comprehensive pre-completion testing regime, with different testing requirements for *new build* using “Example Constructions" as compared with *new build* using other constructions, is now in force for all flats and maisonettes and for houses and conversions.

The recommended minimum number of tests for each situation is listed below:

Recommended minimum number of tests for new build [1,2]				
	No. of attached dwellings	**No. of tests for separating walls [houses]**	**No. of tests for separating walls [flats or maisonettes]**	**No. of tests for separating floors [flats or maisonettes]**
New build using Example Constructions	2 - 20	2	2	2
	21 - 40	3	3	3
	Over 40	1 extra for every 10houses or part thereof	1 extra for every 20 flats or maisonettes, or part thereof	1 extra for every 20 flats or maisonettes, or part thereof
New build	2 - 10	2	2	2

using other constructions	11 – 20	3	3	3
	21 - 30	4	4	4
	Over 30	1 extra for every 10 houses, or part thereof	1 extra for every 10 flats or maisonettes, or part thereof	1 extra for every 10 flats or maisonettes, or part thereof

Recommended minimum number of tests for conversions [1,2]				
	No. of attached dwellings formed by conversion	**No. of tests for separating walls [houses]**	**No. of tests for separating walls [flats or maisonettes]**	**No. of tests for separating floors [flats or maisonettes]**
New build using Example Constructions	1 - 5	2	2	2
	6 - 10	3	3	3
	Over 10	1 extra for every 5 dwellings, or part thereof	1 extra for every 5 dwellings, or part thereof	1 extra for every 5 dwellings, or part thereof

1. Where a separating wall forms a junction with a ground floor or roof a weak point in the *construction* is created affecting the sound performance.
   For this reason 1 test should be carried out on a separating wall at ground and first floor level for attached houses.
2. Each different construction in a development should be tested.

Conversions of traditional buildings have less onerous insulation standards and there are special measures to accommodate the unique circumstances occurring in historic and listed buildings - consultation with both the verifier and the planning officer of the relevant authority is advisable at an early stage and in the case of historic and listed buildings the relevant authority may, at its discretion, agree measures that respect the character of the building.

Apartments within Dwellings: A functional standard (5.2) has been introduced that requires design performance levels of airborne sound insulation of internal walls and intermediate floors. These should provide a minimum of 43dB, R_w sound insulation between an apartment in a dwelling "*where noise is likely to occur* and *any room that is capable of being used for sleeping"*. (This standard does not apply to walls between en-suite bathrooms and the apartments or rooms they serve.)

Pre-completion testing of insulation levels under standard 5.2 is not required. Designers may rely upon published laboratory test results (R_w).

3.2 Non-domestic:

The section on non-domestic residential accommodation is completely new, applies to all residential buildings (other than domestic dwellings) and sets similar standards to those required for domestic dwellings for separating floors and walls forming rooms intended for sleeping.

Scope of Standard: Airborne sound insulation should be provided where any *separating wall* or *separating floor* is formed between areas in *different occupation*. For example:

- Between *rooms* that are intended to be used for sleeping and other *buildings*;
- Between *rooms* that are intended to be used for sleeping and other parts of the same *building,* such as bedrooms and a communal hall.

Impact sound insulation should be provided where any *separating floor* is formed between areas in different occupation. For example:

- Between *rooms* intended to be used for sleeping. The lower *room* should be protected

from sound emanating from the upper *room*;
- Between *rooms* intended to be used for sleeping and other parts of the same *building*. The *room* below should be protected from sound emanating from other parts of the *building* above;
- Between *rooms* intended to be used for sleeping and other parts of the same *building* directly above e.g. common stair or corridor, communal lounge, or car parking garage;
- A roof, walkway or *access deck* located directly above *rooms* intended to be used for sleeping and to which there is access, other than where it meets the conditions of c or d below

The new standard also introduced a requirement for pre-completion testing with at least 1 test carried out on each separating wall and separating floor of each different construction within the completed building, where there is a room intended for sleeping.

The test levels for 'Example' and 'Other' constructions are the same as for Domestic separating floors and walls to "new build" and "converted" domestic dwellings (as shown above):

Test levels for Example and Other constructions in dB		
	New *build and conversions* not including *traditional buildings*	***Conversions* of *traditional buildings***
Minimum airborne sound insulation	56 DnT,w	53 DnT,w
Maximum impact sound transmission	56 L'nT,w	58 L'nT,w

Where it is not possible to carry out a sound test (for example where access to an adjoining building may be restricted or prevented, or where conversion of an attached building occurs, for example to a mid-terrace building where it may not be possible to gain access to the adjacent building to carry out tests to the separating wall) then in such cases, it may not be appropriate to test.

Rooms and rooms used for sleeping within residential buildings: A functional standard (5.2) has also been introduced which requires that airborne sound insulation of internal walls and intermediate floors should provide a minimum of 43dB, R_w sound insulation between any *internal space where noise is likely to occur* and *any room that is capable of being used for sleeping*. (This standard does not apply to walls between en-suite bathrooms and the apartments, or rooms, that they serve.)

Intermediate floors: Improving the sound insulation over only the parts of an intermediate floor that is above or below rooms that are intended for sleeping, could lead to expensive remedial measures if an area is missed or if future alteration work is carried out. It is therefore recommended that sound insulation should be provided across the *entire area of each intermediate floor* if there is a room that is intended for sleeping, located directly above or below the floor.

Testing of insulation levels under standard 5.2 is not required.

More detail can be found on the Scottish Building Standards Agency website at:
< www.scotland.gov.uk/bsd>.

Both of the Domestic and Non-domestic Technical Handbooks can be downloaded as pdf or HTML files together with a brief summary of key changes. Hard copy can be purchased from the TSO - details being available on the above website.

3.3 Traditional buildings:

The new standards recognise that traditional buildings can present particular challenges when being converted to residential use and marginally less demanding performance insulation standards are applied to conversions of traditional buildings. The airborne sound insulation standards are similar to those in the "old" standards (prior to October 2010) whilst the impact sound insulation standard is a little higher. These standards are set as a benchmark – allowing for early stage discussion and consultation with both the verifier and the planning officer of the relevant authority to try to ensure that insulation standards are improved as far as possible in relation to this benchmark. There are also special measures to accommodate the unique circumstances occurring in historic and listed buildings.

Consultation with both the verifier and the planning officer of the relevant authority is advisable at an early stage and in the case of historic and listed buildings it may be possible to agree measures that respect the character of the building whilst seeking to meet the benchmark sound insulation standards. [Note: 'Traditional building' means a building or part of a building of a type constructed before, or around, 1919 using construction techniques that were commonly in use before 1919.]

General Note: These circumstances will require discussion and negotiation with the verifier, as may circumstances where testing is not possible (see above). Verifiers have to satisfy themselves by "reasonable enquiry" that the building has been constructed in accordance with the warrant and that what has been constructed meets the standards – so they may wish to determine the units to be tested and attend tests. A new protocol on testing can be found at: www.scotland.gov.uk/Resource/0041/00415385.pdf.

3.4 Example Constructions:

These are available on the Building Standards website (as a separate document at www.scotland.gov.uk/topics/built-environment/building/building-standards). Alternatively, product manufacturers may have solutions that will achieve the design standards and these will need thorough exploration. There are many changes from the guidance to the "old" standards and there are new "Example Constructions" that provide options to meet the standards for non-domestic residential accommodation and for internal partitions / walls within dwellings.

It should be noted that the guidance notes to each construction *are far more extensive and detailed than for constructions in the previous standards* and will require effort on the part of designers and constructors to ensure compliance with them in design and during construction. The attention and care required should not be underestimated.

Elements of construction (where the Example Constructions have to be interpreted to meet with different design circumstances) will need to be examined carefully to ensure that insulation standards are not reduced and flanking transmissions inadvertently introduced.

Overall: The new Part 5 sections stress that the performance of a construction is dependent upon:

- Critical relationships between separating and adjoining elements (e.g. external walls, roofs and windows) to combat flanking transmission
- Achieving a high quality of workmanship on site
- Supervision throughout the construction process

The introduction of testing regimes reinforces the need to ensure that these matters are carefully and effectively dealt with in design and construction.

3.5 BREEAM / Code for Sustainable Homes:

A separate issue for many developers could be compliance with requirements of BREEAM and CfSH if they are intent upon achieving recognition / ratings under one or other of these schemes as both have specific requirements, recommendations in relation to noise issues that will need to be considered alongside the new Building Standards. The sooner the appointment of an acoustic consultant is made the better with regard to securing BREEAM credits – indeed onew credit depe3ndfs upon appointment being made in sufficient time to influence the design of the project – to ensure that acoustic design issues are addressed and integrated with the Building Standards and other requirements.

Guidance Development:

The content of this Guidance Note is based upon an RIAS Practice Note prepared by RIAS Fellow and Member of the Institute of Acoustics, Nick Charlton Smith, as amended in discussions within the RIAS Practice, Contracts and Appointments and Insurance and Liability committees.

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