TESTING SINGLE LAYERED SOUND-ABSORBING PANELS IN OPEN ENVIRONMENT

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Abstract
This paper describes the dynamic tests performed on the materials used in the manufacturing process of sound absorbing panels the main purpose of which being to determine their flexibility. For this purpose, three dynamic investigation facilities were designed and fabricated: one installation for the determination of the flexibility of gypsum and its components, one installation for determining the absorption coefficient of sound absorbing materials and one installation required for the testing of sound absorbing panels in open environment. The sound absorbing panels can be used in various locations, including: airports, train stations, concert halls, conference halls, Olympic pools, sports halls, libraries, amphitheaters, large offices, traffic related constructions (metros, tunnels, road passages), industrial environment (industrial halls), discos, garages. The testing of sound absorbing panels made of special exterior gypsum was carried out on a 6 panel stand, by using a computer-generated noise source system, a microphone, and a second computer for recording and data processing. All these dynamic tests applied to gypsum-based and special pottery plaster-based materials with sound absorbing properties recorded continuous noise abatement over the entire frequency range used.

Key words: sound-absorbing panels, manufacture, mold, noise

INTRODUCTION

The purpose of the research regarding sound-absorbing panels concerning the noise reduction in home environments is a thorough research concerning sound-absorbing panels and noise absorption phenomenon by means of studying the panel aesthetics and finding new recipes and mixtures of sound-absorbing materials that should materialize by means of design and fabrication of various installations, in order to determine the mechanical characteristics and the flexibility of these materials.

The principle of sound wave absorption within a sound-absorbing material consists in the fact that the air molecules transporting the sound wave penetrate the fibers of the absorbent material, collide with them and lose kinetic energy that is transformed into heat. Thus, the sound waves having penetrated the material are left with less motion energy (mechanical energy) the result being lower amplitude. The thicker the fiber of the sound-absorbing material and the higher the resistance to air circulation, the better the absorption, up to a point where the air can no longer circulate well through the material. Gradually, it comes to reflect the sound waves, obstructing their passage. (Ungur , 2010)

MATERIAL AND METHODS

In order to measure the forces, piezoelectric or resistive force transducers, particularly strain gauges, are used in measurement schemes. Modern appliances are generally compact, including signal conditioning, analysis, measurement etc. providing multiple measurement possibilities and high reliability. Figure 1 shows a block diagram of an automated data acquisition system.

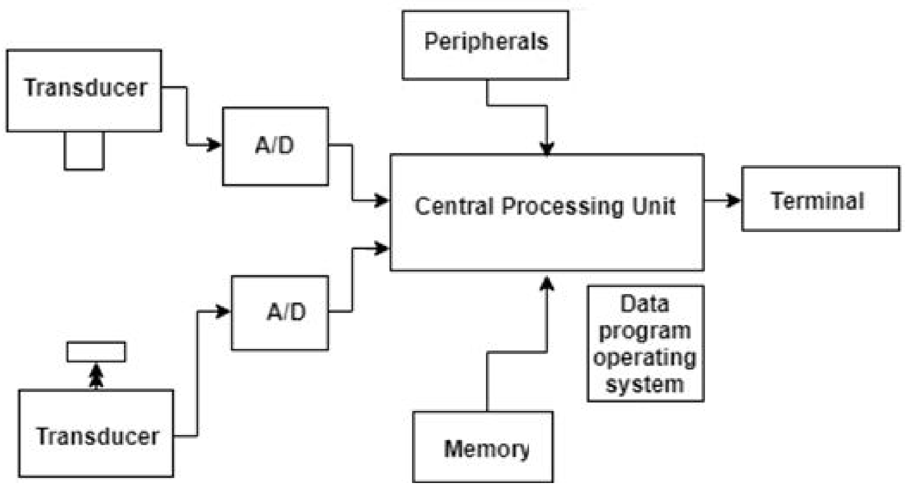

Fig. 1. Block diagram of an automated data acquisition system

Three categories of such analysis systems can be utilized:

- PC-based systems,
- FFT (Fourier Fast Transform) analyzers coupled with PCs or graphic workstations,
- Multi-channel data acquisition systems coupled with PCs or graphics workstations.

Characteristic features of a measurement and analysis system are the peripherals or the interfaces for generating and coupling analog signals. Digital-analogue and analogue-to-digital conversion devices (A/D,D/A) are required for the compatibility of the information processed by the computer with those generated or necessary for transducers, or drivers. Simple and lower-priced PC-based systems use conversion cards inserted into the PC, while advanced systems use separate conversion interfaces and equipment.

RESULTS AND DISCUSSION

A 6 sound-absorbing panel stand was built for the trial and two computers were used: one for signal generation and the other for acquisitions and interpretation of the noise passing through these panels fig.2. (Ungur, 2009)

Fig. 2. Installation for testing the behavior of sound-absorbing panels in outdoor environment

The tests were aimed at studying the behavior of sound-absorbing panels against a noise source located at various distance from the test stand. Thus, the speakers were placed at 0.5 m distance, in front of the test stand and the recording microphone at 0.5 m, behind the stand. Subsequently, the abovementioned distance (of the speakers) from the stand was modified to 1m and 1.5m, respectively, observing the same noise-generating conditions provided by the soundcard of the first computer. (Ungur, 2010)

Interpretation of the results was carried out in the "Zgomote0a3" program by using MATLAB, the output values of which were expressed in volts (V), and the CENTER 332 sonometer in dB, respectively, in order to highlight the possible attenuation of the sound signal at the moment of the passing of the sound through the test stand, by varying the sound frequency and the distance of the noise source from the sound-absorbing panels.

The results of the test are shown in Figure 3 and Figure 4.

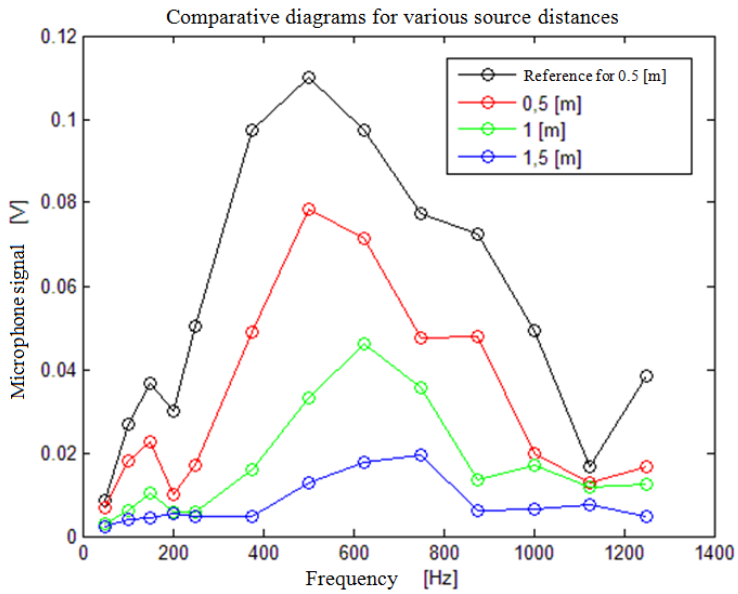

Fig. 3. Measurement diagrams for sound-absorbing panels by using the installation and interpretation of results by using the computer and the “Zgomote0a3” program, rendered in volts.

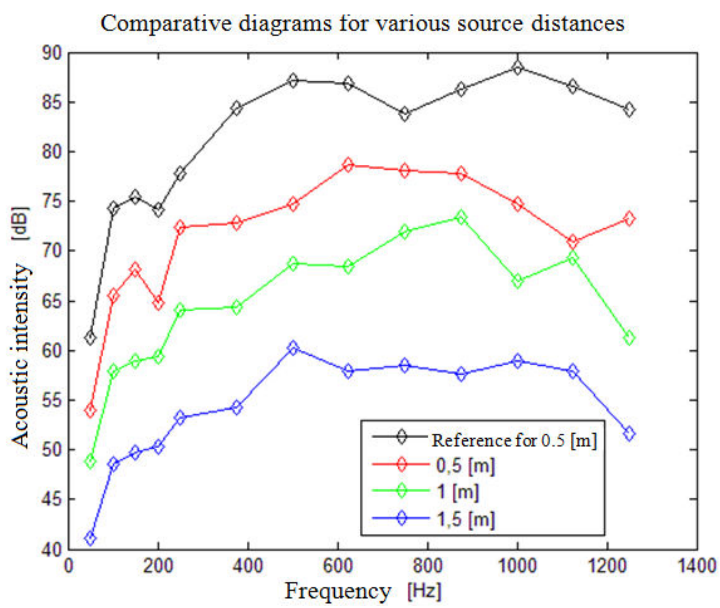

Fig. 4. Measurement diagrams for sound-absorbing panels by using the installation and interpretation of results by using the computer by using the CENTER 332 Sonometer, in dB

In what concerns the aesthetics of sound-absorbing panels for outdoor usage, several attempts were made. The most successful was their painting with geometric motifs as shown below:

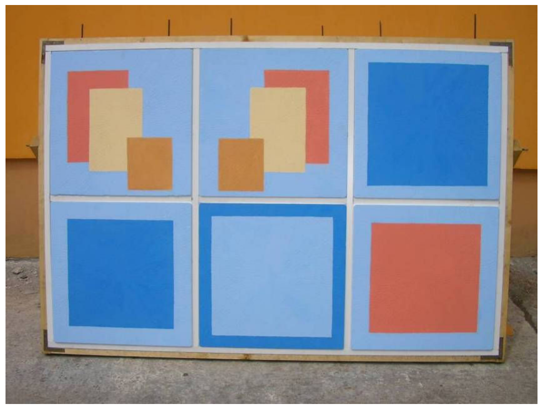

Fig. 5. 6 sound-absorbing panel stand used for outdoor testing.

Fig. 6. Sound absorbing panels used in outdoor environment to protect residential areas.

CONCLUSIONS

The testing of sound-absorbing panels fabricated of special exterior plaster was performed on a 6 panel stand, by using the system shown in Figure 2, consisting of a computer generated noise source, a microphone and a second computer for data recording and processing. The test used the 6 sound absorbing panel stand on which a noise source was applied from 0.5 m, 1.0 m and 1.5 m distance of the stand, was used and the results of the measurements were illustrated in Figure 3 and Figure 4. Both in the measurement with the computer and with the electronic sonometer can be noticed that the sound absorbing panels have caused noise attenuation over the entire frequency range. Thus:

- For the 0.5m distance between source and stand, there will be a -5.4dB and -15.5dB decrement, with a -9.6dB average, the best result being recorded at 1125Hz.
- For the 1.0m distance between source and stand, there will be a -12.5dB and -23.5dB decrement, with a -17.3dB average, the best result being recorded at 1250Hz.
- For the 1.5m distance between source and stand, there will be a -20.2dB and -32.6dB decrement, with a -27dB average, the best result being recorded at 1125Hz.

REFERENCES

1. Arghir, M., Ispas, V., Caraciun, F., Stoian, I, Blaga, F., Borzan, C., 2008, Monitorizarea Zgomotului Traficului Rutier, Editura Didactica si Pedagogica, Bucuresti.
2. Pantea I, 2007, Elemente de proiectare în designul industrial, Editura Universităţii din Oradea.
3 Ungur,P.A., Mihaila, I., Pop,P.A., Marcu, F, 2010, Interior Sound Ambient Insulation, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. IX (XIX), CD_ROM Ed., pp. - , Editor University of Oradea, ISBN 1583-0691.
4. Ungur, P.A., Mihaila, I., Marcu, F., 2009, Testing Equipment for Sound Absorbing Panel in Outdoor Environment. The 14th International Conference of Nonconventional Technologies 5-7 Noiembrie, 2009, Oradea, Revista de Tehnologii Neconventionale, Nr.1, Editura Politehnica Timisoara, pag.100
5. Ungur, P.A., Mihaila, I., 2009, The Painting of Phonic-Absorbent Ceilings, Annals of the Oradea University, Fascicle of Management and Technological Engineering, Vol. VIII (XVIII), pp.149, CD_ROM Ed., pp.879 - 883, Editor University of Oradea, ISBN 1583-0691.
6. Nanu, A., Marcusanu, A., 2005, Tratat de Tehnologii Neconventionale. Prelucrarea Materialelor Neconventionale", Editura Art Press, Timisoara.
7. Pop, P.A., Ungur, A.P., Gordan, M., Lazar, L., Marcu, F., 2009, Geometrical Optimization of Cathode with Direct Heating for Power Magnetrons by Using of Linear Thermal Compensator, The 20th International DAAAM Symposium "Intelligent Manufacturing & Automation: Theory, Practice & Education", 25-28th November 2009, Vienna, Austria, Annals of DAAAM for 2009 & Proceeding of 20th International DAAAM Symposium, pp.1201-1202, ISBN 978-3-901509-70-4, ISSN 1726-9679, pp.601. B. Katalinic Editor, DAAAM International Vienna Publisher, Austria
8. Popescu, M., Serban, L., Matei, V., "Compositie pe Baza de Ipsos-alfa", Brevet de Inventie Nr.114888B RO
9. Teoreanu, I., 1977, Teoria Cimentului si Azbest-Ciment, Editura Didactica si Pedagogica, Bucuresti.
10. Todinca, S., Cor, D., Procedeu de Obtinere a Ipsosului-alfa de Modelaj, Patent N.113459 B1 RO.