On the testing of renovations inside historical opera houses

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This paper deals with the acoustical impact of works inside the Teatro Valli in Reggio Emila. Surveys were held in the theatre before renovations and were repeated with identical procedure and instrumentation also after their completion.

INTRODUCTION

The Municipal Theatre "Romolo Valli" in Reggio Emilia opened on April 21th 1857 and was designed by the architect Cesare Costa. The building occupies an area of 3890 m^2 and is situated near a green area. The main hall has horseshoe plan and is subdivided into stalls, four orders of boxes (summing up to 106) and a lodge. This area is peculiar because its central part is rather deep and hosts a small raked tier. The total number of seats in the theatre is 1136. In Tab. 1 some geometrical data of the main hall are reported. Recently the theatre was restored mainly for safety reasons. In particular in 1998 the upholstery of the seats in the stalls was renovated and in 2000 the furnishing and wallpaper of the boxes were changed, while the painted surfaces and the decorations of the main hall were all polished. In 1997, before the renovations took place, a first set of acoustical measurements in the theatre was made and in 2001, after their completion, a second survey was carried out. In both cases the same setup of the theatre was prepared and the same operating scheme was kept. The comparison between the two sets of data makes it possible to investigate the impact of renovations on the acoustics of the theatre.

THE ACOUSTICAL MEASUREMENTS

For both surveys the theatre was set up for chamber music ore recital, which means that the fire curtain and painted curtain were lowered and the orchestra pit was up. The sound source, a Norsonik dodechaedron, was placed in a symmetric position in the centre of the stage, at 3.5m from its border. A group of 11 receivers were distributed around the left part of the stalls, 4 in the I order boxes, 4 in the III order boxes and 4 in the lodge. The test sequence was an MLS signal of order 16 and the sound probe a Sennnheiser MKE2002 binaural system. While the source was looped, in each position a sample of about 30s of test signal was recorded on DAT and a sound level meter measured the L*eq*. Later in the laboratory the recordings were processed in order to obtain related impulse responses and, by means of Aurora software, most of the acoustical parameters indicated in the norm ISO3382. The only difference between the two measurement campaigns regarded the sound power level of the source during the operation. This caused some difficulties in the analysis of the data and a procedure to compensate the difference was implemented. In Fig. 1 and 2 the averaged values of RT20 and C80 measured in 2001 are presented respectively. The main hall shows a rich reverberation in the lower range, which fits the requirements for opera in the higher range. While the I ord. boxes show a slightly lower RT20 than the stalls, the lodge has a markedly higher reverberation in almost the whole band. This is the effect of the addi-

	S	H	V	N	V/N	S/N
Stalls	340	13,9	4700	414	11,3	0,82
Boxes & Lodge	625	2,5	1500	722	2	0,86
TOT.	965	-	6200	1136	5,45	0,85

Table 1. Basic geometrical data of the main hall of the theatre; plain surface (S), height (H), volume (V) and number of seats (N).

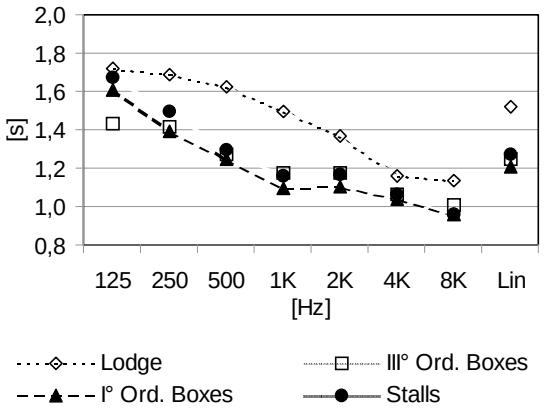

FIGURE 1. Plot of reverberation time RT20 measured in 2001. Data averaged according to respective groups of receivers.

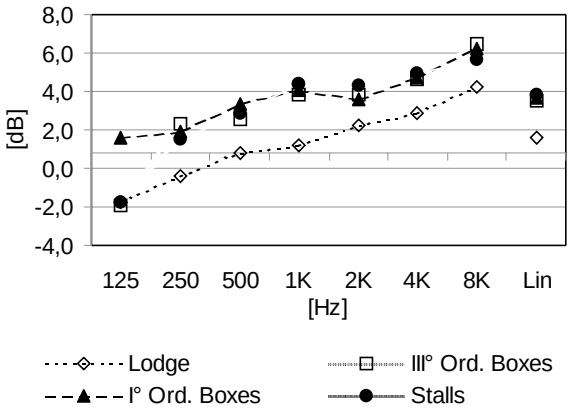

FIGURE 2. Plot of clarity C80 measured in 2001. Data averaged according to respective groups of receivers.

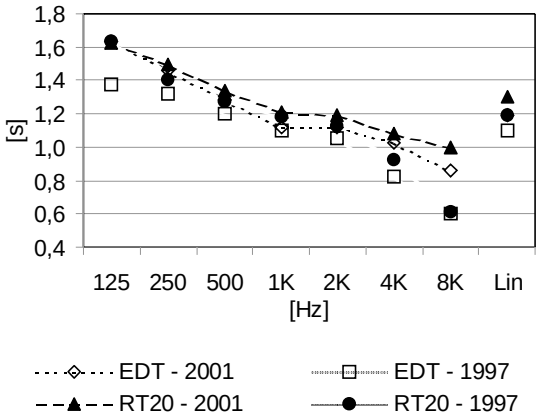

FIGURE 3. Comparison of EDT and RT20 measured in 1997 and 2001. Data averaged among all receivers.

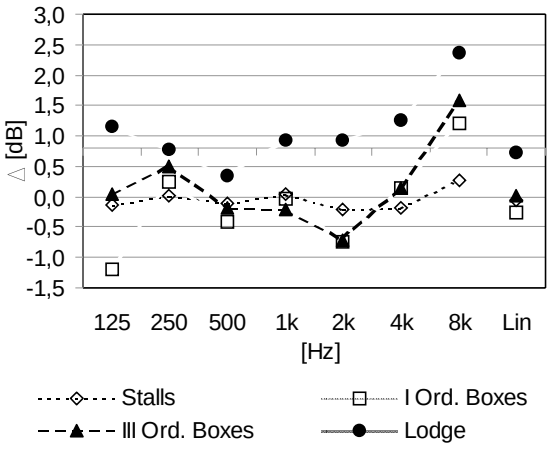

FIGURE 4. Difference between L_{eq} measured in 2001 and in 1997. Data are normalized with respect to the average value of the five points in the stalls which were closer to the source.

tional, partly uncoupled, volume of this area. The C80 has optimal values in most of the passband. Then in Fig. 3 the comparison of averaged values of RT20 and EDT between the 1997 and the 2001 sessions is reported. Both parameters show that the reverberation has undergone a moderate increase in all the bands, which becomes evident above the 2kHz oct. band. In the case of EDT a wider increase regards also the lower range. Finally in Fig. 4 it is seen that the levels measured in 2001 in the stalls do not differ much from 1997 because of the implemented normalisation. In the boxes an increase is reported for the higher frequencies while in the lodge it regards the whole passband.

DISCUSSION AND CONCLUSIONS

Though it is not possible to define the exact effect on acoustics of each single renovation, it is important to consider that the upholstering of seats in the stalls, the furnishing and wallpaper in the boxes caused the greater change in the RT. It seems more difficult to evaluate the effect of the polishing of plasters and decorations. In any case, the present conditions of the theatre are to be preferred considering the optimal values found in literature for this type of hall. The benefit of renovations is extended to every section of the main hall. In particular the sound will be more frequency-balanced thanks to an increased RT in the higher range and, by the correlated effect of a lower clarity, better mixed between players. The lodge seems to have had even better outcome of renovations, but the acoustical conditions (especially in its central part) are still markedly different from the rest of the hall. This work validates the renovation procedure and confirms that matching safety requirements and acoustic quality is nowadays possible. Nevertheless it is necessary to introduce more systematic rules which would take into account the acoustic properties of both the old materials being replaced and the new ones being used in the renovation work.

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