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SOUND INSULATION FIELD TESTS OF APPROVED DOCUMENT E WALL TYPES 1 AND 2

N.J. Tinsdeall
C.J. Grimwood
J.P. Seller

Building Research Establishment, Garston, Watford, Herts, WD2 7JR

1. Introduction

BRE has established a substantial database of information on the sound insulation provided by a large number of different building constructions. BRE is currently monitoring the sound insulation of separating walls and floors in newly built dwellings in order to ensure the database contains information on the sound insulation of current construction types

This paper presents the results of tests carried out during the past three years on the Approved Document E wall types 1 and 2. These wall types are cavity and solid masonry separating walls finished with either plasterboard or wet plaster. The paper also compares the measured performance from these recent tests with the performance of similar walls measured by BRE during the 1970s.

2. Measurement details and procedure

In total 164 field measurements of the airborne sound insulation of separating walls that conform to the guidance given in Approved Document E[1] have been carried out at 42 different sites throughout England and Wales. These field tests comprise:

37 tests of wall type 1B (10 sites)
32 tests of wall type 1D (8 sites)
16 tests of wall type 2B (4 sites)
71 tests of wall type 2C (18 sites)
8 tests of wall type 2D (2 sites)

At all the sites (except a type 1B and a type 2C) a minimum of 4 examples of a type of wall were tested. Measurements were carried out between 4 pairs of rooms in at least 2 pairs of dwellings. All tests were carried out according to BS 2750 Part 4. Measurements were made in one-third octave bands over the frequency range 50 Hz to 3150 Hz. The frequency range has been extended because BRE is interested in obtaining information on the performance of modern wall constructions at lower frequencies. It is currently difficult to obtain reliable field

measurements at low frequencies because of the problems in generating sufficient power using a portable source and in generating a diffuse field. However the data now being obtained at these frequencies may, for example, be useful in assessing the performance of such walls against modern hi-fi equipment which can produce high levels of bass. All the tests were undertaken in unfurnished dwellings. The single figure ratings have been calculated using the procedure in BS 5821 Part 1.

3. Standard of sound insulation

The Building Regulations 1991 (Part E of Schedule 1) do not give a numerical performance standard for post construction testing. The stated requirement is that the separating walls, floors and stairs shall resist the transmission of airborne and impact sound. The Regulations are considered to be satisfied if the construction follows the guidance, including the junction and flanking details, described in Approved Document E[1].

Section 3 of Approved Document E provides a method for the repetition of a non approved construction that has already been built and tested elsewhere. For walls, where 4 sets of measurements are taken then the arithmetic mean of the airborne sound insulation values should meet $D_{nT,w}$= 53 dB with no individual value less than $D_{nT,w}$= 49 dB.

4. Analysis of results

Table 1 below analyzes, by wall type, the single figure ratings in terms of the percentage and number of individual tests that meet the criteria contained in Section 3 of Approved Document E[1]. The frequency distribution for all the tests results are presented as histograms in Figures 1 - 4.

4.1 General performance

The results produced by this series of field tests have shown that 97% (159/164) of Approved Document E constructions tested met 49 dB $D_{nT,w}$ and 77% (127/164) met 53 dB $D_{nT,w}$.

4.1.1 Solid concrete blockwork, density≥ 1840 kgm^{-3}

a. When finished with plaster on both sides (Type 1B) the majority of the separating walls tested (36/37) met 53 dB $D_{nT,w}$.

b. When finished with plasterboard on both room faces (Type 1D) only 17/32 separating walls tested here met 53 dB $D_{nT,w}$

4.1.2 Cavity concrete blockwork, density ≥ 1990 kgm^{-3}, cavity ≥ 50 mm

a. When finished with plaster on both sides (Type 2B) the majority of separating walls tested (15/16) met 53 dB $D_{nT,w}$. It should be noted that the four results that exceed 60 dB $D_{nT,w}$ are from walls constructed with a 150 mm cavity. It would appear that the potential detrimental effect of the higher stiffness of the wall ties required in such constructions may be offset by the greater cavity width.

b. When finished with plasterboard on both room faces (Type 2D) 5/8 separating walls tested here met 53 dB $D_{nT,w}$. It should be noted that in order to meet the details in Approved Document E this wall type requires a step and or a stagger of at least 300 mm to be used.

4.1.3 Cavity concrete blockwork, density ≤ 1600 kgm^{-3}, cavity ≥ 75 mm

a. When finished with plaster on both sides (Type 2C) the majority of separating walls tested (24/29) met 53 dB $D_{nT,w}$.

b. When finished with plasterboard on both room faces (Type 2C) most of the separating walls tested (30/42) met 53 dB $D_{nT,w}$. The performance of a few of these walls has been poor, three of the walls tested failed to meet 49 dB $D_{nT,w}$. These walls were all built at one site and no obvious reason has been reported for the poor performance. It is hoped that further research may provide an explanation. Other sites constructed by the same developer have been visited and tested as part of this survey, similar walls on these sites have been found to perform satisfactorily.

4.3 Performance compared to measured data from the 1970s.

It is interesting to compare the data obtained in the last three years with data for similar walls collected during the 1970s. Table 2 presents data for similar constructions that were tested during the 1970s[2]. Table 2 shows that the mean $D_{nT,w}$ has increased for all the constructions tested. The measured performance of lightweight block walls shows the greatest overall

improvement. This may be due to the increased mass specification for this type of wall introduced in the 1992 version of Approved Document E. However, for wall type 2B, the percentage exceeding 52 dB $D_{nT,w}$ has reduced reflecting a greater spread of field test results for this wall construction.

To assist in the comparison of the data for the two surveys the data is presented as relative frequency distributions in Figures 5-7.

5. Discussion

The data collected during the last three years indicates that the performance of the walls tested has increased when compared with the performance of similar wall constructions tested 20 years previously. There may be several reasons for this, some are discussed below.

Since the inception of the Building Regulations there have been a number of changes to the construction guidance given. In particular, changes to Approved Document E in 1992 intended to improve performance may now be taking effect. Further it is also possible that the quality of workmanship has improved as a result of greater knowledge and awareness of relevant issues amongst the building industry and enforcement bodies.

The nature of the sample of test sites may also be important. During the last three years the majority of our test sites were being developed for Housing Associations, including many Housing Associations who are very aware of the need for good sound insulation and who had volunteered to take part in the test programme.

There is currently a debate as to whether standards of sound insulation are deteriorating and whether post construction testing is either necessary or desirable. This study can inform that debate as it shows a demonstrable improvement in the sound insulation of certain types of separating wall in the absence of a formal post construction testing scheme. Unfortunately, we do not know what proportion of new dwellings are built using the wall types tested during the last three years nor the number of walls that are approved using the "similar construction method" described in Section 3 of Approved Document E.

There is also current concern that the criteria in Section 3 of the Approved Document, which are usually considered to indicate reasonable sound insulation, may not accord with current public perception. It would be interesting to learn whether the subsequent occupants of these dwellings will consider the sound insulation to be "reasonable".

6. Conclusions

The field tests carried out over the past three years have shown that of the Approved Document E wall constructions tested 97 % (159/164) met a $D_{nT,w}$ of 49 dB, 86 % (141/164) met a $D_{nT,w}$ of 52 dB and 77% (127/164) met a $D_{nT,w}$ of 53 dB.

When compared with sound insulation measurements undertaken on similar wall constructions during the 1970s it can be seen that the mean $D_{nT,w}$ has increased. This may be due to improvements in construction guidance given, such as the changes to Approved Document E specifications. Alternatively the increase in measured performance may be due to improved working practices as a result of greater knowledge and awareness of relevant issues amongst, for example, the building industry and enforcement bodies.

7. Acknowledgements

The field measurements discussed in this paper were carried out by Acoustical Investigation and Research Organisation Ltd, Sound Research Laboratories Ltd and Wimpey Environmental Ltd under contract to BRE. The work discussed forms part of the research programme of the Department of the Environment and this paper is published with their consent.

8. References

1. The Building Regulations 1991 Approved Document E, Resistance to the passage of sound, 1992 Edition

2. E.C.Sewell and R.S. Alphey. Ratings of the sound insulation of post 1970 party walls. BRE Information Paper, IP 9/83

Sound insulation field tests of Approved Document E wall types 1 and 2

Wall type	Surface finish	Number of tests N	Average of individual $D_{nT,w}$ (dB)	Number of individual $D_{nT,w} \geq 52$ dB		Number of individual $D_{nT,w} \geq 53$ dB	
				n	%	n	%
All	-	164	55.0	141	86.0	127	77.4
1B	Plaster	37	56.2	36	97.3	36	97.3
1D	Plasterboard	32	52.5	22	68.8	17	53.1
2B	Plaster	16	57.8	15	93.8	15	93.8
2C	Plaster	29	56.1	27	93.1	24	82.8
2C	Plasterboard	42	54.2	35	83.3	30	71.4
2D	Plasterboard	8	54.3	6	75.0	5	62.5

Table 1 Summary of individual test results on wall types 1 and 2 for the past three years. (1993-1996)

Material	Cavity width or solid	Wall Finish	Closest A.D. E Wall type	$D_{nT,w}$ (dB)			
				Average		% ≥ 52	
Heavy Block	solid	plaster	1B	54	(56)	94	(97)
	≥ 50 mm	plaster	2B	57	(58)	99	(94)
	≥ 50 mm	dry-lined	2D	52	(54)	61	(75)
L/weight Block	≥ 50 mm	dry-lined	2C	52	(54)	56	(83)
	≥ 50 mm	plaster	2C	52	(56)	54	(93)

Table 2 Previous test data for similar constructions tested during the 1970s (IP 9/83) Data from 1993 - 1996 is included as (-)

Sound insulation field tests of Approved Document E wall types 1 and 2

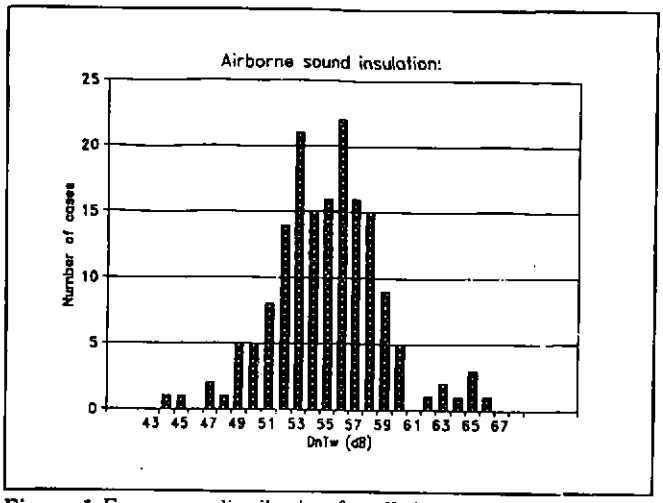

Figure 1 Frequency distribution for all Approved Document wall types 1 and 2 tested during the past three years (1993-1996)

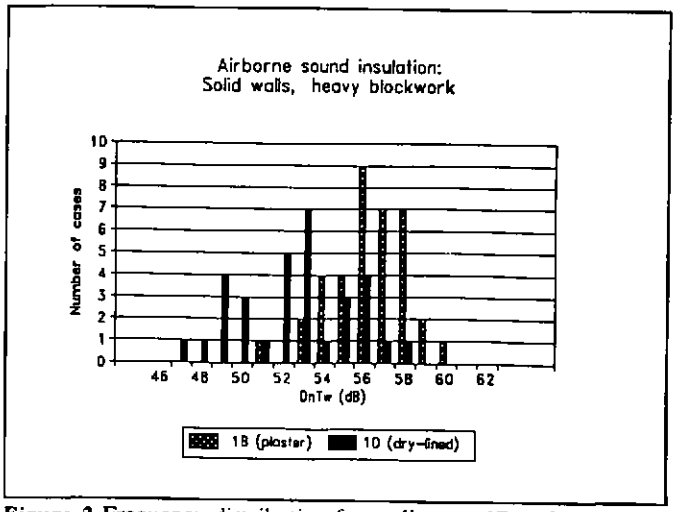

Figure 2 Frequency distribution for wall types 1B and 1D (heavy blockwork, solid masonry) tested during last three years (1993-1996)

Sound insulation field tests of Approved Document E wall types 1 and 2

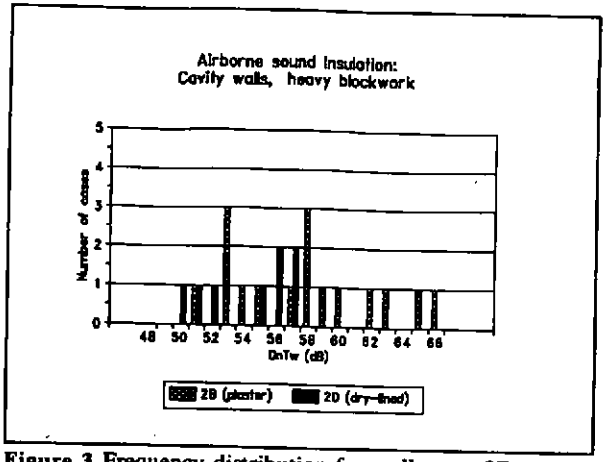

Figure 3 Frequency distribution for wall types 2B and 2D (heavy blockwork, cavity masonry) tested during the past three years (1993-1996)

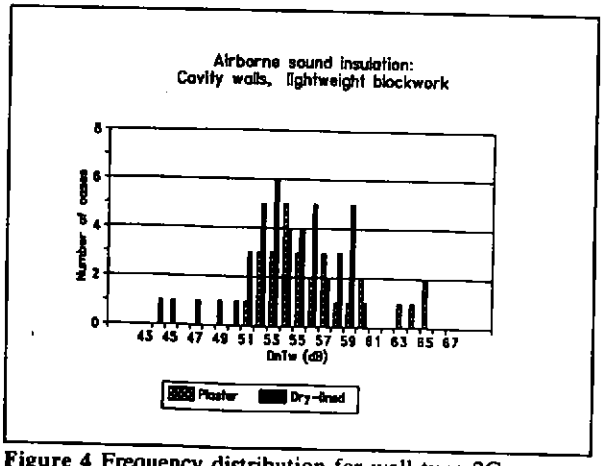

Figure 4 Frequency distribution for wall type 2C (lightweight blockwork, cavity masonry) for the past three years (1993-1996)

Sound insulation field tests of Approved Document E wall types 1 and 2

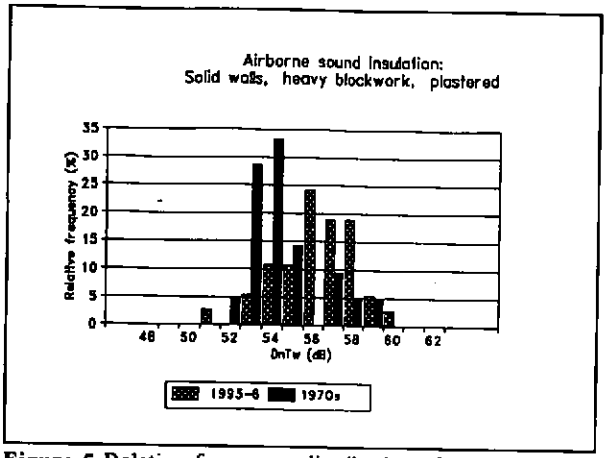

Figure 5 Relative frequency distributions for wall type 1B (solid wall, heavy blockwork, plaster finish).

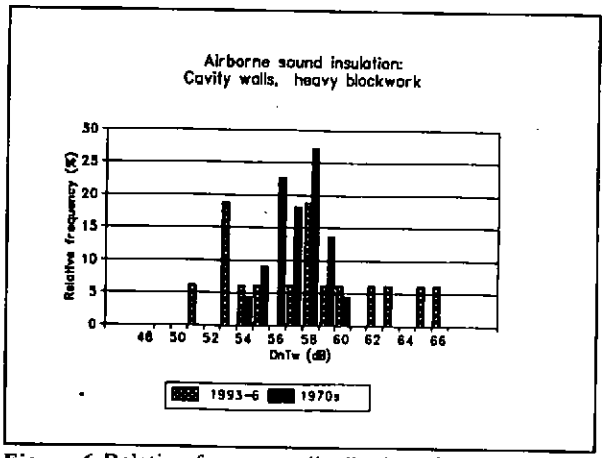

Figure 6 Relative frequency distributions for wall type 2B (cavity wall, heavy blockwork, plaster finish).

Sound insulation field tests of Approved Document E wall types 1 and 2

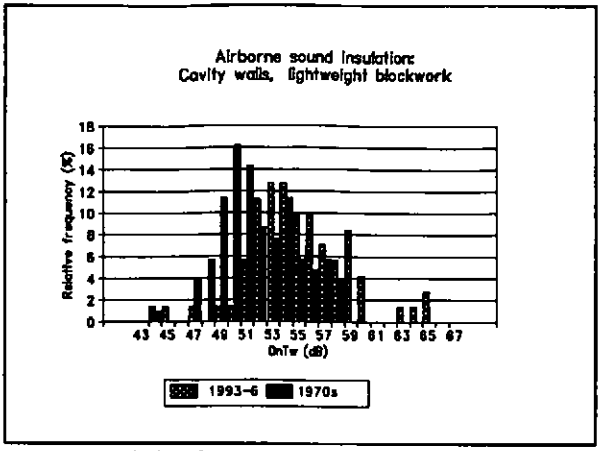

Figure 7 Relative frequency distributions for wall type 2C (Cavity wall, lightweight aggregate blockwork)