

# **HOUSING AND SOUND INSULATION**

## **A Review of Sound Insulation Performance in Scottish Domestic Construction**

### **SUMMARY**

Sean Smith, Robin Mackenzie, Richard Mackenzie and Tim Waters-Fuller.

*Building Performance Centre, School of the Built Environment, Napier University, Edinburgh.*

### **Introduction.**

The main aim of this research was to review the sound insulation performance, relative to Part H (Technical Standards, Scotland), for different types of construction involving party walls and floors used in Scottish housing. The study focused on sound insulation field test data involving over 1400 test results recorded during the period 1992 to 2001.

### **1. Main Findings**

Post construction testing requested by Building Control authorities has led to improvements in the sound insulation performance for houses and flats.

- Domestic construction in Scotland has higher pass rates for sound insulation than in other parts of the UK.
- Specified wall type 1D had a significant failure rate of 49%.
- The use of 13mm dense render to the block wall faces of wall type 1D resulted in 93% pass rates and high levels of sound insulation.
- Frame party walls using timber (wall type 4A) performed consistently well. (96% pass rate – Table 1)
- Hollow-core concrete floors of 200mm thickness gave the best overall performance in terms of both airborne and impact sound insulation.
- Concrete floors using raft type construction had high pass rates for impact sound insulation. (>99%)
- Heavy timber floors (i.e. general refurbished constructions involving ash deafening) had a lower than expected pass rate. This was frequently due to the absence of ash deafening within parts of the existing floor structure.
- Common mistakes during the construction process were the main cause of failures to meet Part H requirements.
- A significant and increasing use is made of new technology materials, especially open-cell polymers, to improve sound insulation.
- Some housing associations now request higher sound insulation standards than those given in Part H.

### **Sound Insulation Testing (Post construction testing)**

- Most local authorities request testing of non specified constructions. (i.e. those constructions which are not specified in the Technical Standards Part H)
- Local authorities in Edinburgh and Glasgow generally request testing of both specified and non-specified constructions.
- Post construction testing requested by Building Control authorities has led to improvements in the quality of sound insulation for houses and flats.
- Due to advances in the technology of test equipment, post construction results and appropriate expert advice on remedial works, if required, can be provided quickly.
- Post construction testing can save the contractor / architect significant financial costs by early identification of sound insulation problems prior to occupancy.
- In addition to post construction testing an increasing number of contractors and architects now ask for expert acoustical advice during the design stage prior to construction starting.

## **2. Domestic Construction in Scotland – Brief Summary of Principal Structures**

### **Masonry walls**

- 282 masonry walls were included in the study. Table 1 shows the pass level performance relative to Part H.
- Six wall types are predominantly built in Scotland.
- Five of the six wall types have high pass rates.
- Specified wall type 1D is the worst performing wall (i.e. solid 215mm dense concrete wall with plasterboard mounted on dabs or timber straps) with a 49% failure rate.
- The most common reasons for failure of wall type 1D are incorrect bonding to the inner leaf of the external cavity wall, mortar not placed full thickness, puncturing of wall surface with services and not laying the block (on its side) full width of wall.
- Very few party walls in Scotland use a wet plaster finish. Plasterboard dry lining is the norm as it provides a clean surface finish, allows easy incorporation of services and is faster and cheaper to construct.
- Non-specified constructions are increasingly being adopted. The use of 13mm dense render to the block wall face of wall type 1D before the attachment of dry linings resulted in a 93% pass rate and generally high levels of sound insulation. The use of mineral fibre or open cell foam backed plasterboard after rendering provided the highest airborne sound insulation performance.

## Frame Walls

- Timber frame construction in Scotland has significantly increased in the last ten years.
- Three frame wall types are used in Scotland and 114 timber frame walls were included in the study.
- The predominant wall design built is specified wall type 4A. All type 4A walls met the Part H performance requirements of 53dB  $D_{nT,w}$ . The average airborne sound insulation performance was 62dB  $D_{nT,w}$ .
- To avoid reducing the effectiveness of wall type 4A, the insertion of electrical sockets should be avoided and care should be taken that the timber sole plates of either side of the wall are not directly connected.

## Concrete Floors

- A total of 159 concrete floors were included in the study for airborne sound insulation and 155 for impact sound insulation. A further 117 floors could be classified into two floor types.
- Pre-cast concrete floor slabs of 200mm thickness was the most commonly used. Beam and block floors are rarely used in Scotland.
- The two predominant raft type constructions involved the use of either integral single layer closed cell resilient battens laid upon a mineral fibre quilt or an integral open and closed cell double layer resilient battens.
- Common mistakes which resulted in lower than expected sound insulation for concrete party floors included - lack of flanking strip between floor board edge and adjacent walls, nails/screws (used for connecting boards to battens) puncturing through resilient layers forming a solid bridge, voids left between pre-cast floor slabs when assembled on site and floor slabs only bearing on the two supporting walls therefore allowing a continuous sound flanking path between lower and upper rooms with no break formed by floor slab.
- Flatted dwellings incorporating designs using steel frames to support pre-cast concrete slabs should ensure adequate sealing of all voids where the slabs meet the steel beam supports.
- The most common ceiling finish was plasterboard on timber branders. More recently resilient metal bars are starting to be used in place of timber branders and result in a higher performance.

## Timber Floors

- 360 timber floors were measured for sound insulation during the period 1992-2001, comprising 198 lightweight (quilt insulation) timber floors and 162 heavy (ash or granular fill deafening) timber floors.
- Detailed construction information was known of 316 timber floors.
- A large variation in types of timber floors were found during the study and divided into 20 different categories.

- High failure rates for 'new build' were recorded for platform floors both for airborne and impact sound tests, including a 34% failure rate for type 3A mineral fibre platform floors. Raft type floors using only integral closed cell foam layer battens without mineral fibre performed the worst. The best performing adapted platform floors incorporated integral double layer closed and open cell foam backed battens with mineral fibre quilt placed in the cavity between the battens.
- The highest recorded floor type was type 3D, typical traditional timber floor with ash deafening, often tested during refurbishment.
- Type 3D performance variability was largely a factor of whether sufficient ash deafening was present in the existing floor. Granular infill was often used as a replacement to provide sufficient mass. Suspended ceilings significantly improved sound insulation performance.
- High performance floors generally used suspended ceilings, resilient ceiling bars or independent ceiling joists.

### **General Comments**

- Contractors, architects or specifiers may use laboratory test data (expressed in dB  $R_w$ ) when choosing a wall or floor type. Care should be taken as only direct sound transmission paths are normally measured in laboratories. Field performance (on site) can be typically 4dB to 7dB lower than laboratory test values.
- Laboratory test results can vary by up to 7dB when the same structure is tested in different laboratories. Future amendments to international standards may lower this variability.
- The replacing of carpets with sanded floors in traditional construction or the use of non-foam backed floor laminates results in increased transmission of impact sound (such as footfall noise). Use of a resilient mat or blanket under laminate floors reduces impact sound transmission through party floors.
- Kitchens located at party walls, which have wall mounted units and services (sockets, switches, pipes, boilers), are likely to have lower sound insulation performance due to the puncturing of the dry lined surface layer. The application of 13mm render to the block wall face prior to the installation of dry linings assists in reducing sound transmission.
- Because of consumer expectation it is recommended that properties described as 'luxury' should incorporate higher performing party wall or floor structures.

<b>PASS RATE (%) for AIRBORNE SOUND INSULATION</b>			
	Target Minimum	Group Individual Minimum	Sample Size
<b>WALLS</b>	<b>53dB <math>D_{nT,w}</math></b>	<b>49dB <math>D_{nT,w}</math></b>	
Masonry Walls	80%	95%	282
Frame Walls	96%	99%	114
<b>FLOORS</b>	<b>52dB <math>D_{nT,w}</math></b>	<b>48dB <math>D_{nT,w}</math></b>	
Concrete Floors	84%	94%	159
Timber Floors (heavy)	76%	92%	162
Timber Floors (light)	73%	90%	198
<b>PASS RATE (%) for IMPACT SOUND INSULATION</b>			
	Target Minimum	Group Individual Minimum	Sample Size
<b>FLOORS</b>	<b>61dB <math>L^1_{nT,w}</math></b>	<b>65dB <math>L^1_{nT,w}</math></b>	
Concrete Floors	98%	99%	153
Timber Floors (heavy)	86%	97%	162
Timber Floors (light)	75%	90%	198
<p align="center"><b>Table 1</b>  Pass rate for various types of party wall and floor constructions relative to Part H (Technical Standards, Scotland).</p>			

### 3. Research Methods

This study, undertaken by a team from the Building Performance Centre, School of the Built Environment, Napier University used field test results measured during the period 1992 – 2001.

Over 1400 field test results were included in the study. The locations of field tests are not disclosed in this study.

Each of the 16 third-octave band values from every test was entered into a data base in addition to the single value weighted result. The single value weighted result was then recalculated as a check procedure on the third octave band data entered.

Where detailed information on the construction was not complete these test results and their constructions were not categorised for further study.

#### **4. Further Information:-**

Copies of the full research document will be made available for purchase shortly from the Building Performance Centre. Enquiries regarding further information about this study or requests for copies when the full document is available should be addressed to:

Dr Sean Smith, Building Performance Centre, School of the Built Environment,  
Napier University, 10 Colinton Road, Edinburgh EH10 5DT

Tel: 0131 455 2380, or Email: [se.smith@napier.ac.uk](mailto:se.smith@napier.ac.uk)

Website: [www.sbe.napier.ac.uk](http://www.sbe.napier.ac.uk)

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