

A Study on Re-usage of Historical Building - from the Aspect of Room Acoustic for Live House

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Abstract. Renovation of historical building not only by the performance of the new usage of space continues its life, but more importantly approaches through the musical performance can be activated. Re-use of buildings as a “Live house” which is performed for the musical show with sound reinforcement system is particularly welcome by young people in Taipei. It is important to foster the promotion of pop music platform since starting to focus on issues of re-use of the interior of historical space in the globe, even domestic and foreign literature on the study slightly is still insufficient, which is concentrated on the main function of music performances. Therefore, this study stationed at Red House Theater “Riverside Message Music Pavilion” to explore the subject through the perspective of redefine their spatial acoustic performance capability, and the issue of noise prevention, reinterpreting the historical space combined with industry existing development of live musical performances. Research method is verified by computer simulation which is to understand the optimization of the performance of room acoustic. The results of preliminary study may offer the on-site users and performers of questionnaire interviews which are corresponding on the future objective field measurement.

Keywords: Historical building · Room acoustics · Live house · Computer simulation

1 Introduction

Music Performance Space (Live house) is to provide independent band and singers small concert venue, in recent years, government departments in Taiwan and other public events, such as “International Gongliao Sea Music Season,” “Kenting Spring Scream Music Festival” and other large activities, not only allows independent non-mainstream music band emerge in the big occasion, but also cooperates with promotion by international exchange of music season. Non-mainstream music belongs

creation, avant-garde with profound implications for the type of music, covering a wide range of music, like the “underground music”, “independent music” and “minority music” are for instance, it is different from the pop music performances aesthetically. Performance hall for live music play an important promoter and concert performances can be divided into temporal and spatial factor [1]. Temporal factor tends to hold “festival-style”, having temporal limit, short and dense. The space factor of performance hall in Taiwan is called music venue for performances (Live house), with respect to the temporal factor, long-term development in nature and continuity venue provide a culture trends with non-mainstream music in Taiwan [2]. The best-rated halls in the Niels Werner Adelman-Larsen’s study have reverberation times that are approximately frequency independent from 0.6 to 1.2 s for hall volumes from 1000 to 6000 m³ [3]. Some researches presented suitable mid-frequency depending on musical style, room volume and seating capacity [3–6]. Through Live hall presence, creating another culture trend for the reuse of historical building, for its pop and independent music performers is encouraged by the formation of a kind of local arts and cultural characteristics to attract domestic and foreign musical performing arts groups have been pilgrimage. In addition to creating a good indoor acoustic space, the electronic sound system is another major focus of this study, the role and function of electro-acoustic system in hall, speakers deliver music to listeners by the PA sound system, known as PA (Public address = Public Broadcasting), however, it is not satisfied to meet various for live status, the system of sound reinforcement (SR) is also introduced in 1965, SR demands not simply transmit the sound, but also receive the brilliant sound from the source, high-quality of sound speaker lead to concert music clearly without distortion which could reach the ears of the listener’s. In the Meanwhile, the musicians can also hear their own sound with the monitoring system, which can improve performance communication among musical band. This paper presents the acoustical simulation for the live house which is relocated at re-usage of historical space. A number of major acoustical features have been employed in order to provide a hall which meets the various criteria for a venue designed to accommodate a sound reinforcement repertoire of events [7]. The paper begins with the general absorption material for the interior elements. Following sections are dedicated to detailed studies concentrating on the major design components. The results presented here not only have been used to verify the design scheme concept, simple field verifications have also achieved in the future newly built in order to characterize information of room acoustic. Riverside Message Music Pavilion relocated at The Red House Theater is opened in September 2008 and has always been considered as the premier live music venue in Taipei city, giving people in Taiwan access to a wider range of music options. The concerts also offer performance groups worldwide opportunities to learn from one another and make improvements accordingly. The volume of the hall is 2420 m³, and equipped the hall with acoustical curtains by modifying its acoustical characteristics. A room form was developed as prototype that had overall proportion and volume similar to the 460 seats is a cross-shaped plane like a western cathedral.

2 Research Approaches

From its completion in 1908 to today, Red House has witnessed the Qing Dynasty, the Japanese occupation of Taiwan. Then in Taipei west door, the construction market and the first commodity trading market, as the major consumer markets of Japanese immigrants (See in Fig. 1). Coming under influences from Japan, Shanghai and Western cultures, it has served as a market for wealthy residents, a gathering site for various Chinese cultural industries, and a window to the ideological trends of Western civilizations. Riverside Message Music Pavilion is relocated east side of cross shape building, 460-seat concert hall will serve a variety of uses: Concert, amplified musicals, drama and speech events. The acoustic requirements for these usages are very different, in terms of reverberation time. There is especially a requirement for additional reverberation for concerts when compared to amplified events. Amplified usage requires a shorter reverberation time and additional acoustic volume for loudness control. The proposed design concept achieves the required variability with an additional variable acoustical absorption were hide behind the sides grillages of the hall. One row of the draperies which is surrounded the stage and projected to the main auditorium is also shown here.

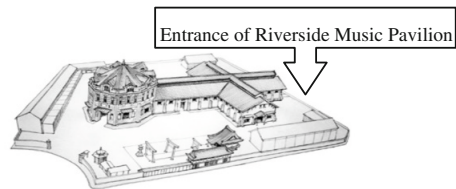


Fig. 1. Red House is used as Taipei Ximen Market (Taihoku Market, Formosa) inaugurated a century ago when the Victorian red and white appearance in period of Japanese government (Source of left photo: Taipics website, source of right Photo: drawing by Lee Chie Lan).

3 Survey and Raw for Study Field

The object of study is focused on Red House Theater _“Riverside Message Music Pavilion”, although the body was established in a historic building, the interior floor plan and detailed configuration is not easy to obtain. The layers within a plane provided by the banks of a message APP configuration reference, scale control plane architecture body to re-draw, and to obtain the relative size of the building and interior configuration, the amount of space through complete three dimensional model of the body, as a follow-up to the performance of a computer simulation of room acoustics basis for assessment. Three dimensional modeling is mainly to carry out computer simulation for field and laboratory sound field performance analysis, including external build model structure cross building, interior beams distributed to the indoor compartment and floor openings, etc., thus rendering the entire system into a three dimensional model.

Exterior of the building components, including windows, sills, doors, roof, floor and other thick dimensions are in the field surveying (See in Fig. 2). As some information is also insufficient, we refer to the facade to match the size of the proportion of students drawn, the appearance of roof height model using by Google Earth is also referred. Get all of the above information, the three dimensional drawing of Riverside Message Music Pavilion began to be built into the model.



Fig. 2. Field surveying on exterior and interior of Red House Theater

From the observation the away from the stage at Riverside Message Music Pavilion, compared to outdoor concerts, sound and visual intimacy is an immersive experience. The main sound absorbing material are mostly black drapery which are installed in around the stage and vertical surface underneath balcony at second floor. Computer simulation does not require much space complex lines formed, this three dimensional model produced in a simplified manner. Due to the live house music is performed in the heritage building, so that the current much structural reinforcement beams are built as shown in Fig. 3 (Upper Left side photo). It will lead to computer simulation test system presents numerous calculation, but are still within the acceptable range. Three dimensional model showing the current status of the analog main draw (See in Fig. 3), according to the site to observe the pictures taken control position, the device comprising an line array sound system, stage lighting, draperies, furniture, and other equipment, in order to simulate the approaching sound performance of absorption the material authenticity.

4 Computer Simulation

When the musical perform, in addition to facing architectural space design, the tone, volume, reverberation may have a influence musical performance, may also have an impact on the live sound effects. To further confirm the performance hall planning

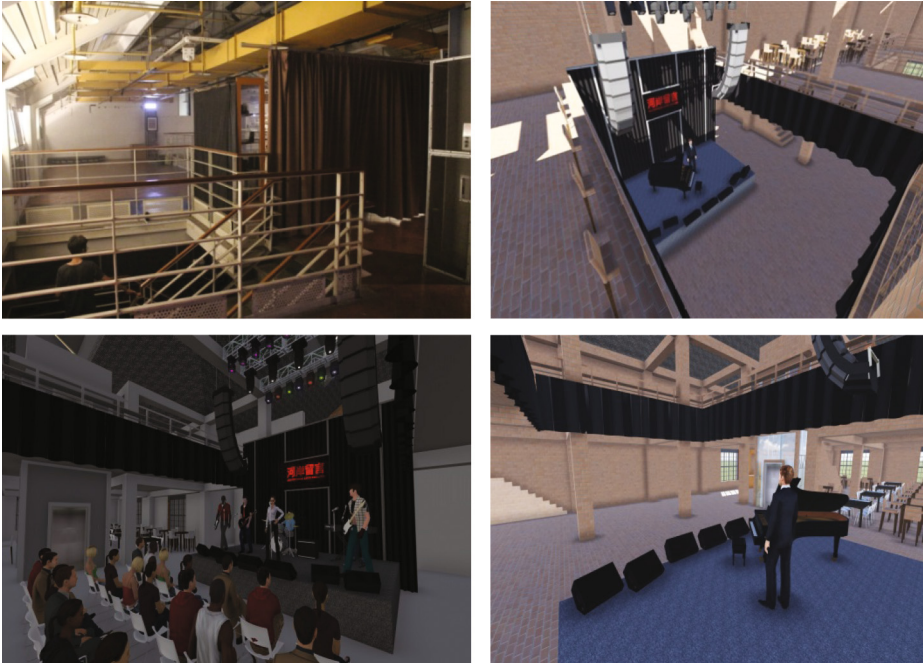


Fig. 3. Current much reinforcement beams were added for support building structure (Upper Left side photo). Three dimensional model drawing are also conducted for surveying

goals and acoustic parameters of the correlation between topography, assess technology includes the design stage through to computer simulation. Computer simulation technology in the 1960 s, Schroeder the basic principles of computer simulation into the room acoustics [8]. Asbjørn Krokstad the first published room acoustic of computer simulation papers, along with hardware and software technology continues to progress, the current auditorium acoustics computer simulation software has matured, widely used in research auditorium acoustics design and evaluation of sound field characteristics [9]. Computer simulation of room sound field by creating a mathematical model of the actual hall, according to the geometric method is for modeling acoustic sound wave propagation in the hall. Since the establishment of and modifications to establish a database of digital material model parameters through information operations, then check the status of the sound quality of the sound field. As shown in Fig. 4, the coverage of 1st order reflections can be evenly distributed to the stage and the frontal audience by only proposed upper reflectors.

The simulation was performed by using the upgraded Odeon software package that can handle energy parameters of ray tracing calculation and was used to validate the schematic concept of using the curve reflectors. The number of rays was set to 20000 and the truncation time of calculation was set to 2000 ms. The source was on the central axis and 3-m from the front edge of the platform. Initiate mode settings of Computer simulation of calculation are listed as shown in Table 1.

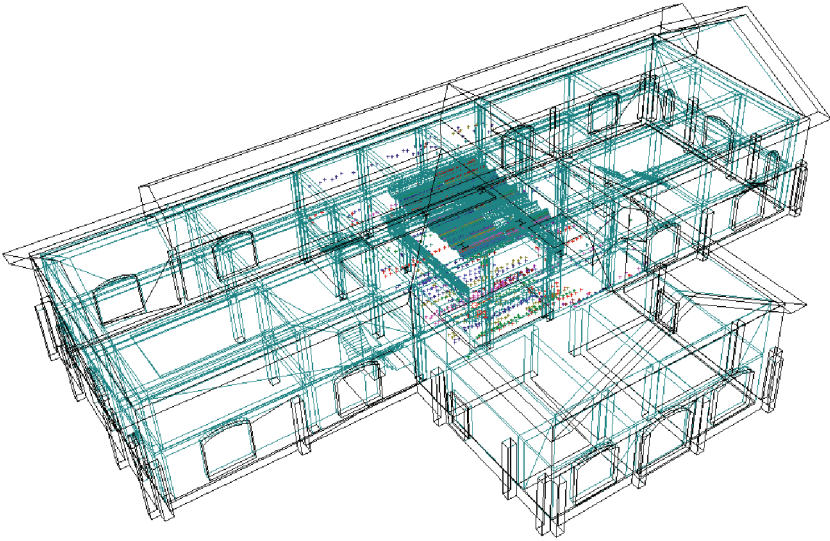


Fig. 4. Simulated 1st order reflection coverage from the upper reflectors.

A slot absorbing panels and a 0.4 scattering factor were assigned to the side and rear walls. Occupied seating with medium upholstery was used for the audience and a 0.7 scattering factor was assigned. 450 m² absorptive draperies for reinforcement music with a 0.3 scattering factor were introduced. Furthermore, acoustics parameters were proposed design target values by computer simulation for the energy parameters RT, EDT and C80. Materials assignments in library of computer simulation are as shown in Table 2.

5 Preliminary Results

A omni-directivity sound source provided by the software package and was used occasionally as references. The source was on the central axis and 1.5-m from the front edge of the platform. Due to the cross-shaped hall-room space and symmetry, averaging 8 measuring points are chosen one side of seating which were symmetrically distributed. Sound source in front of stage is set and simulated perspective and distribution of sound energy particles of schematic model is shown in Fig. 5. Preliminary obtain mono sound parameter, reverberation time (RT), early decay time (EDT) and music clarity (Clarity, C80) are discussed. Acoustical indices, such as RT30, C80, D50, Ts and EDT, are derived from the impulse response which is based on the International Standard ISO 3382 (Bradley 2004) [10]. Preliminary results of acoustical parameters were calculated by computer simulation were summarized in Table 3 when all the acoustical draperies are taken on. The reverberation time at mid-frequency is resulted about 1.13 s.

Table 1. List of Initiate mode settings for computer simulation

Parameter	Set mode
Scatter method	Lambert
Decimate late rays	ON
Transition order	1
Number of rays	20000
Max. reflection order	2000
Impulse response length	2000 ms
Angular absorption	All materials
Late reflection density	600/ms

Table 2. Materials assignments in library of computer simulation

Location distribution	Materials	Frequency (Hz)							Scattering coefficient
		63	125	250	500	1 k	2 k	4 k	
Stage floor	Wood	0.15	0.15	0.11	0.1	0.07	0.06	0.07	0.1
Audience floor	Carpet	0.15	0.15	0.2	0.1	0.1	0.1	0.1	0.1
Audience seat	Medium upholstered	0.62	0.62	0.72	0.80	0.83	0.84	0.85	0.7
Ceiling	48 k Glass fiber	0.1	0.1	0.17	0.63	0.75	0.82	0.93	0.5
Side wall/Rear wall	Slot absorbing panels	0.28	0.28	0.5	0.65	0.7	0.7	0.7	0.4
Stage opening	Drapery	0.03	0.03	0.16	0.46	0.71	0.75	0.7	0.3

When comparing the reverberation time (T30) and early decay time (EDT) of the live concert configuration in the pavilion difference usage with 450 m2 absorptive draperies. The reverberation times (T30) and early decay time (EDT) derived from the simulation for the concert configuration and live music configuration are shown in Fig. 6. Reverberation time averaged from 250 Hz through 4 kHz was decreased by approximately 77 % when the draperies were totally opened.

6 Discussion

Re-use of buildings as a “Live house” which is performed for the musical show with sound reinforcement system is particularly welcome by young people in Taipei. The paper begins with the general absorption material for the interior elements. Computer simulation of room sound field by creating a mathematical model of the actual hall,

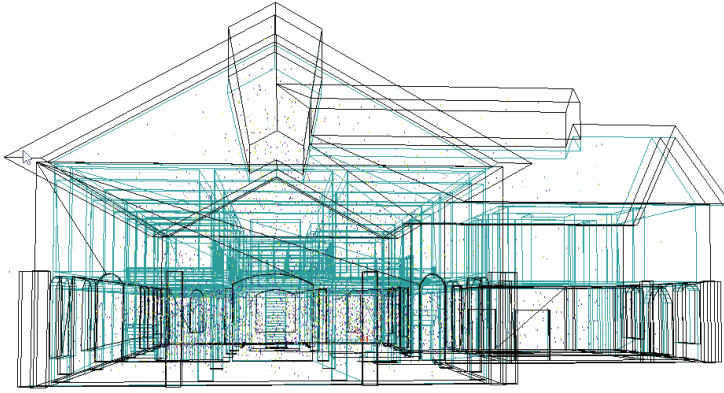


Fig. 5. Simulated perspective model and distribution of sound energy particles

Table 3. Acoustical parameters with live music performance were listed

Frequency Parameter	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
T30(s)	1.43	1.27	1.21	1.15	0.98	0.91
EDT(s)	1.35	1.20	1.15	1.11	0.92	0.85
C80(dB)	2.01	2.45	3.54	3.28	2.52	3.31

according to the geometric method is for modeling acoustic sound wave propagation in the hall. Since the establishment of and modifications to establish a database of digital material model parameters through information operations, then check the status of the sound quality of the sound field. Following sections are dedicated to detailed studies concentrating on the major design components. The results presented here not only have been used to verify the design scheme concept, simple field verifications have also achieved in the future newly built in order to characterize information of room acoustic. Some preliminary results are abstracted as followed:

- (1) Cross-shape room form distributed which is connective with heritage architecture, internal structure system are strengthened to against horizontal energy, interior partitions and related to openings are complete build to three dimensional models.
- (2) The reverberation time at mid-frequency for live music performance is resulted about 1.13 s. derived from computer simulation.
- (3) Reverberation time averaged from 250 Hz through 4 kHz was ideal decreased by approximately 77 % when the draperies were totally opened.
- (4) Subjective assessment objective measurement in live house to investigate immediate hearing experiences, it will be the next phase of evaluation through questionnaires contribution which is corresponding to the physical room acoustics review of among the seats by differences on the property.

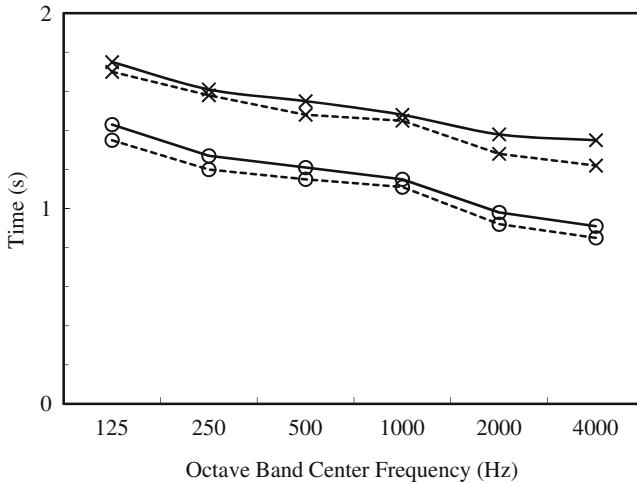


Fig. 6. Reverberation time (T30) (solid line) and early decay time (EDT) (dotted line) derived from computer simulation as a function of frequency band comparing the coupling configuration with curtains (X) to the configuration with all stage curtains (O).

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