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SOMMAIRE

Une étude a montré que le coefficient d'absorption d'un panneau avec une monture E400 peut être nettement modifié par des petits détails de construction. Des recommandations sont formulées pour minimiser toute contribution à l'absorption du cadre du panneau.

Sound absorption variation caused by modifications to a standard mounting

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Investigation has shown that the absorption coefficient of a panel with an E400 mounting can be significantly affected by small details of the mounting construction. Recommendations are provided to minimize any contribution to the absorption from the mounting frame.

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INTRODUCTION

The standard test procedure for measuring sound absorption in a reverberation room in North America is specified in ASTM C423-77.[1] This standard allows the specimen to be mounted in a variety of ways to simulate actual installations; details are given in ASTM E795-81.[2] One of the most common mountings is the E400, which is designed to simulate a suspended ceiling with an air space. A frame is constructed, usually of wood or metal, in such a way that the top surface of the specimen is 400 mm above the floor and the frame is sealed at the floor to provide an enclosed plenum.

During a recent round robin of sound absorption measurements conducted by the Division of Building Research, National Research Council of Canada,[3] the same specimen was used on five different E400 mountings belonging to different laboratories. Three of the frames were made of aluminum, one of wood, and one of gypsum board. Examination of the absorption data showed that the wood frame used by the Division of Building Research produced significantly different readings in the frequency range from 800 to 3000 Hz, and that it was in some way different from the other four. The measurements described here provided an explanation for this difference.

I. MEASUREMENT PROCEDURE

Sound absorption measurements were carried out in accordance with ASTM C423-77, using nine microphones distributed throughout a 251 m^3 reverberant room. The computer-controlled real-time analyzer and decay curve averaging procedures used provided very good repeatability, permitting small differences among specimens to be identified with confidence.

The construction details of the NRCC frame are shown in Fig. 1. It is made of two layers of 19-mm plywood, for a total thickness of 38 mm, with an adjustable aluminum angle mounted around the top to allow for specimens of various thicknesses. The frame is sealed at the bottom by a hollow rubber gasket, which is compressed by the weight of the frame. Figure 1 shows that around the perimeter of the frame there is a cavity, labeled A, which is approximately 35 mm deep and has a variable cross section. This cavity has the potential for acting as a resonant absorber in the frequency region 1000–3000 Hz, the same range as the discrepancies observed in the absorption measurements. The sound absorbing specimen mounted in the frame comprised 600- $\times$ 900-mm panels of rigid glass fiber 50 mm thick, with aluminum *U* channel protective edging.

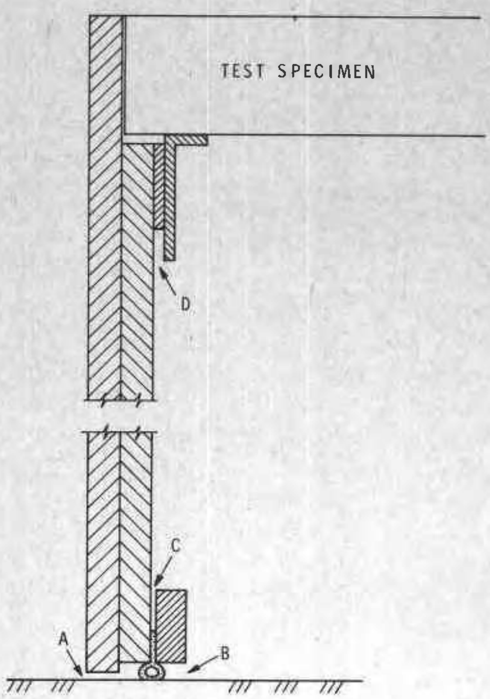

FIG. 1. Cross section of wooden frame used for E400 mounting.

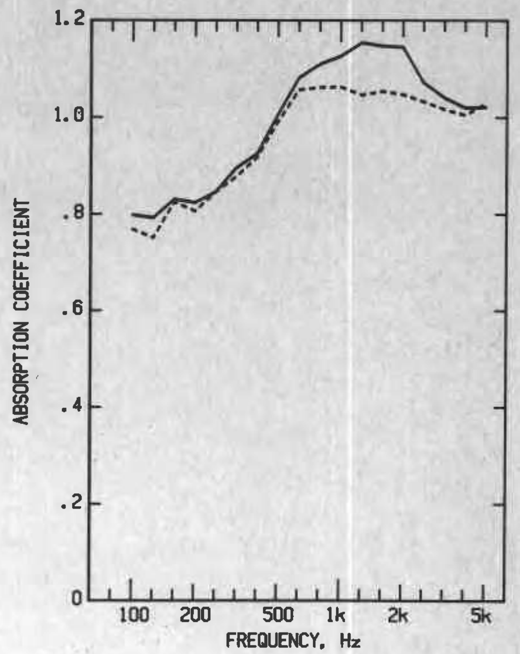

FIG. 3. Effect of taping cavity A; ——— normal, - - - - cavity covered.

II. EFFECTS OF BOTTOM SEAL

Initially it was thought that the gasket was not providing a proper seal between the frame and the floor. To test this, absorption measurements were made with the frame installed in the usual manner, then with the seal at the bottom of the frame improved by applying fabric tape around the inside, and finally with 6-mm dowels placed under the gasket along two adjacent sides of the frame to simulate a very poor seal. The results, plotted in Fig. 2, show that there is no significant difference among the three cases, indicating that the quality of the seal is not an important factor in the measurement and is not the reason for the different results.

III. EFFECT OF FRAME CAVITIES

The effect of the cavity, A, was then investigated by sealing it with fabric tape. The results, given in Fig. 3, show a marked decrease in the values of the absorption coefficients between 800 and 4000 Hz. The reduced values in this frequency range agree quite well with values found when using the frames of other laboratories.

The absorbing panels were then removed from the frame so that its properties alone could be studied. The ab-

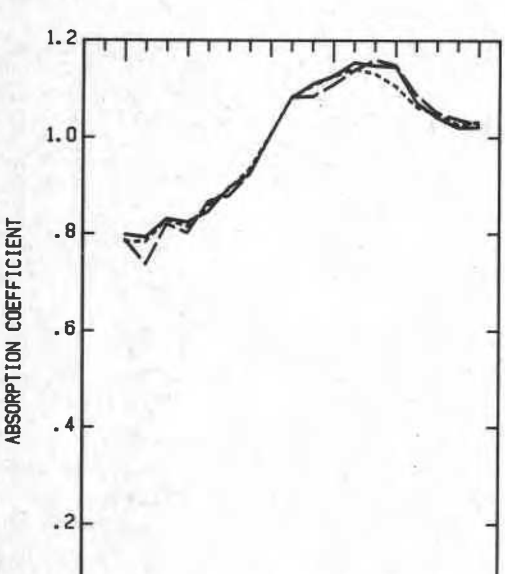

FIG. 2. Effect of varying seal at bottom of frame; ——— normal, - - - - taped, — — — — dowels under gasket.

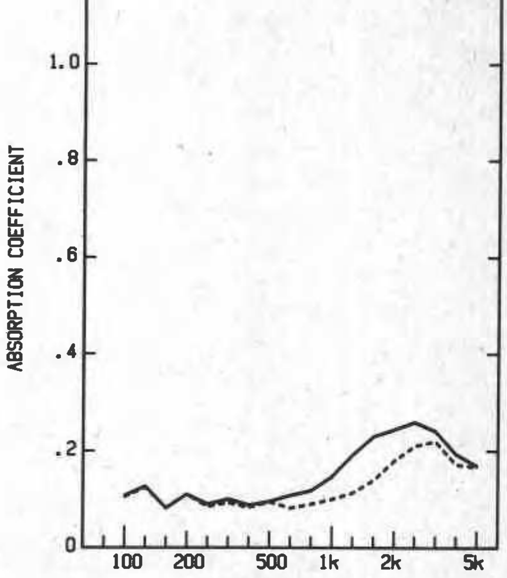

FIG. 4. Absorption of frame; ——— normal, - - - - cavity A covered.

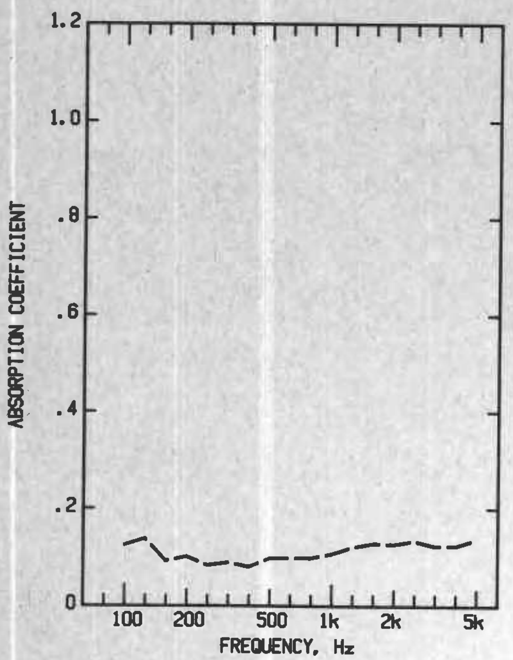

FIG. 5. Absorption of frame with all cavities covered.

sorption of the frame, without taping, assuming the usual specimen area of 6.69 m^2, is shown in Fig. 4. There is a broad absorption peak centered at 2500 Hz, roughly agreeing with the readings of the previous measurement. Also shown in Fig. 4 is the absorption measured after cavity A was sealed with tape. The difference between the two curves explains much of the difference between the two in Fig. 3, which shows the sample installed.

Again in Fig. 1, it is apparent that there are three other potential cavity resonators, labeled B, C, and D. Taping of the three cavities produced the result shown in Fig. 5. The absorption peak above 2000 Hz has been substantially reduced, indicating that there was a contribution from these cavities. The frame also contains cracks associated with corners and a joint where it can be separated into two pieces. These also may contribute to the remaining absorption.

A number of other measurements, not presented here, suggest that with absorbing panels installed in the frame, cavity A has the most influence on the absorption coefficients. Sealing the interior cavities has only a small, although measurable, effect with these panels, but other more porous panels may be more strongly affected.

IV. CONCLUSIONS

The detail of the design and construction of the frame to be used in mounting specimens for sound absorption measurements can have a substantial effect on the measured values. The design must be such that there are no cavities or cracks to act as resonant absorbers opening to either outside or inside the space enclosed by the frame. All joints should be well sealed or caulked, and if the frame is to be demountable care must be exercised that all joints are tight. The seal between the bottom of the frame and the floor should extend for the full width of the frame edge to prevent formation of a cavity around this edge.

ACKNOWLEDGMENTS

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[1]ASTM C423-77, "Standard method of test for sound absorption of acoustical materials in reverberation rooms," Am. Soc. Test. Mater., Philadelphia (1977).

[2]ASTM E795-81, "Standard practices for mounting test specimens during sound absorption tests," Am. Soc. Test. Mater., Philadelphia (1981).

[3]R. E. Halliwell, "Interlaboratory variability of sound absorption measurement" (submitted to J. Acoust. Soc. Am. for publication).