

## Acoustic Environment Control Strategies for Guandu Residential Areas along Baoxiang River

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**Abstract:** Acoustic environment is a concept in environmental physics, which includes both pleasant music and annoying construction sound. According to the Ministry of Environmental Protection's report on noise pollution, about a quarter of cities in China sleep in noise. In view of the current situation of noise control, this paper takes Guandu section of Baoxiang River as an example, after fully studying and analyzing the types and sources of noise along the river, and from the perspective of spatial planning, puts forward the construction strategy of site acoustic environment restoration, and builds the sound landscape of residential environment in small-watershed.

### 1. Introduction

Guandu section of Baoxiang River is at a stage of rapid development, showing a pattern of alternate development between urban villages and cities. After comprehensive consideration of the characteristics of each residential area and its surrounding environment, the five residential areas along the line are listed as the key research objects. The purpose of this study is to propose the strategy of acoustic environment restoration for residential space along the river. Therefore, this study only evaluates the living noise, traffic noise, industrial noise and construction noise along the river. The evaluation process is divided into three stages: firstly, noise measurement is carried out in the selected research area by noise measuring instrument, and the average value is recorded and counted after the measurement results of many people in the group; secondly, the types of noise sources are known through questionnaire issuance and field visits, and the characteristics of noise sources and the acceptance degree of residents are analyzed; thirdly, through the model deduction, the distribution characteristics of residential space along the river are explored to provide the basis for the construction strategies of the acoustic environment restoration of residential space in small-watershed.

### 2. Acoustic Environmental Assessment of Guandu Residential Area along Baoxiang River

Because of the job-housing imbalance in this research area, after excluding the factors such as weather and holidays, the author set the research time as three periods: 09:00-11:00, 12:00-14:00 and 12:00-14:00. These three periods include not only rush hours but also working hours. At the same time, the lunch break time is also considered. Surprisingly, none of the residential areas surveyed met the national noise standards for the division of sound functional areas.

In view of this phenomenon, the author again monitored the five residential areas and found the following regularities: firstly, in terms of the time period of maximum noise in each residential area, the noise in New-Zhujia Village is the greatest, that in Junfa Dianchi One is the smallest, and that in Guzhenjiayuan, the noise fluctuation is the greatest (Fig. 1); secondly, in terms of the time period of minimum noise in each residential area, the noise in New-Zhujia Village is still in the position,

although Junfa Dianchi One's noise is the smallest, but still higher than the residential noise standard (Fig. 2).

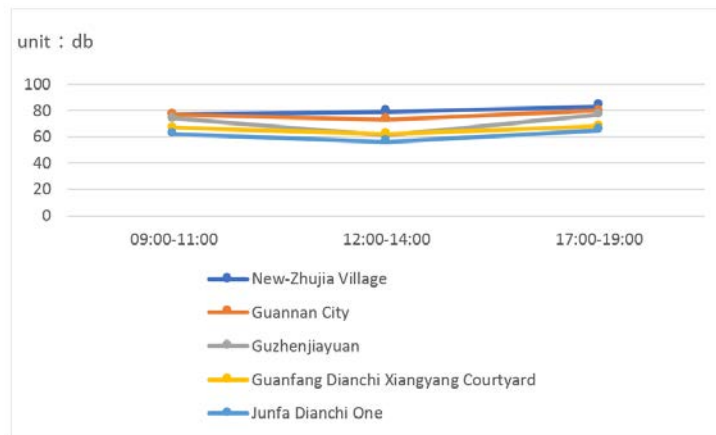


Figure 1. Distribution of noise in each district at the maximum noise level, by the author.

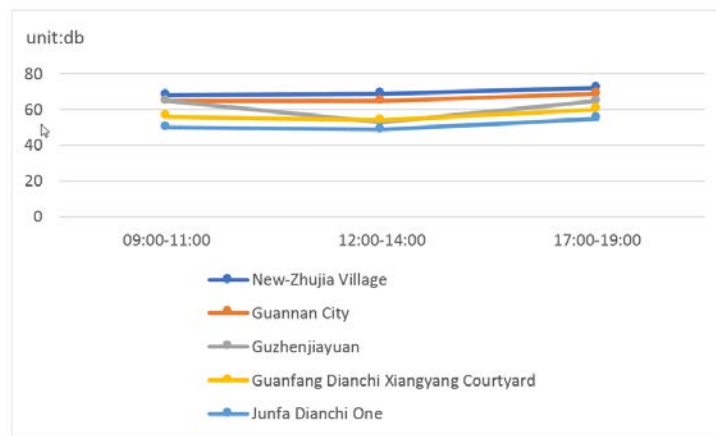


Figure 2. Distribution of noise in each district at the maximum noise level, by the author.

So the author chooses three observation points for measurement and statistics respectively for New-Zhujia Village and Junfa Dianchi One, hoping to carry out comparative analysis based on their spatial characteristics and explore the law.

By comparing the statistical data of six observation points in two residential areas in different time periods (Table 1.), it is not difficult to find: (1) No matter the grade of the residential area or the surrounding environment, the traffic noise has the greatest impact among the noise sources, and the traffic noise increases with the grade of the adjacent roads; (2) For the same residential area, public service facilities will also bring noise to the residential area due to the large focus of traffic flow. (3) Noise changes with activity, with the highest noise during rush hours, the second noise during working hours and the lowest noise during lunch breaks.

Table.1. Statistical Table of Maximum Noise in Different Time Periods at Observation Points.

Point		09:00-11:00	12:00-14:00	17:00-19:00
New-Zhujia Village	1	62db	57db	65db
	2	59db	55db	56db
	3	55db	53db	55db
Junfa Dianchi One	1	59db	58db	61db
	2	56db	54db	57db
	3	57db	53db	55db

### 3. Acoustic Environment Control Strategies for Street-facing Interface along Small-watershed

According to the survey, the relationship between residential space and road interface is the guarantee of a good residential acoustic environment. For this reason, the author puts forward the following classified control strategies according to the characteristics of residential spatial distribution along Guandu section of Baoxiang River:

#### 3.1 Reform the Road Section in Residential Areas near City Road

This type of settlements mainly refers to the areas along the river that have not yet completed urban renewal, just like villages in the city represented by New-Zhujia Village. Most of them are prior to city road construction, and most buildings are closely integrated with roads. The author thinks that we can improve the acoustic environment from two aspects for this type. On the one hand, the road section can be reformed. According to the specific conditions, the way of adding central green belts in the middle or two of lanes can be adopted, or the road can sink to reduce the impact of traffic noise on residential areas. On the other hand, it can take the form of adding silent hedges along the periphery of the building to hide the sight and reduce the noise annoyance (Fig. 3).

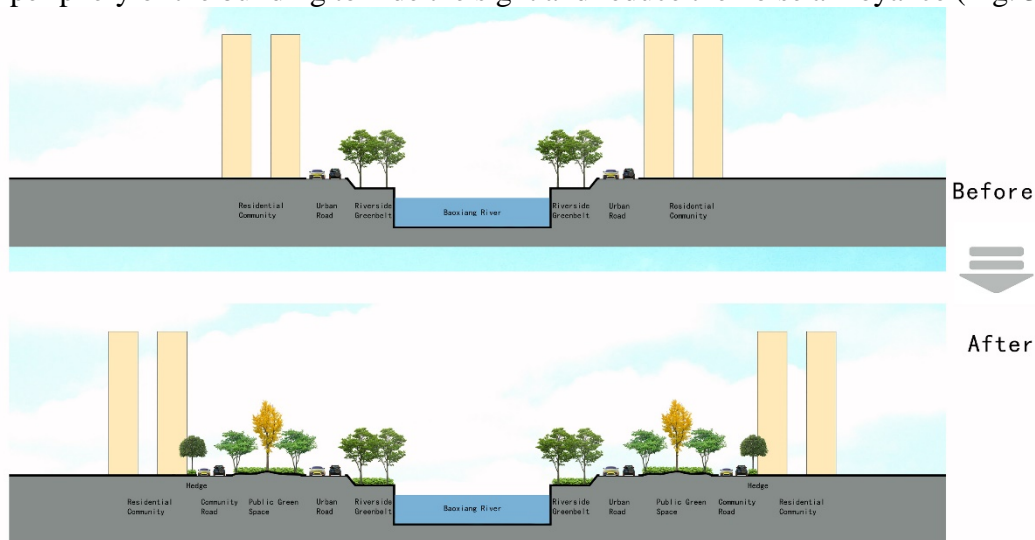


Figure 3. Image of road section reconstruction, by the author.

#### 3.2 Establishment of Riverside Soundscape in Residential Areas with Riverside Space

Adjacent to riverside green space is the second type discussed in this paper. The existence of riverside green space itself has opened the distance between city roads and residential areas, and played a very important role in the noise barrier from the spatial pattern. In view of this type, the author believes that the design of riverside green space should be regarded as the center of gravity.

The design of riverside green space mainly considers adding, that is, using means as borrowing, complementing, backing, hiding to create soundscape. Specifically speaking: Firstly, as far as possible to cover the surrounding residential areas with multi-level greening space combined of arbor, shrub and grass, so that the negative voices brought by traffic could be absorbed as much as possible; Secondly, combined with the characteristics of human activities in the riverside green space, such as adopt space subsidence design at activity space, which not only enriches the sound level, but also does not hinder the activities. It can also enrich the sound level; thirdly, water is used to guide the activity route in order to increase the types of soundscape.

#### 3.3 Utilizing Public Space to Optimize Land Use in Residential Areas

At present, many districts along Baoxiang River have built sound barriers through public space like parking lots, squares, green spaces or public buildings to achieve certain sound insulation effect. These public spaces or buildings adds certain buffer spaces for residential areas on both sides of city roads or rivers due to their own dimensions (Fig. 4). However, it should be noted that buildings (spaces) suitable for peripheral or intersection should be able to adapt to noise or be insensitive to

noise. Mixed housing and other functions (mainly commerce) should be considered to construct a "composite" sound barrier in residential areas with limited space.

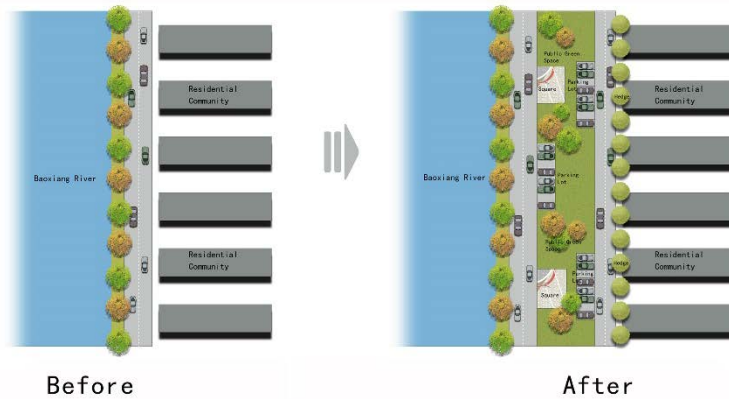


Figure 4. Utilizing public space to optimize land use, by the author.

### 3.4 Guiding the Architectural Layout of New Residential Areas

To a certain extent, the sound environment of the block will be affected by the arrangement, height, the degree of enclosure and body scattering of the buildings. Therefore, the layout should be considered as an important factor for new residential areas. Based on the research, the author puts forward some renewal suggestions on the basis of the traditional layout, i.e. parallel, mixed and slab layout: the layout of parallel buildings should consider the way of long-side layout in the periphery, so as to prevent noise by continuous interface and avoid traffic noise penetrating the whole area (Fig. 5); the layout of mixed buildings should avoid the right entrance and exit, and use the assistance of closed enclosure. Buildings can properly reduce the impact of noise directly passing through residential areas (Fig. 6); slab building layout is suitable for residential areas with high noise and need to be focused on prevention and control. When layout, the gable spacing should be reduced as far as possible, and there should be appropriate deflection along the road, which can not only significantly improve the residential acoustic environment, but also take into account the requirements of sunshine and ratio.

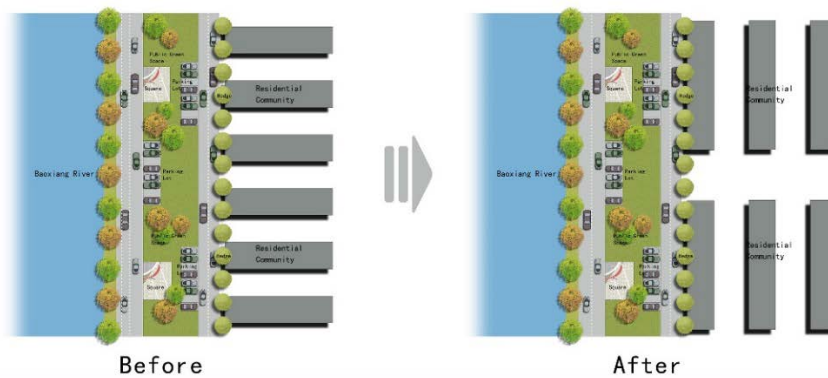


Figure 5. Continuous interface could avoid traffic noise penetrating the whole area, by the author.

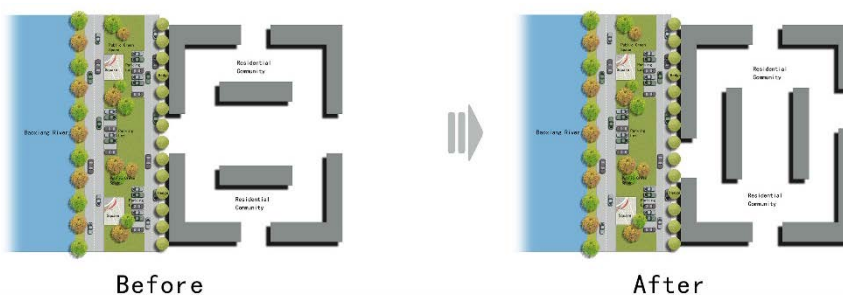


Figure 6. Reduce the impact of noise directly passing through residential areas, by the author.

#### **4. Conclusion**

Based on the investigation of the residential acoustic environment along Guandu section of Baoxiang River, this paper puts forward four strategies for the restoration of the acoustic environment in view of the types of residential areas and the combination of the residential areas with the river and road interfaces. The four strategies start with the relationship between residential areas and rivers and urban roads, which have certain reference significance. However, this study lacks the calculus of model, and it is necessary to further verify the effect of acoustic environment restoration in the follow-up study.

#### **Acknowledgments**

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#### **References**

- [1] Jie Yao, Research on the Design Strategy of Climate Adaptive Office Block: A Case Study of Xiamen Software Park Phase II, D. Huaqiao University. Quanzhou, 2015.
- [2] Shuyang Wang, Study on the Construction and Design of Rural Sustainable Residential Buildings in Cold Areas of North China, Tianjin University, Tianjin, 2011.
- [3] Shuyang Wang, Planning and Control of Acoustic Environment in Water-rich Rural Areas of the Yangtze River Delta: A Case Study of Jiandong Village and Huanggongwang Village, Southeast University, Nanjin, 2017.