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THE EFFECT OF STAGGERED HOUSING LAYOUTS ON THE SOUND TRANSMISSION THROUGH DWELLINGS.

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1. Introduction

One of the sections contained in The Building Standards (Scotland)(Consolidation) Regulations 1971 concerns the resistance to the transmission of sound in buildings. This section, Part H, along with Schedule 10 which contains the Deemed to Satisfy Specifications, ensures that various types of wall and floor construction comply with the regulations as regards their sound insulation qualities. This paper is concerned with the transmission of sound through walls constructed between two adjoining houses.

The Building Regulations recommend that the measurement of airborne sound transmission be carried out in accordance with B.S. 2750:1956[1]. From this B.S. the formula for calculating the sound reduction index, also known as the transmission loss, is given as

$$R = L_1 - L_2 + 10 \text{ Log}_{10} (S/A)$$

where $L_1 - L_2 = D$, the sound pressure level difference between the source room and the receiving room. In this paper the effect that the area of the separating wall (S in the above formula) has on the noise reduction between the rooms under test will be discussed and results from a model study and from field measurements will be compared. Consideration is given to the effect of staggering the layout of houses both in the horizontal and vertical planes.

2. Model Study

The effect of a staggered housing layout on the transmission of sound through the separating walls was studied in the laboratory using a 1/5th scale model of two terraced houses. Figure 1 shows the layout of the model.

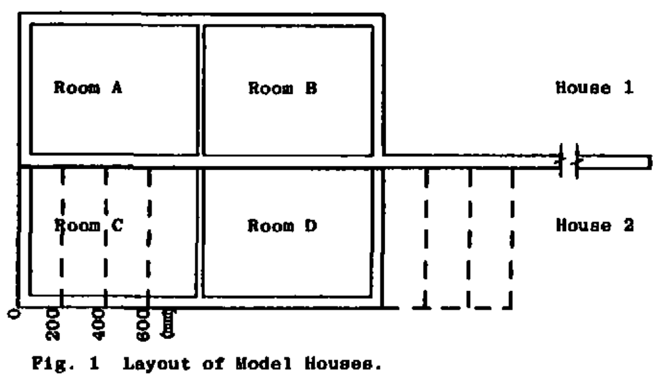

Fig. 1 Layout of Model Houses.

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The diagram shows the model representing two houses and each house contains two rooms. Rooms A and B of house 1 were constructed on a fixed base whilst rooms C and D of the 2nd house were built onto a movable framework. Both sets of rooms were mounted on solid rubber blocks. The separating wall between the two houses was solidly screwed to house 1 and extended beyond room B so that house 2 could be moved along the wall to simulate varying amounts of set-back. House 2 was tightly clamped to rooms A and B at all times during the measurements. Throughout the study room A was the source room and the others all receiving rooms. Because a large number of readings were made in each room for each set-back, the environmental conditions in the surrounding space were constantly monitored.

Figure 2 shows the noise reduction for the separating wall between room A and room C directly opposite. Four curves are shown representing different amounts of set-backs, at 0 mm, 200 mm, 400 mm and 600 mm all measured from the left hand side of the model. These positions are marked on the diagram of the model. As expected, there was an increase in the overall noise reduction except for a slight variation at the lower frequencies.

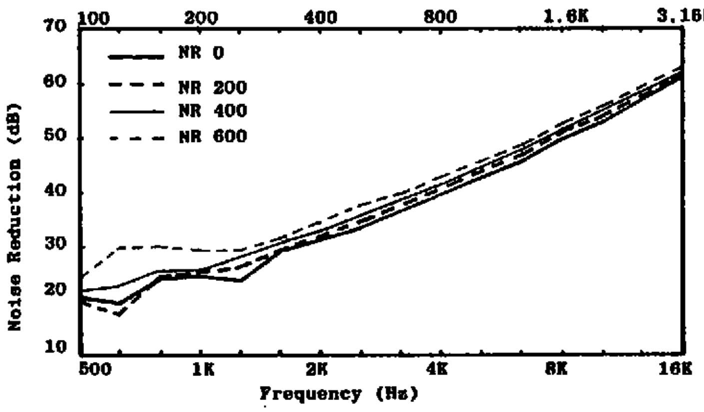

Fig. 2 Noise Reduction at Different Set-backs

However, figure 3 shows that the measured results from the model do not agree with predicted figures. The graph shows the difference in the transmission loss for various amounts of off-set. The transmission loss should be independent of area but it can be seen that this is not so. Agreement at the lower frequencies is slightly better than that at the higher frequencies. This large discrepancy is mainly caused by the effect of flanking transmission.

The results from the model study of two houses indicate that staggering houses to obtain a higher degree of sound insulation between dwellings is not as successful as expected.

3. Field Measurements

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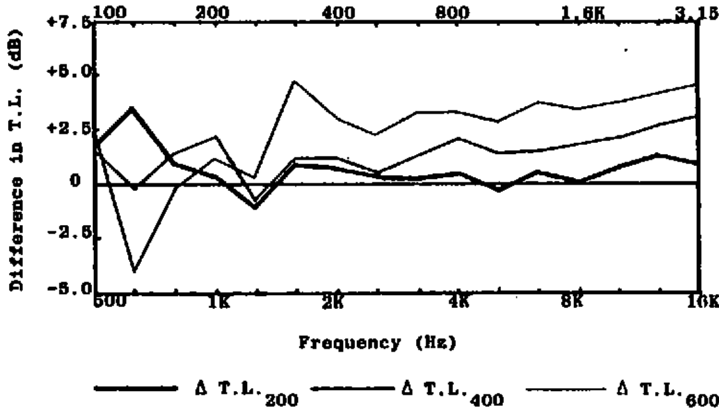

Fig. 3 Differences in Transmission Loss Along Wall.

Staggered housing layouts are quite a common occurrence in modern housing developments especially where the site is sloping or is restricted in size. Of course, this is not a new practice as many flats, houses, tenements etc. were constructed in this manner many years ago. In order to compare the model results with field measurements, tests were carried out in a number of small housing developments. Some of the test houses had no stagger whilst others were staggered in both the horizontal and vertical planes. Again measurements were made to see the effect of the 10 LogS correction. Sound pressure levels were measured in the source room and in the receiving rooms and the reverberation times of the various rooms under test were measured.

Figure 4 shows the results of measurements carried out on the same separating wall between two adjoining houses. Four sets of rooms were tested having different separating wall areas.

As can be seen there is very little difference between the top three curves even although there is a reduction in their areas corresponding to 3 dB and 4 dB, probably caused by measurement error. The lowest curve represents the transmission loss between two rooms with an area reduction corresponding to 13 dB. This, in fact, agrees with the model results. In theory the transmission loss should be constant but in practice it is often lower where there is a stagger in the horizontal and/or vertical plane. This reduction is due to flanking transmission. Similar results were obtained from other tests carried out on houses which had a staggered layout.

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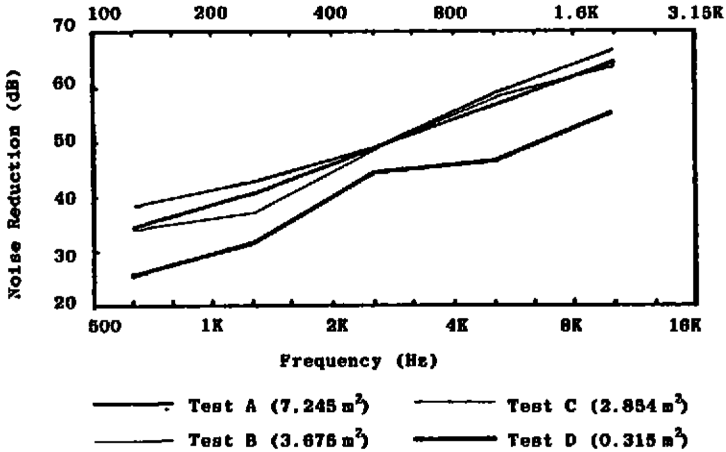

Fig. 4 Noise Reduction + 10 LogS for Four Test Rooms with Different Separating Wall Areas.

4. Conclusion

Results from both the model studies and the field tests have indicated that increases in party wall sound insulation by virtue of staggering the construction are less than that predicted by theory.

5. References

1. B.S. 2750:1956 Recommendations for Field and Laboratory Measurement of Airborne and Impact Sound Transmission in Buildings.