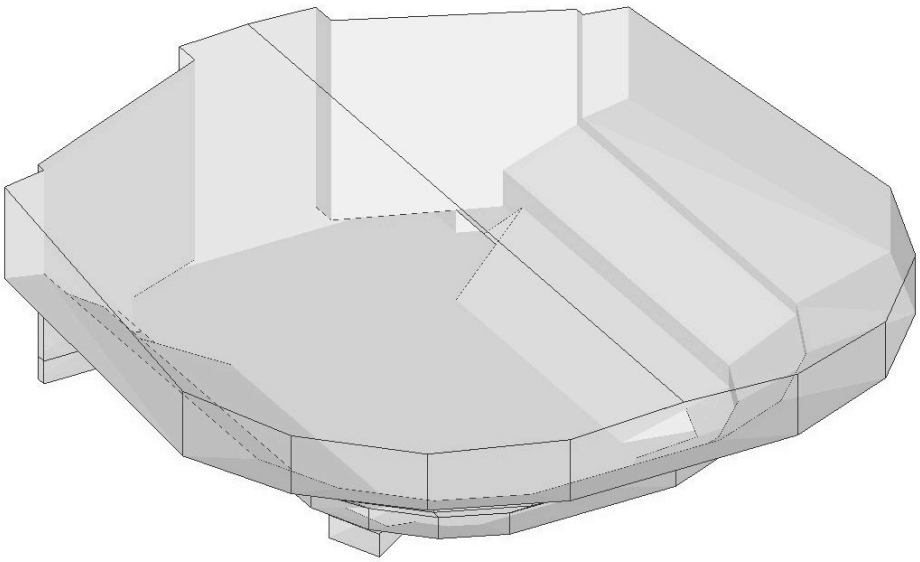
Acoustic Simulation

Voice Evacuation System



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1. Introduction

The study includes the presentation and analysis of the results of acoustic simulations carried out for the PA/VA system designed for the Arena building.

Simulations were made for the arena room.

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 for simulation

Acoustic simulations of the PA/VA system were carried out based on the architectural documentation of the building.

The following parameters were analysed:

- total sound pressure level [TOTAL SPL]
- STI speech transmission value determined by the STIPa method with M weighting including the background noise and masking effect
- Clarity C_{50} and C_{80}

Arena

The body of the object is shown on Fig. 1.

The background noise level was estimated at 85dBA. The listening surfaces were placed 1.6 m above the floor of arena and 1.2 m above seatings.

The room uses 44 speakers ABT-HP240EN66 at the 240W power.

Data of the loudspeakers used were collected in Tab. 1. The arrangement of the speakers has been proposed to achieve optimal sound coverage and STI value. Loudspeakers are mounted to construction elements and directed to arena and seatings (fig. 3)

The interior finishing was adopted in accordance with the provided documentation.

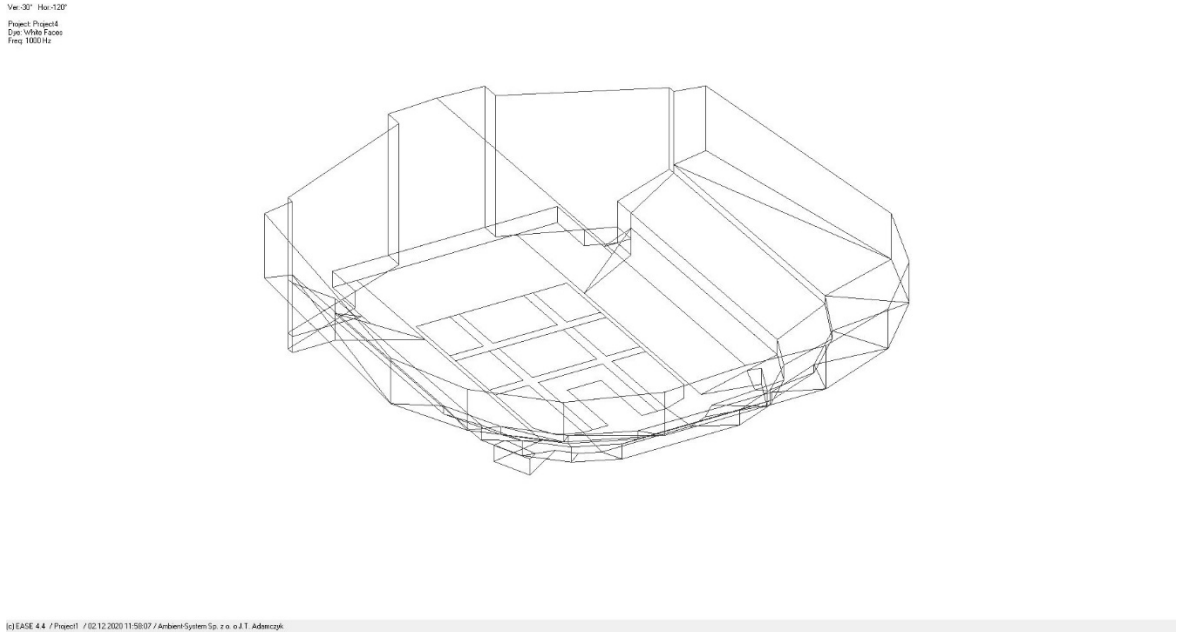

Fig. 1 3D model of the analysed object

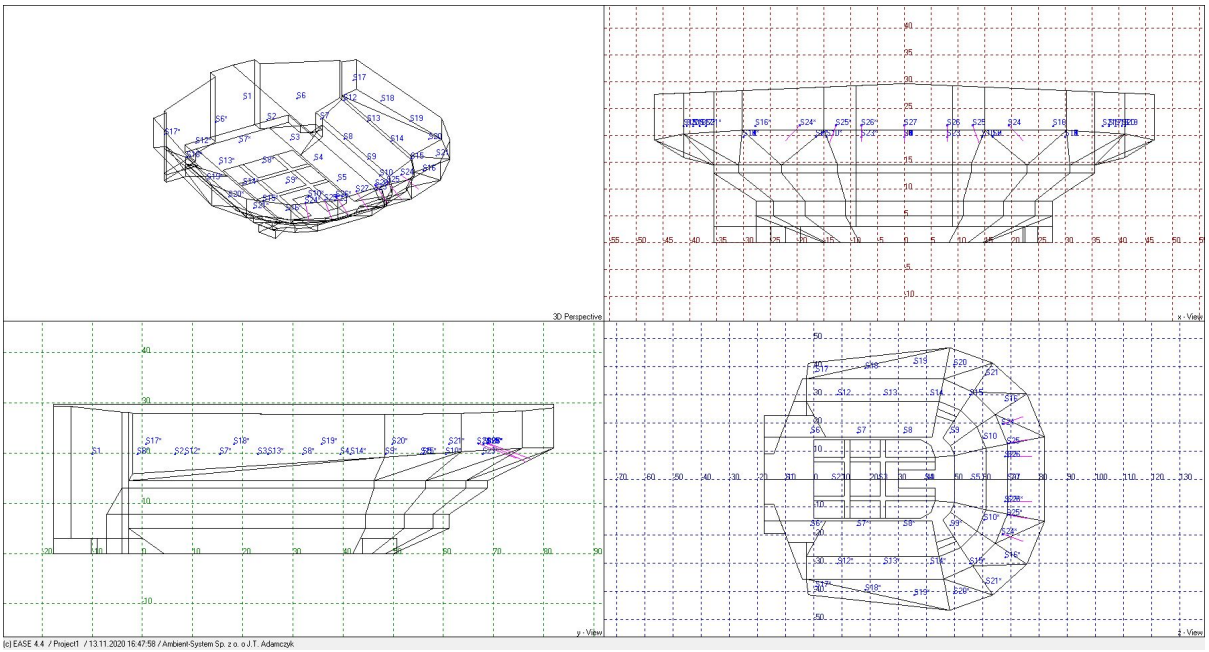

Fig. 2 Object projections

Tab. 1 Parameters of the used loudspeaker

Typ głośnika	Dane		
ABT-HP240EN66	Nominal Power [W]	240	
	Taped power [W]	240/ 120/ 60	
	Impedance [Ω]	42/ 84/ 167	
	SPL nominal power / 1W [dB]	125/ 95	
	Frequency response [Hz]	65-20000	
	Angle of covegare 1kHz [˚]	60 x 60	
	Temperaturę [˚C]	-25 / +70	
	Material	Fiberglass	
	Environmental	B	
	Security level	IP 65	
	Colour	RAL	
	Dimensions [mm]	497 x 497 x 727	
	Weight [kg]	29	

Object data:

- volume: V≈5100m^3
- floor area: S≈520m^2
- equivalent absorption area: A≈630m^2, α≈0,20

The following settings were adopted in the simulation:

Simulation method: AURA simulation

Quantity of rays: 10 000

Response lenght [ms]: 2500

Default scattering coefficient [%]: 20

Scattering method: Standard

Listener height: 1,6m

Calculation method: Pink Noise

Mapping: broadband weighted with the A correction

Noise floor: 85 dBA

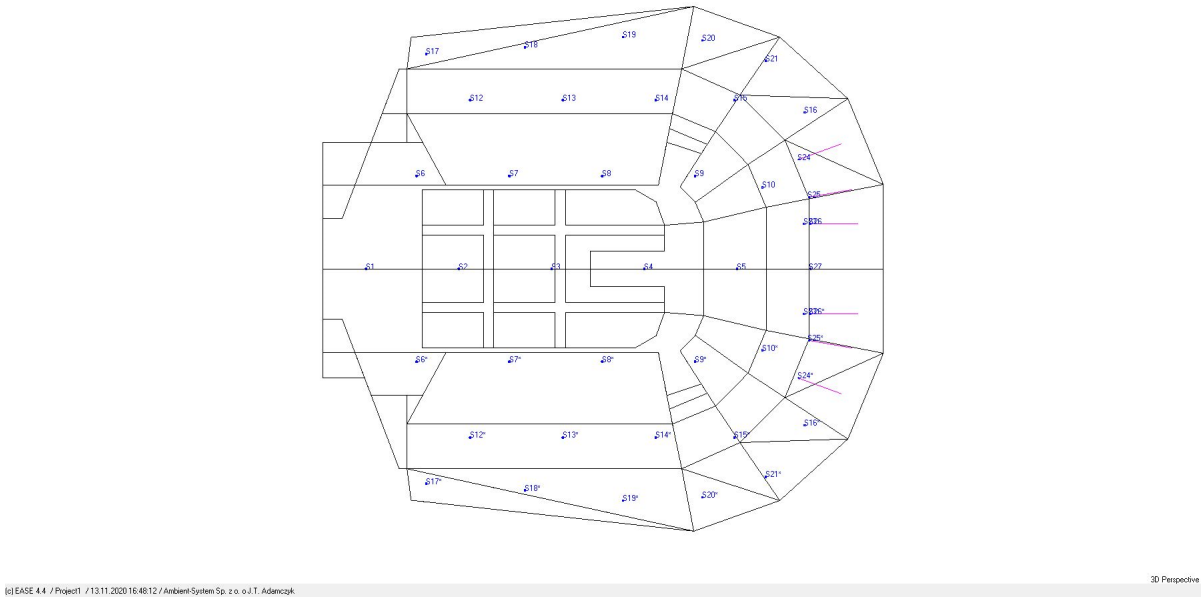

Fig. 3 Loudspeakers placement