RESEARCH ON SOUND FIELD OF TRADITIONAL PERFORMANCE PLACE OF MIAO NATIONALITY -- A CASE STUDY OF THE MIAO BRONZE-DRUM SQUARE IN LANG DE XIA VILLAGE IN GUIZHOU PROVINCE

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The Miao nationality is one of Chinese minority which has abundant Sound culture. For example, in Miao's cultural form, music is closely related with festivals, folk rituals, producing activities, and more Miao ancient songs is the most importantly tool to spread history and culture. For this reason, there are some performance buildings and Spaces related to acoustics. Among them, the bronze-drum square is one of the most primary outdoor performance place in Miao's culture. This paper is based on the test of sound field of bronze-drum square in Lang De Xia Miao's village, which locates at South-eastern in Guizhou province of China. The test used clapping as impulsive sound source stood in the bronze-drum square's centre, and were conducted on 5 test points, contained respectively standing on the distance of 3 meters, 6 meters away from the sound source, and respectively standing on the Second step, the tenth step and the seventeenth step. Through this test, it obtained some important numerical value of sound field characteristic such as the Early Decay Time (EDT), the Reverberation Time(RT), and analyzed the characteristic of sound transmission combined with space morphology, enclosing degree, and ecomaterials. Furthermore, by analyzing the acoustic feature of main sources such as Miao ancient songs, four-around drum, and dialect, this article established the relationship in Miao's traditional performance place between objective evaluation of sound field with traditional culture.

Keywords: Sound field, Traditional performance place, The Miao nationality, Guizhou, China

1. Introduction

Recording and testing artificial voice is one of the important contents in soundscape research, which is related to the protection of traditional sound environment with historical and cultural value. Traditional soundscape research started in Japan. They advocated conducting study in different fields such as environment, sociology, and acoustics, and then established a new perception of voice. Furthermore, because of committing to the protection and research on traditional culture, traditional soundscape protection was one of the main content in Japan. For example, Yamashan discussed historical and humanistic connotations of cultural soundscape in Japan from With folklore perspective, which made some history at soundscape research[1]. In 1993 the Soundscape Institute of Japan was founded. The organization advocated protecting the legacy of historical sound and exploring the connotation of the society, history and culture. in addition, united with Ministry of the Environment, they launched '100-year environmental plan', which was through the activities of "100 kinds of Japanese soundscape: protecting our heritage", to spread the awareness of understanding,
listening and correctly treating the sound environment into civil life[2]. These results unconsciously influenced on the attention of traditional soundscape in the world.

In China, scholars have carried out a series of studies on sound field of Chinese traditional operas, soundscape of Chinese classical gardens and buddhist temples, and sound environment in some traditional Areas. Xiaomei Yuan took the feature of Chinese typical garden soundscape and construction technical principle as the objects to explain cultural connotation and craft from the angle of voice[3]. Xudong Zhang analyzed the function and the features of time, site, content and so on of the traditional Chinese Buddhism temple soundscape to make conclusion that at least 26 districts ever took the bell tone as the local featured landscape[4]. Lingjiang Huang took Lhasa old city as the research case to obtain the sound source, sound space distribution, environmental change and frequency change of soundscape and other conclusions of sound environment, and proposed the concept and method of soundscape protection of Lhasa old city to improve the altitude of traditional Tibetan culture protection. Hui Xie et al. took the Chongqing Ciqikou ancient town as an example to develop the subjective assessment of soundscape in traditional history street of mountainous city and build the design and application principle of soundscape in mountainous city[5]. Zihou Meng regarded the urban sound as the “ignored scenery” and made sound collection and sorting about the old Beijing vendor's shouting, sound of gongs and drums and other soundscape combined with history material[6]. Siyuan Qin initiated the “Urban Voices” project, invited many British sound artists to collect sounds for creation in China and solicited Beijing citizens for the “Beijing sound in your heart” to build a Hutong voice museum[7].

2. Overview of traditional Miao nationality performance space

Miao nationality has a custom that they use music to record life, which has formed a tradition “food protects health and song nourishes heart” and inherits a large number of traditional etiquettes and customs of production and life. Refer to Fig. 1, their national festivals include Guzang Festival, etc. The traditional music includes the flying songs of Miao. Sacrificial utensils include percussion instrument - wooden drum, religion musical instruments - copper bell and bamboo rhizome, and wind instruments - Lusheng and Mangtong. The performance space system derived by the colorful custom activities, especially the bronze-drum Square, is the most important outdoor performance space.

![Figure 2: Drum-memorial Ceremony of Miao nationality](image)

The drum ground is also known as the Lusheng field and is called as “Adalue” in Miao Language, which is the main site of Miao festival party and acts as the drying site of grain at ordinary times. Refer to Fig. 2, one of origins of the name is that the ground is paved with Quartzite or cobblestones to the herringbone or fish pattern (known as “fish bone” in Miao culture which roots that the fish is the object of Miao reproduction worship), and it is shaped like the surface of a huge bronze drum by simulating the drum surface of bronze drum to appear the concentric-circle radial pattern; the other reason is that an ox-horn-shape ‘bronze drum column’ is inserted in the center of ground so that the bronze drum can be suspended, and Miao people gather here on New Year's Day or other festivals and dance and sing around it, which is known as “treading bronze drum”. So nearly every middle or big scale Miao Village has the bronze-drum Square and several
small villages mutually own one bronze-drum Square. The bronze-drum Square is a roomy non-entity performance site where spectators’ stand are paved with stones.

![Figure 2: Bronze drum and bronze-drum square](image)

### 3. Sound field test and analysis of bronze-drum square

#### 3.1 Evaluation criterion of sound field in modern performance space

The title should be typeset using 17 point bold Arial or Helvetica font, with capital letters only. The “Title” style has been adjusted to use these values. This style also adjusts vertical spacing above and below the title. If the title is longer than one line, it should be manually broken to equalize line lengths.

In the design of modern performance architectures, from the subjective point of auditor, suitable loudness, high musical and language articulation, enough musical fullness, good sound space sense and no sound defect and noise distraction are five important factors to influence the auditory feeling when audiences watch the performances[9].

On the one hand, in order to meet the above requirements, the designers may generally make designs of sound field from the SPL, RT, reflected sound distribution, STI, D$_{30}$ and other objective physical quantity aspects to create the best sound effect. Where, the sound transmission relates to the pattern, scale, surrounding degree of space and the structure and sound absorption material of architectures, as well as other acoustic characteristics, for example, the surrounding interface of space can supply sound reflection and increase the reflected sound of audience seats to improve the loudness. Besides, the performance architectures with different using functions have different requests for objective physical quantities, such as, the difference between the drama performance theatre and concert theatre.

On the other hand, for the common indoor performance space, the noise interference and sound articulation are two important reflection indexes of acoustic features. Where the continuous noise produces shielding effect on the speech and music, so the noise should be more than 10dB lower than the signal[10], that is, the certain Signal to Noise Ratio (S/N) should be reached. For example, in the minimum sound pressure level (SPL) position, the S/N should be more than 30 dB[11]. Only when the noise source is effectively controlled, the speech intelligibility can be guaranteed during performance.

#### 3.2 Environment characteristic of bronze-drum square

Compared with the modern performance architecture, Guizhou Miao bronze-drum Square is an open or half-open space. The influence factors of sound field characteristics of outdoor performance space are much more complicated than the indoor space. First, the noise influences in the external environment is the most uncontrollable factor; second, the material types constructing the environment are much and there exists difference of absorption and reflection of various materials on sound,
so the ideal reverberation time and reflected sound distribution are difficult to be controlled; furthermore, it can’t be ignored that the effect of the air temperature and humidity change on the objective indexes of sound field. Therefore, the bronze-drum Square is not able to be evaluated by the standard of modern hall tone quality. In addition, there is no unified standard at present to evaluate it. Consequently, this thesis only evaluates the test results of its reverberation time RT, and analyzes the relationship between acoustic features with the traditional culture through the field test research.

There search item in this thesis is the Lei shan Langde xia Village (known as “Xialangde” in the local), which is a Miao ancient village in Leishan County, East of Guizhou. The “bronze-drum Square” in the village is located on the hillside, which is the main site of greeting guests and performances and the centre of whole village. Refer to Fig. 3, The site takes the ox-horn column as the centre and is surrounded by buildings in three directions, where, in the north direction, a half-round corridor is built and the “beauty arm-chair” is set; in the south direction, the Quartzite are used to pave the stone stages as the audience seats along the small hill and every stage has about 45cm height. The ground is paved with the fine cobblestones and Quartzite. It simulates the emblazonry of bronze drum, where the cobblestones are used to pave the 12 circles of sun-light pattern radial concentric circles and every light and haloing are decorated with the “fish bone”.

![Figure 3: Bronze-drum square in Xia Langde village](image)

### 3.3 Contrastive analysis of EDT \ T20 \ T30

In the test, the clap as the sound source and the reverberation effect produced by the clap is considered in the result analysis[12], so the result only acts as the reference of objective evaluation of this space sound effect and can’t be regarded as the standard of sound environment index judgment. During the test, a researcher stands on the centre of the bronze-drum Square, another tester walks towards the direction of stone stages along the sound source and makes RT test in 5 test points: 3m distance to the sound source, 6m distance to the sound source, second step of stone stages, tenth step of stone stages, and seventeenth step of stone stages. The sound source produces three times in every test point. The test results are shown in Table. 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Test Point</th>
<th>125Hz</th>
<th>250Hz</th>
<th>500Hz</th>
<th>1kHz</th>
<th>2kHz</th>
<th>4kHz</th>
<th>8kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDT</td>
<td>3m distance</td>
<td>0.067</td>
<td>0.038</td>
<td>0.040</td>
<td>0.041</td>
<td>0.032</td>
<td>0.027</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>6m distance</td>
<td>0.031</td>
<td>0.068</td>
<td>0.158</td>
<td>0.198</td>
<td>0.131</td>
<td>0.013</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>2nd step</td>
<td>0.259</td>
<td>0.353</td>
<td>0.403</td>
<td>0.465</td>
<td>0.076</td>
<td>0.045</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>10th step</td>
<td>0.754</td>
<td>0.972</td>
<td>0.445</td>
<td>0.070</td>
<td>0.077</td>
<td>0.080</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td>17th step</td>
<td>0.354</td>
<td>0.359</td>
<td>0.154</td>
<td>0.194</td>
<td>0.466</td>
<td>0.448</td>
<td>0.176</td>
</tr>
</tbody>
</table>
Figure 4 shows the contrast result of Early Decay Time (EDT) of every frequency band in every point. It illustrates that the change of acoustic energy is most gradual in about 3m position and the time is shortest. EDT in about 6m stage is bigger than the 3m position. EDT of points in the stages has no rules about the distribution of frequency band.

![Figure 4: Contrastive curve of early decay time (EDT)](image)

Figure 5 shows $T_{20}$ contrast results still illustrate that the change is most gradual in about 3m position and $T_{20}$ value is minimum.

![Figure 5: Contrastive curve of reverberation time $T_{20}$](image)
Refer to Fig. 6, the $T_{30}$ contrast results (Fig. 6) show that $RT_{30}$ is minimum in about 3m position; although $RT_{30}$ is about 0.45s in about 6m position, the change of every frequency band is even; and $RT$s in three test points of stages are longer.

![Figure 6: Contrastive curve of reverberation time $T_{30}$](image)

The above analysis results show that the values of EDT, $T_{20}$ and $T_{30}$ are obviously increased from the about 3m position to the 17th stage. Where, there is nearly no RT in 3m position, and there is reverberation effect in points from 6m position, especially, the RT values are high in points of every stage. It can be concluded that the reflected sound is from the stone material ground and stone stages. In summary, the RT of sound field in this performance space and the RT difference among every stage is obvious. The research has found that: if the RT of sound field is shorter, the sound articulation is higher; if the RT is longer, the music articulation is lower and the fullness is higher.

4. Conclusion

Considering the sound effects, the RT of normal theatre should be designed to be about 1.5 seconds. So Langde xia Village bronze-drum Square is not the ideal dramatic performance site in accordance with the requirements of the modern hall sound quality, but we can easily find that its sound field features embody their cultural adaptation by the analysis of Miao traditional performance culture. The Miao activities always integrate the watch and performance and the bronze-drum Square is mainly used for the musical performance and collective activities, so they have low requirements on speech articulation, environment noise, reverberation time and space distribution. What's they focus on is the atmosphere. Besides, the great difference of reverberation in stages increases the auditory feelings of audiences. The sound source passes through the different levels of sound attenuation from production so that the more dimensional space sound effect is formed. The audiences can hear different strengths of sound which can increase the fullness of sound field.

In summary, the Miao traditional performance space–bronze-drum Square is fully designed and built from the traditional construction customs of Miao people, and it melts into the subjective consciousness of audiences and gradually forms the auditory habits of local people. Its rich history and culture connotation and the reverberation formed in the special space material, surrounding degree and spatial pattern establish a special sound environment that relevant to the Miao performance custom. It is a special case in Chinese traditional performance sound fields and possesses precious history and culture value.
5. Acknowledgements

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