Acoustic program in the competition for the reconstruction of the “La Fenice” opera house after the fire of 29 January 1996

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Abstract: This paper describes the acoustic program of the competition opened by the town Council of Venice for the reconstruction of the “La Fenice” opera house after the fire which destroyed it on 29 January 1996. The experience of the Authors in the preparation of this document suggests the idea of a guideline which establishes a general agreement on the objective parameters and on the procedures to be introduced in the acoustic program of an architect competition.

BACKGROUND

After the fire which destroyed “La Fenice” opera house on 29 January 1996, the town Council of Venice decided to proceed with its reconstruction. Following a harsh discussion, the decision was taken to rebuild the theater “as it was and were it was”. The Prefect of Venice was appointed as the Commissary for the reconstruction of the new “La Fenice” opera house. Very soon he established a working group entrusted with the preparation of the program for the architect competition. At the end of September 1996 the program was ready and the competition opened: six months were allowed for the invited participants to present the projects. Five architects presented their projects. A commission for the judgement was established by the Prefect: F. Dal Cò, E. Bettanini, D. Commins, A. Di Tommaso, and L. Mazzarolli, were the nominated members. Daniel Commins had the task of evaluating the acoustic aspects of the projects. The Italian architect Gae Aulenti won the competition with the building company Impregilo S.p.a. The construction site was opened in September '97, and the new theater is expected to be opened at the end of September 1999 although an appeal of one of the participant companies has been recently accepted.

THE ACOUSTIC PROGRAM

An important part of the program of the competition concerns the acoustic requirements of the theater in order to obtain good acoustic conditions in the building in general and excellent room acoustics in the main hall. As the acoustics of “La Fenice” was praised since its opening on 16 June 1792, the working group entrusted with the preparation of the acoustic program has decided to deeply investigate in detail the project of Gianantonio Selva, the architect who built the “La Fenice” opera house at the end of the 18th. century [1].

The program of the architect competition strongly recommends to built the main hall “as it was” and many drawings and construction details are given to help the architects in this task. The part of the program concerned with the acoustics, includes the results of some experimental measurements taken by L. Tronchin [2] in October and November 1995, just two months before the fire: binaural measurements of the impulse response were performed in a large number of positions within the hall according to the ISO standard 3382.

The management of “La Fenice “ has given the indication that the new theater will be used not only for opera and ballet but also for concert music; an acoustic chamber was suggested for this task. Specific acoustic requirements are stated for the rehearsals rooms for the orchestra, choir and ballet. One important modification was specified for the main hall; the pit orchestra should be large enough to house at least 90 musicians. Also the stage should be as large as possible and with modern and highly technological devices.

The acoustic program is subdivided in a general part and in some special parts concerning the acoustics of the main hall, of the rehearsals rooms, of the foyer, of the work shops and of heating and ventilating rooms. Of course, most of the acoustic program is devoted to the main hall: in the following only this room will be considered.

THE ACOUSTICS OF THE MAIN HALL

Specifications

The program prescribes the acoustic requirements of the main hall by objective parameters such as the Reverberation Time (T60), the Strength (G), the Center Time (t_c), the Definition Index (D), the Lateral Efficiency
(LE), the Speech Transmission Index STI, the Clarity C80 and C50. Although the hall has to be "as it was", the architects are asked to include in their design proposal a report which clearly demonstrate how these values are predicted. For this purpose, computer simulations or scale models are proposed and the "auralization" technique also suggested. If computer simulation programs are used, the report must describe the adopted acoustic model and the acoustic data applied for the predictions. If scale models are used, a complete description of the material, of the sound sources and of the measuring instrumentation must be given.

The report has to show, with tables and graphs, the predicted values of the required objective parameters in at least 20 positions of the main hall, regularly distributed in the stall and in the boxes. The predictions will concern different configurations of the hall: with and without the audience; with the curtain open and closed. At least two positions of the sources must be tested: one on the stage and one on the pit. The investigations will concern the frequencies from the center octave of 125 Hz to the center octave of 4000 Hz. A range of reference values of these objective parameters is also given (tab.1).

<table>
<thead>
<tr>
<th>T60</th>
<th>C80</th>
<th>D</th>
<th>ts</th>
<th>LF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 &lt; T60 &lt; 1.8</td>
<td>-2 &lt; C80 &lt; +2</td>
<td>&lt; 50%</td>
<td>&lt; 140 ms</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Occupied 0.5-1 kHz</td>
<td>Average 0.5-1 kHz</td>
<td>Average 0.5-1 kHz</td>
<td>Average 0.5-1 kHz</td>
<td>Average 0.5-1 kHz</td>
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</tbody>
</table>

Noise and vibration requirements

High sound and vibration insulation requirements are set for the main hall: total noise from external and internal sources must comply with NC 20 curve. Accelerations must be 70% of the values of the "base response rating". In their design proposal the architects are required to include a complete description with drawings and sketches, of how the acoustic and vibration requirements will be fulfilled.

Verification tests

In order to verify if these requirements are really achieved, some measurements are expected to be carried out during and at the end of the construction process. Intermediate tests are intended to show possible discrepancies in a phase where it is still possible to change the design. For example, measurements in the hall before the introduction of the chairs may give a suggestion on their most convenient type to establish the expected reverberation times in the frequency range of interest. The final test is intended to verify the objective parameters required in the acoustic program and for the evaluation of the acoustic of the hall. The acoustic program also requires a subjective judgement on the acoustics of the main hall by experts like musicians and conductors proposed by the management of the theater.

COMMENTS AND CONCLUSIONS

Although one architect competition may be very different from another in relation to the type of building it deals with - for example a new building or a restoration or, like in the case of "La Fenice", a reconstruction - it is believed that there is a need to establish a general agreement on the objective parameters and on the procedure to be introduced into the acoustic program for a competition. This paper is intended as a contribution for the preparation of such a guideline. Moreover the experience of the "La Fenice" opera house raises the question of a systematic acoustic characterization of the theaters which should be done according to standardized methods. The acoustics of a theater is a cultural heritage which must be known and preserved.

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REFERENCES