Acoustics of the Historical Opera House of Bordeaux: Comparison between the Results of Objective and Subjective Surveys

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Abstract: This paper deals with the relationships between objective and subjective results of an acoustic survey in the historical opera house of Bordeaux. The comparison of the ordinary listeners' answers with the objective results shows that the auditory sensations are fitting with the measured criteria obtained in the opera configuration with the opened pit and sceneries on the stage.

INTRODUCTION

The historical opera house of Bordeaux, called Grand Théâtre de Bordeaux (GTB), was built between 1773 and 1780 by Victor Louis. In 1990 the last restoration conducted by B. Fonquernie as architect and A. Y. Xu as acoustic consultant gives back to this building its early spirit. The architectural modifications were the reestablishment of the depth of the Italian stage, the modernization of a part of the machineries and the deepening of the pit. The number of seats (1200) remains the same, only the upholstered chairs on the wooden floor were specially designed and the under part material of the balconies was changed in order to improve the acoustics of the hall [1]. The total cubic volume is about 19,000 m³, 13,773 m³ of which are for the flytower and the surface of respectively the stage and the audience area is 576 m² and 156 m². The walls and the ceiling are made of painted wood with a lot of ornamentations. The hall has a horse-shoe shape. It is used for concert as well as for opera.

RESULTS OF THE OBJECTIVE SURVEY

The measurements are conducted with the opened pit and sceneries on the stage, but without people in the audience area. The first source position is on the middle of the stage, the second one in the middle of the pit. There are 3 receiver points on the floor level (N1), 4 at first and second balconies (N2) and 4 at third balcony and in the upper gallery (N3). The measured objective criteria are: RT60, EDT, Clarity, Definition, G (= Lp - Lw), STI and RASTI. The different values and curves are given below.

<table>
<thead>
<tr>
<th>Source on stage</th>
<th>Source in the pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVEL</td>
<td>STI</td>
</tr>
<tr>
<td>N1</td>
<td>0.58</td>
</tr>
<tr>
<td>N2</td>
<td>0.48</td>
</tr>
<tr>
<td>N3</td>
<td>0.55</td>
</tr>
</tbody>
</table>

FIGURE 1

FIGURE 2
RESULTS OF THE SUBJECTIVE SURVEY

The investigations are conducted with an original questionnaire proposed by our research team (2) to ordinary opera-goers during four performances of "Traviata" in order to have available statistical population answers. The results of an earlier experiment (3) carried out with a test-questionnaire built with simple words, which explain the sensations of the listeners, have shown that the questions are correctly understood. For this reason we decided to use it with a large audience and to validate the results by comparison with the measured objective criteria. The questionnaire is composed of six parts, containing about thirty questions concerning different themes about the needs and the expectations of the listeners as general appreciation for opera house, the physical aspects of the comfort (acoustics, visibility, temperature, space around the seats,...), aesthetics aspects, neutralisation of performance effect, this hall and the sound and the classical descriptors of conditions.

The analyse is made aboul 430 questionnaires and the population was constituted by half-part of subscribers. They were well distributed in the audience area : equally on the left and right side of the hall, most of them (44%) on the floor level (N1), then (34%) on the upper one (N3), last (22%) in the middle part (N2).

Only answers concerning physical comfort are discussed here. On the whole the more important attributes are good acoustics, good vision of the stage and comfortable chairs ; the less important ones are temperature and size of the hall. Among acoustical attributes, all the propositions of hearing sensation descriptors to have a "good" hall seem to be equally important. The only point where the answers differ in opinion, concerns the preference to be surrounded by the sound : 47% have this preference and 45% have not.

Concerning the estimation upon this hall the results show clearly that the great majority of the asked audience has a favourable judgement (pleasing to the eye, quiet, clean,...). Only 30% of the answering people find they have a bad vision of the stage. With regard to the acoustical qualities, the sound seems clear (see figures 3 & 4), coming directly from the stage (no surrounding by the sound sensation), there is a good hearing perception of the singers on the stage and of the musicians ensemble execution in the pit, the sound attack impression is very clear which is well correlated by the weak values of Reverberation Time and EDT (figures 1 & 2). The opinions are divided about the emergence of some sounds and the strength vs frequency as the values of G show it in Table 1.

In spite of comfort defects due to the age of the opera house as the lack of space between the seats the architecture of the Grand Theatre de Bordeaux is very well appreciated.

ACKNOWLEDGEMENTS

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REFERENCES