1 THE ATHENS ACADEMY OF PERFORMING ARTS; ACOUSTIC DESIGN OF THE 300-SEAT MULTIPURPOSE AUDITORIUM

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2 INTRODUCTION

This is an educational project, which is going to be implemented in central Athens. The development involves practice and teaching rooms, a meeting room for teachers, relevant administration and ancillary spaces, as well as a 300-seat multipurpose auditorium (Table 1, Fig. 1); the latter is designed to accommodate music (chamber orchestra, small music ensembles, soloists etc.), opera, dance, as well as drama performances, lectures, seminars, etc. In the present paper, there will be presented basic features of the acoustical design of the multipurpose auditorium.

<table>
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<th>Table 1: Basic Features of the Auditorium</th>
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<tr>
<td>Architects (students)</td>
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<td>Supervised by</td>
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<tr>
<td>Dimitra Nikolau (Design Advisor)</td>
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<tr>
<td>Alexandra Sotiropoulou (Acoustics Advisor)</td>
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<td>Use</td>
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<td>Capacity</td>
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<td>Height (min./max.)</td>
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<td>Volume</td>
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<td>Target R.T. (500, 1000) (occupied)</td>
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3 ROOM ACOUSTICAL DESIGN

3.1 Design of the variable acoustic Modules

Variable acoustics in the multipurpose auditorium is mainly achieved thanks to, on the one hand, variable acoustic modules built in the room boundaries, and on the other hand variable-tilt ceiling reflectors. There is also, a variable orchestra pit (closed vs open) which is suitable for opera and dance performances.

The variable acoustic module, is a timber box (0.90 m x 1.20 m x 0.30 m depth) with rotating 20 mm-thick louvers on its façade exposed to the auditorium. When louvers are closed the reflecting mode is on. When louvers are open, two types of module are distinguished. Namely: Module A, which allows for sound diffusion, and is used mainly with music performances; and Module B, which allows for sound absorption, and is used with speech performances (Figures 2 and 3).
3.2 Acoustic design of the Auditorium

The auditorium employs the fan shape, with inverted fan shape at its rear part, and narrow hall cross-section. This shape encourages early lateral reflections, which are good for both speech and music performances. The back wall of the auditorium comprises an indented surface, with the aim to encourage diffusion (Fig. 1). This wall can change from reflective to absorptive mode depending on the requirements, thanks to Modules-B which are mounted on its skin. The absorptive mode (-B2) is used with speech events, whereas the reflective mode (-B1) is used with music performances.

The lateral walls of the auditorium involve a pattern of alternating reflective (Module-A1) and diffusing (Module-A2) vertical strips. This pattern is used with music performances (Figures 4,7,8). In order to introduce extra absorption required for speech events, absorptive vertical strips (Module-B2) are added to the upper part of side walls, namely above + 3.10 m re lowest level of audience floor. In the area that extends below level 3.10 m down to the floor, the strips comprise Module-A2, in order to enhance reflected sound to the audience (see Figures 4,5,6).

Furthermore, free suspended reflectors from the ceiling, provide useful reflections to the audience during speech events. By contrast, for music events, the suspended panels can be leveled up (thanks to their variable tilt) and be shifted vertically, each at distinct level, so as to provide diffused sound (Figures 5,7).

Rear-most seats are no more than 21.50 m apart from proscenium line, which is considered acceptable for adequate speech loudness in most of the audience area.

The acoustic design of the auditorium was based on predictions of the classical Reverberation Time (RT). The target RT for music configuration at mid frequencies was set at 1.40 s. The volume of the auditorium was then decided (2560 m$^3$) using the simplified Reverberation Time formula according to Kosten $^1$

\[
RT = \frac{0.16V}{S\alpha_{eq}}
\]

where RT : desired Reverberation Time [s]
V : optimal room volume [m3]
S : equivalent audience area [m2]
$\alpha$ : equivalent sound absorption coefficient, (1.07 for full-room at mid freq.)

Given the volume of the auditorium, the target RT for speech performances was then adopted at 1.15 s (in the occupied hall at mid frequencies) according to Cremer $^2$.

3.3 Results, Conclusions

The expected (predicted) Reverberation Time is shown in Figures 6 and 8 respectively for speech and music. Apparently this falls within the target values adopted in this study.

4 NOISE PROTECTION DESIGN

For the noise protection design of the auditorium, the criterion value 25 NC is adopted, which corresponds to very good listening conditions. This development is located in a noisy area of Athens; however the multipurpose auditorium is entirely underground, which saves a lot of costs for insulation against urban noise. For protection against interior noises, first, buffer zones are employed around the auditorium, secondly, sound insulating solid core doors and boundary partitions are used, last, care is taken for quiet operation of the hall’s infrastructure.

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Figure 1: Architectural Drawings  
a) Plan of Speech Configuration and Music Configuration  
b) Section of Speech Configuration  
c) Section of Music Configuration
Figure 2: Details of Module A

Figure 3: Details of Module B
Figure 4: Elevation of side wall a) Speech Configuration b) Music Configuration
Figure 5: Inside View of the Auditorium - Speech Configuration

Figure 6: Predicted Reverberation Time (RT) - Speech Configuration
Figure 7: Inside View of the Auditorium - Music Configuration

Figure 8: Predicted Reverberation Time (RT) - Music Configuration
5 REFERENCES

3. ALPHA AKOUSTIKI Ltd, www.alphacoustics.com

Acknowledgements

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