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Can the house building industry ever achieve full compliance with the sound insulation requirements of National Building Regulations and create truly sustainable homes?

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Summary

In England and Wales the Building Regulations, Approved Document E, which concerns the sound insulation between attached residential homes was revised in 2003. One of the drivers for this revision was the poor compliance rates with respect to the earlier Approved Document E and a high level of complaints reaching government. A survey by BRE [1] estimated that, in new dwellings, as many as 40% of new separating floors and up to 25% of new separating walls failed to meet the earlier standards. The revised Approved Document E introduced mandatory testing of a sample of new and converted attached residential properties on all developments. The objective of this change was to achieve a 95% level of compliance within 10 years and this paper examines whether this has actually been realised.

During the consultation process in 2002 the House Builders Federation successfully persuaded the UK Government to give them the opportunity to develop an alternative method of compliance with Approved Document E which would not involve mandatory testing. This project resulted in what is now known as the Robust Details certification scheme. The development of the Robust Details route as a means to demonstrate compliance is well documented elsewhere and this paper looks at how successful it has been in assisting the house building industry towards full compliance.

Finally, consideration is given to the future and if the lessons learnt in England and Wales can be transferred to other countries with different Building Regulation Standards.

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1. Introduction

The Building Regulations 1991 in the form of Approved Document E 1992 edition controlled the sound insulation between residential homes in England and Wales. A change took place in 2003 with the introduction of a revised Approved Document E which had minor amendments applied to it in 2004. Whilst the new ADE increased the sound insulation criteria the most significant change was the introduction of mandatory testing. Prior to the introduction of this change a consultation process was undertaken.

Studies by BRE [1] indicated that the operation of the then current building regulations and guidance in Approved Document E did not always achieve satisfactory standards of sound insulation in practice. One study indicated that about 25% of occupants living in dwellings that attained the then current standards for sound insulation rated the insulation as poor or very poor. A second study by BRE [2] looked at complaints about sound insulation between dwellings that had been approved under current Building Regulations and found a poor level of compliance with current (implicit) standards in the cases investigated. Field tests of sound insulation between new dwellings, undertaken by BRE on behalf of DETR, also showed that there was a wide range of performance for some constructions included in the then current guidance and that examples of non-compliance with those standard were continuing to occur. BRE estimated that, in new dwellings as many as 40% of new separating floors and up to 25% of new separating walls failed to meet the then current standards. This clearly

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illustrated that there were problems with the operation of a system that relied on a combination of plan checking and site visits for enforcement.

The proposed amendments had an overall objective of securing standards of health, safety and welfare for persons in or about buildings in respect of resistance to the passage of sound, without imposing disproportionate bureaucracy and costs on builders, materials producers, building owners or building control bodies.

The key objectives were to improve standards of sound insulation and to significantly improve compliance with the Regulations by the introduction of a pre-completion testing regime and to improve the usefulness of current guidance to designers and builders by clarifying the text in the Approved Document and identifying changes in standards and practice.

The proposed changes for new dwellings, particularly the pre-completion testing regime, were intended to both improve standards and to reduce the failure rate to below 5% over 10 years.

2 Pre-Completion Testing

The revised Approved Document E required that as part of the construction process that sound insulation performance should be measured at a rate of one in ten. That is on a development of 100 attached houses there should be 10 party walls tested. When a development consists of just two attached houses then the party wall between the two houses must be tested. This requirement consequently requires that somewhat more than 10% of the attached dwellings built are tested. The exact percentage is open to speculation but for the purposes of this paper I will assume that at least 10% are tested. The sound insulation criteria are shown in tables I and II.

Table I. Sound Insulation requirements for walls.

Wall Type:	$D_{nT,w} + C_{tr}$
Purpose built.	≥45 dB
Material change of use.	≥43 dB
Rooms for residential purpose, purpose built.	≥45 dB
Rooms for residential purposes, material change of use.	≥43 dB

Table II. Sound Insulation requirements for floors

Floor Type:	$D_{nT,w} + C_{tr}$	$L'_{nT,w}$
Purpose built.	≥45 dB	≤62 dB
Material change of use.	≥43 dB	≤64 dB
Rooms for residential purpose, purpose built.	≥45 dB	≤62 dB
Rooms for residential purposes, material change of use.	≥43 dB	≤64 dB

Testing of the party walls and floors is undertaken by either UKAS accredited testers or tester who are registered under the Association of Noise Consultant's Scheme for Pre-Completion Testing. The advantage of this second scheme is that a database is held centrally of all test results

3 Test Statistics

With the permission of the ANC I interrogated the statistical analysis of the pass/fail rates for the last 3 years. The results of this analysis is shown in Tables III to V1

Table III. Airborne sound insulation, historic compliance levels for walls.

	2009	2010	2011
Purpose built new build.	97.9%	98.8%	98.8%
Material change of use.	96.9%	96.7%	97.3%
Rooms for Residential Purpose – Purpose Built.	91.1%	90.8%	92.6%
Rooms for Residential Purpose – Material Change of use.	82.0%	82.8%	85.8%
Walls overall compliance levels.	96.8%	97.5%	97.3%

Although the overall compliance rates are better than 95% it can be seen that when a material change of use is involved the compliance rates are much lower than the average. The reason for this is generally that the sound insulation achievable will depend on the existing construction and structures over which the builder has little control. The failure to employ an acoustic consultant at an

early stage in the design process exacerbates the problem.

Table IV. Airborne sound insulation, historic compliance levels for floors.

	2009	2010	2011
Purpose built new build.	97.4%	97.0%	97.5%
Material change of use.	90.0%	90.3%	92.7%
Rooms for Residential Purpose – Purpose Built.	97.6%	98.7%	98.9%
Rooms for Residential Purpose – Material Change of use.	89.8%	86.2%	93.6%
Floors overall compliance levels.	95.0%	94.1%	95.8%

As with the walls, it is the material changes of use that lowers the overall average.

Table V. Impact sound insulation, historic compliance levels for floors.

	2009	2010	2011
Purpose built, new build.	98.2%	97.5%	98.6%
Material change of use.	95.0%	95.5%	96.2%
Rooms for Residential Purpose – Purpose Built.	97.4%	99.4%	99.4%
Rooms for Residential Purpose – Material Change of use.	92.0%	90.9%	96.7%
Floors overall compliance levels.	97.1%	96.7%	97.8%

Again it is the material changes of use that lowers the overall average. However the impact sound insulation is generally easier to control and engineer. The availability of bonded soft floor coverings is probably a major contributor to this effect.

Table VI. Historic global compliance levels.

	2009	2010	2011
All walls and floors.	96.3%	96.1%	97.0%

Several conclusions can be drawn from this analysis:

- The objective of achieving 95% compliance for ADE has been achieved in much less than the hoped for ten year period.
- The performance is generally stable over the three year period.
- The analysis over the three years included a total of 83,142 tests which is a large sample and consequently the results can be applied to the whole population.
- Over the three year period the average compliance level was 96.5%.

The compliance level of 96.5% is of course a slight under estimate of the actual compliance level. The analysis above has had all the retests of failed structures removed from the data set. When a failed test is reported to the Building Control body they are then obliged to not only consider increasing the rate of testing to greater than one in ten but to insist that the builder undertakes remedial works until the structures achieve a test result that meets or exceeds the requirements in Tables I and II.

Providing the Building Control Bodies are working effectively then all the failures will have been remediated and re-tested with a ‘pass’ result. On that basis the ultimate compliance level should be slightly better than 96.5% but is unlikely to ever reach 100%. The reason for this is that there will still be the untested dwellings that would have failed but which did not receive remedial works to ensure a pass.

4 Robust Details

The problem with pre-completion testing was that it introduced a huge element of uncertainty into the construction process right at the worst possible time in the build, just before completion and hand over. The house-building industry considered that the removal of this uncertainty was highly desirable and was given the opportunity to put forward a possible alternative to PCT called Robust Standard Details (RSD) for new build separating walls and floors in attached houses and apartments. These details for separating walls and

floors would have to consistently meet the Building Regulations requirement of Approved Document E, and thus would not require routine on-site testing. If the house-building industry was successful in designing and testing such details, these would be presented before the Building Regulations Advisory Committee (BRAC) and released for public consultation prior to a final decision by the Minister. This resulted in one of the largest and most intensive projects ever undertaken by the UK house-building industry which was initiated by the House Builders Federation, now called the Home Builders Federation. This was the development of what is now known as the Robust Details route. The development of the Robust Details is described in detail elsewhere [3] and will not be covered here.

As a result of this project Robust Details Ltd was created. Given that this scheme is an alternative to Pre-Completion Testing BRAC felt that it would be prudent to insist on the establishment of an Inspectorate to provide feedback to the government and confirm that the scheme was still 'robust'.

In addition to the initial assessment, all RDs are subject to continuous performance monitoring. This process checks that RDs consistently achieve the expected performance levels. It also underpins confidence in Robust Details as an effective means of demonstrating compliance with the requirement of Approved Document E, 2003. RDL is committed to sound-testing 2% of properties completed under the scheme.

With the permission of the Robust Details Ltd, I have examined their database of compliance levels in the same way as for Pre-Completion Testing and the following table show the results.

Table VII. Robust Details, Compliance levels.

	2009	2010	2011
Airborne, walls.	99.5%	99.7%	99.6%
Airborne, floors.	100.0%	98.9%	97.5%
Impact, floors.	99.7%	98.1%	98.3%
Global compliance.	99.6%	99.3%	99.2%

Several observations are relevant with respect to the above analysis:

- The objective of achieving 95% compliance for ADE was achieved almost immediately as this is a fundamental criteria for a structure being a Robust detail.
- In their annual report for 2006/7 RDL reported that compliance levels had reached 97% which is only three years after their start up.
- The overall performance over the three years 2009 to 2011 was 99.4% and this was based on 3,630 tests which is a significant sample.
- Of the 0.6% of tested structures that failed to comply with the requirements of Approved Document E none of them had been built correctly in accordance with the Robust Detail as shown in full in the RDL handbook.

It is true that Robust Details cannot be used in material change of use situations; consequently I would expect slightly higher compliance rates. This alone cannot account for the truly high compliance rates achieved. In addition, there is little doubt that the best practice principals enshrined within each Robust Detail has provided a significant amount of knowledge transfer to builders who have remained with Pre-Completion Testing as their preferred method of complying with buildings regulations. The nett effect has been a raising of build quality and build standards throughout the house building industry, at least as far as sound insulation is concerned.

5 Scotland

All though Scotland is part of the United Kingdom it is a self contained country with respect to Building Regulations. The Building Regulations have always been different in Scotland from those of England and Wales and different again to those of Northern Ireland. In 2010 Section 5 of the Building Regulations in Scotland [4] was revised and introduced mandatory testing on a similar basis to that employed in England and Wales since 2003. Again testing is by UKAS or ANC testers but it is too early to analyse the ANC database for Scotland as it does not yet hold a meaningful number of tests.

However the requirements of the revised Section 5 are very different to those in England and Wales having different pass/fail levels and even using a different descriptor for airborne sound insulation whilst retaining the same descriptor for impact sound insulation.

Table VIII. Scotland, Section 5, design performance levels.

	New build and conversions not including traditional buildings	Conversion of traditional buildings
Minimum airborne sound insulation	56 dB $D_{nT,w}$	53 dB $D_{nT,w}$
Maximum impact sound transmission	56 dB $L'_{nT,w}$	58 dB $L'_{nT,w}$

Given the success, over some nine years, of Robust Details in England and Wales, it is understandable that an extension of the Robust Details scheme to suit the new parameters and accepted pass/fail criteria in Scotland was attractive. In order to do this the existing performance levels for Robust Details in England and Wales had to be recalculated from $D_{nT,w} + C_{tr}$ to just $D_{nT,w}$, a relatively simple task. Then the results had to be compared to the values of 56 dB $D_{nT,w}$ and 56 dB $L'_{nT,w}$ for new build in Scotland. A new Robust Details handbook was created composed of only those existing Robust Details that met these new criteria.

On the 31st of January 2012 Robust Details in Scotland was launched.

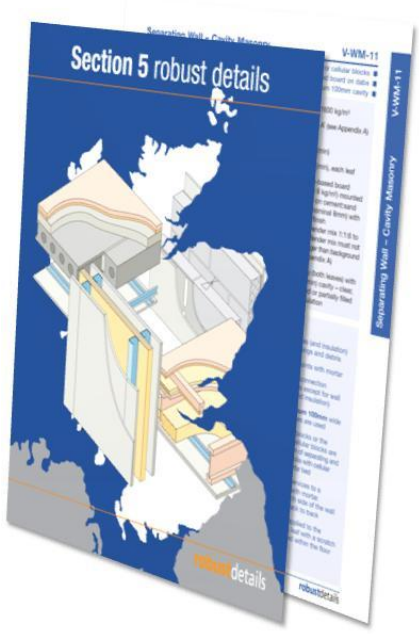

Figure 1. The Robust Details Handbook for Section 5, Scotland.

The significance of this achievement has implications for other countries. The Robust Details approach is transferable across borders and can be moulded to comply with the requirements of other and varied National Building Regulations.

6 Drivers

It is clear from the experience in England and Wales, and now Scotland, that the critical component in achieving these high compliance levels is mandatory testing.

National governments would need to have the political will to introduce mandatory testing within their own countries. This is the 'stick' that drives change. Without it no progress can be made.

The experience of transferring Robust Details to match the new Building Regulation requirements in Scotland has shown that this can be done, probably in most countries, with reasonable ease.

However, in some countries building methods and systems are employed that are unique to that area of the world and clearly these would need to be included within the Robust Details route if at all practical.

The way this can be accomplished is to treat each country specific system as a generic Candidate Robust Detail [5]. As with all new Candidate Robust Details, thirty sound insulation tests of the construction in the field would be collected. Providing the thirty test results showed that the construction met that country's criteria for a Robust Detail they could then be included in the handbook. If they fail that key test it is still possible that they could have their sound insulation performance increased by a process of making the construction more 'robust'.

This whole process of transferring the Robust Details approach to other European countries may be simplified and made more straight forward by the work of the COST Action TU0901. This COST Action is aimed at 'Integrating and Harmonising Sound Insulation Aspects in Sustainable Urban Housing Constructions. The Working Group 1 of this pan European research project is specifically looking at how to harmonise the acoustic descriptors used throughout Europe for building regulations purposes and will provide guidance for all national Governments on the most appropriate descriptors to use.

7 Sustainable Homes

Turning now to consider the issue of 'sustainability' and how it is affected by sound insulation.

At first glance it is not obvious why sound insulation has anything to do with sustainability. However, if we think about the situation where two attached houses have very poor sound insulation people will not want to live in them. Clearly such houses will not last very long and will need to have significant remedial works done to them to make them more viable as residential accommodation. If people do not want to live in such houses then they become redundant properties and will ultimately be replaced by better housing. Now if poor sound insulation is clearly not sustainable then the corollary is that good sound insulation is a sustainable characteristic, making the houses more desirable as long term homes for people.

8 Conclusions

The title of this paper posed several questions.

Firstly, can the house building industry ever achieve full compliance with the sound insulation requirements of National Building Regulations? Well clearly the answer is no but we can get very close to full compliance.

It also asked if the house building industry can create truly sustainable homes? True sustainability needs to consider many different and diverse factors and it is clear that a good standard of sound insulation between attached dwellings is a significant contributor to a sustainable home. Certainly the absence of good sound insulation is significantly detrimental to the concept of sustainability.

Acknowledgement

I would like to acknowledge both the Association of Noise Consultants and Robust Details Ltd who both allowed me access to their respective databases of sound insulation test results.

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