FACADE OF PERFORATED PLATE: ANALYSIS OF ITS ACOUSTIC BEHAVIOR

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Abstract: *This paper was designed to contribute to the application of acoustic solutions in construction. It is presented absorbing behavior of multilayer panels perforated plate, the study was demonstrated by simulating the proposed models using the program Sound Flow. The results were calculated and optimized using simulation software to achieve sound absorption coefficient.*

Keywords: *acoustic, panels perforated, SoundFlow .*

1. INTRODUCTION

Worldwide, the overall noise level is alarmingly high. we live in a noisy society mainly due to the technological environment in which we evolved.

We all know that noise pollution not only makes it hard to relax, but it causes stress and is a real threat to our health. We can not stop development, so any solution to noise will help us improve our physical and mental wellbeing.

All constructive solutions that protect us froma acoustic shock, always have a direct bearing on our quality of life, both physical and mental. Those solutions designed for acoustic enhancement are useful for both new construction and for rehabilitation so as to attenuate any noise and can enjoy the much desired peace and tranquility inside and outside the home.

As discussed in the beginning, the noise is a type of pollution to which we are exposed, that is why this finally master project aims to make the analysis of one of the most important parameters of the acoustic behavior of multilayer panels, as is the sound absorption coefficient. As such, this project focuses on the absorption of low frequency noise (noise from external source); specifically arises absorb noise generated by car traffic, planes and trains.

2. BASIC CONCEPTS

2.2 The Sounds. Sounds are vibrations mainly airborne, which can be perceived by the human ear and interpreted by the brain. They are characterized by its intensity, by the set of frequencies, and any variations thereof in time. People can interpret sounds as signals or noise, distinguishing the former as carriers of useful information, while the latter are undesirable sounds because they interfere with hearing the signal, its intensity or unpleasant frequency, or convey information not desired.

2.1 Frequency. Frequency is a measure of the number of repetitions of a periodic phenomenon per unit time. the international system unit is called hertz frequency and is symbolized by hz, the german physicist heinrich hertz in honor. a frequency of 1hz corresponds to a repetition period of one second. for example, we say of a woodpecker knocking beak into the bark of a tree 10 times per second, its head oscillates at a frequency of 10 hz.

The audible frequency range for people ranging from 20 to 20,000 Hz. (Cycles per second), although in practice this varies from one person to another, again depending on the age of it. The sounds below 20 Hz are called infrasound and ultrasound 20.000Hz above.

2.3 Intensity. Also called volume or amplitude of the sound. It is the quality that allows us to distinguish between loud and soft sounds. Strong as an ambulance siren and soft as a whisper. This intensity measures the sound pressure level (dB), which carries the sound wave on the particles of the medium through which it propagates.

2.4 Decibels. The intensity of the various noise is measured in decibels (dB), unit of measure of sound pressure. The threshold of hearing is 0 dB (minimum stimulus intensity) and the threshold of pain is 140 dB.

2.5 Sound propagation. Sound is transmitted through materials, solids, liquids or gases but not through empty media. to the sound may reach our ears need a space or propagation medium, this usually is usually the air. In general the speed of sound is higher in the solid and lower in the gases. In gases the particles are further from each other and hence the frequency of interaction is lower than in liquids and solids. The speed of sound in air at 20 ° C is 345 m / s.

2.6 Noise pollution. managing urban noise centered on the control of noise generated by activities in the urban residential land, however, public sensitivity to this form of pollution is increased. So now the environmental management processes involved in management of environmental noise generated mainly railways, traffic, roads, airports, factories, ports, leisure on public roads, municipal services and works.

Environmental noise pollution due to excessive sound that disrupts normal ambient conditions in a given area. While noise does not accumulate, moved or maintained over time as other pollutants, can also cause extensive damage to the quality of life of people if not properly controlled, this, together with the degree of impact caused by a besides noise source depending on its intensity, also depends on the sensitivity to the noise that has the receiver.

Noise pollution is generated by unwanted sounds that negatively affect our quality of life thereby preventing the normal development of our activities.

3. ANALYSIS AND RESULTS OF THE STUDY MODEL

3.1 Input data. All models use a 1.5mm thick plate with holes staggered and placed with airflow resistivity of 5 Kpa.s/m2. In the model which has absorbent material is used in all cases Rockwool wool with properties of density and air flow resistance is 75 kg/m3 to 45kPa.s / m2 respectively. Then discuss the absorption coefficient in each of the models and the changes produced by varying parameters such as the separation distance of the plate from the wall of the facade (d), the diameter of the holes (Ø) and the porosity of the sheet (p). For the analysis we reference the model with separation d = 700mm, holes diameter Ø = 3mm and porosity p = 40%.

3.2 Brief explanation of the software SoundFlow. SoundFlow a simulation software for the calculation of absorption, reflection and transmission of sound in multilayer structures. Allows the modeling of wall structures, floor and ceiling by specifying layer materials and thickness. In the database these materials are divided into three classes: absorbent, perforated sheets and plates. The classification depends on the mechanisms of sound absorption and for each of the types, different physical properties are used to define it. The program can display the following calculation results:

- Coefficient absorbtion
- Coefficient reflection
- Loss transmission including input impedance real part and imaginary,and the magnitude and phase
- Reflection factor including real and imaginary part and the magnitude and phase.

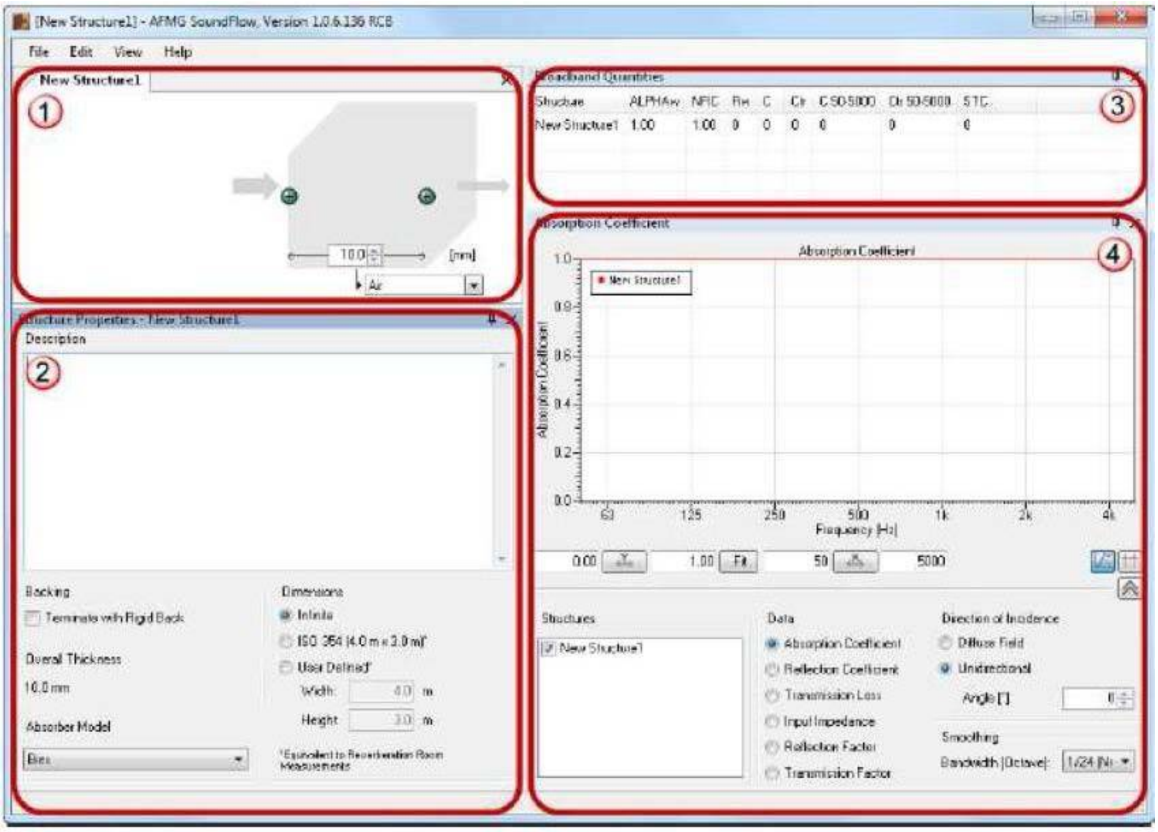

FIG. 1. *AFMG program window SoundFlow*

Section 1: Definition of the structure:

The pictorial representation of the structure to define the number of layers thickness and material.

Section 2: Properties of the structure:

The content of this window depends on the layer is selected in the structure. When a specific layer is selected edges will turn yellow and in this window properties that may be edited are displayed.

Section 3: Quantities broadband:

The table shows the set of indicators common broadband.

Section 4: Results Window:

The results can be displayed via a chart or by tables. When changes are made to the properties window the results are updated automatically.

3.3 Analysis of model 1: Sheet (1.5mm) + Air + Absorbent (50 mm) + Wall

a. VARIABLE AND SEPARATION WALL PLATE [500 mm, 700 mm, 800 mm, 1000 mm]

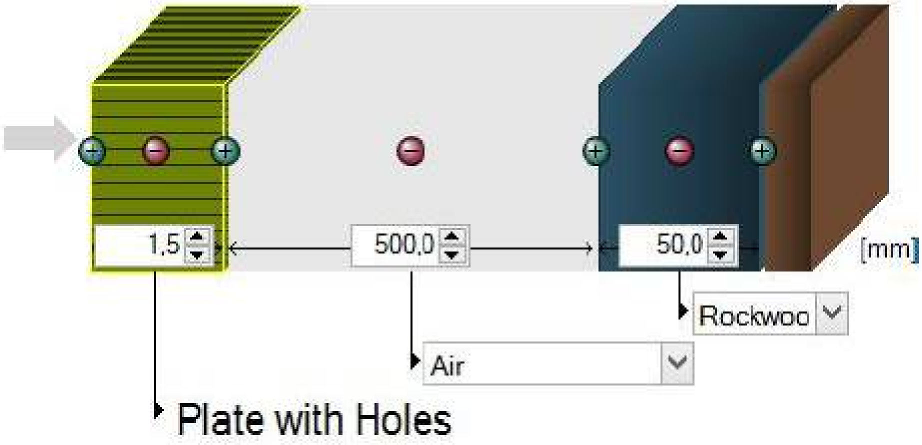

FIG. 2. Results d=500mm. Model 1

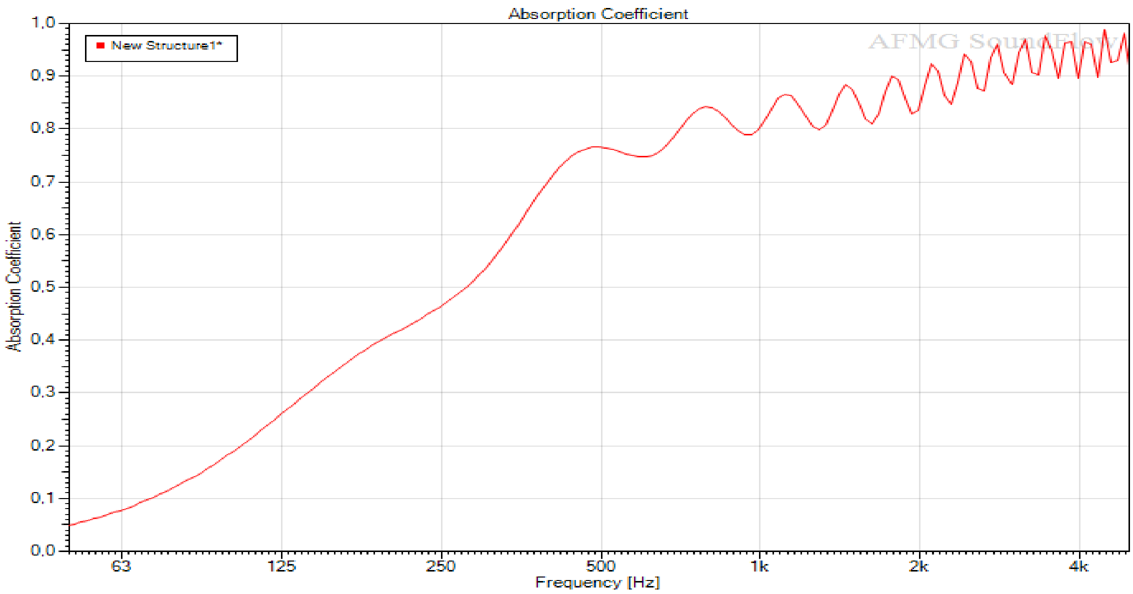

FIG. 3. Results d=500mm. Model 1

ANALYSIS:

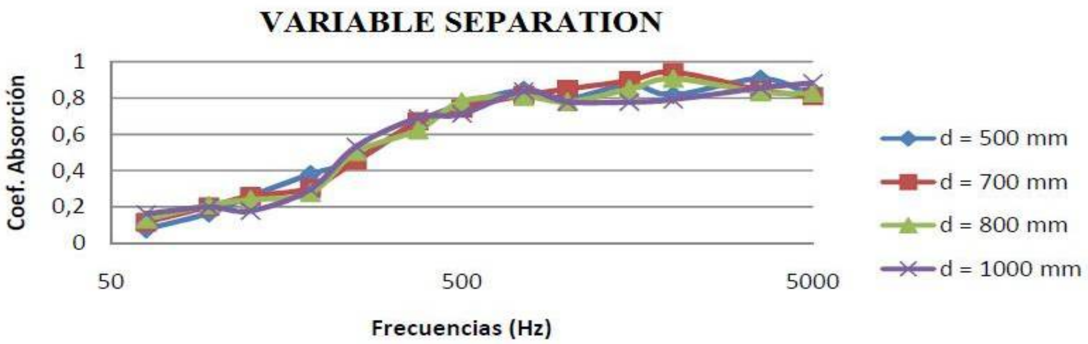

FIG. 4. Analysis influence the separation of the wall plate. Model 1

The trend line that is closest to the graphical representation of our model is a polynomial degree 3 curve. It can be seen to gradually increase as the separation distance of the wall plate to the curve shifts to the left and downward. By example comparing the curves for a distance of 500 to 700 millimeters graphic shifts a frequency of 425 hz with a coefficient of absorption 0734-375 hz with.

An absorption coefficient of 0.672. Namely that is reduced by 11.72% and a frequency coefficient of 8.44% absorption. When the spacing changes from 800 to 1000 mm movement curve is a counterclockwise 32.43% and 35.74% of a downwards. it thus the shift of the curve increases as the gaps they increase.

b. VARIABLE DIAMETER HOLE [1 mm, 3 mm, 5 mm, 10 mm]
ANALYSIS:

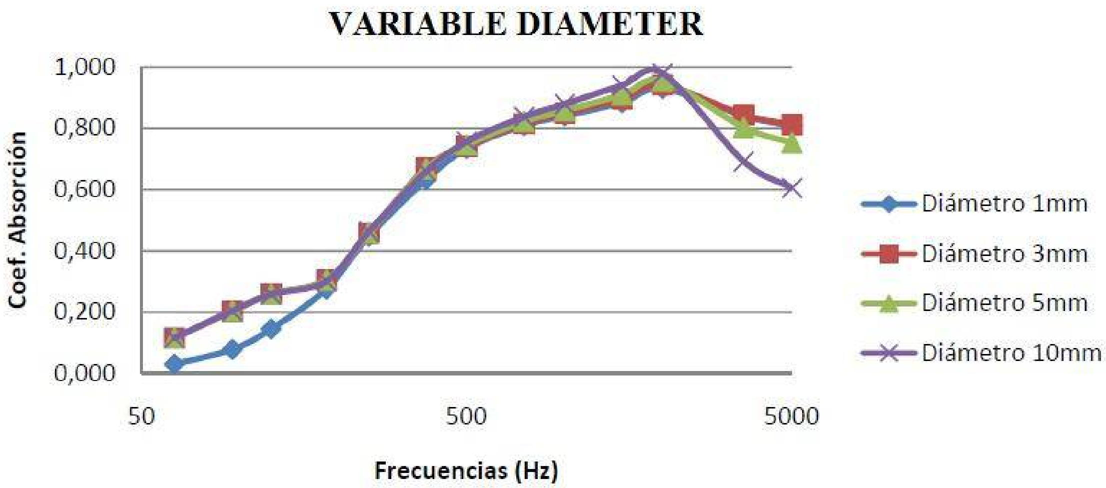

FIG. 5. Analysis influence the diameter of the holes of the plate. Model 1

For frequencies up to 2000 Hz the variation of the absorption coefficient in perforated plates with holes of 3.5 and 10 mm is almost the same, except for a slight increase of 4% around 2000 hz when the hole measured 10mm. from that point diameter growth is a reduction of the coefficient of absorption. From 185 hz plates with holes of 1mm in diameter behave like the others, to that extent its absorption coefficient is a 60% lower.

c. Varying porosity [35%, 40%, 45%, 50%]
ANALYSIS:

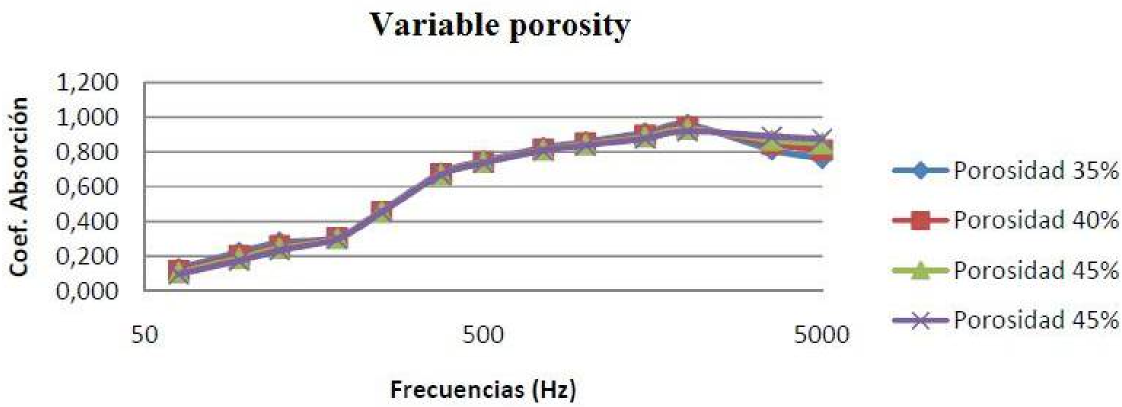

FIG. 6. Analysis influence of the porosity of the sheet. Model 1

4. CONCLUSIONS

Tabel 1.

d	500mm	700mm	800mm	1000mm	700mm				700mm			
Θ	3				1	3	5	10	3			
ρ	40				40				35	40	45	50
5 KPa.s/m2												
Frecuencias	Resulatados											
50	0,049	0.078	0.094	0.122	0.017	0.078	0.078	0.078	0.089	0.078	0.071	0.064
63	0,078	0.116	0.133	0.161	0.031	0.115	0.115	0.116	0.130	0.116	0.105	0.096
80	0,121	0.163	0.178	0.191	0.053	0.163	0.163	0.163	0.181	0.163	0.149	0.138
100	0,182	0.215	0.218	0.197	0.090	0.215	0.215	0.215	0.235	0.215	0.199	0.186
125	0,258	0.259	0.240	0.181	0.145	0.260	0.260	0.260	0.277	0.259	0.245	0.234
160	0,337	0.289	0.253	0.211	0.219	0.289	0.289	0.290	0.299	0.389	0.281	0.275
200	0,405	0.333	0.322	0.376	0.316	0.330	0.329	0.333	0.334	0.333	0.332	0.331
250	0,465	0.458	0.497	0.526	0.448	0.455	0.457	0.456	0.461	0.458	0.455	0.453
315	0,556	0.625	0.622	0.564	0.581	0.631	0.625	0.624	0.636	0.625	0.617	0.610
400	0,691	0.676	0.653	0.700	0.642	0.675	0.676	0.679	0.676	0.676	0.675	0.675
500	0,761	0.739	0.761	0.730	0.733	0.734	0.735	0.734	0.740	0.736	0.732	0.729
630	0,76	0.783	0.774	0.781	0.753	0.783	0.784	0.786	0.783	0.783	0.783	0.783
800	0,828	0.817	0.806	0.811	0.821	0.833	0.817	0.816	0.822	0.817	0.814	0.811
1000	0,815	0.824	0.827	0.830	0.830	0.830	0.824	0.824	0.825	0.824	0.822	0.821
1250	0,831	0.830	0.840	0.832	0.844	0.847	0.831	0.833	0.829	0.830	0.831	0.832
1600	0,852	0.850	0.847	0.851	0.830	0.850	0.850	0.849	0.851	0.850	0.848	0.846
2000	0,877	0.870	0.872	0.869	0.859	0.872	0.871	0.873	0.867	0.870	0.871	0.872
2500	0,901	0.905	0.901	0.904	0.882	0.900	0.906	0.908	0.900	0.905	0.907	0.907
3150	0,931	0.929	0.930	0.931	0.902	0.929	0.931	0.934	0.920	0.929	0.934	0.935
4000	0,939	0.940	0.943	0.941	0.902	0.940	0.943	0.948	0.924	0.940	0.947	0.951
5000	0,947	0.947	0.942	0.959	0.902	0.950	0.951	0.958	0.925	0.947	0.957	0.962

Focusing on the wing we are intterested in increasing the absorbtion acoustics to reduce traffic noise 125 hz,it is concluded that the best separation of the plate to the wall is 700 mm.furthermore most beneficial for increased absorbtion is working with holes 3 mm in diameter. Finally clearly shows that the smaller the porosity is greater than the absorbtion in our cases select the sheet with a percentage of 35% perforated area.

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