CSPAcoustics

Minimising the Risks of Sound Insulation Test Failure - Test Risk Management

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Summary:

The 2010 changes to Section 5 (Noise) in the Scottish Building Standards significantly increased levels of sound insulation, extended the scope of the regulations to all residential buildings (not just attached domestic dwellings, as was previously the case, and introduced requirements for testing of completed sound insulating walls and floors.

In addition, through the 'Example' constructions, they also introduced new, extensive and detailed construction guidance and more recently also revised the *standards for internal walls and floors within domestic residential accommodation.*

The introduction of post-completion testing has meant that designers, inspecting agents and constructors have had 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, or face unknown costs and time delays in dealing with remedial work and re-testing to obtain Completion Certificates for the project.

Strategies and tactics to deal with these issues therefore need to be considered 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. The following notes outline the essential of that TRM process:*

1.0 Test Risk Management - Strategy and Recommendations

For most clients the risk of post-completion sound insulation test failure will be a matter of considerable concern given that release dates and project 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 the risks of test failure will be done to 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 cost of implementation of this strategy will be considerably less than the consequent costs of failure (remedial costs, time delays and re-testing costs) and will also increase confidence of an on-time, on-cost completion.

The essential elements of this strategy are:

1.1 Client and Project Team at Project Inception: All involved recognise that test failure could be a major problem, bearing in mind that:

- It could be difficult to identify cause(s) of failure
- It could be very difficult to remedy the failure(s)
- How much of the project is affected could be difficult to assess
- There could be significant (unbudgeted) cost, disruption and delay implications
- There could be considerable indirect 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:

- Clients are advised of the requirement for post completion testing and discussions with acousticians and designers take place to agree strategies to minimise test failure risks
- Team agrees to develop, adopt and implement a project ***Test Risk Management*** strategy
- Existing / standard constructions are reviewed and amended / replaced with designs that will meet the new standards
- Requirements are integrated to comply with BREEAM requirements, when applicable
- Best "buildability / costs" options are discussed with supply chain partners / teams
- Details on current schemes are revised accordingly

1.3 **Consider What Could Go Wrong:** The team recognises that briefing, concept design, detailed design, 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' as opposed to 'Other' or 'Bespoke' constructions
- Potential flanking transmission paths with non-standard details
- Service routes, ducts and constructions
- Inadvertent changes to critical specifications
- Negative effects on sound insulation performance of construction elements of some traditional workmanship practices
- Poor workmanship on sound insulation performance of construction elements
- The Client and Project Team agree 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:

- Developing remedial construction strategies to be incorporated into designs (for implementation 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"
- Planning for careful checks by designers / acoustician of developing and finalised designs (especially where details vary from Example Constructions)

1.5 Consider critical design issues by:

- Giving early and careful consideration to requirements for, and use of, recessed down-lighters and laminate floor finishes
- Thinking carefully about routing of services and locations of sockets sets
- Considering implications of sprinkler systems in terms of services, access and routing
- Advising Housing Association (et alia) Clients to ban the installation of laminate flooring by tenants and fixing of loudspeakers to party walls / ceilings (include in lease conditions)
- Considering use of absorptive materials in common areas to reduce potential 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 the acoustician is doing them)
- Make sure the checks will happen (if someone else is doing them)
- Make sure reports on checks are discussed at regular project team meetings
- Be aware that design / specification changes 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, testing of early completions to avoid repetition of construction defects, or
- Testing of late completions to keep contractors on their toes, or
- Early *and* late testing for the best of both worlds and to maximise ***Test Risk Management***
- Include the planned testing period(s) in project programmes and review regularly
- Advise Contractors and Clients of testing requirements
- Provide a check list of what has to have been completed 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 completion date changes

1.8 Provide the Contractor with a 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
- Floors must be bare and carpets must not have been laid (and must be lifted if laid before testing)
- Doors should be in place and fully fitted, external and internal doors fitted and with seals and drop bars fitted and active
- All door/window ironmongery must be fitted
- Trickle-vents to windows must be fitted and working
- 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 (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 during the test
- 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 4.0 above) to all or part
- 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.

3.0 Overview of the 2015 Standards: The Part 5 (Noise) sections to the 2010 Technical Handbooks are largely unaltered in the 2015 publications – retaining all aspects of the increased scope of application (to all domestic and non-domestic residential buildings), revised performance standards and post-completion testing requirements which came into force in 2010 and 2011 apart from one significant change which is to Regulation 5.2 where the guidance on the sound insulation performance standard for insulation between rooms within dwellings has been revised downwards. The following summaries of the basic requirements of the Standards should be supplemented by reading the full text of the standards and guidance, which can be found at <www.scotland.gov.uk/bsd>.

3.1 Domestic: Standard 5.1 in the 2010 Standards introduced significantly higher sound insulation standards for separating floors and walls to "new build" and "converted" domestic dwellings (with consequential changes to constructions) as compared with the preceding Standards:

Design performance levels in dB		
	New build and conversions (not including traditional buildings)	***Conversions* of *traditional buildings***
Minimum airborne sound insulation	56 $D_{nT,w}$	53 $D_{nT,w}$
Maximum impact sound transmission	56 $L'_{nT,w}$	58 $L'_{nT,w}$

A comprehensive post-completion testing regime, with different testing requirements for *new build* using "Example Constructions" as compared with *new build* using other constructions, also came into force for 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 (see notes 1 & 2 below)				
	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 using other constructions	2 - 10	2	2	2
	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 (see notes 1 & 2 below)				
	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.

Traditional, Historic and Listed Buildings: Less onerous insulation standards apply to conversions of traditional buildings and there are special measures to accommodate the unique circumstances occurring in historic and listed buildings – so consultation with both the verifier and the planning officer of the relevant authority is advisable at an early stage. 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: The functional requirement (5.2) introduced in the 2010 Technical Handbook required design performance levels of airborne sound insulation of internal walls and intermediate floors to 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.)

This functional requirement has now been amended in the 2015 Standards so that the minimum airborne insulation level for walls (only) *has been reduced to 40dB, R_w*. The Standard for intermediate floors remains at 43dB, R_w.

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

3.2 Non-domestic Residential Accommodation:

Airborne sound insulation must 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 2015 Standards maintain the requirement for post-completion testing for projects introduced in the 2010 Technical Handbook (Non-Domestic):

At least 1 test has to be carried out on each *separating wall and separating floor of 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: The functional standard (5.2) introduced in the 2010 Technical Handbook is unchanged in the 2015 Handbook and 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; other than:

a. a wall between an en-suite bathroom and the apartment or room it serves
b. a hospital
c. a place of lawful detention.

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> from which 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.

3.3 Traditional buildings: The 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 the 2010 and 2015 Standards) 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 situations 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 wish to attend tests. A protocol on testing has been developed and is available at:

<http://www.gov.scot/Resource/0046/00469878.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).

It should be noted that the guidance notes to each construction are far more extensive and detailed than for constructions in the pre 2010 Standards and thus require careful attention 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 Part 5 Technical Handbooks 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 with the use of ***Test Risk Management*** strategies highly commended.

3.5 BREEAM:

A separate issue for many developers could be compliance with requirements of BREEAM if they are intent upon achieving recognition / ratings under this scheme which has specific requirements and 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 one credit depends 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 requirement.

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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