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SOUND TRANSMISSION THROUGH DOUBLE PLASTER PANELS: INFLUENCE OF ASSEMBLING SYSTEM

M A Sobreira (1) & M Recuero (2)

(1) E T S I Telecomunicacion, Campus Universidade de Vigo, Spain, (2) E U I T Telecommunicacion, Madrid, Spain

1. INTRODUCTION

In this paper the results of the sound transmission measurements of different double plaster panels are presented. The double panels were built from different combinations of single plaster panels, and these structures were assembled in two different ways: screwing (no air gap betweeen the two layers) and pasting (two single panels are glued with gypsum paste). These assembling systems are usual in Spain when mounting prefab plaster panels to divide rooms inside buildings. A S.E.A. model was also developed to estimate the sound reduction index of these structures [1], [2] with both assembling systems: the sound reduction index of the panels tested is calculated using this model, and then compared to the experimental values. The predictions show good agreement with the measurements.

2. THE MEASUREMENTS

The airborne noise acoustic insulation measurements were carried out in the transmission rooms of the D.I.A.C.'s laboratories (Polithecnic University of Madrid). The panels were mounted in a baffle (a rigid and heavy wall, with mass m>150 Kg/m^2). The size of the baffle was: length: 6.72 m; height: 2.76 m; the window inside the support wall, were the panels were mounted, is 1.2 m wide and 2.5 m high. The panels were mounted inside the window and fixed with gypsum paste; intensity mappings of the panels were made in order to check that there were no cracks or fissures. After that, the sound transmission index was calculated according to ISO 140-part III.

Measurement Results and Discussion

Only two particular cases of the set of panels measured and the general conclusions will be presented here.

Case 1: Panel N10+N10. The notation N10+N10 is refered to a panel builded by combining two identical single plaster panels of 10mm thick each. Each single panel mass is 7.5 Kg/m^2, so the double panel has a mass density M=15 Kg/m^2. The panel was measured with the two different assembling systems described above: a) both single panels screwed without any air gap, b) both single panels pasted with points of gypsum paste (so there was and airgap between both panels due to the thickness of the gypsum paste, this gap were about 1cm wide). Fig. 1 shows the result obtained for both situations. The classical mass law for field incidence is also depicted ($R(dB) = 20log(m \cdot f) - 47$).

It could be supposed that the sound reduction index of case a) can be calculated by means of the mass law equation for single panels. It can be observed in Fig. 1 how the sound reduction index measured in this case is lower than the calculated by the mass law (Panel Screwed: —; Panel Pasted: - -; Mass Law -.-). The low reduction index is due to the high degree of coupling between the two identical layers. So it can be noticed how these kind of panels neither can be treated as single nor their sound reduction index can be calculated from the classical mass law equation. It has been observed that this panel keeps the coincidence frequency (inside the 3.150 Hz 1/3 octave band) at the same frequency band that the single plaster panel 10 mm thick. Therefore the only advantage to use these kind of double panels is to keep the coincidence region as high as possible (a simple plaster panel with m=16.8 Kg/m^2 has its coincidence frequency in the 1.600 Hz 1/3 octave band).

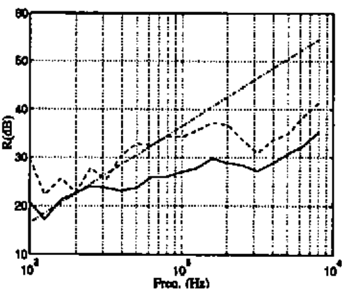

Fig. 1. *Sound Reduction Index Panel N10+N10*

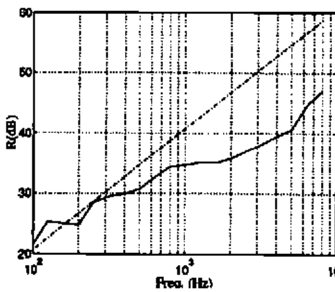

Fig. 2. *Sound Reduction Index Panel N10+N19*

Fig. 1 also shows the results for case b). Here the coupling between the two layers is made in two ways: through the acoustic shortcircuits (points with gypsum paste) and through the air cavity produced by the thickness of the paste. As the gypsum paste has similar characteristics to the plaster panels, the coupling through them will be high [3]. In spite of this, the sound reduction index is higher than the measured in case a), but anyway lower than the expected for a double panel: R just aproaches the mass law values for single panels.

Case 2: Panel N10+N19. Due to the different thickness (10mm and 19mm) of the two layers of this panel, a lower degree of coupling is expected–compared to case a)–. Fig. 2 shows the measurement results when this panel is assembled using gypsum paste. It can be observed how the sound reduction index is still lower than the calculated by means of the mass law equation, mainly at medium and high frequencies (from 800 to 8000 Hz), due to the efect of acoustic shortcircuit of the gypsum paste, mainly at high frequencies. From the mass law values depicted in Fig. 2 it could be expected that a simple panel with the same total mass (i.e. $m=7.5 + 16.8 = 23.3$ Kg/m^2) would have a higher Sound Reduction Index.

In short, from the measurements results, we can say that none of the two assembling systems shows an optimum behaviour (as expected). Anyway, the double panels assembled with points of gypsum paste have a higher Sound Reduction Index than those that have been screwed.

3. S.E.A. MODEL

A classical SEA model, applied to sound transmission through panels, was programmed in order to calculate the sound reduction index of different combinations of plaster panels [4],[5].

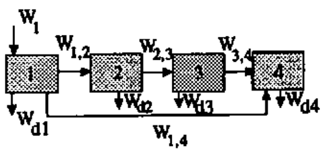

Fig. 3. *S.E.A. model for a screwed double plaster panel*

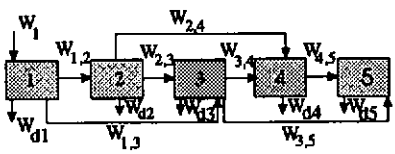

Fig. 4. *S.E.A. model for a double panel assembled with paste.*

Fig. 3 shows the model of transmission chosen for screwed panels; $W_{i,j}$ represents, as usual, the net energy flow between the systems i and j; if j=i+i, this energy flow is provoked by the resonant transmission and if j>i+i, the energy flow is caused by the non-resonant transmission.

Fig. 4 shows the model for the panels assembled with gypsum paste. It is the same model as the classical one [4],[6] for double panels, but direct transmission (non-resonant) due to the points of gypsum paste is taken into account. The result of the calculations are showed in Fig. 5 (N10+N10 panel; measured values: —; calculated values: -.-) and Fig. 6 (N10+N19, Measured Vs. Calculated Values).

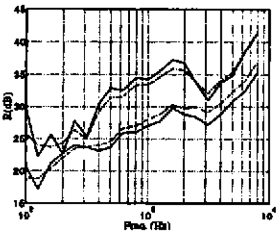

Fig. 5. *Sound Transmission calculated by SEA. Panel N10+N10*

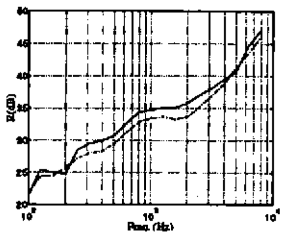

Fig. 6. *Sound Transmission calculated by SEA. Panel N10+N19*

4. CONCLUSIONS

In this paper the results of measuring double plaster panels with two different assembling systems has been presented. The performance of both systems is far from the optimum expected for a double panel, anyway the second one (two single plaster panels assembled with gypsum paste) shows a better behaviour. Also a S.E.A. model for both situations has been developed. S.E.A. calculations shows good agreement with the measurements [7].

5. REFERENCES

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