THE ACOUSTICS AND RESTORATION OF "SALONE PEDROTTI" IN PESARO

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SUMMARY

This paper deals with the experimental results gathered in order to define the acoustic characteristics of the "Salone Pedrotti" in Pesaro, before its restoration.

The hall is rectangular, with about 800 divided seats between the stalls and the two galleries. It is one of the few examples of shoe-box halls in Italy.

To evaluate the acoustic characteristics of the hall, the main acoustic parameters in use today were measured at various points.

The results of the measurements revealed values of the acoustic parameters which were very close to those considered optimal for halls of this size and use. From the results of the measurements, the great importance of the ceiling and the link between the top of the stage and the loft, comes out. The wall separating these two parts is formed by a light structure made of plaster and straw, unlike the heavy walls usually imposed by fire protection regulations. The ceiling is therefore not only a passive element of acoustic reflection, but also an active element, capable of radiating acoustic energy coming from the top of the stage.

In view of the required restoration of the ceiling, further studies are being carried out in order to better understand the acoustic function of this element of the hall and to be able to give valuable advice regarding the necessary interventions to safeguard this acoustic function and at the same time strengthen the structure.

DESCRIPTION OF THE THEATRE

The " Salone Pedrotti" is a concert hall located on the first floor of an extension of the 18th century palace named "Oliveri-Machirelli", which now hosts the Rossini Foundation. The theatre was inaugurated on 29 February 1892, in occasion of the centenary of Rossini's birth, and was immediately considered to have very good acoustics.

The hall has a rectangular shape, with two balconies inside: the first one is disposed only at the two sides of the hall about one metre above the stalls; the second one is disposed on the sides and rear about 6.5 metres above the stalls, and it is sustained by light steel columns.

The total number of seats is divided into 391 stalls, 196 seats on the first balcony and 247 on the second balcony, giving a total of 834 seats. The armchairs in the stalls and on the first balcony are upholstered and tissue-covered, while those on the second balcony are in wood, with a thin cushion on the seat and on the back.

The stage is elevated 1.2 m over the stalls floor, and occupies an area of 250 m^2. It contains scenes made in large part of painted material, including the cover, while the back wall is covered with stratified wood panels up to height of 3m. The stage and the room are connected through a proscenium 13m wide and 11m tall, and the stage does not extend inside the room as it usually happens in other theatres.

The room's volume is nearly 7500 m^3, the stage is 4000 m^3. The total volume is therefore 11500 m^3. No orchestra pit is present, making this room substantially different from most Italian theatres.

The walls are covered with gypsum plaster; the ceiling is almost flat, and is constituted by a gypsum layer reinforced with straw. The floor is a wooden structure (beams and boards) both in the stalls and in the balconies.

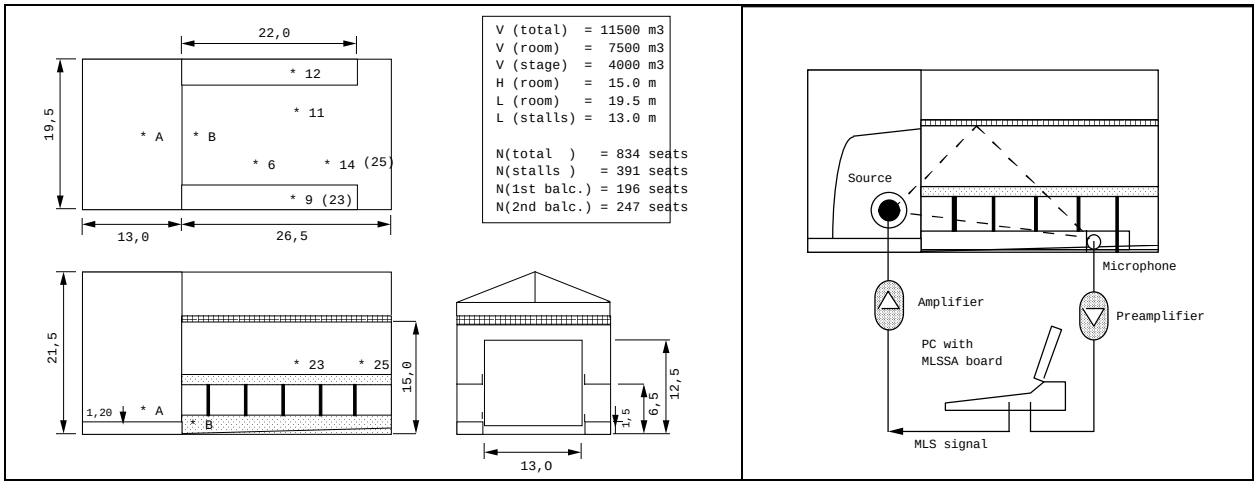

Fig. 1 - Plant and sections of the room (left) and measurement setup (right).

EXPERIMENTAL RESULTS

The experimental setup (shown in fig. 1) was constituted by a portable PC fitted with a MLSSA acquisition board, a power amplifier, an omnidirectional loudspeaker, a dummy head with binaural microphones, a DAT recorder and a real-time octave band analyser. The basic quantities measured are 64-k points long Impulse Responses, from which the acoustic parameters are computed accordingly to ISO-DIS 3382.

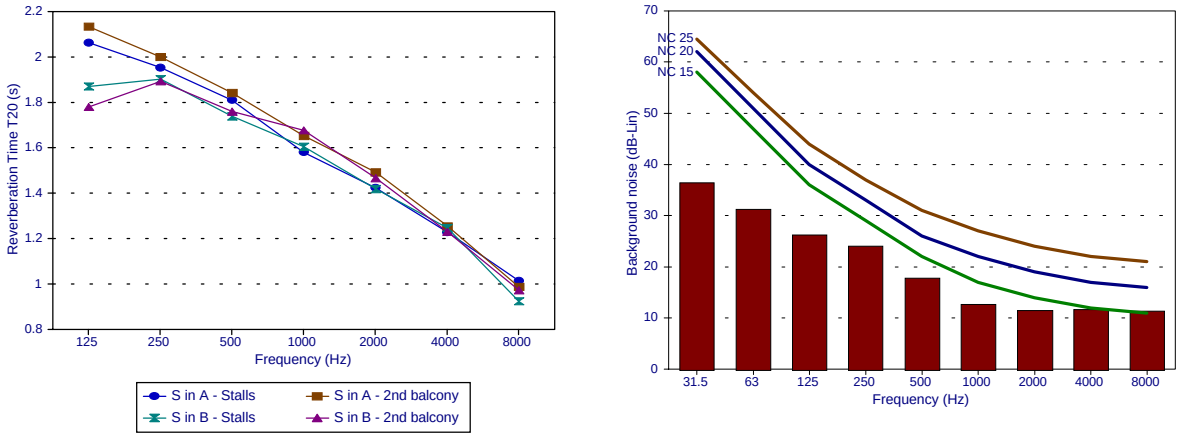

Fig. 2 - Reverberation times (left) and background noise (right)

Fig. 2 shows the reverberation times measured in the empty room, with two different source locations, and the measured background noise level superinposed to the NC curves. It is evident how the reverberation time values are optimal for concert halls, and the background noise is very low.

Fig. 3 shows the average measured values of Clarity C80 and Center Time t_s, compared with the optimal ranges suggested by Muller [1].

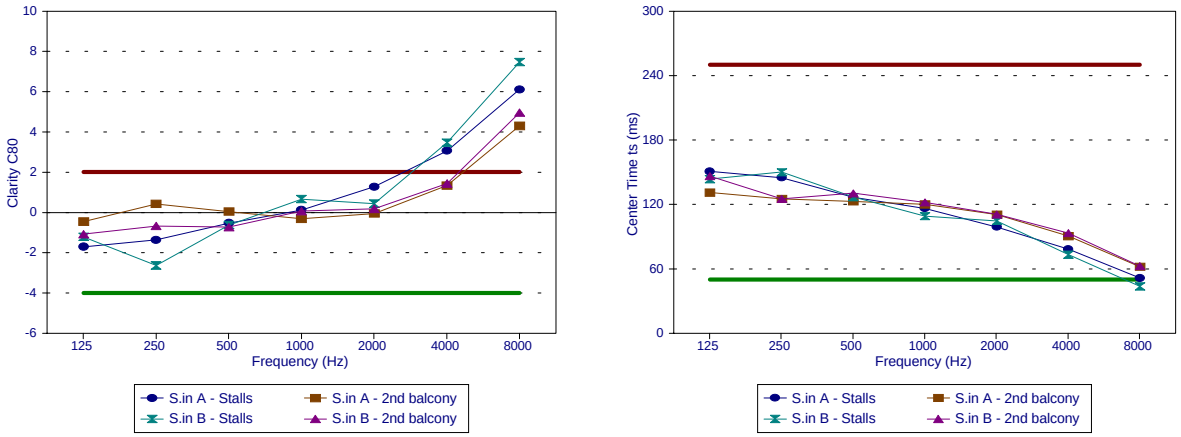

Fig. 3 - Average values of Clarity (left) and Center Time (right).

It is clear again that this theatre is perfectly satisfactory. Also an accurate visual inspection of the impulse responses shows everywhere perfectly smooth responses, with strong asymmetrical early reflections and absence of late echoes or double slopes. The experimental justify the reputation of this room for its good acoustics.

At some points, measurements were made also with the traditional impulsive excitation technique (blank shots with a pistol). Table 1 compares the results obtained with the two different techniques.

Table 1 - Overall values of acoustic parameters (125-4000 Hz)

	Point	6 L	6 R	9 L	9 R	11 L	11 R	12 L	12 R	14 L	14 R	23 L	23 R	25 L	25 R	Mean	Std.dev.
MLS signal	C50	-1.0	-2.0	-3.7	-5.9	-2.2	-1.7	-7.3	-5.5	-1.0	-2.7	-1.8	-1.7	-3.5	-3.3	-3.1	1.9
	C80	1.4	0.8	-0.5	-1.9	-0.2	0.4	-2.0	-1.4	1.6	0.3	-0.1	0.2	1.0	0.8	0.0	1.1
	D50	42	38	29	20	36	37	15	21	39	34	39	41	30	31	32	8.0
	ts	119	123	136	147	135	130	147	148	117	125	128	129	118	121	130	10.5
	EDT	1.98	1.88	1.82	1.88	1.95	1.91	1.86	1.90	1.78	1.75	1.94	2.08	1.59	1.76	1.86	0.12
Pistol shot	C50	1.9	0.5	0.7	-2.5	0.4	0.9	-3.0	-0.5	0.4	-1.0	-0.8	-2.5	-1.2	-0.9	-0.5	1.4
	C80	3.3	2.0	2.5	-0.3	2.0	2.5	-0.3	1.4	2.5	1.9	0.7	-0.9	2.0	1.7	1.5	1.2
	D50	57	52	48	34	48	53	31	44	49	43	44	35	43	44	45	7.2
	ts	85	91	96	114	100	90	123	101	97	97	114	119	103	100	102	10.9
	EDT	1.59	1.64	1.63	1.58	1.71	1.61	1.66	1.66	1.58	1.51	1.78	1.60	1.60	1.50	1.62	0.07

As previously reported [2], some differences appear sistematically in the overall values, showing a sound field coming from the pistol shots characterized by more clarity and lower reverberation. This is certainly due to the different spectrum, the pistol shot being particularly rich in medium and high frequencies, while the dodechaedron loudspeaker is very rich in low frequencies.

RESTORATION

The “Salone Pedrotti” is now under restoration, to consolidate the structure of the ceiling, balconies and lateral walls and to meet fire regulations. Regarding the balconies and lateral walls, the restoration is based on structural stiffening work that should not have any acoustic relevance.

The consolidation of the ceiling poses instead an acoustic problem, in order to mantain the delicate equilibrium of the sound energy which comes from the top of the stage, passes through the loft and is transmitted to the hall through the ceiling; this is possible because the partition

over the proscenium is made of a light gypsum and straw panel. This partition will have to comply with fire regulations, which require a complete separation between the stage and the hall; to maintain the present low sound insulation, the proposal is to install large fire-proof doors, usually left open, with an intrinsically safe gravity self-closing mechanism, that closes them in case of fire.

At the same time, the consolidation of the ceiling will be made with light steel wires, as shown in fig. 4; this increases the number of points in which the ceiling is sustained, and mantains the same contact characteristics given by the nails which now connect the gypsum panels to the wood beams and which will not be removed.

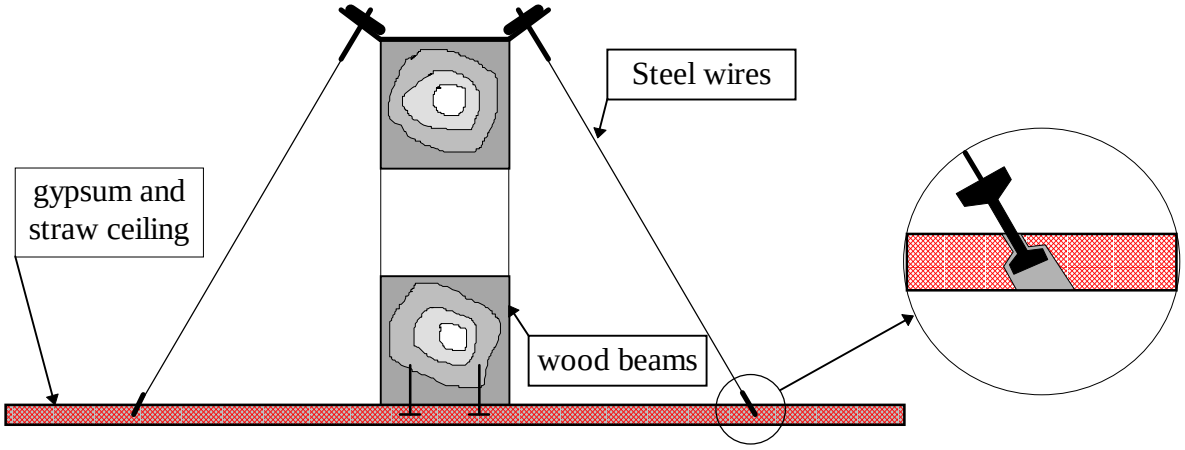

Fig. 4 - Particulars of the restoration of the ceiling

CONCLUSIONS

The main goal of this work was to take an accurate “acoustic photograph” of the room, employing the most recent digital signal processing systems; the acquired data constitute the reference against which the acoustics of the room after restoration shall be compared. The analysis of the experimental responses produces values of the main acoustic parameters that perfectly agreei with the “good acoustics reputation” of the room.

On the other hand, the results indicate the importance to preserve some unusual structural characteristics, and this suggested the employment of specific restoration techniques, which mantain unaffected these components.

After the restoration has been ultimated, the experimental measurements will be repeated with the same technique, enabling an accurate comparison of the results, and suggesting minor adaptations to mantain completely unchanged the acoustics of the theatre, which is actually one of the few concert halls in Italy.

REFERENCES

[1] H.A. Muller - “Room Acoustical Criteria and their Meaning”, Proc. of the Conference "Acoustics and Recovery of Spaces for Music", Ferrara (1993).

[2] A. Cocchi, A. Farina, P. Fausti, M. Garai, G. Semprini - “New possibilities in Room Acoustics Measurements: Real-Time analyzers, DAT Computer: a comparative approach”, FASE Congress, Zurich, 1992.