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# NEW BUILDING REGULATIONS FOR SOUND INSULATION

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## INTRODUCTION

A new format for Building Regulations for England and Wales was introduced during November 1985. In the case of sound insulation the old Part G has been superceded by Part E, but the changes have more significance than just a new name. The old Regulations were contained in a Statutory Instrument and could only be changed with the consent of Parliament. The new Regulations are in the form of functional requirements, listed in a Statutory Instrument, but ways of satisfying the requirements are suggested in supporting Approved Documents which are not Statutory Instruments. An advantage of the new system is that the ADs can be updated without consulting Parliament, but a consequence is that the solutions they contain are not deemed-to-satisfy the requirements.

The new Regulations are actually being introduced in two stages. Stage 1 is mainly a recasting of the old Regulations into the new form, while Stage 2 will include not only a reappraisal of the technical content but also a review of subjects for inclusion in Building Regulations. The results of Stage 2 should follow public consultation during 1986.

In the case of sound insulation the opportunity to make some technical changes was taken in Stage 1 and the basis of these changes is the subject of this paper.

The main changes are:

Adoption of BS 5821 (ISO 717) rating method.
Introduction of new constructions.
Dry-lining on some party wall constructions allowed.
Introduction of lightweight masonry inner leaves with certain window configurations.
Introduction of a construction only for use in step or stagger conditions.

## ADOPTION OF BS 5821 (1984)

The decision to replace the AAD rating method by BS 5821 was the outcome of a joint research project conducted by BRE and CSTB, our French counterpart. Both organisations conducted field surveys of sound insulation between dwellings [1] and followed these measurements with social surveys [2] so that the relation between various physical measures of sound insulation and subjective satisfaction could be explored. The two organisations used similar measurement techniques and questionnaires so the findings could be compared. In the case of BRE physical measurements made at 70 sites were used and 900 people living at these sites were interviewed. Sound insulation ranged from $D_{nT,w}$ = 44 to 68 with a mean of 51.

Field measurements of sound insulation yield values at 16 frequencies and rating methods are used to reduce this information to a more usable single figure. The objective was to find the rating method giving single figure values having the best correlation with subjective assessments. This work was part funded by the European Commission so the principal rating methods in use by member states were evaluated. These are shown in Fig 1. In addition some straight lines of various slopes were also included to show the importance of weighting different parts of the frequency spectrum. The subjective assessments were obtained from the answers to the question "How would you rate the sound insulation of your house from the one(s) next door?". Possible answers were: 1 very good, 2 good, 3 fair, 4 poor, or 5 very poor. The results of the analysis took the form of regression coefficients between subjective ratings and the corresponding physical ratings. Possible alternatives to the usual 10 log (T/0.5) reverberation time correction were also investigated and corrections of the type 10 log (S/A), 10 log (A/10) and no correction were tested.

The analysis showed that the main rating methods tested had similar correlation coefficients, of the order 0.7 for grouped data, and were not significantly different. Of the standardizing corrections 10 log (T/0.5) was superficially better than the others and "no correction" led to appreciably lower correlation coefficients. As no rating method which clearly performed better than the others had been identified it was decided to recommend ISO 717:1982 (equivalent to BS 5821:1984) as it had no major shortcomings and was already the most widely used.

The original standard for party walls was based on the performance of traditional solid brick walls, and the intention was not to change this standard. We established the equivalence between AAD and $D_{nT,w}$ by determining the proportion of solid brick walls in our data bank which satisfied the requirement of not exceeding 23 AAD and then determined the $D_{nT,w}$ corresponding to the same pass rate. This was $D_{nT,w} = 53$. An additional requirement was also added that no example in a group of four should have performance below $D_{nT,w} = 49$. This was to prevent rooms with poor insulation being accepted because other rooms in the group tested had insulation good enough to compensate for them when the mean was calculated.

## NEW CONSTRUCTIONS

Three types of construction have been included in the AD which were not previously deemed-to-satisfy. These are:

1. Timber framed party wall;
2. lightweight timber party floors; and
3. Party wall comprising masonry core with free standing panels on each side.

There is little to say about the timber framed wall. For sound insulation it is one of the best of the common constructions and the examples in our data bank have a mean $D_{nT,w}$ of 60 with 95% better than 57.

Two types of lightweight timber floor have been included as shown in Fig 2. These only just meet the criterion for inclusion in the AD and the Department has a contract with a research association to investigate ways of improving the performance.

The other new construction comprises a masonry core with free-standing panels of plasterboard on both sides of the core and along the external wall. This is capable of excellent results and it may be possible to lower the specifications when we have sufficient practical experience.

## DRY-LINING

Our field measurements have shown that in some cases dry-lined constructions perform about as well as their plastered counterparts, while in other cases the dry-lined version performs worse than the plastered version. The effect seems to depend on the porosity of the surface of the wall material. For example cavity party walls built from lightweight aggregate blockwork have a porous surface and our measurements show that both plastered and dry-lined versions have a $D_{nT,w}$ of 52. In contrast cavity walls built from dense concrete blocks have a mean $D_{nT,w}$ of 57 when plastered but this reduces to 52 when dry-lined, and the level achieved by 95% of examples falls below 49. In the case of solid brick walls the reduction associated with dry-lining is about 1dB, and the construction still meets the criteria for inclusion in the AD.

## LIGHTWEIGHT INNER LEAVES

It is now very common for the inner leaf of an external wall to be built from lightweight thermally efficient blockwork, which may have a mass as low as 60 kg/m². Our field measurements showed that in some, but not all, circumstances unexpectedly poor sound insulation and lightweight inner leaves seemed to go together. In particular it was found that in flats the floors between units at the gable-end often had lower insulation than floors between otherwise similar units in mid-block positions. The external walls were built from the same materials at mid-block and gable-end positions and the front and back elevations were similar in both situations, but the main difference was the gable end wall was often of large area unbroken by windows. It was this large area of external wall that provided a flanking path past the floor. The situation was sometimes confused by floors between mid-block flats showing the same unsually low insulation as the units at the gable end. This proved to be because the party walls were cavity types also built from lightweight blockwork and so each leaf of the party wall provided a flanking path equivalent to the inner leaf of the gable wall. The difference in insulation between floors at the gable end and floors in mid-block position (with heavy party walls) is illustrated in Fig 3 which shows the frequency distribution of the difference. The typical difference in $D_{nT,w}$ is about 2 which is not a great deal in subjective terms but is important in the context of Regulations.

An important conclusion of this work [3] is that although the front and back elevations also comprise a large area of inner leaf their effect as flanking paths is less than the same type of wall in the gable-end position. This seems to be because the front and back walls are broken into sub-areas by windows and doors and these areas are too small to vibrate independently at low frequencies.

The outcome of this is that the AD stipulates that where lightweight inner leaves are used the external wall must be divided by windows of a specified size.

## STEP OR STAGGER CONDITION

Our field survey has shown that a step (vertical displacement) or stagger (horizontal displacement) enhances the sound insulation between dwellings separated by cavity party walls of plastered masonry compared with similar dwellings built in-line. This means that some types of party wall that do not perform well enough for unrestricted use can be accepted in favourable step or stagger situations. The improvment in sound insulation is larger than would be expected from a reduction in common wall area and appears to be mainly due to a reduction in coupling between corresponding modes in the two leaves of the wall. A theoretical model [4] indicated that for a step or stagger of at least 300 mm the improvement in insulation should be about 3dB and larger displacements were of little benefit. The predicted gain in insulation depends to some extent on the critical frequency of the wall leaves. In Fig 4 the predicted gain in dB(A) is shown as a function of displacement for three values of critical frequency. The actual gain in insulation is shown in Fig 5 where the measured performance of 14 stepped plastered cavity walls made from lightweight aggregate blockwork is compared with a larger sample of similar in-line walls. The gain is of the order 3dB and this has allowed a type of wall which does not meet the normal criteria to be included.

## CONCLUSION

The Approved Document describes the constructions in much greater detail than in the previous Regulations and it also has an introduction which outlines the physical principles on which the different designs are based. It is thought that this additional information will make designers more aware of the importance of detailing and so enable them to produce buildings which consistently provide "reasonable" sound insulation.

## ACKNOWLEDGEMENTS

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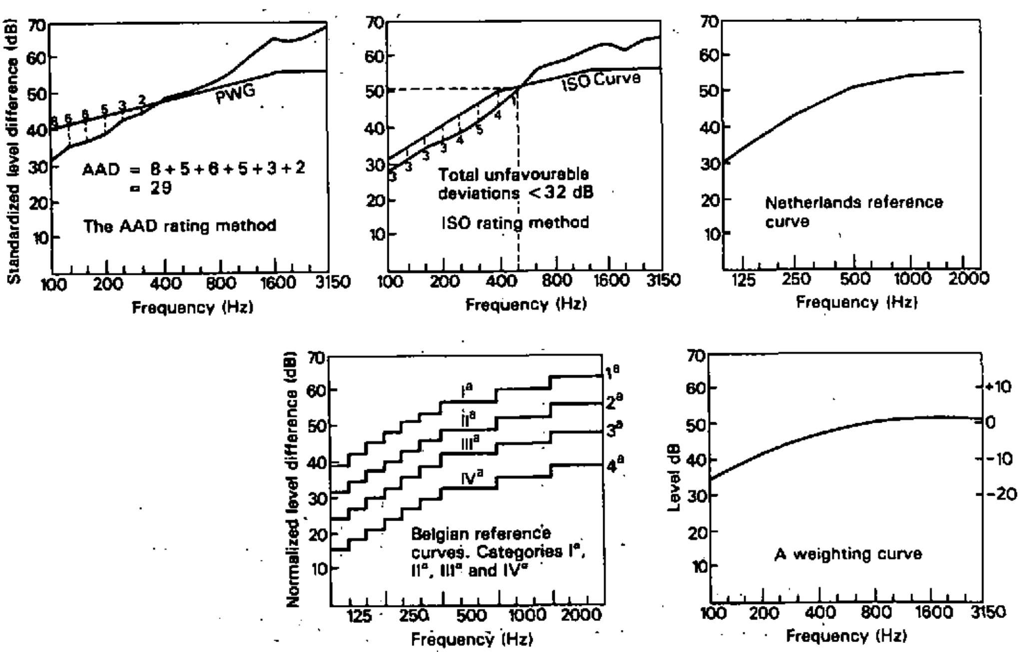


Figure 1 Main rating methods used in Europe

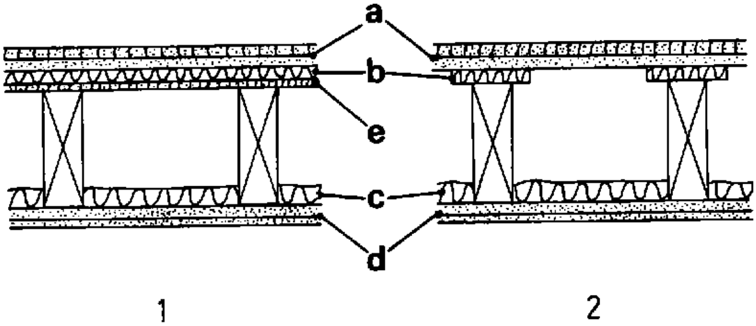


Fig.2 Timber floors

a Floating layer
b Resilient layer
c Absorbent or pugging
d Ceiling
e Plywood deck

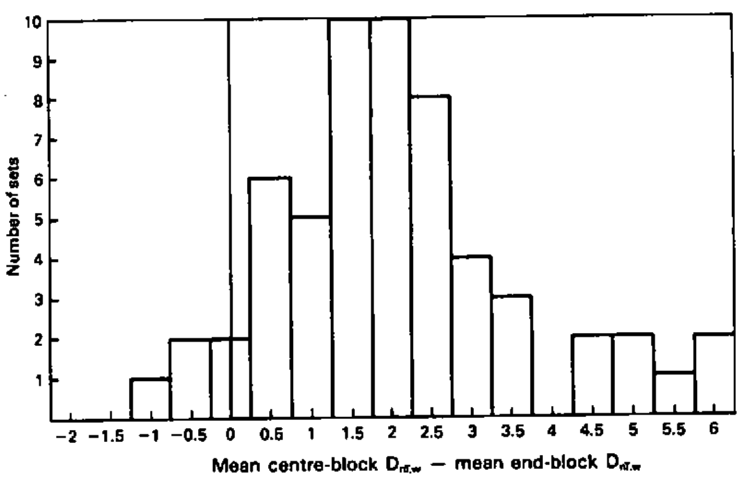


**Figure 3** Floating floors with party walls heavier than inner leaves, airborne ratings: distribution of differences between mean centre-block and mean end-block ratings within sets

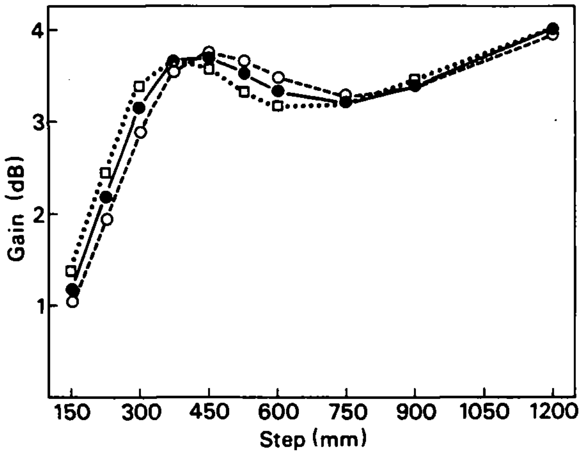


**Figure 4** Predicted gain in dB(A) insulation vs step size
O---O $f_c$ = 240 Hz; ●——● $f_c$ = 280 Hz; □····□ $f_c$ = 330 Hz

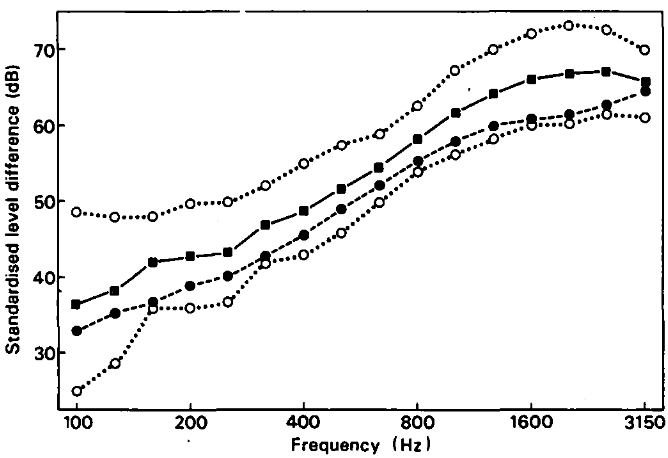


**Figure 5** Comparison of mean (■——■) and 90 per cent range (O····O) of 14 stepped but not staggered plastered lightweight aggregate blockwork walls with corresponding mean for in-line walls (●---●)