Acoustic quality in the Theatre "PalaFenice", Venice

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Summary: The burning of the Teatro La Fenice, in Venice, has been a tragedy also for the acoustical community. The Municipality of Venice decided to build a tense-structure (called PalaFenice) in the isle of Tronchetto, as temporary auditorium for operas and concerts.
The use of such a structure provokes many different acoustic problems, quite different from those already known to musicians at La Fenice.
In this paper the acoustic quality of the theatre has been analysed, and compared to the acoustic measurement already performed in the former La Fenice theatre. Binaural measurements have been performed in the hall using the impulse response technique, (including absorption of the ceiling), and a dummy head located at different listening positions. According to ISO 3382, many acoustic parameters have been evaluated, like listening level, ITDG, reverberation time, IACC and others, and their values have been mapped. Also Ando's quality maps of preferences, with reference to two different kinds of musical signals, was accomplished from experimental measurements. The measurements pointed out a not-suited behavior of the structure at low frequency, and low reverberation time and intelligibility in the hall. A hypothesis of acoustic chamber has been formulated, and the acoustic quality has been analized

INTRODUCTION

In 1996, January the 29th La Fenice burned down completely. While the world wide cultural community was asked to design the new "La Fenice", the Municipality of Venice decided to build a temporary tense-structure that should host the orchestra in the meantime or the reconstruction. The hall was called "PalaFenice", and is still located in the Isle of Tronchetto.
The main hall has about 1100 seats; the stage is about 400 m^2.
The particular shape of the theatre, accomplished with the typical limitations of tense-structure, since the beginning gave a poor acoustics to the theatre. The listening quality in the hall, that should have to be close to that of La Fenice, was too "dry". In order to improve the acoustics of the theatre, binaural measurements of IRs have been planned, by using a dummy head, an omnidirectional loudspeaker and binaural microphones. In the theatre 19 different points have been chosen, in a middle part of the hall. Some extended measurements have been conducted, once changing the position of sound source, once checking the symmetry of the hall. Additional measurements were conducted on the ceiling, by measuring a calibrated *pressure-IRs* as close as possible to the cloth, and a calibrated *velocity-IRs* directly on the cloth. The measurements clearly pointed out that the reverberation time was too low, the clarity too high, and the center time too low. The sound was not well distributed among all the seats in the hall.

THE ACOUSTIC SHELL

Since the acoustic behavior of the hall has been considered not properly adapted for the performances, an acoustic shell, based on a wooden-modular shape, have been designed and checked in a performance in the theatre. The acoustic shell has been checked also in other theatres and churches.

FIGURE 1 The acoustic shell

From a subjective point of view, the acoustic shell demonstrated to slightly improve spatialization of sound field, while the music seemed to be more blended and live.

THE MEASUREMENTS AND THE RESULTS

Two years later the first campaign, the acoustic measurements have been repeated in the same positions of the previous measures, by using of the same technique and instruments.

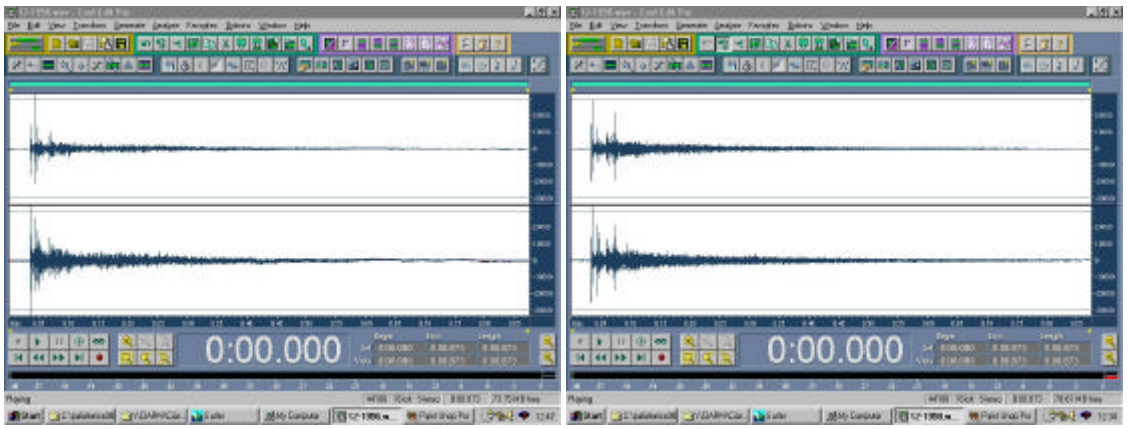

FIGURE 2 IR for point 12: 1st campaign (1996, left) and 2nd campaign (1998, right)

The comparison of IRs clearly showed a strong reflection coming from the ceiling of the acoustic shell, as shown in fig. 2, underlining the influence of the shell in the sound quality. From the IRs the acoustic parameters suggested by ISO 3382 were calculated.

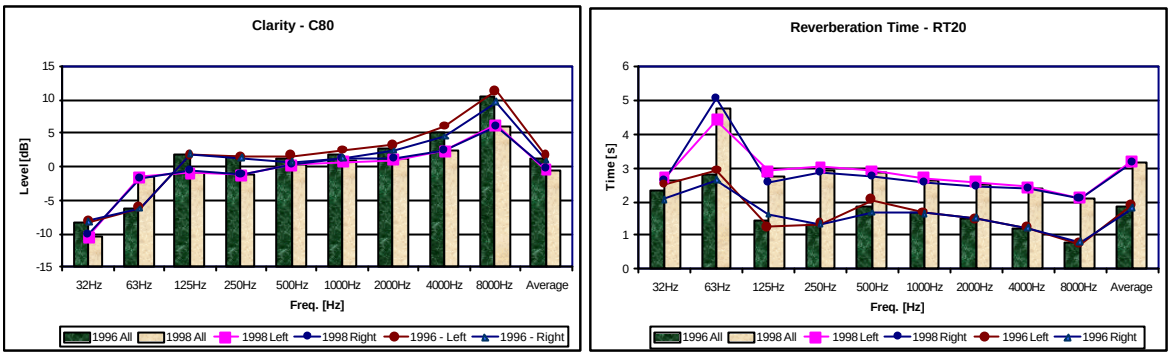

FIGURE 3 Clarity C80 (left) and Reverberation Time RT20 (right)

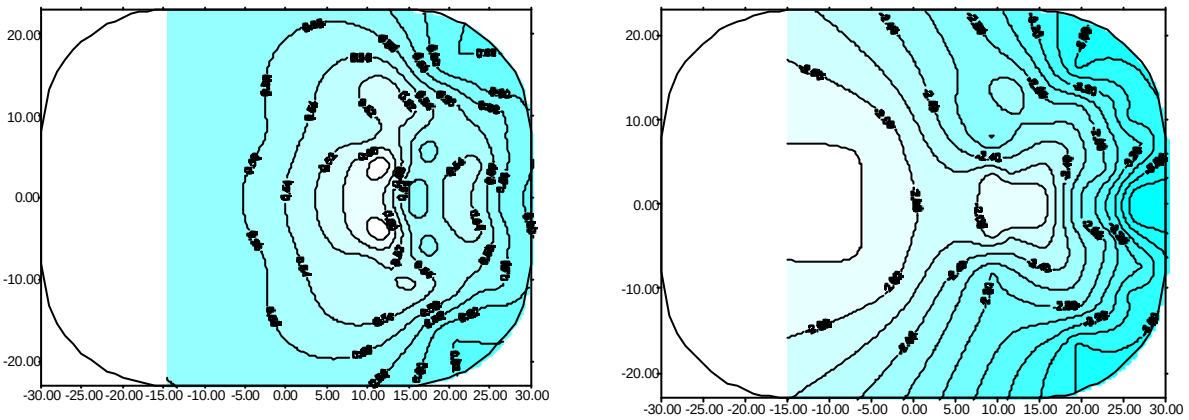

FIGURE 3 STI (left) and Ando' preference index for Mozart' music (right) WITHOUT the acoustic chamber

The acoustic shell slightly improved the acoustic behavior of the hall. The sound field resulted to be more diffuse and blended. The influence of the chamber has been focused on especially at low and middle frequencies. The averaged value of clarity, calculated on 50 and 80 milliseconds, passed from about 1.5 to less than 0 dB. The center time, calculated at the frequencies of 125 and 250 Hz, passed from about 80 to almost 200 milliseconds. The reverberation time increased especially at mid frequencies. RT20, passed from 1.5 – 1.7 s to more than 2 s, and almost 3 seconds at 250 Hz. The analysis of IRs pointed a set of late reflections in the middle part of the hall, not useful neither for intelligibility neither for strength.

The spatial distribution of the parameters revealed still focalization in the center of the hall. The calculation of Ando' preference index underlined the influence of focalization, and in those positions, due to the distribution of strength, the value of the index is worse.

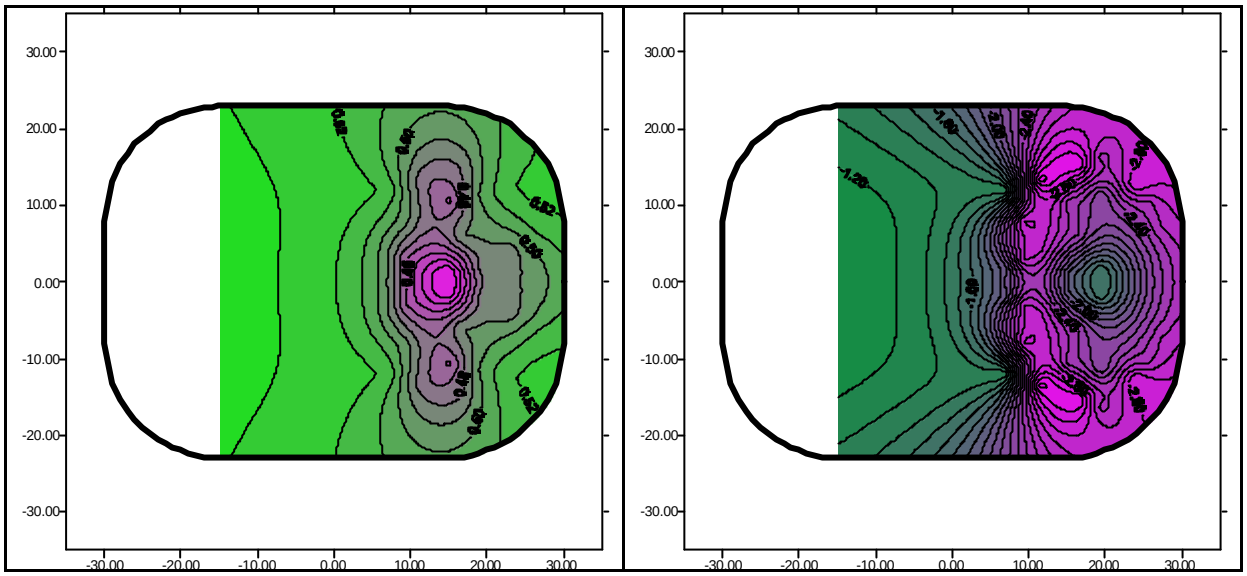

FIGURE 3 STI (left) and Ando' preference index for Music (right) WITH the acoustic chamber

CONCLUSIONS

Being a tense-structure, in the PalaFenice the listening quality is affected by focalization, especially in the seats where the strong late reflections coming from the roof covering are determining The introduction of the acoustical shell slightly improved the values of reverberation time, even if in the middle of the hall they assumed not suited values.

The spatial distribution of G was not really uniform on the hall, and in same positions in the middle of the hall the strength was worse.

The acoustical shell improved the listening quality, even if some corrections of the chamber could give a better distribution of sound energy among all the position on the hall.

ACKNOWLEDGEMENTS

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