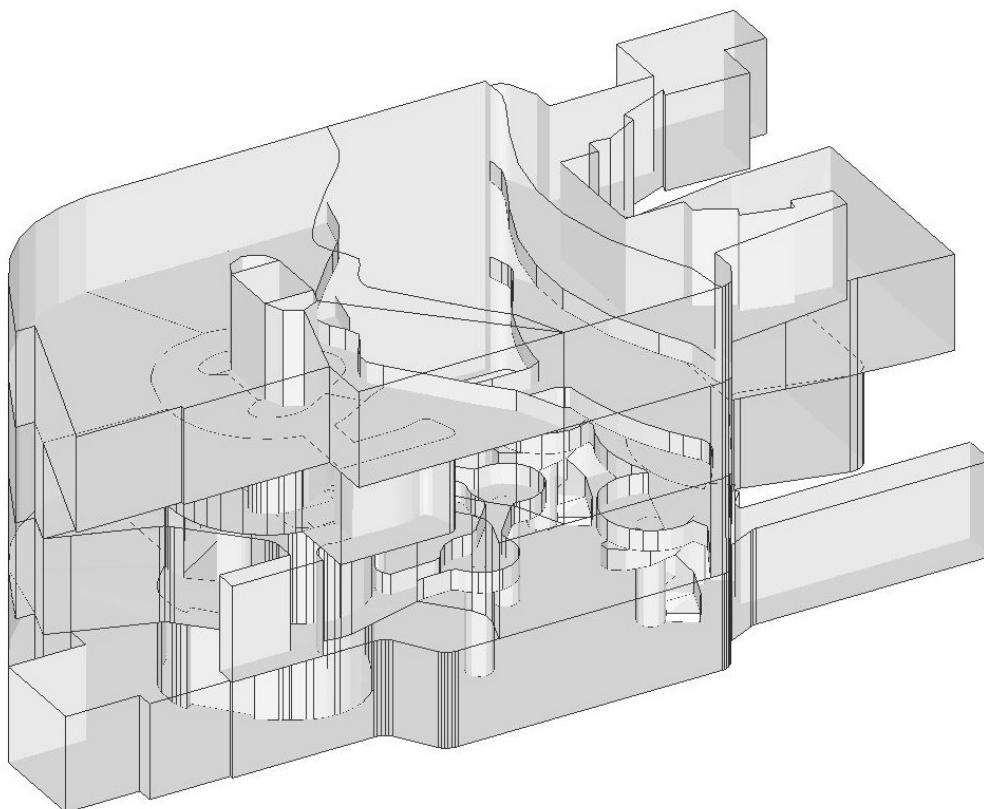


Acoustic Simulation

VAS



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November 2020

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1. Introduction

Simulation has been done for Pavilion building.

Object dimensions:

Volume $\approx 10\,850\text{ m}^3$, floor surface $\approx 1\,650\text{ m}^2$

The calculations were made in the EASE 4.4 program. The AURA method was used - a method with high reliability, using an advanced ray-tracing algorithm. The algorithm used by AURA, in contrast to the Standard method implemented in the EASE program, actually simulates the propagation of sound waves in space. The Standard method is based only on the calculation of direct sound, while reverberation in the room is estimated based on algebraic statistical formulas formulated at the beginning of the 20th century. The algorithm used in the Standard method does not simulate the propagation of the wave in space, it does not take into account the wave reflections from obstacles and room divisions. The Standard method gives reliable results only in a limited range of cases, where the acoustic field is perfectly diffused and there are no obstacles in the way of the speaker - listener. It is not applicable at all in flat rooms (eg. garage), long ones (eg. corridor, tunnel), those in which the acoustic absorption is unevenly distributed (eg. a waiting room with a strongly sound-absorbing ceiling) and rooms with a complicated architectural shape (e.g. passage). In such cases, the AURA method should be strictly applied. The results obtained using the AURA and Standard methods cannot be compared in any way.

2. Input data to simulation

Acoustic simulations of Voice Alarm System have been done based on interior concept projects and building architectural documentation.

The results of simulation contain:

- Total Sound Pressure Level (Total SPL) for each octave (respectively 500, 1000, 2000, 4000, 8000 Hz)
- Broadband Total SPL
- Speech Transmission Index (STI) measured by STIPa method M-weighted with background noise.

2.1. Pavilion building

Room has been presented on fig. 1. Value of noise level estimated at **75dBA**. Audience areas are located at 1.6 m above the surface. It was assumed that room is empty – there are no people.

In the control cab are 61 SP-S206B (ceiling-speakers) set on 3W tapping. In small areas are located 4 SP-W6 which are installed at 2,2 m above the surface (floor), set on 1,5W tapping. In the most exacting areas (open space with 18,7m to the ceiling) are installed line array speakers SP-LA60, 2,2m above the surface.

Speaker parameters described respectively in table 1, 2, 3. Figure 2 presents speaker's locations (violet lines represents SP-LA60s aiming directions).

In order to improve acoustic parameters in object – especially reverberation time, applied acoustic treatment. On the ceiling of each floors- Acoustic material in class A – for eg. Fiberglass 50 mm (AF 530 2" MOUNTING 4) – fig.4. Figure 3 shows acoustic material location (orange painted faces).

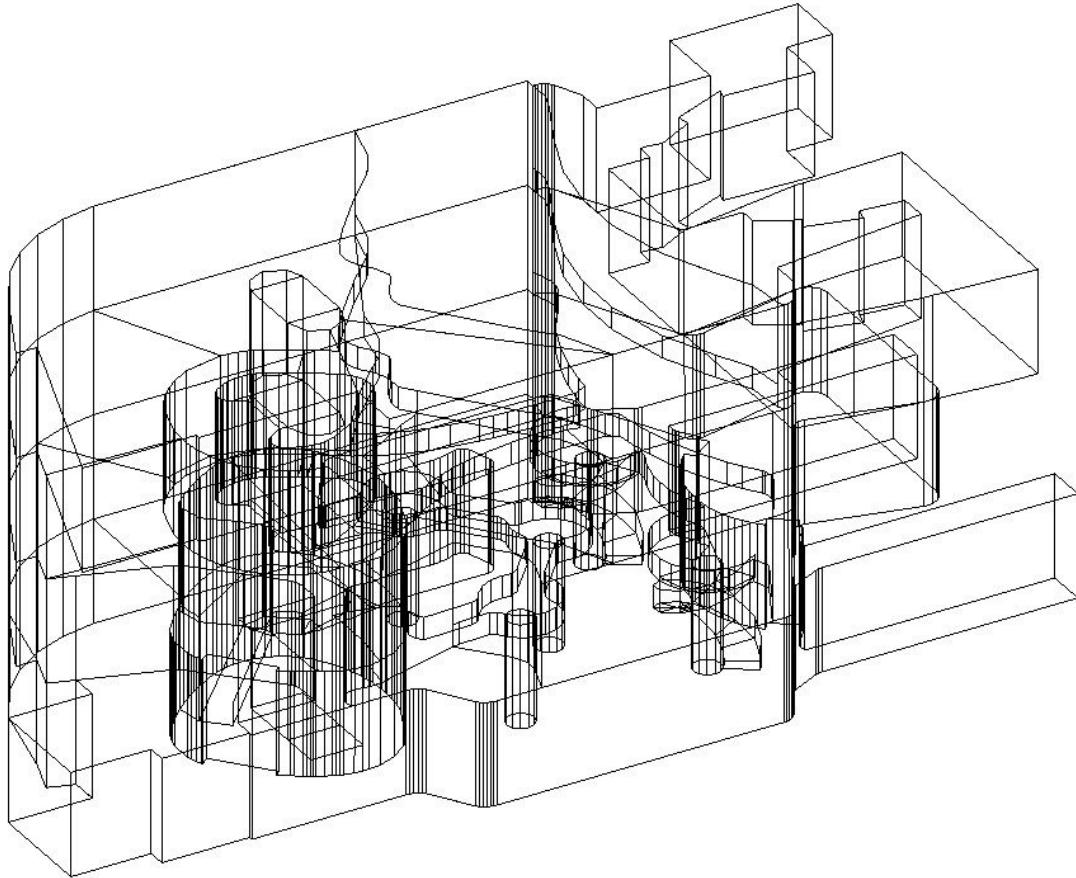


Figure 1 Object projections

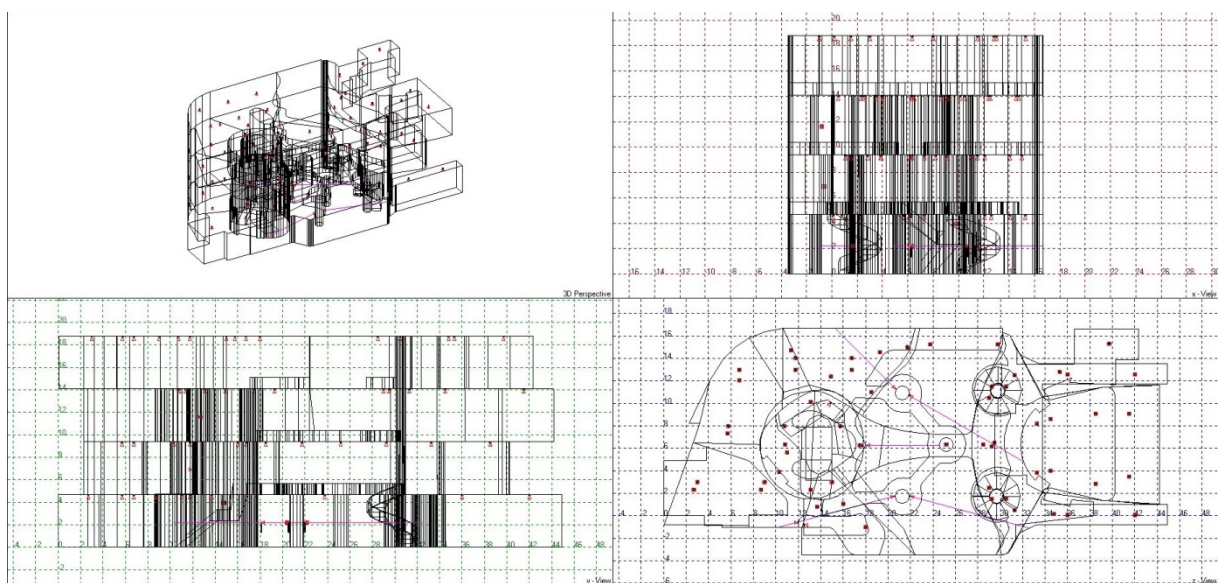


Figure 2 Speaker's locations

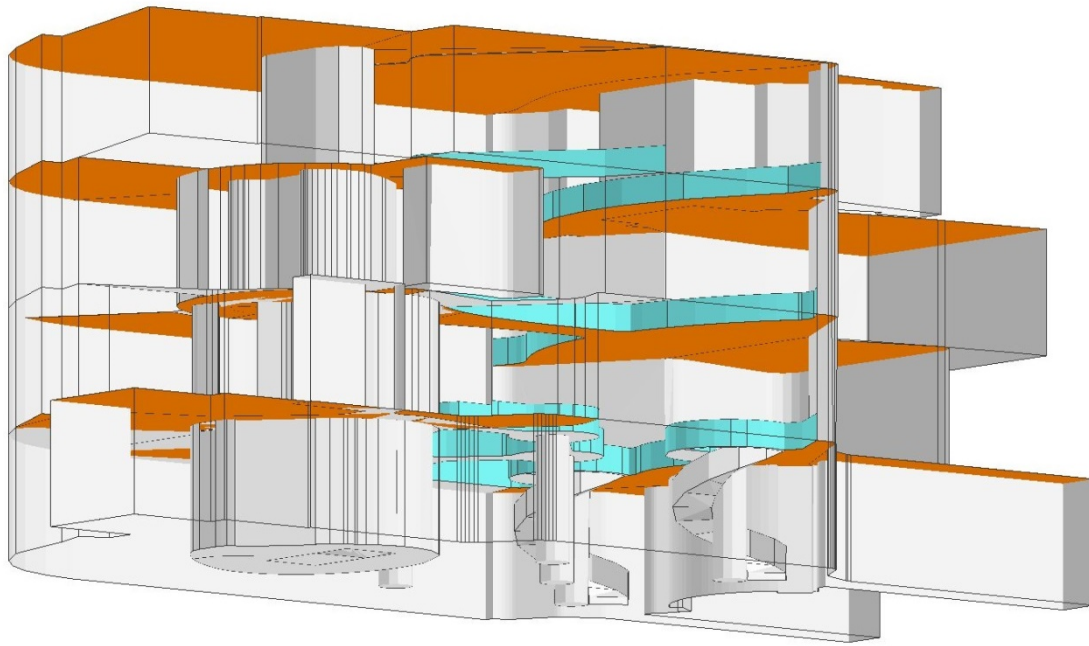


Figure 3 Acoustic material location

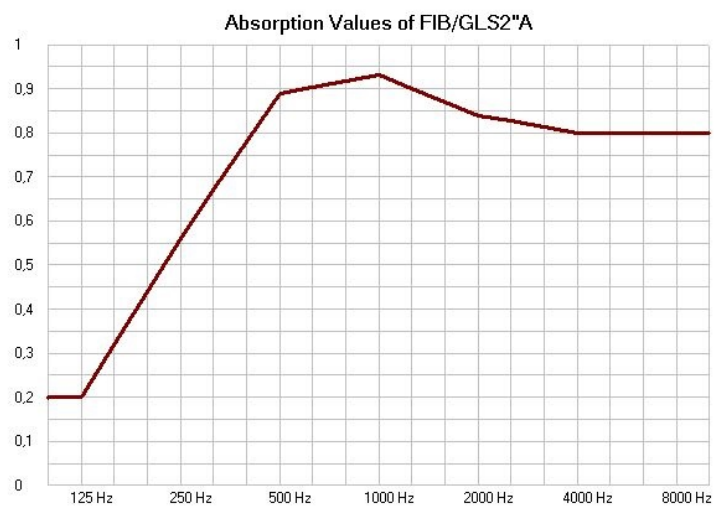




Figure 4 Exemplary material used in object

Table 1 SP-206B speaker parameters

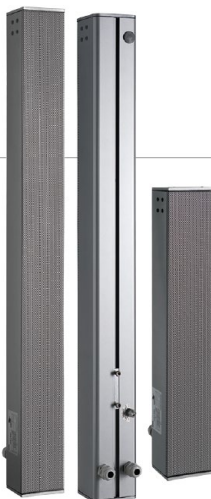
Type	Specification	
SP-S206B	Rated power [W]	6
	Power tapings [W]	6; 3; 1,5; 0,75
	Impedance [Ω]	1667/3333/6666/13333
	Max SPL [dB]	101 / 93
	bandwidth [Hz]	120-20000
	Coverage angle 1kHz / 4 kHz [°]	180 / 70
	Temp [°C]	-10 / +55
	Material	Steel
	Working environment	A
	Degree of protection	IP 32 C
	color	White/black
	Dimensions [mm]	Ø199
	Weight [kg]	1,1


Table 2 SP-W6 speaker parameters

Type	Specification	
SP-W6	Rated power [W]	6
	Power tapings [W]	6/3/1,5/0,75
	Impedance [Ω]	1667/3333/6666/13333
	Max SPL [dB]	101/94
	bandwidth [Hz]	120-20000
	Coverage angle 1kHz / 4 kHz [°]	180/80
	Temp [°C]	-10 / +55
	Material	Stal
	Working environment	A
	Degree of protection	IP21C
	color	Paleta RAL
	Dimensions [mm]	260 x 180 x 80
	Weight [kg]	2,3


Table 3 SP-LA 60 speaker parameters

Type	Specification	
SP-LA60	Rated power [W]	60
	Power tapings [W]	60; 30; 15; 7,5
	Impedance [Ω]	166,6; 333,3; 666,6; 1333,3
	Max SPL [dB]	114/96
	bandwidth [Hz]	136-20000
	Coverage angle 1kHz / 4 kHz [°]	230/110
	Temp [°C]	30/8
	Material	-25 / +70
	Working environment	Aluminium
	Degree of protection	B
	color	IP 33 C
	Dimensions [mm]	Paleta RAL
	Weight [kg]	870 x 80 x 110
	Rated power [W]	5,5



Room data:

- Volume $\approx 10\,850\text{ m}^3$
- Room Surface $\approx 1\,650\text{ m}^2$
- Avg. Absorption Area:
 - without acoustic treatment $A \approx 375\text{m}^2$, $\alpha \approx 0,05$
 - with acoustic treatment $A \approx 1563\text{m}^2$, $\alpha \approx 0,19$

Simulation setting:

Simulation method: AURA simulation

Number of Particles: 5 000

Default Scattering: Slightly Structured Surfaces [%]: 20

Scattering Method: Standard

Audience area height: 1,6m

Counting method: Pink Noise

Mapping : Broadband A-weighted

Noise level: 75 dBA

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