Defra Contract NO0234

An investigation into the effect of historic noise policy interventions

Final Report

ANNEX 4

BUILDING REGULATIONS

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1 INTRODUCTION

1.1 Format and Structure of Annex

1.1.1 The Annex considers the following matters:

Section 2 Describes the policy and the factors that influence its effect
Section 3 Describes the development of the Regulations up to 1992
Section 4 Describes the development of the Regulations after 1992
Section 5 Reports on the compliance rates under the 2003 Regulations
Section 6 Provides an assessment of the policy's effects
Section 7 Presents the Summary and Conclusions

1.2 Principal organisations and individuals contributing to this report

Building Research Establishment (BRE)

1.2.1 BRE has a history stretching back over 90 years, one of its forerunners – the Building Research Board (BRB) – first met in 1920 becoming the Building Research Station (BRS) in a year later and BRE in 1972. It has been involved in research and design relating to sound transmission in dwellings from before 1950 and cover the whole of the study period. Results of its work in this field are referred to in the course of this report[1].

Environmental Protection UK (EPUK)

1.2.2 Environmental Protection UK traces its roots back to the foundation of the Coal Smoke Abatement Society (CSAS) in 1898, making it one of the oldest environmental NGOs. CSAS was founded by London based artist Sir William Blake Richmond and over the following decades the Society was instrumental in the introduction of the 1926 Public Health (Smoke Abatement Act) and the 1956 Clean Air Act. Following increasing concerns from members about involvement in noise issues, a National Noise Committee was established in 1984 and a Land Quality Committee in the late 1990s. The NSCA changed its name to Environmental Protection UK (EPUK) in October 2007[2]. A particular contribution to this report is the survey undertaken by the NSCA in 1986 into sound transmission in conversions.

Noise Abatement Society

1.2.3 The Noise Abatement Society (NAS) was founded in 1959 by the late John Connell OBE, whose campaigning led to the Noise Abatement Act and the designation of noise as a 'statutory nuisance'. Since then, the NAS has continued to provide informed input to Government to guide noise policy and has developed other roles that support its objective to raise awareness of, and find solutions to, noise pollution.

[1] Gary Timmins MIOA, the current Head of Acoustics at BRE, provided input for BRE.
[2] Mary Stevens, formerly Head of Policy at EPUK provided input for this report drawing on EPUK's data archives.

1.2.4 The NAS runs the UK's only national noise helpline offering free advice for those who are suffering from noise nuisance at home, work and in the community and is also involved in many projects and campaigns which aim to improve the aural landscape for all. The NAS works with industry to encourage the production of quieter goods, with academics and scientists to identify the issues and research possible solutions, and with government to change policy and effect change[3].

1.2.5 *Philip Dunbavin FIOA*, played a key role in the formulation and delivery of the Robust Details (RD) system that, alongside Post Completion Testing (PCT) of finished dwellings, was introduced into Part E of the Building Regulations in 2004 and has provided input based on that experience.

[3] Lisa Lavia, Managing Director of the NAS, has provided the input drawing on NAS data.

2 POLICY AND INFLUENCING FACTORS

2.1 Policy to be examined

2.1.1 (iv) relevant changes to the Building Regulations

2.2 Question to be answered

2.2.1 What benefits have the relevant changes to the Building Regulations brought about?

2.3 Policy Background and Summary

2.3.1 Regulation of building construction was introduced in London by the London Building Act of 1667 following the Great Fire in 1666. The Building Regulations as a national code were introduced in 1965 and included the regulation of sound (Part G) but only in newly-built or extended properties.

2.3.2 Amendments to the 1965 (and to later) regulations were made but more fundamental changes occurred in the new regulations introduced 1972, 1985, 1992, and 2003/4.

2.3.3 The principal differences between the regulations are:

- 1965 Compliance could only be demonstrated by the use of a '*deemed to satisfy construction*' defined in the Regulations
- 1972 Compliance could also be demonstrated for a construction not on the list of those '*deemed to satisfy*' by sound transmission tests to demonstrate that defined criteria were met
- 1985 The previous acoustic performance standard (Grade I) was replaced with the single number system using BS 5821/ISO717 eg, $D_{nT,w}$
- 1992 More detail was provided for '*recommended solutions*'[4] to try to improve compliance and extension of Part E to include conversions
- 2003[5] Increase in performance requirements and introduction of mandatory testing and Robust Details system

2.4 The policy in practice – matters influencing implementation

2.4.1 In 2001 the Department of the Environment, Transport and the Regions (DETR) published a consultation document on proposed changes to the regulations. One of the proposed changes was to require mandatory testing on site of the acoustic performance of completed dwellings to check compliance with the relevant standards[6].

[4] These were introduced in the 1985 Regulations to replace the '*deemed to satisfy*' constructions in earlier regulations.
[5] There were minor amendments in 2004.
[6] Details of the PCT system are provided in Sections 5.2 and 5.7.

2.4.2 When the new regulations were finalised in 2003 the mandatory post completion testing (PCT) requirements proposed in that 2001 consultation had been modified in two ways.

2.4.3 First, in response to the opportunity afforded to the house-building industry to propose an alternative to PCT, the House Builders' Federation (now called the Home Builders' Federation) initiated one of the largest and most intensive projects ever undertaken by the UK house-building industry. This led to the creation of Robust Details Ltd (RDL) which holds a databank of test results for different Robust Details constructions and an Inspectorate to monitor the continuing compliance rate of Robust Details with the required standards.

2.4.4 The second amendment was an initiative from the Association of Noise Consultants (ANC) in relation to the approval of testers. Approved Document E expressed a preference for testing bodies to have UKAS accreditation. In order to meet the need for suitably qualified testers to be available in sufficient numbers within a reasonable time-scale the ANC set up a new Registration Scheme to include approved members of the ANC who had demonstrated competence in this activity. Testers operating under the ANC Registration scheme are required to lodge their test data centrally, as part of the Quality System implemented by the ANC. UKAS accredited testing organisations are not required to lodge their test results in any centralised database.

2.5 The policy in practice – matters influencing the effect of the policy

2.5.1 The following factors influenced the effect of introducing the policy:

A: Variation in workmanship (ie, variability in construction)
B: Variation in results of tests
C: Availability of suitable qualified testers
D: Sampling effects (ie, where PCT is applied)
E: Size of database for a Robust Details Construction
F: Effectiveness of on-site inspections (as opposed to tests)
G: Lifestyles of occupiers
H: Ambient noise
I: Hard floor surfaces
J: Expectation
K: Other confounding factors

2.5.2 Factors *A* to *F* are either an inherent part of the policy or form its expected context. They are to varying extents either controllable or measureable so that provision can be made for their anticipated effects (eg, by incorporating an adjustment to the test standard to take them into account).

2.5.3 The other factors listed above also have the potential to influence the effectiveness of the policy but their occurrence is to varying degrees either not controllable or predictable to the same extent as the first group of factors. This second group of confounding factors are briefly discussed below.

G: Lifestyles of occupiers

2.5.4 The standard of sound insulation required to be rated as satisfactory/acceptable by occupiers depends on the lifestyle of the neighbours and the expectations of the occupiers. It can be affected by an occupier's sleep/work patterns and the leisure activities they pursue in the dwelling. Occupiers can be either more sensitive than average or generate more noise than average (for the time of day) and both these variations from the norm might require better than average performance.

H: Ambient noise

2.5.5 It is possible that in an area having a higher than average ambient noise level (eg, from a steady source such as road traffic) deficiencies in sound insulation will be less noticeable than in an area where there is a lower ambient noise level. Noise ingress can have the effect of masking noise from neighbours. When external noise levels are low, or where the sound insulation provided by the building façade is greater than necessary, the potential masking benefit will be reduced, which often results in a lower perception of the effectiveness of sound insulation.

I: Hard floor surfaces

2.5.6 The use of hard floor surfaces instead of carpets or other resilient treatment increases impact noise in dwellings below the floor and increase impact noise problems. Such surfaces can arise from the removal of carpets and renovation of the existing timber floors, by the provision of ceramic tiles, or by the installation of wooden laminate floors to create a timber floor finish. The popularity of these interior design trends, in particular wooden and laminate floors has led some local authorities and landlords to issue guidelines or restrictions on their use. Defra also commissioned research on this issue [7] which included guidance on its use.

J: Expectation

2.5.7 The expectation of a house occupant can vary depending whether the occupant is an owner or tenant, and whether a particular premium was paid for a property and whether the sales literature implied a quality above and beyond regulations such as being described as "luxurious" or "peaceful".

2.5.8 Other circumstances that can affect an occupier's expectations are moving from either a detached property or one with particularly high level of sound insulation or from a house to a flat. The occupier might then perceive even a good level of acoustic separation as being below their expectation.

K: Other confounding factors

2.5.9 Inappropriate internal layouts (eg, where the 'stacking' in flats juxtaposes different room uses on either side of a party floor) can contribute to problems with noise from neighbours.

[7] The development and production of a guide for noise control from laminated and wooden flooring. Defra, 2005.

2.5.10 Over the study period, there has been an increase in the number and range of domestic appliances (eg, washing machines[8]) and audio-visual equipment (music systems and televisions) used in homes, which can generate high levels of noise.

2.5.11 Factors *G* to *K* have not been taken into account in assessing the effectiveness of the policy as there is no way of quantifying their impact, there being no suitable data available.

[8] The percentage of households with a washing machine increased from 66% in ***1972*** to 93% in 2002. For dishwashers – which produce less vibration than washing machines – the figures are: 4% in ***1981*** and 28% in 2002. 'Living in Britain', General Household Survey, 2002.

3 DEVELOPMENT OF BUILDING REGULATIONS UP TO 1992

3.1 Pre 1992 Sound insulation requirements and data summary

3.1.1 In 1936[9], new legislation was enacted requiring all local authorities to make and enforce "Building Bylaws". Whilst a degree of guidance was issued centrally[10], the local authorities were ultimately responsible.

3.1.2 The Interdepartmental Committee on House Construction published the Housing Manual 1944 to provide guidance for local authorities and others on the design and construction of houses and two-storey blocks of flats. The topics covered included sound insulation.

3.1.3 In 1961, a new public health act was introduced providing for the preparation of building regulations for England and Wales, excluding inner London. Following extensive work by Building Regulations Advisory Committee (BRAC), the Building Regulations 1965 were produced, which came into force in February 1966 and included Part G – Sound Insulation. At this stage, Part G only addressed newly built properties or parts of properties that were extended. In the case of a building being made into several new dwellings ie, a conversion, Part G did not apply.

3.1.4 The requirement in Part G was that walls and floors between dwellings, and between dwellings and other parts of the same building not used exclusively with the dwelling *should provide adequate resistance to the passage of sound*. To achieve the requirement, the only route available was thorough use of a *deemed to satisfy construction*. These constructions were specified in some detail and included:

- density of materials
- wall tie specification
- finish specification

3.1.5 Following 7 amendments to the 1965 Building Regulations, the Building Regulations 1972 were produced and two key changes[11] were introduced. The first key change was to introduce restrictions on flanking sound[12] transmission through specifications of the associated, abutting structures.

[9] From the Introduction of Guide to The Building Regulations 1972, The Architectural Press, 1975, AJ Elder ARIBA

[10] British Standard CP3: Chapter III (1960) Code of Basic Data for the Design of Buildings, replacing the Code of Functional Requirements of Buildings. This was itself revised in 1972 and then replaced in 1987 by BS8233. BS8233 was revised in 1999.

[11] The basis and form of building regulations for sound insulation in England and Wales(N(C)10/86 BRS 146/86).

[12] Flanking sound transmission is said to occur when noise travels between two rooms by routes other than directly through the wall or floor separating them. For example, noise in a flat can travel to the neighbouring flat via the inner leaf of the external wall. Taking this route, the sound in effect bypassing the separating floor or wall. If a flanking path dominates or controls the measured performance, it means that regardless of improvement works to the separating wall or floor; the measured sound insulation performance will remain unchanged.

3.1.6 The second key change was an option provided through sound insulation testing of an existing building to justify a construction not listed in the Building Regulations as being equivalent to "deemed to satisfy". The criteria for testing were based a party wall and party floor grade for both airborne and, in the case of floors, impact sound transmission. The development of these criteria is discussed in more detail within Section 3.2 of this report.

3.1.7 The test standard, BS 2750:1956 was referenced to provide a consistent test method to be used by practitioners. The performance standard introduced allowed for replication of existing dwellings that had passed the prescribed test.

3.2 Development of the 1972 Party Wall and Party Floor Grades

3.2.1 In 1948, the Building Research Station (BRS), as it then was[13], undertook a social survey[14] of 2,017 homes comprising 537 Flats and 1,480 houses. The focus of the survey was towards middle and lower incomes of up to £10 per week. Once the street was selected, randomly selected homes within each street were chosen to conduct the survey. The survey sought to establish whether people:

- noticed noise from particular activities/sources
- were troubled by noise from particular activities/sources
- had their sleep disturbed by noise from particular activities/sources

3.2.2 The survey was split into three elements:

- sound originating within the occupants homes
- sound originating within a neighbour's home
- sound originating from outside

3.2.3 In respect of neighbour noise, for houses, the typical construction was 9'' solid brick walls and:

- 27% of those surveyed were troubled by noise from their neighbours,
- 20% complained that their sleep was disturbed

3.2.4 In respect of neighbour noise, for flats of concrete construction:

- 35% of those surveyed were troubled by noise from their neighbours,
- 26% complained that their sleep was disturbed

3.2.5 In respect of neighbour noise, for flats of (timber) framed (floor) construction:

- 57% of those surveyed were troubled by noise from their neighbours,
- 52% complained that their sleep was disturbed

[13] In 1972 the BRS merged with the Fire Research Station and the Forest Products Research Labs to form the Building Research Establishment.
[14] A Survey of Noise In British Homes, Dennis Chapman, BRS National Building Studies Technical Paper No. 2. 1948.

3.2.6 Following this social survey, RIBA[15] presented a report to the Minister of Works[16] setting out that the required insulation between homes should be 55 dB, averaged over the frequency range of 100-3150 Hz. The RIBA report recommended that the 55 dB figure be applied equally to walls and floors.

3.2.7 Unfortunately, at that time there were very few practical constructions that would achieve this high level of sound insulation, other than an 11'' cavity brick wall, a point that was recognised by RIBA (see also paragraphs 3.2.11 and 3.2.19).

3.2.8 In 1954, BRS (Parkin and Stacey[17]) published a pivotal report in the Journal of the RIBA in which they presented the findings of recent research in sound insulation of housing and flats. The report drew together the data from the 1948 BRS social survey, results of nearly 1000 sound transmission tests and further survey information incorporating the opinions of a further 2,291 occupants of properties with specific levels of sound insulation.

3.2.9 The measurements demonstrated that there was a very wide range of on-site performance, which was consistent with the data originally presented by RIBA. The largest variation in test results were for separating floors with performances as low as 30 dB, averaged across the frequency range, and up to 55 dB.

3.2.10 The report recognises a number of interesting observations including that 64% of the surveyed population who lived in houses and benefited from average to high sound insulation of 50-55 dB would rather hear some noise from their neighbour compared to 25% who would rather hear no noises from their neighbour.

3.2.11 The report also identifies that the 11'' cavity brick wall, despite offering +5dB in terms of average sound insulation performance, did not receive a corresponding improvement in subjective response. This was largely attributed to low and mid frequency performance being broadly similar for the two constructions.

3.2.12 For flats which had low sound insulation (at around the 30 dB level) the occupants were the least disturbed by noise. This was considered to be down to socio-economic factors since the homes were typically more crowded and smaller in size than the properties with high and medium levels of sound insulation.

3.2.13 Parkin and Stacey recognised that a simple average of sound insulation across a wide frequency range is not a sufficiently good descriptor, particularly when comparing different construction types whose sound insulation does not vary with frequency in the same way – eg, solid and cavity masonry walls.

[15] Post War Building Study 15 - RIBA

[16] Citing "Sound Insulation and Acoustics" Post War Building Study No. 14, which could not be located during this stage of the research.

[17] Recent Research on Sound Insulation in Houses and Flats: PH Parkin & EF Stacey. The paper was re-printed from the Journal of the Royal Institute of British Architects, 1954, 61(9), 372-6. 1954

3.2.14 Curves of sound insulation versus with frequency were proposed that, below which the performance of the construction should not fall below by more than a specified amount. This approach had already been adopted in Germany (DIN 52211, published in 1953). In respect of impact sound transmission, the performance should not exceed a specified curve by a set amount.

3.2.15 Three charts were presented and referred to the Airborne sound insulation for house walls, Airborne sound insulation for walls and floors in flats (Grade I and Grade II) and Impact sound insulation for floors in flats (Grade I and Grade II).

3.2.16 The concept of adverse deviations is introduced in that the ***average*** adverse deviation per frequency band should not be more than 1 dB to achieve the relevant grade. In respect of airborne noise, an adverse deviation is below the grading curve whereas for impact sound an adverse deviation is above the grade curve for the particular party structure. Where a result fails to meet the relevant grade, it was suggested that the result be reported as "x dB lower than" the relevant grade.

3.2.17 In respect of acceptability, the report states that:

- Grade I: insulation is such that the neighbours' noise is only as disturbing as several other things.
- Grade II: insulation is such that neighbours' noise is to many of the tenants the worst thing about living in the flats, but at least half of the tenants are not seriously disturbed.
- 8 dB worse than Grade II [18]: 'deputation' level[19].

3.2.18 It is worth noting that the grading was only recommended to be applied to party structures between living rooms and bedrooms.

3.2.19 The BRS-defined Grade I and Grade II standards were noted in Report of the Wilson Committee (1963) [20] as providing an average airborne noise reduction of 50 dB. It also reported that a 9" brick wall between houses should reduce airborne noise transmission by slightly better than Grade I. To achieve a 5 dB improvement on Grade I the wall thickness would have to be increased to about 18" which would be uneconomic for normal housing.

3.2.20 The Wilson Committee also noted that '*insulation of 50 dB appears to provide sufficient protection against internal noise in dwellings for most people, although a proportion will still not be completely satisfied'.*[21]

[18] ie, An aggregate adverse deviation of more than 8 dB

[19] It was recognised that where sound insulation was sufficiently low, tenants would petition or lobby the landlord (eg, the local authority) in an attempt to force them to modify the construction. Based on experience at the time, the nearer a construction performed to being 8 dB worse than Grade II, the greater the chance of this type of lobbying or of 'deputations' was.

[20] In April 1960 the Government had appointed a committee chaired by Sir Alan Wilson to '*examine the nature, sources and effects of the problem of noise ....*' See Committee on the Problem of Noise, Final Report (para 133). Cmnd 2056. HMSO.

[21] *Op cit*., para 135.

3.2.21 In 1972 the Building Research Station became the Building Research Establishment (BRE) and it distilled the details of the grading system into BRE Digests 96, 102 and 103. The wall and floor grading were then used in a slightly modified way within the 1972 Building Regulations, Part G. The modification was to move away from the aggregate adverse deviation (AAD) over 16 frequencies as being less than 1 dB to the aggregate adverse deviations being less than 23 dB.

3.2.22 The values that defined Party Wall Grade and Grade I are shown in **Table 3.1**[22].

Table 3.1 Performance Requirements given in 1972 Building Regulations [1]

Frequency (Hz)	Airborne party wall grade [2]	Airborne party floor grade [2]	Impact party floor grade [3]
100	40	36	63
125	41	38	64
160	43	39	65
200	44	41	66
250	45	43	66
315	47	44	66
400	48	46	66
500	49	48	66
630	51	49	65
800	52	51	64
1000	53	53	63
1250	55	54	61
1600	56	56	59
2000	56	56	57
2500	56	56	55
3150	56	56	53

Note 1 Part G
2 Sound reduction (in dB)
3 Octave band sound pressure level (in dB)

3.3 Development of the 1985 Approved Document E

3.3.1 In 1985, the structure of the Building Regulations changed and led to the more modern Approved Document form of guidance to demonstrate compliance. In the context of the revised structure, sound insulation between homes became Part E and the 1985 Approved Document E[23] was produced.

[22] A further grade – Grade II – was defined. However, this was not used as a standard but as a means of assessing the performance of constructions worse than Grade I.
[23] Approved Document E to The Building Regulations 1985.

3.3.2 The principal difference between the 1985 Approved Document and its predecessor, was that of performance, although the 'deemed to satisfy' constructions were also updated and became "recommended solutions".

3.3.3 The party wall and floor grading systems were also replaced with a system base on numerical, single figure measures of sound insulation performance in line with the new British Standard rating system for sound insulation BS 5821-1&-2:1984 (dual numbered as ISO 717). New performance targets were then calculated by rating the party wall and floor grades in accordance with the new method. The values to be achieved by rating the party wall and floor grades were as follows:

- Party wall grade = 53 dB, $D_{nT,w}$
- Airborne party floor grade = 52 dB, $D_{nT,w}$
- Impact party floor grade = 65 dB, $L'_{nT,w}$

3.3.4 The performance targets adopted were as follows:

Where not more than four tests of the construction were undertaken:

- Party wall mean result greater than 53 dB, $D_{nT,w}$ with no individual test result less than 49 dB, $D_{nT,w}$
- Party floor airborne mean result greater than 52 dB, $D_{nT,w}$ with no individual test result less than 48 dB, $D_{nT,w}$
- Party floor impact mean result less than 61 dB, $L'_{nT,w}$ with no individual test result greater than 65 dB, $L'_{nT,w}$

Where eight or more tests of the construction were undertaken:

- Party wall mean result greater than 52 dB, $D_{nT,w}$ with no individual test result less than 49 dB, $D_{nT,w}$
- Party floor airborne mean result greater than 51 dB, $D_{nT,w}$ with no individual test result less than 48 dB, $D_{nT,w}$
- Party floor impact mean result less than 62 dB, $L'_{nT,w}$ with no individual test result greater than 65 dB, $L'_{nT,w}$

3.3.5 Although the intention was to provide an equivalent standard to the previous standards but transposed into the new rating system, this did not result in an exact correspondence between the 1972 and 1985 standards.

3.3.6 BRE IP 9/83 notes that "the differences between the shapes of the [airborne noise] reference spectra [between the BS 5821 system and the AAD system that preceded it] make the BS 5821 system relatively less stringent than the AAD system up to 200 Hz and relatively more stringent at mid-frequencies".

3.3.7 As is previously mentioned (paragraph 3.2.11), and will be discussed in section 4.4, low frequency performance is considered to be an important factor in the subjective acceptability of a structure's sound insulation performance.

3.3.8 As regards the transposition of the impact noise standard, the Defra report on laminate flooring[24] quotes from a paper by Adams [25] on the ratings obtained by applying the 1972 and 1985 criteria to measured test data as follows:

> *"Using measured results from 40 floor tests in the range AAD 0 to 50, 78% satisfied the pre 1987 requirement of Grade I/AAD 23, but 100% passed the new mean $L'_{nT,w}$ of 61dB. The poorest mean impact performance permissible of 61dB under the new standard was equivalent to the previous rating of an AAD of 47. The previous standard would not permit higher than 23, as such the new standard could be collectively 24dB worse across a range of frequencies. Adams' concluded that there had been a considerable reduction in the acceptable impact performance for separating floors between flats and that the overall 'single' target criteria was 5dB worse."*

3.4 Noise Council [26]Report on Noise Legislation (1986)

3.4.1 'Sound insulation' was one of the topics considered in this report which included the following paragraphs [authors' emphasis]:

> *"An objective assessment of the effectiveness of the Regulation was carried out by Department of the Environment's Building Research Establishment in which random performance checks were made on some 1,250 party walls and some 500 party floors between dwellings built during the 1970s [27]. Briefly, 55% of party walls and 63% of party floors were found to fail the minimum performance standard and thus, by implication, failed to provide adequate sound insulation. An associated survey of the attitudes and opinions of the occupants of these dwellings [28] identified "poor sound insulation" as the main defect of modern housing, a quarter of all respondents mentioning it, compared with less than one fifth of that number mentioning "condensation" as being a defect of their homes.*
>
> *This failure of the 1966/1972 Regulations to provide adequate sound insulation in even the majority of cases is typical of initial control procedures, as was found by Schultz in his survey of control*

[24] *Op. cit.*
[25] Sound Insulation, the implications of the new performance standards. Adams MS. Royal Institute of Environmental Health of Scotland (1993).
[26] Following the disbanding of the Noise Advisory Council, the following bodies formed the Noise Council as an independent body to review noise issues. The bodies were: the Institution of Environmental Health Officers, the Institute of Acoustics, the Royal Environmental Health Institute of Scotland, the Institution of Occupational Safety and Hygiene.
[27] Footnote 14 of the original document. Sewell, E. C. and Scholes, W. E.--Sound Insulation Performance between Dwellings built in the early 1970s. Current Paper CP20/78. Building Research Establishment, Garston, 1979.
[28] Footnote 15 of the original document. Langdon, F. J., Buller, I. B. and Scholes, W. E.- Noise from Neighbours and the Sound Insulation of Party Walls in Houses. J. Sound Vib. (1981), Vol. 79, No.2, pp. 205-228.

measures in force in European Countries [29] and, in retrospect, it is not difficult to suggest explanations for this lack of effectiveness.

Sound insulation is a very complex subject and is not completely understood, even by specialists. Apparently trivial changes of materials or layout or design detail can have significant influence on performance, as can quality of workmanship. It is not surprising then that procedures relying on the checking of designs by non-experts, that proposed constructions complied with a list drawn up on the basis of building practices current in the 1950s; or, on the opinion of the Building Control Officer, who has many other responsibilities; or, on possibly selected results of performance of the proposed wall or floor, perhaps carried out in buildings significantly different from those proposed and built with unknown standards of workmanship, have consistently failed to achieve the requirements.

Schultz concluded from his study that "effective control will be achieved only when we require measurements in the finished building ... and impose a penalty for failing to meet the requirements". This very powerful approach has been taken up in France and the rate of compliance with the minimum requirements for sound insulation has improved from less than 50% to over 90 %.

The improvement has been achieved by the testing of a small sample of newly constructed dwellings on a semi-random basis, with a requirement that the builder takes remedial action in cases of sub-standard performance. The performance data gathered during the routine testing is used to contribute to the steady flow of guidance for builders on design and construction techniques for good sound insulation.

In the light of these facts it is difficult to understand why the very recently introduced procedures for controlling sound insulation between dwellings in the UK[30] appear to be designed specifically to eliminate performance testing as a means of approval and even as a means of post construction testing of the adequacy of the sound insulation.

On the other hand, the 1985 Regulation is associated with greatly improved design guidance, which may contribute to an improvement in the compliance rate, but all experience shows that without post construction performance checking, the problems of substitution of unsuitable materials, design modifications and defective workmanship will remain.

[29] Footnote 16 of the original document. Schultz, T. J.-A Survey of Enforcement Practice with respect to Noise Control Requirements in Building Codes in a Number of European Countries. Report No. 3350. Bolt, Beranek and Newman Inc., Cambridge, Mass., 1976.

[30] Footnote 17 of the original document. The Building Regulations 1985. Approved Document E, Sound. HMSO, London.

Furthermore, without continuous performance testing, the new design guidance will rapidly become outdated and it is highly likely that within a few years the 1985 Regulation will be even less effective than its predecessor. However, because the new regulation discourages performance testing, there will be little or no objective evidence of this, which may be convenient for those with responsibility for the enforcement of minimum standards, but of no comfort at all for the occupants of new dwellings with sub-standard insulation against neighbours' noise."

3.4.2 The summary of its conclusions included the following points:

1 No legislation should be introduced unless the resources are available to implement it fully and uniformly.

2 The Building Regulations dealing with sound transmission between dwellings are a clear demonstration of the failure of legislation to prevent noise problems.

3.5 Development of the 1992 Approved Document E [31]

Acceptability of the Existing Standard

3.5.1 Prior to the publication of the 1992 edition of Approved Document E, BRE was requested to review acceptability of the existing situation and to make recommendations.

3.5.2 The most recent and relevant satisfaction data available was from a BRE social survey undertaken with the results published in 1982 in BRE IP13/82. The homes selected for the survey were taken from a previous measurement survey of sound insulation undertaken by BRE of post 1970 houses such that the subjective response could be correlated against the objective measurements.

3.5.3 Criticism was made relating to sound insulation by 20% of respondents without prompting from the interview team

3.5.4 Respondents were then asked to rate their sound insulation and the statistics from BRE IP13/82 show that where performance complied with the standards given in the 1972 Part G (equivalent to AAD not exceeding 23 dB, and considered similar to the 1985 Approved Document E Requirements) that:

- 46% of people rated the sound insulation as good/very good
- 29% of people rated the sound insulation as fair
- 25% of people rated the sound insulation as poor/very poor

[31] Approved Document E to The Building Regulations 1991 (1992 Edition).

3.5.5 Where performance complied with the standards given for the original party wall grade and Grade I floors (equivalent to AAD not exceeding 7/8 dB) that:

- 55% of people rated the sound insulation as good/very good
- 29% of people rated the sound insulation as fair
- 16% of people rated the sound insulation as poor/very poor

3.5.6 This is in contrast to the full sample size in which:

- 36% of people rated the sound insulation as poor or very poor
- 43% of people judged their sound insulation as falling short of what they expected

3.5.7 Given that these were post 1970s houses and the performance target was essentially the same from the 1965 regulations to the 1985 edition of Approved Document E, the data was still considered relevant. It was considered reasonable to draw the conclusion that the performance requirement was appropriate but that the level of compliance was thought to be relatively low. As a result, it was recommended that the overall performance target should remain unchanged from the 1985 edition.

3.5.8 Although the performance requirements for newly developed construction types remained in place unchanged, recommended solutions became significantly more detailed and robust in order to increase compliance rates.

3.5.9 Consideration was given by BRE as to whether the assessment of plans could be used as a means for a new construction to be used. However, this approach was not recommended by BRE since present knowledge at the time would not allow for an accurate assessment to be made. It was also recognised that workmanship and a lack of specific guidance on appropriate detailing would introduce significant potential for poor performance when new, untried constructions were to be built on-site for the first time.

3.5.10 The next option considered by BRE was using controlled condition or laboratory tests. Laboratory tests were considered owing to the potential cost savings for manufacturers. In order to offset the anticipated statistical uncertainty, BRE recommended that the performance target be increased by 1 dB if only three tests were conducted and 2 dB if only 2 tests were conducted over the mean performance value. Laboratory assessment was permitted within a specialised test facility in the 1992 edition of Approved Document E for separating walls. The target was set at 55 dB, $D_{nT,w}$, and the test laboratory had to incorporate the facility to build flanking elements such as external walls, internal floors and roof junctions.

Extension of the Regulations to Conversions

3.5.11 The largest change introduced in the 1992 edition of Approved Document E, was the inclusion of building conversions (Material Change of Use).

3.5.12 Conversions were included as a result an increasing concern that sound insulation was not being considered within conversions. The National Society for Clean Air[32] reported the results of a survey in relation to sound insulation of conversions (NSCA 1986: Report on sound insulation in flat conversions, Part 1 Outline of the problem and NSCA survey results). In addition, the NSCA also reported that a number of requirements relating to sound insulation were being imposed as planning conditions.

3.6 The NSCA Report on Sound Insulation in Flat Conversions (1986)

3.6.1 By the mid 1980s the trend of converting large old properties into flats over the previous decade had led to concerns about the quality of sound insulation in flat conversions. Meanwhile, complaints about noise from neighbours resulting from poor sound insulation were on the increase. The 1985 Building Regulations required sound insulation for purpose built flats, but no such requirements were in place for conversions.

3.6.2 In order to acquire evidence to present to the Department of the Environment (DoE) concerning this problem, NSCA undertook a survey in 1986 to study the extent of the problem. The survey did not only gather information about complaints but sought to ascertain the policies operated by local authorities (LAs) in respect of conversions and to discover how many were being undertaken each year. A subsequent NSCA Report in January 1987 outlined possible technical and legislative solutions.

3.6.3 Responses to the 1986 survey were received from 130 LAs of which 28 had received complaints about noise in converted flats – a total of 681 complaints – compared to 38 complaints from occupiers of purpose built flats (all from 1 LA).

3.6.4 Because conversions constitute a change of use in planning terms, a planning application is required and the survey asked for the number of such applications received over the preceding 3 years. This enabled an estimate of the number of conversions undertaken per year and this is reported in **Table 3.2**.

3.6.5 For the 89 Local Planning Authorities (LPAs) that received them there were an average of 22 applications per year and for the 86 LPAs that provided further data that amounted to an average of 67 units per year (each).

Table 3.2 Planning applications received for conversions: 1983 – 1986 [1]

No of Cases Received	Number of Local Planning Authorities	No of Units covered by cases	Number of Local Planning Authorities
5771	89	17,372	86
None	8	None	8
Not known	33	Not known	36

Note 1 NSCA Report on Flats in Conversions – Part 1 1986

[32] The NSCA changed its name to EPUK in October 2007.

3.6.6 One of the specific policy options investigated by the NCSA survey was the extent to which LAs used planning conditions to require improved sound insulation for conversions in the absence of powers under the Building Regulation to do so. Data from the survey on the use of planning controls in respect of sound insulation are shown in **Table 3.3**.

Table 3.3 No of LPAs using planning conditions[1]

Impose Conditions	Refuse if sound insulation inadequate	Appeals Against conditions	Problems implementing conditions
55 [2] – Yes	26 – Yes	4 – Yes	20 – Yes
75 – No	101 – No or Not arisen	124 – No or Not arisen	107 – No or Not arisen
–	3 – Not known	2 – Not known	3 – Not known

Note 1 NSCA Report on Flats in Conversions – Part 1 1986

2 6 of these LPAs impose conditions primarily to benefit neighbouring properties rather than to reduce noise transmission between flats in the converted property

3.6.7 The survey also inquired as to the reasons why the many LPAs that did not use planning controls to impose sound insulation requirements had adopted that policy. Among the reasons given was that sound insulation was not a planning matter based on either that this was the view of the LPA's own Planning Department or the DoE's opinion to that effect.

3.6.8 On the matter of the DoE's opinion, the NSCA study reported that a Noise Committee member had received the following statement by the DoE in July 1985:

> *"The attitude that the Department generally takes to conditions requiring sound insulation between flats is that such conditions are simply not an appropriate use of planning control."*

3.6.9 This issue was eventually examined in the courts after the East London Housing Association had been successful at a Public Inquiry hearing an appeal against a decision of LB Newham to impose planning conditions requiring sound insulation to be provided on an application for a conversion.

3.6.10 After that decision, LB Newham appealed to the High Court where it was held that the Inspector had erred (in law)[33] in not taking into account the advice in Circular 1/1985 (*The Use of Conditions in Planning Permissions*) paragraph 19 of which recognised that planning conditions might be justified where '*they can prevent development being carried out in such a manner which would be likely to give rise to onerous requirements under other powers at a later stage*'.

3.6.11 The NSCA's second report (1986) proposed technical remedies to sound insulation in conversions. The report also favoured the impending extension of the Building Regulations to cover conversions. However, in the interim it supported the decision in the Newham case that planning conditions might be justified in the circumstances identified in Circular 1/1985.

3.7 The Batho Report (1990)

3.7.1 In 1990 the Department of the Environment appointed the Batho Committee to examine eight topics relating to noise. Two of the topics were "*Neighbourhood Noise*" (which the committee said might be better described as 'noise from neighbours') and "*Noise within Buildings*". The committee reported in 1990.

3.7.2 The Batho Report describes '*Neighbour**hood** Noise*' as 'noise from neighbours' which would now be classified as '*Neighbour Noise*' since neighbour***hood*** noise encompasses noise from commercial and entertainment activity rather than noise from neighbours.

3.7.3 The report cites a questionnaire on the extent of annoyance from different noise sources undertaken by the Building Research Establishment 1986/7.

3.7.4 There were over 14,000 responses and it suggested that 14% of adults were bothered by neighbour noise. Those most bothered were people aged 25 – 34 living in flats rented from a local authority. As a comparison, 11% were bothered by road traffic noise and 7% by aircraft noise.

3.7.5 The extent of annoyance from neighbour noise according to the noise source is shown in **Table 3.4**.

Table 3.4 Extent of neighbour noise nuisance/annoyance 1986/87 (BRE)

Source	% people complaining
Amplified music	34
Dogs	33
Domestic activities	9
Voices	6
DIY Activities	5
Car Repairs	3
Other	10

[33] LB Newham v Secretary of State for the Environment and East London Housing Association Ltd (High Court, 17 February 1986).

3.7.6 The Batho report recommended that improvement of neighbourhood noise control might be achieved by:

- changes to existing legislation
- providing effective back up to make sure existing legislation works as intended
- encouraging co-operation in neighbourhoods
- promoting effective publicity and education, and
- better building insulation standards.

3.7.7 In relation to the topic '*Noise within Buildings*', Batho's recommendations were:

- 46. The provisions in the Building Regulations for flat conversions should be as high and as close to the new build provisions as possible.
- 47. In order to provide an opportunity for a site inspection, developers should be required to notify the building control officer before any sound insulation work takes place.
- 48. Research should be undertaken to develop an accurate and reasonably simple site test which would indicate whether a building achieved a reasonable level of sound insulation.
- 49. Once such a test had been developed it should be a requirement that premises covered by the Building Regulations provision would be tested on completion of construction.

3.8 The 1992 Regulations

3.8.1 The 1992 Regulations presented floor and wall treatment options with equivalent standings to the recommended solutions. A performance based approach for the laboratory and field approval of new forms of construction was included.

3.8.2 The principle behind both approaches was similar to the new-build equivalents, however the expectation was that the existing or current construction type would be tested and then the treated construction tested. The performance requirements for field tests were simply the individual targets for new build with no mean requirement.

3.8.3 The final changes between the 1985 and 1992 documents were the extension to include kitchens and also stairs that performed a separating function.

3.8.4 Consideration was given prior to the 1992 Approved Document to mandatory on-site performance testing to ensure compliance. Compliance testing was not recommended for the following reasons:

- cost, principally who would be expected to pay for the tests,
- determining appropriate remedial actions and the costs associated with any remediation works

- who would be responsible for the remedial works ie, the architect, the developer, product supplier or potentially, building control.

3.8.5 The introduction of mandatory testing was finally adopted in the 2003 revision as described in the following chapter.

4 DEVELOPMENT OF THE BUILDING REGULATIONS AFTER 1992

4.1 Background

4.1.1 The Building Regulations 1991 in the form of Approved Document E (ADE) 1992 edition controlled the sound insulation between residential homes in England and Wales. A major intervention 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.

4.2 Proposals for amending Part E: consultation

4.2.1 The consultation process started on the 19th of January 2001 and the Regulatory Impact Assessment of the consultation document set out the reasons for the changes and the key objectives, which illustrate the situation at the time. These are summarised in the paragraphs below in italics (taken from the consultation document).

Large numbers of complaints about domestic noise

4.2.2 "***7****. The Chartered Institute of Environmental Health (CIEH) reports indicated that the number of complaints about domestic noise had reached over 5,000 per million population, and that the total number of such complaints trebled in the 10 years between 1986 and 1996. The 1996 English House Condition Survey (EHCS) indicated that 4.7 million (nearly one-quarter) of householders were bothered by noise from traffic, industry or other noise. Specifically, 0.67 million householders* [3.4%] *were bothered by noise from neighbours which they attributed either to poor design of the building or a combination of poor design and behaviour of the neighbours[2]"* [34].

4.2.3 The 1948 BRS survey found that the percentage of people who were bothered by noise from their neighbours depended on the type of construction with occupiers in houses (typically having 9" brick party walls), flats with concrete floors, and flats with timber floors reporting values of 27%, 35%, and 57% respectively (paragraphs 3.2.3 to 3.2.5). The BRE 1982 report (based on sound transmission measurements undertaken in 1978 on houses built in the 1970s and a subsequent social survey) found that 43% of people judged their sound insulation as '*falling short of what they expected'* (paragraph 3.5.6).

4.2.4 It appears therefore that compared to 1948 there might have been a deterioration in satisfaction achieved by party walls in houses in the 1970s but that by 1996 the percentage of occupiers bothered by noise from their neighbours (reported in the EHCS for a range of dwelling types) was much lower than was found in the 1948 survey even for occupiers of houses (3.4% compared to 27%).

[34] See paragraph 51 from the Department for Environment, Transport and the Regions consultation document on page 25 of this Annex.

Current sound insulation standards originate in the 1950s

4.2.5 "***8**. Current standards of sound insulation in dwellings can be traced back to surveys carried out in the 1950s which indicated that 225mm thick solid brick walls and solid concrete floors provided reasonable standards of sound insulation at that time. Values derived from the performance of these constructions were used as the basis for selecting constructions for inclusion on a deemed-to-satisfy list that accompanied the 1965 Regulations, and with some refinements, in Approved Document E in 1985 and 1992."*

Improvements in living standards

4.2.6 *"**9**. Since the 1950s, there have been considerable improvements in living standards. One of the consequences of this is an increased use of home entertainment systems (with increased power output at low frequencies) and other domestic electrical appliances, and also an increase in the amount of noise that people are likely to make at home. Further, the trend towards home working, reduced contact with neighbours and rising expectations has meant that people are less tolerant of noise disturbance. The focus of the media on noise and neighbour disputes has also heightened public awareness of the problem.*

"

Poor compliance and low satisfaction with existing sound insulation standards

4.2.7 "***10**. Studies by BRE, which are referred to later, indicate 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* 24% *of occupants living in dwellings that attained the* [then] *current standards for sound insulation rated the insulation as poor or very poor"*.

4.2.8 "*A second study by BRE looked at complaints about sound insulation between dwellings that had been approved under* [the then] *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 show 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 standards were continuing to occur. BRE estimate 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 illustrated that there were problems with the operation of the then current system that relies on a combination of plan checking and site visits for enforcement."*

Adverse effects of noise

4.2.9 *"**11**. Noise, at the sort of levels typically encountered in dwellings, can lead to a wide range of adverse health effects including loss of sleep, stress and high blood pressure. Quantifying the risks attributable to exposure to environmental noise and, particularly, neighbour noise is difficult but it is suggested that there are between one and ten deaths per year in the UK (these being suicides or as a result of assaults) attributed to noise from neighbours. The number of less severe problems attributed to noise (such as stress, migraines, etc.) is estimated to be about 10,000 per year. The same problems are experienced by people living in rooms for residential purposes (i.e. students in halls of residence, elderly people in residential homes etc.) although there are no equivalent figures for health risks."*

Overall aim

4.2.10 *"**14**. The proposed amendments have an overall objective of securing reasonable 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."*

4.2.11 "***15**. The key objectives are 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."*

4.3 Regulatory Impact Assessment – Detailed Reasons

4.3.1 The Regulatory Impact Assessment of the consultation included the detailed reasons in support of the overall aims. The following is a direct extract from the consultation document and as such retains the numbering from the original document.

***"47.** Data from the Chartered Institute of Environmental Health (CIEH) indicates that the number of complaints about domestic noise per million people has risen in the last twelve years. 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. In the period between 1986 and 1996 the total number of domestic noise complaints has trebled, although the rate of increase has reduced during recent years. 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 following increased media coverage may also play a part.*

***48**. Data regarding reported noise problems was gathered during the 1996 English House Condition Survey (EHCS). This showed that over a third of households (7.0 million households) experienced problems with noise over the last year. Respondents to the EHCS who said they had problems with noise were then asked to identify the source of the noise. 67% (4.7 million) of all households having a problem with noise said that it originated from sources such as traffic, industry, etc.*

The remaining 33% (2.3 million) said that the noise was due to neighbours (immediate neighbours, those in common areas or both).

49. *EHCS data shows that occupants of flats (10.9%) report a higher number of noise problems from immediate neighbours than those living in houses (4.9%). Residents in detached houses (2.5%) report fewer problems than those living in semi-detached (5.3%) or terraced houses (6.1%). It appears that dwelling age does not have an effect on the extent of reported problems with no significant difference reported by occupants living in post 1980s dwellings compared to those living in dwellings constructed pre 1980.*

50. *Nearly 80% of the 2.3 million households that claimed that the noise was due to neighbours 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.*

51. *In summary the 1996 EHCS survey has shown that:*

- *4.7 million households (24% of all households) were bothered by traffic, industry or other noises;*
- *2.3 million households (12%) were bothered by noisy neighbours (either immediate neighbours, those in common areas or both);*
- *1.6 million households (8.3%) were bothered by noise from neighbours and attributed it solely to the behaviour of the neighbours;*
- *0.67 million households (3.4%) were bothered by noise from neighbours and attributed this solely to the poor design of the building or a combination of the poor design of the building and behaviour of the neighbours. In the case of conversions it was far more likely that the residents considered that the problem was due to poor building design.*

4.3.2 These responses show that, taking all sources together, over a third of households (36% = 7 million) were bothered by noise.

4.3.3 Paragraphs 50 and 51 of the consultation document also enable an estimate to be made of the number of people who considered that problem was solely a result of poor design: ie, a value of at least 0.37 million. That is about 2% (of the total of 19.6 million households).

4.3.4 Note that nearly 0.30 million people also thought that poor design was a contributory factor (paragraph **Error! Reference source not found.**).

52. *NHBC field staff regularly receive complaints about poor sound insulation in new dwellings. For new buildings, those complaints received in the first two years are referred back to the builder to put right and only become formal claims if the builder defaults. For the years 1998/99 there was 163 formal claims processed for poor sound insulation between dwellings [35] and these are thought to represent the tip of the iceberg. In many cases each formal claim will front many further sound insulation problems in similar buildings, where owners may be afraid of blighting their properties.*

[35] Footnote 6 of the original document: "NHBC .*Private communication August 2000."*

> ***53.*** *Perhaps the main survey on the subjective acceptability of sound insulation across separating walls was carried out by Langdon et al [36] and reported in 1982. Whilst the method of rating sound insulation has changed since the survey was published, the target standard is still about the same. The survey found that poor sound insulation was mentioned spontaneously by 20% of respondents, and that 24% of respondents in dwellings at or below the target standard ranked poor sound insulation as the most important of a list of nine housing defects. In response to another question approximately 25% of respondents in dwellings that attained the target standards rated the insulation as poor or very poor, whilst a further 25% rated the insulation as fair. Considerable annoyance was attributed to impact sounds such as footsteps and slamming doors in adjoining dwellings, and as the insulation against airborne sound improved so annoyance from impact sounds became more common.*
>
> ***54.*** *A study undertaken by BRE[37] between 1992 and 1994 investigated complaints (mainly to local authorities and housing associations) about sound insulation between dwellings that had been approved under Building Regulations and that appeared to comply with the relevant design guidance in the current version of 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. Noise from amplified music, television, radio, domestic appliances (particularly washing machines, telephones, and vacuum cleaners), footfalls, the slamming of doors and plumbing noises could all be heard in complainant's dwellings. The survey also found that some people were dissatisfied even when their home met current standards although these complaints were often concerned with banging doors and other noises not controlled by regulations.*
>
> ***55.*** *Since the BRE study was confined to dwellings where the occupants were dissatisfied it cannot be extrapolated to indicate what proportion of the total population are dissatisfied with the standard of sound insulation in their homes, nor to investigate what proportion of domestic noise complaints might be attributable to poor sound insulation. However, the study does provide evidence of non-compliance with current standards and that sound insulation problems do arise when non-compliance occurs.*
>
> ***56.*** *BRE 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. The proposed changes for new dwellings, particularly the pre-completion testing regime, are intended both to improve standards and to reduce the failure rate to below 5% over 10 years."*

4.3.5 The objective stated in Paragraph 56 above was to achieve a 95% level of compliance within 10 years, that is, by 2013. The analysis in the following chapter assesses whether that objective was actually achieved by the change to ADE.

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[36] Footnote 7 of the original document: *"FJ Langdon, IB Buller, WE Scholes. Noise from neighbours and the sound insulation of party walls in houses. Journal of Sound and Vibration 79, pp2205-2228, 1981"*

[37] Footnote 8 of the original document: *"C Grimwood. Complaints about poor sound insulation between dwellings in England and Wales. Applied Acoustics Vol. 52, No.3/4, pp211-223. 1997."*

4.4 Technical Development of the Building Regulations 2003

4.4.1 As well as introducing mandatory performance testing, this edition also introduced a new rating system and the justification for the target and measure included in the 2001 DETR consultation package [38] stated:

"The current Part E does not state a clear performance standard, and this has also caused confusion. Performance targets are often taken from those given in Section 3 of Approved Document E, although they are intended for a different purpose. For separating walls these targets are a mean performance value of 52 dB $D_{nT,w}$ with no examples below 49 dB $D_{nT,w}$. Although the proposed Requirement E1 still asks for reasonable sound insulation, the proposed Guidance on the Requirement does contain explicit sound insulation performance targets for dwellings, whether purpose built or formed by material change of use. The same targets for airborne insulation have been applied to walls and floors, whereas previously the target for floors was 1 dB lower than for walls. The targets for dwellings formed by material change of use are lower than for purpose built dwellings."

"The index adopted for insulation against airborne sound has been changed from $D_{nT,w}$ to $D_{nT,w}+C_{tr}$. This index is defined in BS EN ISO 717-1:1997. It is measured over the same frequency range as $D_{nT,w}$ but attaches more importance to low frequency noise which is subjectively important. In response to complaints about poor sound insulation, the opportunity has been taken to raise the target standard by about 3 dB, but the actual target values are numerically lower than current values because of the way the new rating index works. To arrive at the revised performance target for new dwellings, the 49 dB has been increased by 3 dB, and then reduced by 5 dB because C_{tr} is typically about 5 dB, although it will be smaller (e.g.-8dB) for constructions with poor low frequency performance. A further reduction of 2 dB has been made to allow for measurement accuracy, resulting in a target of 45 dB."

4.4.2 It is worth making a number of observations:

- The basis for the mean performance targets in 1992 ADE were the historic party wall and party floor grades from the 1972 regulations. The individual performance requirement was to allow for some statistical variation and/or measurement uncertainty. The individual performance value for new separating wall constructions (49 dB, $D_{nT,w}$) was taken as a starting point which is 3 dB lower than the mean value permitted for up to eight tests. By taking the individual performance values and adding 3 dB to raise standards, the actual net effect of raising base performance value was, from one perspective, essentially negated.
- Further reducing the performance specification due to measurement uncertainty reduces the impact of raising standards, but had the effect of imposing an absolute minimum requirement rather than one that was open to debate.

[38] The Buildings Act 1984. The Building Regulations 2000. Proposals for Amending Part E – Resistance to the Passage of Sound. A Consultation Package issued by the Building Regulations Division. (Summary, page 5.)

- By rating the 1972 grades of sound insulation in the new system, with no deviations, a $D_{nT,w}+C_{tr}$ of 50 dB is achieved for the party wall grade and 48 dB $D_{nT,w}+C_{tr}$ for the party floor grade.
- By rating the 1972 grades of sound insulation in the new system, with 23 dB deviations broadly applied, $D_{nT,w}+C_{tr}$ of 48 dB results for the party wall grade and 46 dB $D_{nT,w}+C_{tr}$ for the party floor grade.
- The current target is 45 dB $D_{nT,w}+C_{tr.}$

4.4.3 Depending on the outcome of any assessment of complaints made after the introduction of the mandatory testing and revised compliance target, consideration should be given to whether the actual target is greater, less than or equal to that of the 1965, 1985 and 1992 Building Regulations.

4.4.4 In respect of the new rating index, this was based on listening tests conducted at BRE correlating subjective impressions of sound insulation against recordings of music through differently performing walls [39]. The best correlating descriptor, $D_{nT,w}+C_{tr\ 50\text{-}5000\ Hz}$,was not used since it placed too much reliance on accurately measuring sound insulation below 100 Hz within the field environment and so was not considered practical. $D_{nT,w}+C_{tr}$ was adopted as it gave the second best correlation between acceptability and numerical performance. The study did not include the old party wall grading system making use of aggregated adverse deviations, since it was not recognised internationally.

[39] New building regulations on the resistance to the passage of sound for England & Wales, Hopkins, Grimwood, Seller, Wright, Ling & Fothergill, 2001.

5 COMPLIANCE RATES UNDER THE 2003 REGULATIONS

5.1 The ANC Registration Scheme for Pre-Completion Testing

5.1.1 When new Building Regulations, and their accompanying Approved Document were published in 2003, new and converted dwellings were required (except in certain circumstances) to be tested for sound insulation. Approved Document E (ADE 2003) said that "Test bodies conducting testing should preferably have UKAS accreditation (or a European equivalent) for field measurements".

5.1.2 At the time, few acoustic consultancies were UKAS accredited for these tests, and the Association of Noise Consultants, with encouragement from the Office of the Deputy Prime Minister (ODPM, now Department of Communities and Local Government) set about forming its own Scheme which would be acceptable to all concerned.

5.1.3 This was achieved, and in July 2003, ODPM issued a circular letter which confirmed that approved members of the ANC Registration Scheme were suitably qualified to carry out pre-completion testing.

5.1.4 Registration under the ANC scheme and accreditation by UKAS are achieved by different processes but both are considered equivalent for the purposes of testing under ADE. Initially, the pool of ANC-registered test bodies grew more rapidly than the numbers of UKAS-accredited test organisations but currently there 84 ANC PCT-Registered companies and 42 UKAS-accredited companies for the field measurement of sound insulation.

5.2 The PCT Scheme in practice

5.2.1 ADE2003 requires that one set of tests be undertaken for every 10 dwellings in a group (houses, flats, Rooms for residential purposes or bungalows are defined as the groups) and each sub-group (typically these are construction groups such as timber, concrete, metal, hybrid etc but further sub-grouping occurs where significant differences in construction occur such as different supporting floor junctions, changes to inner leaf construction, curtain walling, steps/staggers, etc).

5.2.2 Usually one unit should notionally be “selected” for the set to centre around. One set of tests for houses typically consists of two airborne sound insulation tests of separating walls commonly including at least one test at ground floor level and one test at first floor level. For flats one set of tests usually consists of two airborne sound insulation tests of separating walls, two airborne and two impact sound insulation tests of separating floors.

5.2.3 In the case of rooms for residential purposes the situation is more variable but often comprises; two airborne sound insulation tests of separating walls and one airborne and one impact sound insulation test of separating floors.

5.2.4 In the event of fewer than 10 properties, one set of tests (or as close as possible to one set) is carried out. All of the above is subject to the Building Control Body’s approval; they can specify and reject tests as they see fit.

5.2.5 ADE2003 states that usually the Building Control Body (BCB) would be expected to select the units for testing. However, experience suggests it is usually the tester and developer who either suggest a test programme or simply submit the test report. Occasionally, and more often in conversions, the Building Control Body may have concerns over a particular detail or unit and set a conditional approval eg, "Sound test in accordance with ADE but include Units A and B".

5.2.6 The results of tests are not averaged. One failure within a test series in essence provides evidence that the whole Group/sub-group fails regardless as to the size. If a structure fails a test then remedial action must be carried out and it is then re-tested with more remedial work being undertaken if necessary until it passes. It is also usual for the remedial treatment to be applied to all spaces within the flat that fails and it should be extended to all other untested units.

5.2.7 If there are failures then ADE2003 encourages the Building Control Body to specify an increased rate of testing. The developer is often encouraged to do this by his tester so that evidence can be gathered to establish whether a systemic failure of the construction exists or simply a localised defect/poor detailing. The extent to which any increased rate of testing occurs varies. Experience includes developments where 100% testing has resulted post failure and others where remediation treatment is only applied to the single room that failed. Both approaches may be considered reasonable, depending on the cause of failure.

5.3 Pre-Completion Testing Statistics

5.3.1 With the permission of the ANC we studied the statistical analysis of the pass/fail rates for the last three years of their centralised test result lodgement database. These statistics are produced on a six monthly basis for the first and second half of each year, which means that the data presented in the tables below can also be examined for consistency over time.

Table 5.1 Airborne Sound Insulation – Walls – Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
Purpose built new build.	98.1	97.6	98.6	99.0	98.3	99.3
Material change of use.	96.3	97.5	96.3	97.0	97.1	97.4
Rooms for Residential Purpose – Purpose Built.	93.4	88.8	90.3	91.2	93.5	91.6
Rooms for Residential Purpose – Material Change of use.	84.6	79.4	81.2	84.4	86.0	85.6

Table 5.1 Airborne Sound Insulation – Walls – Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
Walls overall compliance levels.	97.1	96.5	97.3	97.6	97.5	97.0

Table 5.2 Airborne Sound Insulation – Floors – Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
Purpose built new build.	96.6	98.2	96.9	97.2	97.8	97.3
Material change of use.	89.0	91.0	89.0	91.6	92.0	93.4
Rooms for Residential Purpose – Purpose Built.	98.1	97.0	98.9	98.5	98.9	98.9
Rooms for Residential Purpose – Material Change of use.	89.4	90.1	88.3	84.2	92.5	94.7
Floors overall compliance levels.	94.0	95.9	93.5	94.8	95.7	95.9

Table 5.3 Impact Sound Insulation – Floors – Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
Purpose built new build.	97.8	98.5	97.4	97.6	98.5	98.6
Material change of use.	94.5	95.6	95.0	96.0	96.4	96.0
Rooms for Residential Purpose – Purpose Built.	97.0	97.9	100.0	98.8	98.8	100.0
Rooms for Residential Purpose – Material Change of use.	94.6	89.3	95.8	86.0	93.8	99.7
Floors overall compliance levels.	96.6	97.6	96.6	96.8	97.7	97.8

Table 5.4 Sound Insulation – Global Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
All walls and floors.	95.9	96.6	95.8	96.4	97.1	96.9

5.3.2 Several conclusions can be drawn from the above data:

- The objective of achieving 95% compliance for ADE has been achieved sooner 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 and is statistically valid (ie, it applies to the whole population of properties).
- Over the three year period the average compliance level was 96.4%.

5.3.3 The compliance level of 96.4% is an underestimate of the actual compliance level of the new housing stock post the implementation of mandatory testing. The analysis above has had all retests of failed structures removed from the data set. Providing the Building Control Bodies are working effectively then all the failures will have been remediated and re-tested with a 'pass' result.

5.3.4 On that basis the ultimate compliance level should be approaching 100% for all ***tested*** properties. However, the lower figure is the more appropriate value for the whole population of properties since remediation cannot occur for the few percent of failures that occur on sites where no tests a conducted.

5.3.5 It is possible that some of these untested properties (ie, untested 'failures') might be remediated if they are covered by the property's warranty and a validated claim is raised via that system. (NHBC's Claims Department experience of the post PCT/RD process is covered in Section 5.8.)

5.3.6 Thus the level of compliance overall is slightly larger than the figures in **Table 5.4** but will be less than 100%.

5.4 Alternative to Pre-completion testing – Robust Details Ltd.

5.4.1 On 5th July, 2002, the Minister responsible for the Building Regulations (England and Wales) outlined measures to be included in the new Part E, Resistance to the Passage of Sound (Office of the Deputy Prime Minister (ODPM, 2002). These measures involved the requirement for a minimum proportion of new build dwellings on each site to be tested for sound insulation (also known as pre-completion testing or PCT).

5.4.2 It was also revealed, however, that the house-building industry would be 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 be required to be high performance constructions capable of consistently meeting the Building Regulations requirement of Part E, as set out in 2001 in the consultation document for Approved Document E (ADE) (Department of the Environment, Transport and the Regions (DETR), 2000a). Due to their high performance the constructions should not require the check provided by routine on-site testing.

5.4.3 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.

5.4.4 Following that announcement one of the largest and most intensive projects ever undertaken by the UK house-building industry was initiated by the House Builders' Federation, now called the Home Builders' Federation.

5.5 Robust Details Ltd – System and Inspectorate

5.5.1 As a result of the RSD project Robust Details Ltd (RDL) 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 central government and confirm that the scheme and constructions were still 'robust'.

5.5.2 In addition to the initial assessment, all Robust Details (RDs) are subject to continuous on-site performance monitoring. This process checks that RDs consistently achieve expected performance levels, and the regular presence of the RD Inspectors ensures a high level of compliance with the published details in completed properties[40]. The Inspectorate also underpins confidence in Robust Details as an effective means of demonstrating compliance with Requirement E1 of Approved Document E, 2003. RDL is committed to sound-testing 2% of properties completed under the scheme.

5.5.3 Under the scheme each plot receives a unique plot registration number, and an individual checklist is completed per plot by the site agent who, on completion, signs a pre-printed plot specific certificate declaring full compliance with the registered RD. This is then used as the evidence that the plot has complied with ADE2003 requirements.

5.5.4 The RDL Inspectorate sits outside normal building control and is formed of qualified, experienced acousticians – not building inspectors. They do not directly support the Building Control Body, and are paid by, and report to, RDL.

[40] RDL inspectors are required to inspect 1% of all plots as a population. In reality the inspection rate has historically been closer to 2%. It is worth noting that to achieve one inspection many plots are examined to ensure that all aspects of the construction process can be seen. Inspectors typically view five plots for one inspection report.

5.5.5 The inspectors' role is to randomly select sites from the registration database provided by RDL for their territory, up to target numbers to help RDL to comply with their obligations to the Department for Communities and Local Government. Then, under the RDL rules, they are able to attend sites with no notice (though commonly a few days of advance notice are given) to inspect plots under construction and undertake performance testing on completed units. If no defects are found, that information is passed back to RDL.

5.5.6 If a few minor and correctable defects are observed, the developer has a time limit within which to correct them. If a construction fails a test the inspector conducts an investigation to find out how what was built deviates from the RD specification. (It is important to note that no correctly built Robust Detail has been known to fail to meet the required standard.)

5.5.7 If a construction is inspected and found not to resemble the registered detail, and/or it is established that the construction has not been built correctly, or if it fails a test, then RDL withdraws the registration of that plot under RDL and informs the developer and Building Control Body of that and of the findings. The plot or site then reverts to normal Building Control procedures and is subject to PCT in the usual way.

5.6 Robust Details Ltd – Compliance levels

5.6.1 The RDL database of compliance levels was examined in the same way as for Pre-Completion Testing and **Table 5.5** shows the results.

Table 5.5 Robust Details Ltd - Compliance Levels (%)

	1st Half of 2009	2nd Half of 2009	1st Half of 2010	2nd Half of 2010	1st Half of 2011	2nd Half of 2011
Airborne, walls.	99.0	100.0	99.8	99.6	99.7	99.5
Airborne, floors.	100.0	100.0	97.7	100.0	98.9	96.1
Impact, floors.	99.4	100.0	100.0	96.2	96.5	100.0
Global compliance.	99.3	100.0	99.4	99.2	99.2	99.1

5.6.2 Several observations are relevant with respect to the above data:

- The objective of achieving 95% compliance for ADE was achieved almost immediately as this is a fundamental criterion for a construction being a Robust Detail.
- In their annual report for 2006/7 RDL reported that compliance levels had reached 97% only three years after their introduction.

- The overall performance over the three years based on this analysis was 99.3% based on 3,630 tests which is statistically valid (ie, it applies to the whole population of properties)
- In their annual report for 2010 RDL reported a global compliance rate of 99.48%. This is slightly better than the above data (which treats airborne and impact for floors as two separate tests) would suggest. Quite frequently when a floor fails the airborne requirement it also fails the impact requirement which reduces two failed tests down to one failed structure. Consequently RDL's published figure is correct and not inconsistent with the above analysis.

5.7 Comparison of PCT and RD Systems

5.7.1 These two systems have both resulted in large increases in compliance rates and it is therefore interesting to note the slight differences between them as regards inspection and testing.

INSPECTION

PCT No special measures, part of normal BCO inspection regime

RDL In addition to the normal BCO inspection regime, the Clerk of Works has individual checklists for every registered plot which (s)he completes and signs off. Furthermore, RDL's team of dedicated inspectors visually inspect a further 1% of all registered plots.

TESTING

PCT Tests on 10% at every **site**

RDL Random 2% of all **plots** registered

5.7.2 Under the RDL system no plot subject to an inspection is tested and vice-versa. Thus the combined effect of the inspection and testing procedures provides coverage of more sites than either would achieve on its own.

5.8 Data from the National House Building Council

5.8.1 The National House Building Council (NHBC) are the leading home warranty and insurance provider for new and newly converted homes within the United Kingdom. They are also the largest Corporate Approved Inspector with over 25 years experience in providing Building Control.

5.8.2 NHBC have provided data from its Claims and Building Control databases, to assist with assessing the impact of the 2003 edition of Approved Document E.

5.8.3 The Building Control dataset provided includes data back to 1988 and identifies that a significant lag appears to occur from the implementation of the current 2003 edition of Approved Document E.

5.8.4 The NHBC data shows that in the year of publication of the 1992 edition of Approved Document E; Final Certificates (construction completed, ready for sale) were issued for 26% of properties completed under the new requirements and 98% of properties two years after it came into force.

5.8.5 In contrast; the uptake of the 2003 edition was much slower and the data shows that it took two and a half years from publication to reach 30% of properties and six years to reach 98% of properties to be issued with Final Certificates under the new requirements.

5.8.6 One undesirable consequence, evidenced by the above analysis, of introducing the mandatory testing requirement and new performance measure was that of developers registering sites significantly in advance of building (providing Initial Notices) to avoid the need to undertake testing. In practice, this had the effect of delaying the impact of the new controls, and has been evidenced within other areas of the Building Regulations when new controls or requirements are imposed.

5.8.7 Additional NHBC data relating to their warranty claims activity was supplied for this project. The data includes all contacts received by the NHBC department regarding neighbour noise relating only to sound insulation between 1998 and 2010. The data supplied includes all contacts received by NHBC relating to this topic, whether a successful claim was made against the warranty or otherwise. The proportion of any erroneous contacts has been assumed as being generally consistent between years.

5.8.8 During the three year period immediately before the mandatory pre-completion testing was introduced, 547 contacts in relation to neighbour noise were made to NHBC. This figure compares against 335 contacts from 2008 to 2010.

5.8.9 It is not considered appropriate to simply compare the absolute number of contacts in different periods since these would, most likely, be related to the number of properties constructed in each period. To remove the potential skewing effect of number of properties being completed, the number of contacts should be normalised by dividing by the number of properties constructed within each period.

5.8.10 It has been assumed that there would be a lag of one year between issuing a Final Certificate and an unfavourable contact being received by NHBC. The number of properties receiving a Final Certificates from NHBC relevant to the contacts received in the 2000-2002 period was 215,072 and 262,029 relevant to the 2008-2010 period. Using these normalised figures, the number of noise contacts received per property receiving Final Certificates in 2008-2010 was 50% less than the 2000-2002 period.

5.8.11 The analysis of the NHBC data indicates that in spite of the two to four year lag in adoption of the mandatory performance testing that a significant reduction in noise complaints has occurred since it came into force.

5.9 Summary

5.9.1 The introduction of the 2003 edition of Approved Document E sought to raise compliance levels with Requirement E1 by introducing hard and fast performance requirements along with empowering Building Control Bodies and Approved Inspectors to be able to insist on mandatory testing. The intention of the requirement for testing was to ensure 98% compliance with the performance standards within 10 years of publication which it was hoped would lead to improved levels of occupant satisfaction in new or newly converted homes.

5.9.2 It is clear from all the evidence that the intervention by the introduction of mandatory testing has achieved all of its objectives, within a much shorter time period than initially considered possible.

5.9.3 This is a dramatic example of how effective positive research led intervention can be.

6 ASSESSING THE EFFECTS OF THE POLICY

6.1 Approach to assessing the effects

6.1.1 The effectiveness of the policy is largely determined by the following factors;

- The standard of performance set by the regulations
- The outcome of the standard set
- The degree of compliance with the standard
- The scope of its application (eg, types of building)
- The number of properties affected

6.2 The Performance Standard

6.2.1 Chapters 3 and 4 have described the development of the Building Regulations in the periods up to 1992 and after 1992 respectively. The changes in the technical standards set out in detail in those chapters are summarised in **Table 6.1** below.

6.2.2 Note that these technical standards relate to tests conducted to demonstrate that the performance of a new construction was acceptable. For the period before 2003 there was no requirement to test constructions that were already approved and/or described in the Regulations current at any particular time. (The table does not refer to increases in the degree of detail specified for 'recommended solutions' in order to increase compliance rates.)

Table 6.1 Performance Standards for new construction types [1]

Year	Airborne Sound Insulation			Impact Sound Insulation	
	Party Wall	Party Floor	*Party Floor*	Party Floor	*Party Floor*
1972	PWG (55)[2]	Grade I	*Grade II* [3]	Grade I	*Grade II* [3]
1972 [4]	53 [4]	52 [4]	*47* [4]	65 [4]	*70* [4]
1985	53 [5]/ 49 [6]	52 [5]/ 48 [6]	–	61 [5]/ 65 [6]	–
	52 [8]/ 49 [6]	51 [8]/ 48 [6]	–	62 [8]/ 65 [6]	–
1992	No change to on site test standard			–	–
2003	45 [9]	45 [9]			
1972	50 [10]	48 [10]	*43*	–	–

Note 1 **Note that the rating index changes and so numerical values cannot all be directly compared**
2 Party Wall Grade (mean of normalised level reduction from 100 to 3150 Hz)
3 Was not a criterion but was used to rate floors. It is 5 dB worse than Grade 1
4 Value equivalent to 1972 curve using BS5821: 1984 rating system
5 Average where no more than four tests of a construction are conducted
6 No test result to be worse than this value
7 $L'_{nT,w}$: value equivalent to 1972 curve using BS5821: 1984 rating system
8 Average where 8 or more tests of a construction are conducted
9 New index adopted – $D_{nT,w}+C_{tr}$, about 5 dB lower than $D_{nT,w}$. (paragraph 6.2.5)
10 Rating of curve used for 1972 Regulations assuming no deviations to 2003 index

6.2.3 Because the rating methods changed between the 1972 and 1985 and between the 1992 and 2003 Regulations the numerical values in **Table 6.1** require some interpretation.

6.2.4 Between the 1972 and the 1985 Regulations the rating system changed and values using the new system were derived for the standard curves against which the performance of a construction had previously been assessed.

6.2.5 By rating the 1972 performance standard for new constructions as shown in **Table 6.1** with the new BS5821/ISO717 rating curves it can be seen that the 1985 performance standard were broadly equivalent to the 1972 standard.

6.2.6 However, the value of any individual example could be up to 3-4 dB worse than those equivalent values. It is assumed that these variations were included to allow for the fact that the 1972 Regulations permitted a prescribed margin below the values of the standard curves and did not need to meet them exactly.

6.2.7 The intention is understood to have been to use the same performance standard but to specify equivalent values using the new rating system.

6.2.8 The studies conducted when the 1992 Regulations were being developed concluded, at the time, that it was not necessary to increase the standard but that the focus should be to improve compliance rates. No changes were made to the performance standard.

6.2.9 The rating system introduced in the 2003 Regulations was intended to make the rating system more sensitive to low frequency performance which is subjectively important. The 1992 airborne sound insulation performance standard was amended by the introduction of a weighting term – C_{tr} . Because the effect of this weighting is to reduce the numerical rating of a construction, the criterion was reduced by the amount by which typical 'acceptable' and 'traditional' constructions were affected by the new term – ie, 5 dB.

6.2.10 Other adjustments (described in paragraph 4.4.2) lead to the values shown in **Table 6.1** which also shows the ratings for the curves used as the basis of the 1972 Regulations using the C_{tr} weighting.

6.2.11 Despite the lowering of the numerical ratings in the 2003 Regulations they were intended to increase the standard in two ways. First, there was an improvement of 3 dB which applied to all airborne tests. Secondly, the airborne standard for party floors in new buildings was set to the same value as for party walls – an improvement of 1 dB.

6.3 Summary of changes in the standard

6.3.1 The standard for party walls is still broadly based on the performance of a 9" brick wall that a 1948 study found to prevent about 75% of occupiers being troubled by noise from their neighbours. Subsequent changes have transposed it to the BS5821 rating method (1985) and a refinement of that method (the addition of the C_{tr} weighting in 2003) is intended to ensure that new types of construction do not neglect low frequency performance for gains at middle and high frequencies.

6.3.2 Note that in the 1996 EHCS, the percentage of occupiers who did not report being bothered by noise from their neighbours was about 88%[41].

6.3.3 As regards the standard for party floors, the airborne noise standard in the 1972 Regulations was 1 dB worse than for houses (when rating the two curves as equivalent $D_{nT,w}$ values), but the low frequency performance was more than 1 dB worse than the standard for walls. This can be seen from the values in **Table 6.1** and the ratings of the two curves (Party Wall Grade and Grade I) using the C_{tr} weighting which gives values of 50 dB and 48 dB respectively). The standard in the 2003 Regulations is the same for walls and floors (in new constructions) and is set at the standard equivalent to the old party wall grade and so there has been an improvement in this standard (for party floors).

6.3.4 Note that although there is only a difference of 2 dB between the weighted ratings of the Party Wall Grade and Grade I standards, the 1948 survey found that about 35% of occupiers of flats of concrete construction (which is assumed to be the basis of the Grade I curve for floors) were troubled by noise from their neighbours. Of course, unlike occupiers of houses, occupiers of flats will experience impact as well as airborne noise and so this increase in the proportion of occupiers troubled by noise from neighbours might not all be a result of the lower airborne noise insulation that they are likely to have experienced.

6.3.5 It has been suggested that the current standard for impact noise is not as stringent as the 1972 standard (see paragraph 3.3.8)

6.3.6 Before the 1992 Regulations came into force, conversions were not subject to the noise requirements of the Building Regulations. A typical construction for party floors in such buildings is a simple timber joist floor which can have performance as low as 259 AAD with respect to Grade II[42.] That is about 11 dB worse than Grade II which in terms of acceptability is worse than 'deputation level'. Since the Grade II curve is 5 dB worse than the Grade I curve, the Grade II curve corresponds to a $D_{nT,w}$ value of 47 dB and a $D_{nT,w}$ +C_{tr} value of 43 dB.

6.3.7 One of the suggested remedial treatments in such a case is an independent ceiling and that can achieve a Grade I rating (equivalent to 52 dB $D_{nT,w}$ and 48 dB $D_{nT,w}$ +C_{tr} . The extension of the Sound Insulation section in the 1992 Regulations to cover conversions was therefore a major improvement in the standard that applied to those kinds of dwellings[43].

[41] See bullet point 3 on page 25.
[42] Insulation of floors in converted dwellings against sound transmission. Turner S W London Environmental Supplement No 2, Summer 1983.
[43] Similar improvements in impact noise performance can be achieved for wood-joist floors by the installation of an independent ceiling.

6.4 The outcome of the standard set

6.4.1 The basis of the Party Wall Grade in the 1972 Regulations was that of 9" brick wall. Social surveys in the 1940s and 1950s had found that with that degree of sound insulation 27% of those surveyed were troubled by noise from their neighbours. However a more recent study (EHCS 1996) found a lower rate of bother from neighbour noise (12%). In about three-quarters of those cases the bother was attributed solely to the behaviour of the neighbours with the remaining cases (3%) being considered to be caused by a combination of the neighbours' behaviour and poor building design or solely the result of poor design

6.4.2 A review conducted when developing the 1992 Regulations concluded that for those structures in the survey that met the standard in the 1985 Regulations (which was intended to be equivalent to the 1972 Regulations) only 20% of occupiers rated the sound insulation 'poor'. However, that survey was concerned with houses and consequently did not address the acceptability of the impact noise standard.

6.4.3 The Grade I standard was developed for flats and includes both airborne and impact noise and at the time occupiers of structures that met the standard rated noise from neighbours as only a minor disturbance. However, as noted in the preceding Section, the current impact noise standard might not be equivalent and its acceptability might be lower than the 1972 standard.

6.5 Noise Abatement Society's National Noise Helpline

6.5.1 The National Noise Helpline (the Helpline) was established in 2006 and initially operated Monday through Friday during normal working hours. Since April 2010 it has been operational 24/7. The Helpline has never been widely advertised and has always provided free, confidential and impartial support and advice. It has received approximately 4500 calls to date[44]. The fact that callers to the Helpline have had to search out and find a little known resource in their attempt to find help and answers gives weight to their determination to find solutions and register their concerns. Some of the key findings from analysis of the Helpline data to date show that:

- Typical callers to the Helpline live in houses rather than flats which they own or rent privately and their most prevalent complaint is about neighbour noise experienced from within their dwelling.

- The largest category of complaints to the Helpline for the period 2006-2011 concerned neighbour noise, the proportion of which increased from 34% of calls in 2006 to 51% January–April 2011.

[44] Noise Abatement Society Research, National Noise Helpline findings (2006-12)

- The majority (nearly 50%) of complaints to the Helpline about neighbour noise concerned general living noise including normal social interaction between inhabitants of dwellings and parties. In the majority of cases, callers felt that these issues were attributable to poor insulation within dwellings.

- 40% of complaints to the Helpline about Building Noise (ie, in relation to the quality rather than the process of construction) within the neighbour noise category [45] were about noisy flooring and poor insulation with callers citing what they saw as poor building and construction standards, including doors that slam shut in new build properties (although it may be noted that slamming doors are not covered by current Building Regulations).

6.5.2 In the cases of complaints about neighbour noise, people going about their daily lives make noise, but the effects on neighbours seem to be compounded by inadequate insulation and noisy flooring.

6.5.3 The types of complaints received year on year over the period from 2006 to the present are broadly consistent. While it may be difficult for a noise sufferer to distinguish between unreasonable behaviour and poor structure, Helpline complaints reflect callers' expectations about what is acceptable.

6.5.4 The NAS believes that a proportion of current complaints from occupants of new properties relates to dissatisfaction with the underlying standards, rather than non-compliance to those standards. This view is extrapolated from comments made when callers are asked to describe the noise problems they are experiencing, often general living noise (i.e. flushing of loos; operation of bathroom and/or kitchen fans; walking on floors; and opening and closing of doors).

[45] In the NAS Helpline analysis, figures in the general **category headings** represent the total number calls logged to the category. Calls that specify noise issues within the '**category**' are represented in the sub-category '**type**' headings; and one call may be logged in several '**types**' or '**sub-types**'.

For example:
Person A contacts the Helpline with a complaint about neighbour noise. He or she may also mention animals, social (appliances) and lack of soundproofing during the call. The data 'hits' for the call are, therefore, logged as: 1 x category, 3 x types and 2 x sub-types:

✓Neighbour (category)
- ✓Animals (type)
- ✓Social (type)
  - ✓Appliances (sub-type)
- ✓Building/construction (type)
  - ✓Poor insulation (sub-type)

6.5.5 In these cases, as their properties have been built to modern regulatory requirements by reputable companies, they can easily conclude that the standards must be improved rather than assume non-compliance on behalf of the developers. This conclusion is borne out a) in recent research carried out by ICM for Rockwool which found that more than one in ten (11%) of Britons who have been disturbed by noise in the past 12 months complained about the din from neighbours walking on wooden floors, rising to one in four (25%) of those living in flats[46] and: b) in the points highlighted in paragraph 7.4.20.

6.5.6 Some situations require special consideration:

- Conversions of shop units, offices, etc. to gyms, health clubs and other 'active' uses, creates challenges where construction standards for sound transmission for the previous use are no longer adequate, and where hours of operation extend into evenings and weekends.

- Noise/vibration transmission within steel frame buildings, and those incorporating other relatively innovative structures, can also generate unusual or unexpected problems for occupants as steel frames can transmit noise/vibration within the structure with little attenuation.

6.6 Rate of compliance with the standards

6.6.1 Before the implementation of 2003 Regulations there was concern about the degree of compliance by the 'recommended solutions' with the standard they were expected to reach. For example, a survey of performance in post-1970 dwellings indicated that 55% of party walls failed to meet the requirements of the 1976 Building Regulations, as did 60 % of party floors for impact sound insulation and 44% for airborne sound insulation[47].

6.6.2 Before 2003, there were attempts to improve the degree of compliance by increasing the level of detail included in the descriptions provided for the 'recommended solutions'.

6.6.3 However, the Regulatory Impact Assessment accompanying the consultation on the 2003 Regulations stated (paragraph 56 of that document) that "BRE estimated 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."

6.6.4 The introduction of the pre-completion testing (PCT) system was intended to improve compliance so that within 10 years the failure rate would be reduced to below 5%.

6.6.5 In practice the PCT system has achieved that target within about 6 years.

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[46] http://www.rockwool.co.uk/news/document+viewer?docid=2324, Accessed 8/07/2012. ICM interviewed a random sample of 2005 GB adults aged 18+ from its online panel between 25th and 26th April 2012. Surveys were conducted across the country and the results have been weighted to the profile of all adults. ICM is a member of the British Polling Council and abides by its rules. Further information at www.icmresearch.co.uk.

[47] BRE IP 13/82 reporting data from CP52/74 and CP20/78

6.6.6 The compliance rate for the Robust Details (RD) system is also high but the data in **Table 5.5** requires some explanation.

6.6.7 The RD system serves as an alternative to the PCT system but does not completely replace it. In the event of a tested structure failing a test conducted under the RD programme then its registration under RD is withdrawn and it is subject to the normal methods for demonstrating compliance with ADE2003. In practice that means PCT. Consequently, structures ***tested*** under the RD programme that fail are transferred from RD system to become failures under the PCT system.

6.6.8 No correctly implemented RD construction has been known to fail a test and so the compliance rate for tested RD structures is 100%. However, because not all the plots ***registered*** under the RD scheme are tested there will still be some non-compliance with the ADE2003 standard. As noted earlier, some of these untested failures might be identified and remediated by the developer or under the property's warranty where it applies.

6.7 Estimated numbers of properties affected – datasets used

6.7.1 The consultation document for the proposed 2003 Regulations included an estimate of the number of people affected by sound transmission between dwellings. The 1996 English House Condition Survey (see sub paragraph 51 on page 25) found that 670,000 householders (about 3% of all households[48]) were bothered by noise from neighbours that they attributed to poor design of the building, or a combination of poor design and the behaviour of their neighbours. About two-thirds of this number considered the problem was caused wholly or partly by poor building design.

6.7.2 An approach to estimating the potential scale of the population affected by the changes in the Regulations has been attempted. Several sources of information have been consulted to estimate the numbers of ***properties*** affected by the regulations. Some of these have been referred to in the earlier part of this report but we have also introduced others in this section. The sources considered were:

- The English House Condition survey
- DCLG data on new permanent dwellings completed annually
- NSCA Study on conversions

The English House Condition Survey

6.7.3 The English House Condition Survey (EHCS) was started in the 1960s and until 1991 was under the aegis of the Department of Environment. During that period it was updated every 5 years. It gathered a range of physical and social data, the standard of dwellings, the facilities provided, and the form of tenure, and the opinions of occupiers. The data gathered changed from time to time but from the 1976 survey information on the kind of dwelling (eg, terraced house, purpose-built flat) was included[49].

[48] The 7 million households who reported noise problems constituted over a third of the households in the survey, see sub-paragraph 48 on page 20.

[49] Data on Conversions were not included until the 1981 survey.

6.7.4 From 1996 the survey was carried out by the DCLG (and its forebears) and from 2001 was undertaken annually. From 2008 it was merged with the Survey of English Housing (SEH) to form the English Housing Survey (EHS).

6.7.5 The surveys have been used to determine the breakdown of the housing stock between the following types that are considered to represent an increasing potential for problems to arise if there is poor sound insulation between dwellings:

- Detached houses and Bungalows
- Semi-detached houses
- Terraced houses
- Purpose-built flats
- Conversions

6.7.6 The results of this analysis are shown in **Figure 6.1** on which the number of dwellings of each kind is shown for each year. Note that the years shown in **Figure 6.1** are not consecutive. They have been selected by considering the years in which new versions of the Regulations were published – 1972, 1985, 1992, and 2003 – together with the years in which the EHCS was undertaken. A recent year, 2009, has also been included.

6.7.7 It can be seen that apart from the noticeable increase in the number of conversions between 1986 and 1991 that the changes between the years shown in the estimated stock of each kind of dwelling are small in comparison with the total number of each kind. Consequently this information has not been used to estimate the number of properties subject to the changes in Building Regulations. However, it provides a guide to the proportion of different kinds of dwelling over the period of the study.

6.7.8 This dataset shows that proportion of houses that were attached (ie, semis and terraces) has fallen from about 76% in the period 1976 – 86 to about 68% in the period 1991 to 2009.

DCLG data on new permanent dwellings completed

6.7.9 DCLG data on completed units is compiled from a range of sources (eg, LAs, NHBC). The dataset LiveTable 244[50] provides annual completions of new dwellings (houses and flats combined) from 1946 – 2011 and data for the years 1970 -2010 are shown in **Figure 6.2**.

6.7.10 **Figure 6.2** shows that the number of dwellings completed each year is between 100,000 and 300,000, a much smaller number than the total housing stock which is between 20 and 25 million (ie, of the order of 1%).

[50] DCLG Live Table 244 House building: England historical calendar year series.

6.7.11 DCLG Table 254[51] provides information for the years 1991/92 – 2010/11 by house and flat but the raw data contain no further distinction of dwelling types. That data is shown in **Figure 6.3** and it can be seen that during the 1990s about 80% of new completions were houses but that that fell to about a 50:50 split between houses and flats by the mid-2000s.

6.7.12 Finally, data on Net Gains to the housing stock are available for the years 1991/2 to 2010/11 in which the contribution from conversions is included apart from the 3 year 2004/5 to 2005/6 [52].

6.7.13 Data on conversions from houses to flats and vice-versa do not contain individual records which show where, for example, a single house was converted into three flats, but simply the net change that results from such conversion in each local authority district (in this example the net gain would be two dwellings).

6.7.14 Data from the Net Gains tables are shown in **Figure 6.4**.

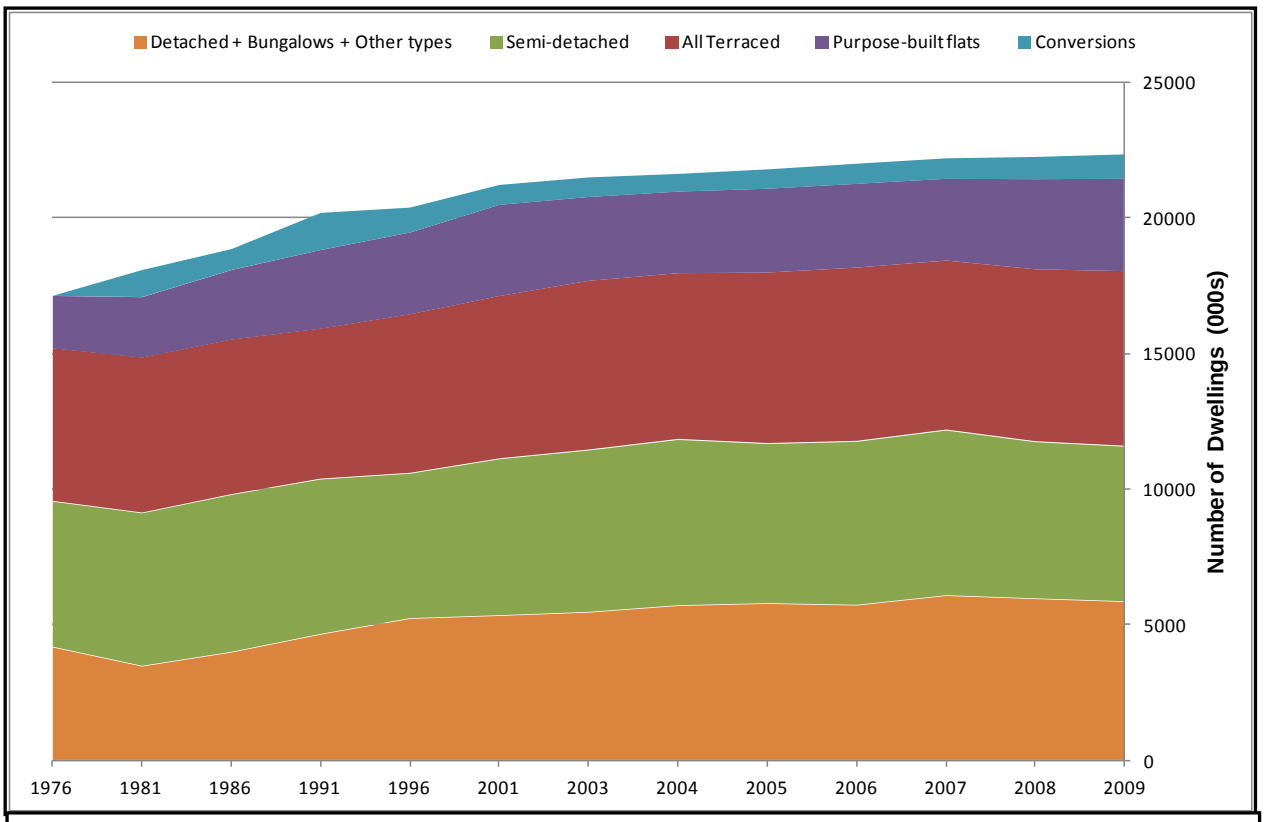

Figure 6.1 Composition of housing stock by dwelling type for selected years (Full scale = 25 million, No data in 1976 for Conversions)

[51] Annual Table 254
[52] Table 1c 20212261.xls. These figures are for conversions from houses to flats. Conversions of eg, barns, industrial buildings to residential use are collected under a separate heading.

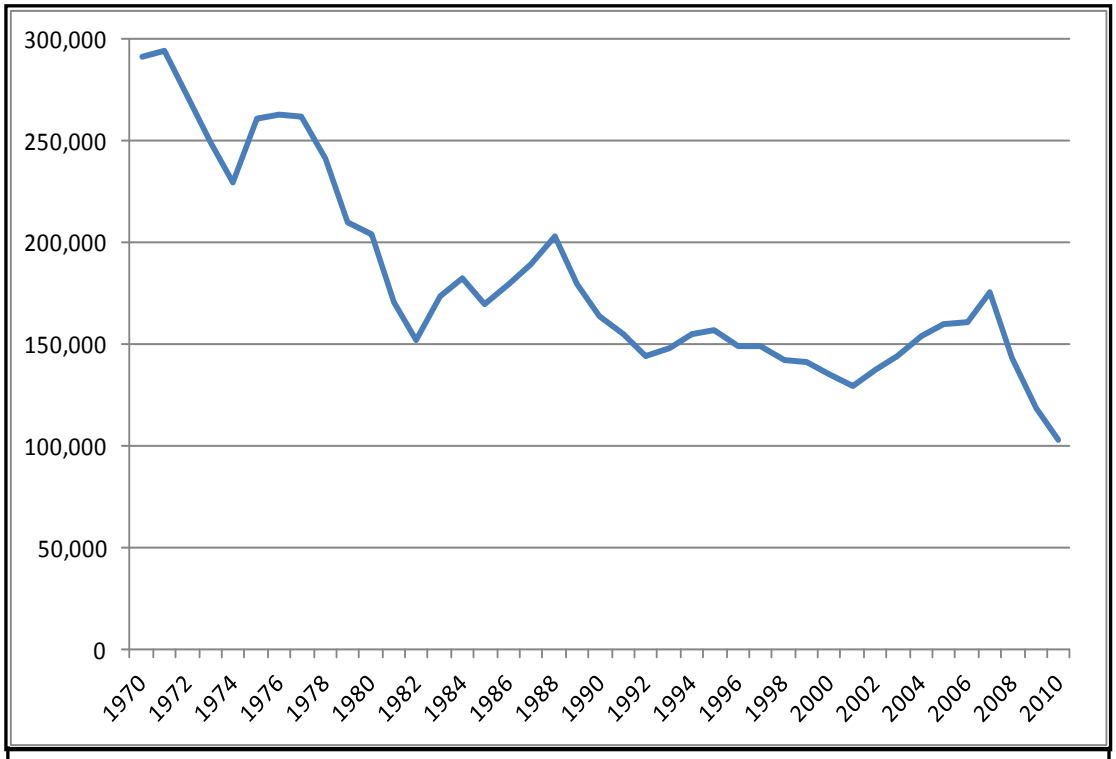

Figure 6.2 **Number of permanent new dwellings completed each year (Houses and flats combined , Full scale = 300,000)**

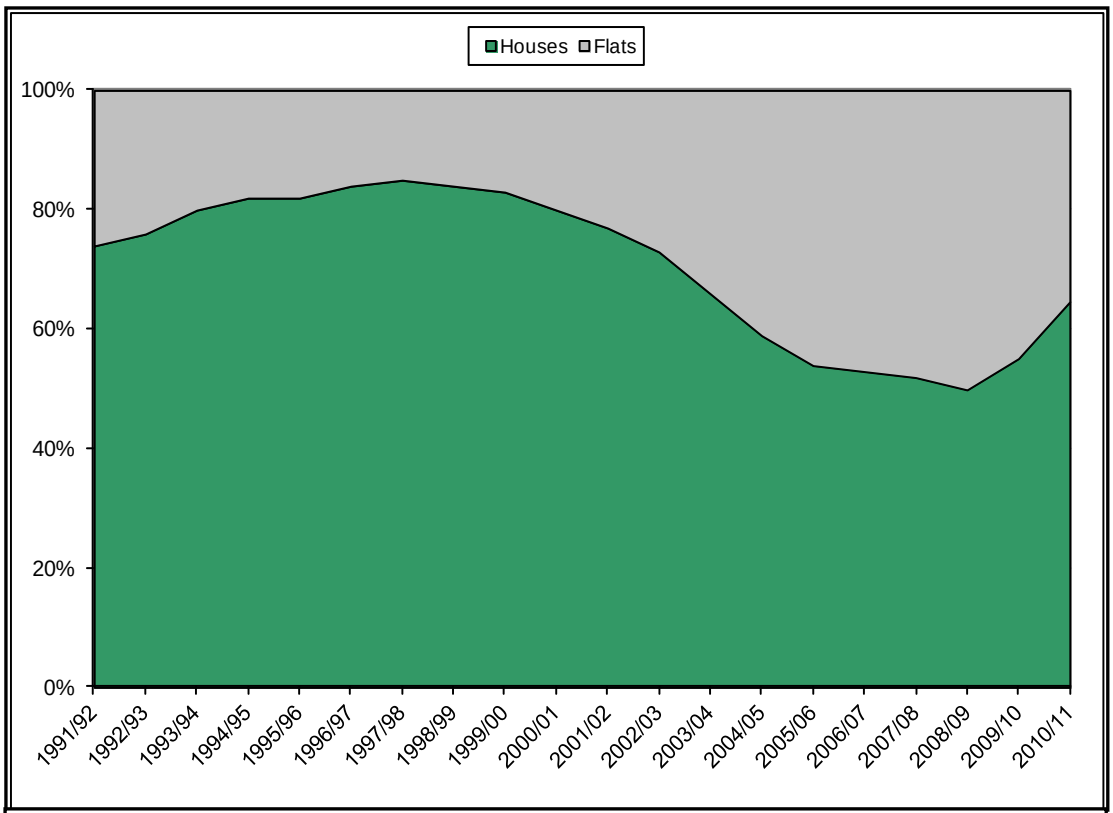

Figure 6.3 **Permanent new dwellings completed each year Breakdown between Houses and Flats**

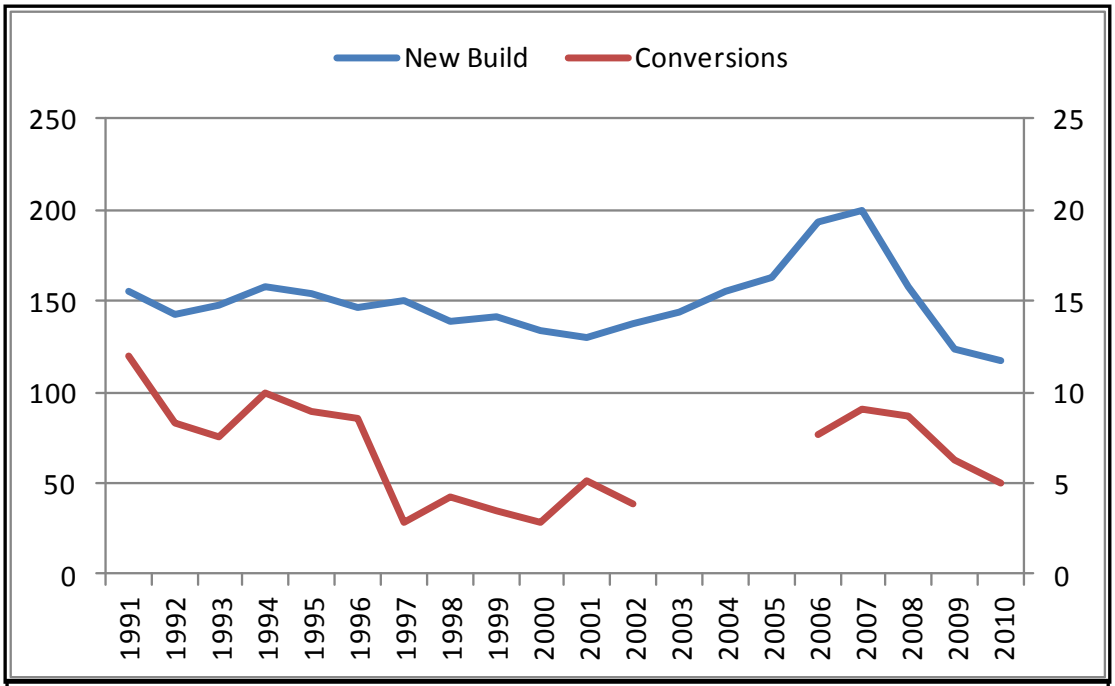

Figure 6.4 Net Gains to Housing stock each year (000s)
New build = Purpose built Houses and Flats (Left hand Scale)
Conversions = Flats from existing dwellings (Right Hand Scale)
(No data for conversions for 2003 – 2005)

6.8 Estimated numbers of properties affected – derivation of totals

6.8.1 The data described above has been used to estimate the number of properties affected in the period 1991 to date. Three categories of property have been used: attached houses (ie, semis and terraces), purpose built flats, and conversions. The methodology is set out below.

6.8.2 Data for the total new build completions each year has been subdivided into houses and flats using the DCLG datasets 254 (**Figure 6.2**) and 244 (**Figure 6.3**).

6.8.3 The figures for houses include detached houses and bungalows and so overstate the number of houses that would benefit from those parts of the regulations intended to improve sound insulation between separately occupied dwellings.

6.8.4 To determine the number of attached properties the total figure for new build house must be reduced to take account of the proportion of new build houses that are detached houses and bungalows.

6.8.5 If it is assumed that the proportion of attached houses in the existing housing stock is indicative of the proportion of such houses in new build houses then data from the EHCS can be used to subdivide the total for new build houses between attached and non-attached houses. For the period 1991 to date the proportion of attached houses in the total stock of ***houses*** is about 68% (paragraph 6.7.8).

6.8.6 The above process has been used to estimate the number of attached houses and purpose built flats completed in each year over the period 1991 to 2010 and the results are shown in **Table 6.2** which also shows the estimated number of conversions.

6.8.7 The values for (purpose built) flats are derived directly from DCLG data. The figures for attached houses (shown in a shaded column in the table) have been adjusted downwards from the DCLG figures for all houses by applying a factor of 68% as explained above.

6.8.8 The figures for conversions in the table have been derived in the following way. The 'Net Gain' column contains DCLG data apart from the years 2003 to 2005 for which there are no DCLG data. Values have been inserted for those years by taking the average number of 'Net Gain Conversions' from the DCLG figures for the preceding 6 years (1997 – 2002).

6.8.9 As explained above (paragraph 6.7.13), the Net Gain figures relate to the change in the number of units not to the actual number of conversions created which will be a higher figure in most cases[53]. The DCLG figures have therefore been increased to take account of that by using data from the NSCA survey on the average number units in a planning application (**Table 3.1**).

6.8.10 The final column – Estimated Units (ie of conversions) – is the result of increasing the figures in the Net Gain column by a factor of 2.

6.8.11 The estimated numbers of properties derived from this process are also shown in **Table 6.2**: for the periods 1992 – 2002 and 2003 – 2010.

[53] The DCLG data also records under the Net Gain category, cases where a property that has multiple dwellings is converted into a smaller number of units. That would result in a negative value. However, such cases are expected to be a very small proportion of the total.

Table 6.2 Estimated Numbers of Properties completed per year (000s)

Year			Numbers of		Numbers of Conversions	
	New Build [1]	% Flats [1]	Flats [1]	Attached Houses [2]	Net Gain Conversions [3]	Estimated Units [4]
1991	155	26	**40**	78	12	**25**
1992	143	24	**34**	74	8	**18**
1993	148	20	**30**	81	8	**16**
1994	158	18	**28**	89	10	**21**
1995	155	18	**28**	87	9	**19**
1996	146	16	**23**	84	9	**18**
1997	150	15	**22**	87	3	**6**
1998	139	16	**22**	80	4	**9**
1999	141	17	**24**	80	4	**7**
2000	133	20	**27**	73	3	**6**
2001	130	23	**30**	68	5	**11**
2002	138	27	**37**	69	4	**8**
2003	144	34	**49**	65	*4* [5]	**8**
2004	156	41	**64**	63	*4* [5]	**8**
2005	163	46	**75**	60	*4* [5]	**8**
2006	193	47	**91**	70	8	**16**
2007	200	48	**96**	71	9	**19**
2008	158	50	**79**	54	9	**18**
2009	124	45	**56**	47	6	**13**
2010	118	35	**41**	52	5	**11**
Total						
1992 – 2002			306	870	65	138
2003 - 2010			551	482	48	101
1991 - 2010			**856**	**1352**	**113**	**239**

Note 1 Data direct from DCLG dataset or derived from combination of DCLG datasets
Figures for flats are for purpose built flats
2 DCLG figures reduced to 68% from EHCS data
3 Data direct from DCLG dataset except 2003 – 2005 which have been estimated
4 DCLG figures increased by 33% based on NSCA survey findings
5 No DCLG data – values are the average of DCLG figures for 1997 - 2002

6.9 Assessment of new system under the 2003 Building Regulations

6.9.1 At the time of the last improvement in Building Regulations Part E governing acoustic separation for dwellings, extensive debate took place over the period 2001-2003 on the balance between spending on pre-completion testing, and spending on standard packages of sound insulation.

6.9.2 While building code legislation has consistently recognised the detrimental effects of environmental and neighbourhood noise, the standards chosen have sought to balance economic considerations with requirements for increased housing stock.

6.9.3 Monitoring of compliance to the 2003 Regulations has demonstrated success in achieving high rates of compliance in a relatively short period. The trigger points when new standards and techniques can be employed are new build, conversion to and from flats/houses, and DIY changes such as adding solid floors.

7 SUMMARY AND CONCLUSIONS

7.1 Effect of the policy

7.1.1 It is considered that the most significant policy changes were:

- The extension of the 1992 Regulations to include conversions, and
- The introduction of the PCT/RD schemes in the 2003 Regulations

Effect of 1992 Regulations on Conversions

7.1.2 Although the 1992 Regulations did not require testing, the standard of sound insulation in a typical untreated conversion was so poor that even a treatment that did not realise its potential or achieve the required standard is likely to have provided a noticeable and worthwhile improvement in sound insulation. However, that is not to say that the percentage of floors for which the required standard would have been achieved would have been high

7.1.3 Reference has been made (paragraph 4.2.8) to the BRE estimate of a failure rate of up to 40% for new separating floors. It is considered that the failure rate for floors in conversions could well be higher than for purpose-built constructions because timber floors are more likely to be found in conversions than in purpose-built flats and any treatment has to be retrofitted rather than being an integral part of the design.

7.1.4 In the absence of better data it has been assumed that in the absence of the policy the failure rate could have been 100% (see also section 7.2) and that when the policy was in place the failure rate was 40%.

7.1.5 The number of conversions estimated to have been covered by this measure in the period 1992 – 2002 is 138,000, in 65,000 properties/buildings (**Table 6.2**).

Effect of 2003 Regulations (all properties)

7.1.6 In the case of new build properties, before the 2003 Regulations were introduced BRE had estimated that as many as 40% of new separating floors and 25% of separating walls might fail to meet the standard then current (see Section 4.3).

7.1.7 Because many conversions have timber floors and any treatment has to be retrofitted, it is considered likely that the failure rate for floors conversions would have been higher than the rate for purpose-built flats

7.1.8 By 2009 the compliance rates from the ANC's PCT database and the RDL database were over 95%; **Table 7.1** summarises the results from Section 5.

Table 7.1 Summary of compliance rates under ANC and RD schemes (%)

Element and Test	ANC data 1st Half of 2009	RD Data 1st Half of 2009	ANC data 2nd Half of 2011	RD Data 2nd Half of 2011
New Build				
Walls – Airborne	98	99	99	99
Floors – Airborne	97	100	97	96

Table 7.1 Summary of compliance rates under ANC and RD schemes (%)

Element and Test	ANC data 1st Half of 2009	RD Data 1st Half of 2009	ANC data 2nd Half of 2011	RD Data 2nd Half of 2011
Floors – Impact	98	99	99	100
Material Change of Use				
Floors – Airborne	89	N/A	93	N/A
Floors – Impact	97	N/A	96	N/A
Overall for all buildings tested [1]	**96**	**99**	**97**	**99**

Note 1 Combined results for airborne and impact tests.
For ANC data includes all categories eg, Material Change of Use

7.1.9 The number of units estimated to have been covered by the introduction of mandatory pre-completion testing in the period 2003 – 2010 (**Table 6.2**) is 551,000 flats, 482,000 attached houses, and 101,000 conversions (in 48,000 properties).

7.1.10 The standard for airborne noise in the 2003 Regulations included a stricter control of low frequency performance than that in the 1992 Regulations and the above compliance rates relate to that new enhanced standard.

7.2 Effect of no policy – 1992 Regulations and conversions

7.2.1 In the absence of the 1992 extension of the policy to conversions the total number of conversions that would not then have been covered by those policies is estimated to be 138,000 (in 65,000 properties, see **Table 6.2**).

7.2.2 However, in the absence of that policy it is likely that the use by some LPAs of planning conditions to require sound insulation treatment in conversions would have been continued. It is uncertain what the effect would have been because:

- The numbers of LPAs continuing to using that method is not known
- The standard of insulation that would have been sought is not known
- The standard of insulation that would have been achieved is not known

7.2.3 The number of applications for conversions received in the period 1983 – 1986 by LPAs responding to the survey for the NSCA's 1986 report (Section 3.6) was for a total of was 5771 units (**Table 3.2**) – an average of 1924 per year. Only 55 of the 130 responding LAs imposed sound insulation conditions. The total number of applications received nationally in that period is not known and so the percentage of that total received by those LPAs that did impose conditions on sound insulation has not been determined.

7.2.4 However, over the period 1991 to 1996 the annual number of units is estimated to have varied from 16,000 to 25,000 falling to a range of 6,000 to 11,000 for the period 1997 to 2003 (**Table 6.2**). It seems likely therefore that the number of LPAs imposing sound insulation conditions (and only about two-thirds of the responding LPAs did so) would have affected only a small proportion of the total applications.

7.2.5 The number of conversions that would have failed to meet the standard over the period 1992 to 2002 has therefore been estimated neglecting any effect from that factor. The failure rate applied was the BRE estimate of up to 40% for new separating floors, though it is considered that the failure rate for conversions (many of which have timber floors) might have been higher.

7.2.6 On that basis it has been estimated that 83,000 conversions (in 39,000 properties) that would have failed to meet the standard if the 1992 policy had not been implemented, then did achieve the standard as result of implementing the policy.

7.3 Effect of no policy – 2003 Regulations

7.3.1 In the absence of the (2003) policy the estimated number of properties that would not have benefitted from the increased level of compliance is as stated in paragraph 7.1.9.

7.3.2 The estimated number of dwellings that might have passed or failed the standard with and without the 2003 policy is shown in **Table 7.2**. The figures have been derived by applying the BRE failure rate estimates and compliance rates derived from **Table 7.1** to the numbers of purpose-built flats, attached houses, and conversions completed in the period 2003 - 2010 as previously described.

7.3.3 The net effect of the policy over the period 2003 – 2010, assessed in terms of preventing 'failures', is therefore estimated to have been about 198,000 attached houses, 111,000 purpose-built flats, and 29,000 conversions (in 14,000 properties).

Table 7.2 Estimates of properties failing standard after 2003 (000s)

Condition	Purpose-built Flats	Attached Houses	Conversions
No Policy			
BRE Estimated ***Failure*** rate (%)	*40*	*25*	*[assumed to be 40%]*
Total completed	551	482	101
Estimated number of failures	**220**	**120**	**40**
With Policy			
Pass rate (%) [1]	*96*	*98*	*89*
Total completed	551	482	101
Estimated number of failures	**22**	**10**	**11**
Net effect of policy			
Failures without policy – Failures with policy	**198**	**111**	**29**

Note 1 Derived from **Table 7.1**

7.3.4 Note that even though failure rates are only a small percentage, because the absolute number of constructions being completed each year means that there may still be significant numbers of dissatisfied occupiers.

7.3.5 The effect of a small change in the failure rate is illustrated by comparing the estimated numbers of failures for Attached Houses with the figure for Conversions in **Table 7.2**. Although it was estimated that there were more than four times as many attached houses than conversions completed in the relevant period, because the compliance rate for conversions was 89% compared to instead of 98% for attached houses, the total number of 'failed units' is about the same (11,000 conversions and 10,000 attached houses).

7.4 Lessons Learned

7.4.1 From a high level point of view, the lesson learned is illustrated by the change in the level of competence and understanding of the issues surrounding sound insulation within buildings.

7.4.2 The Wilson Report noted under the heading '*Professional Knowledge*':

> "*151. We have referred in previous paragraphs to the Code of Practice for sound insulation and noise reduction in buildings*[54]*. Except for certain new facts, mainly about noise levels and people's reactions to them, which were not available at the time the Code was drafted, there is little in this chapter which is not already covered by the Code, and the latter contains a good deal of specialised information for the building designer and contractor which would be inappropriate in our Report. It is relevant to enquire into the reason for the obvious gap between the present knowledge as assembled in the Code, and the efficiency of its application as shown in many existing buildings. It seems to be generally accepted by expert witnesses, including the Royal Institute of British Architects, that one of the basic reasons is the inadequate training of architects and builders in the principles of sound insulation and noise exclusion. We think that it is very important that their training in these subjects should be improved, and we hope that the professional bodies will quickly be successful in the efforts they have announced to do this.*"

7.4.3 In the authors' experience, at the start of the study period, acoustics, acoustical terminology, and even simple understanding of the principles involved was totally absent among not only the lay population but also architects, surveyors and other professionals directly responsible. Architects were sometimes unable to distinguish between sound absorption and sound insulation and would make such errors as attaching acoustic tiles to walls when improved sound insulation was needed.

[54] See footnote 10 of this report on page 7.

7.4.4 As a result of the progressive advance of the Building Regulations, aided by semi-official publications such as the booklet "Sound Control for Homes" produced by the Construction Industry Research and Information Association (CIRIA)[55], the series of BRE publications, books published aimed at entry-level readers, the Institute of Acoustics Diploma, and improvements to the syllabuses of professional courses, besides Approved Document E itself, it is now normal for the relevant professionals to understand the topic sufficiently to enable appropriate design and construction management measures to be taken.

7.4.5 Regulations alone are not effective unless steps are taken to foster sufficient knowledge dissemination to make it possible for those in a position to give effect to them to know what to do.

7.4.6 At a more detailed level the lessons learned have been considered under the following headings:

- Strategic policy approach
- Elements of the policy
- Practical implementation of policy
- Topics for consideration in future policy development
- Information available for the design of future policy

Strategic policy approach

7.4.7 It is clear that the introduction of the PCT/RD scheme has led to a large increase in the rate of compliance with its attendant benefits.

7.4.8 Although the option to insist on mandatory testing was considered at the time of the revision in 1992 Regulations (paragraph 3.8.4) it was not taken forward and alternative measures aimed at improving compliance were introduced. Unfortunately, those measures did not prove to be as effective in raising compliance rates as the PCT/RD schemes have been[56].

7.4.9 It is estimated that in the period between 1992 and 2002 about 122,000 flats and 218,000 houses failed to meet the standards but almost all of them would have been expected to do so had the current system (ie, under the 2003 Regulations) been in place in 1992 (**Table 7.2**).

7.4.10 In addition to the non-compliant structures built since 1992, there is a substantial number of pre-1992 properties in which the occupiers do not have the benefit of the standard of sound insulation required by the Building Regulations current at the time they were constructed. However, the resources required for a programme of retrospective treatment would need to cover the Identification of the affected housing, make provision for temporary re-housing of occupiers in some cases, as well as the cost of specifying, installing and inspecting the treatment itself. It is therefore likely to be prohibitively expensive.

[55] CIRIA is an independent member based, not-for-profit association that provides business improvement services and research activities for its members and those engaged with the delivery and operation of the built environment

[56] The success that could be expected from a PCT scheme had been noted in the Noise Council's 1986 report – see Section 3.4.

Elements of the policy

7.4.11 In some respects the RD scheme is natural successor to the 'deemed-to-satisfy' (1972) and 'recommended solutions' (1985) approach in earlier Regulations. However, there are some important differences and while some of them might be regarded as a matter of degree others are more innovative.

- Level of detail
  The amount of detail provided with 'approved constructions' has steadily increased as regards both the scope (ie, specification of parts of the construction other than the principal element) and the level of detail.

- Knowledge base
  The RD system is supported by a database of test data in which a minimum of thirty examples of each construction is required prior to it becoming a Robust Detail. The level of detail about each test/construction type has enabled confidence limits for compliance to be determined and if the requirements of ADE are not met or exceed in at least 95% of the spot check field tests undertaken by the RD Inspectors, the construction is removed from the RD handbook[57].

- New constructions
  To be accepted as a new RD, data from a minimum of 30 field test examples must be submitted and approved. Under previous Regulations a new construction type could be approved and widely used by a developer on the basis of only 4 tests on 'similar' constructions.

- Inspection
  Specialist RD inspectors are used, focusing solely on the sound insulation aspect of the Regulations and also have the role of providing knowledge transfer to site managers and other workers at site level. Hitherto sound insulations requirements were treated no differently to inspections by Building Control Bodies from the other parts of the Regulations.

- Testing
  The consequences of failure are a powerful sanction and ensure close attention is paid to building the design accurately and to a good standard of workmanship. When a test reveals a failure to meet the requirements of ADE then the plots and sometimes the entire site (if the cause is a site wide systemic fault) are removed from the Robust Details scheme and revert to the PCT approvals process which carries significant cost penalties for the builder.

[57] To date this has happened on two occasions, the two constructions were E-WM-7 and E-FC-3.

- Continuous monitoring of on-site performance of constructions
  A benefit of the testing regime (see below) is that the database of test data for each RD is continuously expanded and any systematic deterioration in the standard can be rapidly identified, investigated, and the construction details updated as necessary.

Practical implementation of policy

7.4.12 Implementation of the PCT policy required sufficient suitably qualified testers to be available. It is understandable that UKAS was identified as the appropriate a body to ensure that testers were suitably qualified since:

> *"The United Kingdom Accreditation Service is the sole national accreditation body recognised by government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services.*
>
> *Accreditation by UKAS demonstrates the competence, impartiality and performance capability of these evaluators."* [58]

7.4.13 At the time, a very small number of acoustic consultancies were accredited by UKAS for activities other than sound insulation testing but most of the bodies undertaking such tests or having the capability to undertake them were not accredited by UKAS and were unfamiliar with their systems.

7.4.14 Fortunately, the ANC took the initiative to devise and propose a registration scheme for sound insulation testers which was accepted as an alternative by the Department. The ANC scheme brought several benefits compared to the UKAS system:

- Centrally held database of test results established for long term monitoring of the scheme, construction types and ultimately the sound insulation performance of the housing stock.
- Provision of good practice guidance to members involved with testing activities.
- Additional registration process which enabled the pool of qualified testers to grow more rapidly

7.4.15 The prospect of the PCT system led the house-building industry to develop an alternative approach – the Robust Details system. That has led to a successful alternative means of raising compliance rates and has also provided the further benefits of a large and detailed database of tested constructions. This database provides a mechanism to develop and approve new constructions as designs change, both at no direct cost to Government.

7.4.16 Compliance was largely achieved with a sampling regime of measurements at the 10% level and so 100% testing of everything built is not necessary.

[58] UKAS website, http://www.ukas.com/about-accreditation/about-ukas/, accessed 8 March 2012.

7.4.17 A powerful sanction is required to ensure that remedial action is taken in the event that a structure fails a test. Under the scheme building control approval is made dependent on successful remedial work being undertaken and a pass being achieved and that is an essential element of the scheme.

Possible issues for further consideration

7.4.18 NAS believe that a proportion of current complaints from occupants of new properties relate to dissatisfaction with the underlying standards, rather than non-compliance to those standards (see paragraphs 6.5.4 and 6.5.4.

7.4.19 Conversely, the ECHS 1996 survey found that 80% of households who experienced problems with neighbour noise said this was either wholly or partly the fault of the neighbours in question (see section 4.3.1)

7.4.20 The following issues with the current standards have been either identified or raised as concerns

- The airborne noise standard for walls is not equivalent to the original Party Wall Grade (this might have been offset by the introduction of the C_{tr} rating system)
- Floor constructions that would have failed the Grade 1/AAD system pass the $L'_{nT,w}$ standard
- There is still some debate as to whether the $L'_{nT,w}$ standard truly aligns with subjective assessment of lightweight structures.
- Horizontal impact sound transmission such as that between houses resulting from stair usage or doors slamming has yet to be addressed[59].

Types of development where special consideration might be required

7.4.21 Based on comments from callers to the NAS's National Noise Helpline (see Section 6.5), the NAS considers that the following situations might merit attention:

- Conversions of shop units, offices, etc. to gyms, health clubs and other 'active' uses, creates challenges where construction standards for sound transmission for previous use are no longer adequate, and where hours of operation extend into evenings and weekends.
- Noise/vibration transmission within steel frame buildings, and those incorporating other relatively innovative structures, can also generate unusual or unexpected problems for occupants as steel frames can transmit noise/vibration within the structure with little attenuation.

Information available to inform future policy development

7.4.22 There are two kinds of resources available to assist in the design and monitoring of new polices. It is also possible that one of them might assist in the identification of policies

[59] See para 53 from DETR consultation document on page 25 of this report.

7.4.23 First, the databases of test data established by the ANC's PCT scheme and by RD should enable any changes considered in the rating method or the standard to be tested for a range of construction types. In that way alternative standards can be considered and compared [60].

7.4.24 The body of test evidence available according to construction types is more up to date and larger than ever before. The continuation of these test regimes and databases provides a means of monitoring the implementation of any new standard.

7.4.25 Mention has been made of the EHCS (paragraphs 6.7.3 *et sequi*). It collects both physical information about the properties together with the opinions of the occupiers. The strength of EHCS is that it provides periodic evidence of how a statistically representative sample of people think about noise in their properties

7.4.26 Some of the questions posed and the data collected have changed over the time the survey has been operated to reflect concerns current at the time of the survey. For example, the surveys for 1996, and annually from 2001 to date included questions relating to noise from neighbours including whether poor building design was a factor [61].

7.4.27 The data relating to these topics are not available from the DCLG website but in principle could be acquired and analysed to show whether problems with neighbour noise associated with poor design have changed over the period from 1996[62].

7.4.28 Although, the existing data from the survey could not only be considered for evaluating past policies; it might provide indicators for future policy areas. Furthermore, by having input into the questions posed in future survey years and the data collected it could also be used to design and monitor new policies[63].

[60] Statistical analysis of the PCT database results are regularly made available to CLG for that purpose. CLG have observer status on both the ANC PCT Committee and RDL's Standards Committee and are always copied in with the minutes of those meetings.

[61] See para 51 from DETR consultation document on page 25 of this report.

[62] For the 2009 survey it is believed to be possible to isolate dwellings 1990-2001 and from 2002 onwards in order to further analyse the data but sample sizes might then be too small to produce reliable results.

[63] The EHCS has been superseded by the EHS, see paragraph 6.7.4.