# NEW BUILDING REGULATIONS ON THE RESISTANCE TO THE PASSAGE OF SOUND FOR ENGLAND & WALES

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ABSTRACT
In 2002 the new Building Regulations and Approved Document E for England and Wales on the 'Resistance to the passage of sound' will be published. This paper by the authors of Approved Document E describes the main changes proposed in the 2001 consultation document. It is hoped that the final documents will be in the public domain before September 2002 such that the oral presentation can focus on the final published documents.

## BACKGROUND

In 2001 the Government published: (a) the proposals for amending the Part E Requirements in the Building Regulations, (b) the proposals for amending Approved Document E (the document containing approved technical guidance) and (c) the draft Regulatory Impact Assessment (a document describing the issues, an assessment of the benefits to building occupants and the costs of the proposals).

Between January and April 2001 there was a consultation period in which interested parties were invited to comment on the proposals. After the consultation period, the document was revised in the light of the comments that were received and in 2002 the new Building Regulations and Approved Document E for England and Wales on the 'Resistance to the passage of sound' will be published. The whole process was carried out under the direction of the independent Building Regulations Advisory Committee.

The Building Regulations for England and Wales contain the legal Requirements that, for sound, are generally non-technical in nature. The associated Approved Document contains the Secretary of State's view on how these Requirements can normally be satisfied alongside specific technical guidance.

## MAIN PROPOSALS (2001 CONSULTATION DOCUMENT)

The main proposals in the 2001 consultation document were:

- Changes to the Requirement for airborne and impact sound insulation between dwellings.

- Clarify that Part E Requirements apply to all types of dwelling including rooms for residential purposes (e.g. rooms in hotels, hostels, residential homes, boarding houses but not hospitals or similar institutions).

- Increase the target sound insulation standard by about 3dB.

- Introduce new sound insulation indices incorporating the ISO 717 spectrum adaptation terms, $D_{nT,w}+C_{tr}$ for airborne sound insulation and $L'_{nT,w}+C_{I}$ for impact sound insulation.

- Introduce a field sound insulation testing regime for airborne and impact sound insulation in dwellings and rooms for residential purposes, referred to as "pre-completion testing".

- Introduce a new Requirement for airborne sound insulation of internal walls and floors based upon laboratory airborne sound insulation data.

- Introduce a new Requirement for façade airborne sound insulation.

- Introduce a new Requirement to control reverberation in the common internal parts of buildings.

- Introduce a new Requirement to provide sound insulation between school rooms, protect school rooms from external noise and provide suitable reverberation times in school rooms.

**SOUND INSULATION BETWEEN DWELLINGS: THE SITUATION IN ENGLAND & WALES (2001)**

BRE Acoustics Centre estimate that in new dwellings, as many as 40% of new separating floors and up to 25% of new separating walls may fail to meet the current numerical standards. Therefore, improving compliance with the Building Regulations was a significant issue in the revision process.

Data from the Chartered Institute of Environmental Health (CIEH) indicates that the number of complaints about domestic noise per million people has risen since 1987. In 1987/88, the number of complaints was just over 1,500 per million people, but by 1997/98 the number of complaints about domestic noise had reached 5,051 per million people. The 1997/98 CIEH report states that 148,006 complaints about domestic noise were reported from 225 responding local authorities. Part of the reason for the rise in noise complaints is thought to be due to changing lifestyles and rising expectations. Heightened awareness of the issue due to the media may also play a part.

Data from the 1996 English House Condition Survey (EHCS) show that over a third of households (7.0 million) experienced problems with noise. Of the respondents to the EHCS survey who said they had problems with noise, 33% (2.3 million) said that the noise was due to neighbours (either immediate neighbours, those in common areas or both). However, nearly 80% of the 2.3 million households said that the noise was either wholly or partially the fault of the neighbours in question, and not solely a consequence of a flaw in the design of the building. EHCS data also show that occupants of flats (10.9%) report a higher number of noise problems from immediate neighbours than those living in houses (4.9%).

Data were also available from a BRE study[1] in 1992-1994 that investigated complaints about sound insulation between dwellings that had been approved under Building Regulations and that appeared to comply with the technical construction guidance in Approved Document E. The study found that, in the main, complainants lived in dwellings with sound insulation below the standard generally regarded as reasonable for Building Regulations purposes. The study provides evidence of non-compliance with current standards and demonstrates that sound insulation problems do arise when non-compliance occurs.

**SOUND INSULATION: SINGLE-NUMBER QUANTITIES**

Previous technical guidance in Approved Document E referred to $D_{nT,w}$ for airborne sound insulation and $L'_{nT,w}$ for impact sound insulation.

Compared to televisions and radios that were available in the 1950s, modern home entertainment systems have high power outputs at low frequencies. Consideration was therefore given to use of the ISO 717 spectrum adaptation terms that include the 50Hz, 63Hz, and 80Hz third octave bands. However, there was concern about the repeatability of field measurements when using single-number quantities that incorporated data down to 50Hz. This was considered a potential problem if used with pre-completion testing. An alternative solution was to replace $D_{nT,w}$ with $D_{nT,w}+C_{tr}$. Subjective listening experiments reported by Wright and Fothergill[2] supported the adoption of $D_{nT,w}+C_{tr}$ to deal with noise from some amplified music. The building industry had already been introduced to $D_{nT,w}+C_{tr}$ through a joint project[3] between government and industry to set enhanced levels of sound insulation, and therefore this indicator had already gained some acceptance. The proposal to use $D_{nT,w}+C_{tr}$ was also intended to ensure that timber and steel constructions would achieve similar airborne sound insulation to masonry constructions at low frequencies.

For impact sound insulation, it was proposed that $L'_{nT,w}$ be replaced by $L'_{nT,w}+C_I$ to take advantage of the improved correlation[4] between objective and subjective evaluation of impact noise using this indicator. Single-number quantities that included the 50Hz, 63Hz, and 80Hz third octave bands were not proposed due to concern about the repeatability of field measurements.

It was proposed that the normal way of satisfying the Requirement on airborne and impact sound insulation would be to build separating walls and floors, and stairs that have a separating function, together with the associated flanking constructions, in such a way that they achieve the sound insulation values shown in Tables 1a and 1b.

| | **Airborne** $D_{nT,w} + C_{tr}$ **dB (Minimum values)** | **Impact** $L'_{nT,w} + C_I$ **dB (Maximum values)** |
|---|---|---|
| **Purpose built dwellings** | | |
| Walls | 45 | - |
| Floors and stairs | 45 | 62 |
| **Dwellings formed by material change of use** | | |
| Walls | 43 | - |
| Floors and stairs | 43 | 64 |

**Table 1a.** Dwellings - performance requirements for separating walls, separating floors, and stairs that have a separating function.

| | **Airborne** $D_{nT,w} + C_{tr}$ **dB (Minimum values)** | **Impact** $L'_{nT,w} + C_I$ **dB (Maximum values)** |
|---|---|---|
| **Purpose built rooms for residential purposes** | | |
| Walls | 43 | - |
| Floors and stairs | 45 | 62 |
| **Rooms for residential purposes formed by material change of use** | | |
| Walls | 43 | - |
| Floors and stairs | 43 | 64 |

**Table 1b.** Rooms for residential purposes - performance requirements for separating walls, separating floors, and stairs that have a separating function.

For historic buildings undergoing a material change of use (i.e. a conversion), it may not be practical to improve the sound insulation to the standards in Tables 1a and 1b. It was therefore proposed that the sound insulation should be improved as much as is practical and then affix a notice declaring the measured sound insulation values inside the building.

**PRE-COMPLETION TESTING**

One of the main aims of the revision was to improve compliance with the proposed numerical standards of sound insulation. Although a construction design may be considered "robust" in terms of its sound insulation at the design stage, problems commonly occur on site due to poor workmanship, substitution of building materials and design changes on site. Therefore, to improve compliance it was considered necessary to introduce a testing regime for sound insulation. The testing would be carried out when the dwellings were fully built but before hand-over to the buyer. It was intended that testing should be seen as part of the construction process, hence the title "pre-completion testing".

The proposal was that testing should be carried out at the developers' expense but that it was the responsibility of the building control body to indicate which properties were to be tested. The following guidance was proposed for building control bodies:

*The results of tests only apply to the particular constructions tested but are indicative of the performance of others of the same type in the same development. Therefore, in order for meaningful inferences to be made from tests, it is essential that developments be considered as a number of notional groups, with the same construction type within each group. Grouping should be carried out according to the following criteria. Flats, rooms for residential purposes and houses (including bungalows) should each be considered as three separate groups. In addition, if significant differences in construction type occur within any of these groups, sub-groups should be established accordingly.*

*One set of tests should be carried out between the first dwellings or rooms for residential purposes scheduled for completion and/or sale in each group or subsystem-group, regardless of the intended size of the group or subsystem-group. As further properties on a development become ready for testing, building control bodies should indicate at what point(s) they wish to conduct any further set(s) of tests. Assuming no tests are failed, building control bodies should aim to have at least one set of tests carried out for every ten dwellings or rooms for residential purposes.*

In the proposal, the single-number quantities for airborne and impact sound insulation contained a built-in allowance for measurement uncertainty of 2dB. Therefore, it was intended that if any test showed that one of these values was not achieved by any margin, the test would register as a failure.

BRE Acoustics Centre estimate that in new dwellings, as many as 40% of new separating floors and up to 25% of new separating walls may fail to meet the current standards. Pre-completion testing was intended to reduce the failure rate to below 5% over 10 years.

**CONSTRUCTION GUIDANCE IN APPROVED DOCUMENT E**

The technical guidance on the construction of separating walls and floors with their associated flanking constructions was updated and clarified, especially on flanking constructions, junction details and wall linings. The simple diagrams of wall and floor constructions that were previously used in the Approved Document were replaced with more detailed drawings.

The opportunity was taken to replace generic material descriptions with dynamic/acoustic specification parameters wherever suitable. In previous technical guidance, building materials were described using a generic material name, density and physical dimensions. However, generic descriptors can be problematic because: (a) they sometimes allow a range of products to be used that have significantly different dynamic/acoustic properties, (b) they hinder innovation in the building material industry, and (c) they hinder the regulator in the

"maintenance" of technical guidance due to the introduction of new materials or the cessation of material production.

Previous technical guidance referred to the use of butterfly ties in separating masonry cavity walls. Butterfly ties are described in a British Standard and are considered as a generic tie in the UK. However, many manufacturers produce proprietary wall ties. Hence, the dynamic stiffness[5] parameter was introduced to describe the dynamic properties of proprietary wall ties similar to the butterfly tie. The opportunity was also taken to use the dynamic stiffness parameter to describe wall ties for use in external masonry cavity walls where dynamically stiff wall ties can reduce the low frequency airborne sound insulation.

For floating floors on concrete base floors, previous technical guidance referred to two generic types of floating floor consisting of either a screed or a timber raft on a resilient material, where the resilient material was described by a combination of material name, density and thickness. These generic types of floating floor were kept in the new technical guidance but with the resilient materials also described by the dynamic stiffness parameter measured according to EN 29052-1. In addition, to allow manufacturers of proprietary floating floors to assess the suitability of their products against these generic types of floating floor, laboratory performance was introduced into the technical guidance using the weighted reduction in impact sound pressure level $\Delta L_w$ measured according to ISO 140-8.

It was not proposed that the constructions in the new technical guidance of Approved Document E should be exempt from pre-completion testing. This is due to the fact that built constructions rarely correspond exactly with designs in an Approved Document (or any other written guidance) which along with poor workmanship, substitution of building materials and design changes on site lead to poor sound insulation.

**INTERNAL SOUND INSULATION**

The proposed new Requirement for protection against sound within a dwelling or rooms for residential purposes was that they shall be designed and constructed such that: (a) an internal wall between a room containing a WC and a living room, dining room, study or bedroom (except where the WC is en-suite) shall provide reasonable resistance to sound and (b) an internal wall between bedrooms and between bedrooms and other rooms, and an internal floor between bedrooms and between bedrooms and other rooms, shall provide reasonable resistance to sound.

It was proposed that the normal way of satisfying the Requirement would be to use constructions that provide laboratory airborne sound insulation values of 40dB $R_w$.

**FAÇADE SOUND INSULATION**

Protection of the building envelope from external noise is traditionally achieved through the planning system in the UK where other issues such as site layout can also be considered. The proposals gave examples of constructions likely to perform reasonably but also allowed any type of construction to be used provided that limits on internal noise were met. Technical Annexes provided information on the nature of the target internal levels, guidance on assessing external noise levels and guidance on how to demonstrate compliance by calculation or testing when non-standard constructions were used.

**REVERBERATION IN COMMON INTERNAL PARTS OF BUILDINGS**

The proposed new Requirement was that the common internal parts of buildings which contain dwellings or rooms for residential purposes shall be designed and constructed in such a way as to prevent more reverberation around the common parts than is reasonable. It was proposed that the normal way of satisfying the Requirement would be to apply the sound absorption measures described in the proposed Approved Document E, or other measures of similar effectiveness.

The technical guidance in the proposed Approved Document E was based upon absorption areas rather than reverberation times because: (a) it was not intended to introducing testing for this Requirement, (b) the use of absorption area avoids ambiguities in the interpretation of reverberation times for stairwells and long corridors and (c) it makes it easier for architects to specify surface treatments. Two methods are described to satisfy the Requirement, Method A and Method B.

Method A is to cover a specified area with an absorber of an appropriate class that has been rated according to ISO 11654. For entrance halls, corridors or hallways cover an area equal to or greater than the floor area, with a Class C absorber or better. For stairwells or a stair enclosure, calculate the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding ground floor) and the ceiling area on the top floor. Either, cover at least an area equal to this calculated area with a Class D absorber or cover an area equal to at least 50% of this calculated area with a Class C absorber or better. The absorptive material should be equally distributed between all floor levels.

Method B is to determine the minimum amount of absorptive material using a calculation procedure in octave bands between 250Hz and 4kHz. Method B is intended for corridors, hallways and entrance halls as it is not well suited to stairwells. For entrance halls, provide a minimum of $0.20m^2$ total absorption area per cubic metre of the volume. For corridors or hallways, provide a minimum of $0.25m^2$ total absorption area per cubic metre of the volume.

## ACOUSTIC CONDITIONS IN SCHOOLS

The Department for Education and Skills (DfES has ended the exemption of maintained schools from the Building Regulations, therefore, the new Requirement formalises the situation that all new schools will come under the building control system. However, the proposed Approved Document E will continue to refer to DfES technical guidance documents. The DfES technical guidance for sound insulation between rooms, protecting rooms from external noise and providing suitable reverberation times in rooms is currently being updated for publication in 2002.

## CONCLUSION

This far-reaching revision of Part E of the Building Regulations for England and Wales aimed to improve the acoustic environment for the occupants of dwellings, rooms for residential purposes, and schools. One of the most important proposals was pre-completion testing which was introduced to tackle the problem of a poor level of compliance with the Building Regulations.

## ACKNOWLEDGEMENTS

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