

Analysis and Control of Acoustic Environment Based on Campus Landscape

--Take Xinyang Agricultural and Forestry University as an example

Manyi Fu

Xinyang Agricultural and Forestry University, Xinyang, Henan, 464000, China

Email: 304761473@qq.com

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Abstract: As a place for teachers and students to study and work, the campus environment as a whole can not be ignored, and the campus acoustic environment is an important part. In this paper, the acoustic environment of Xinyang Agricultural and Forestry University is monitored and analyzed. Through the use of tab8151 noise monitoring decibel meter with A-weighting, the acoustic environment of the campus is monitored. The instantaneous sound level data of the area is monitored by Excel, Photoshop, adobe The illustrator software makes statistical calculation, analysis and drawing, and then uses arcgis10.2 software to process Kriging interpolation method to obtain the noise quality distribution map of Xinyang Agricultural and Forestry College. Referring to the environmental quality standard for noise (GB3096-2008), it is concluded that the school's acoustic environment quality is good, the sports area is the main source of noise, which has a certain impact on the new dormitory building, and the table tennis field has a certain impact on the old dormitory building It has a certain impact. Then, combining with the professional knowledge, this paper puts forward some suggestions and measures for the later transformation of campus environment.

1. Introduction

With the gradual development of our modern society and the traffic in each urban area, the social sound environment has become more and more important to people. From the medical physiological point of view, any sound that disturbs people's daily life, study and work is called noise[1]. Noise can cause direct harm to people's daily life, work, study and physical health, and can cause some physiological or psychological diseases. 50 decibels of noise can interfere with people's attention shifting, and 90 decibels of noise can affect people's attention stability. With the continuous development of modern colleges and universities in China, the intricate and complicated sound environment and the lack of prevention and control in the campus have made the noise in the campus gradually become an important factor affecting the work and study life of the staff and students[2]. Long-time noise can distract students' attention and thus affect their learning effect, and the management of campus noise has become an important task in the construction of campus environment[3].

2. Research Ideas and Methods

2.1 Regional Studies

Xinyang Agricultural and Forestry University is located in Pingqiao District, Xinyang City, Henan Province. It is close to National Highway 312 in the south, New Twenty-Fourth Avenue in the east, and Sanqiao residential area in the north. The school campus covers an area of more than 1430 acres, building area of more than 445,000 square meters, now more than 15,000 school students, 960 staff.

2.2 Research Techniques

1.2.1 Identification of measurement points. Because the campus area is larger, the campus is divided into teaching area, sports area, student dormitory area, life service area four areas. Among them, the teaching area includes one teaching building, two teaching buildings, administrative building, library, experimental teaching building and science and technology teaching building; the sports area includes basketball court, tennis court and sports field; the student dormitory area includes the new dormitory area and the old dormitory area; and the life service area includes the family home of teachers (cultural museum garden), school hospital, two restaurants, ginkgo restaurant and Biyuntian restaurant. According to the regional functional characteristics, 66 measuring points were set up, including 30 points in teaching area, 8 points in sports area, 17 points in student dormitory area and 13 points in life service area. Point 18 is shared with the new dormitory area, and point 53 is shared with the old dormitory area and the ginkgo restaurant. The distribution of measurement points is shown in Figure 1.



Fig.1 Schematic Diagram of Measurement Point Distribution

1.2.2 Measurement methods: Spot measurement shall be conducted on the campus, and hand-held noise monitoring instruments shall be carried out at least 3.5 meters away from the reflections (excluding the ground) and at least 1.5 meters away from the ground.

1.2.3 Measurement conditions: The measurement shall be carried out under the weather conditions without rain, snow or lightning, and the wind speed shall not be more than 5m/s, and the measurement shall be stopped when the wind speed is more than 5m/s.

2.2.1 Monitoring Equipment: Tab8151 Noise Monitoring Decibel Instrument.

1.2.5 Select measurement time and frequency. The measurement time interval is 9: 00-10: 00 AM and 4: 00-5: 00 PM. A instantaneous sound level is recorded at 5s intervals for each measurement point, and 100 consecutive data are recorded. The measurement time is 3 days, namely, Tuesday, Thursday and Saturday. Because the sound environment of campus traffic is basically stable from Monday to Friday, Tuesday and Thursday are chosen as the representatives, while Saturday is taken as the representatives of rest days and Thursday working days for comparison.

2.2.2 Measured Value Processing: the Measured Data Are Arranged from Low to High, and the Equivalent Continuous a Sound Level is Used for Calculation, with Reference to the Following Formula;

$$L_{eq} \approx L_{50} + \frac{d^2}{60} \quad d^2 = L_{10} - L_{90}$$

In the formula, L_{eq} is the equivalent continuous A sound level of the measuring point. L_{10} , L_{50} and L_{90} refer to the data arranged in descending order, in which the data ranked 10th, 50th and 90th are listed. The final value of a certain measurement point on a certain day is the average of the equivalent continuous A sound level for three time periods on that day.

1.2.7 Analysis software: After monitoring the data of the campus, we first use Excel to count and calculate the measured noise data, then use Adobe Illustrator and Photoshop to make noise quality range map of different areas of Xinyang Agricultural and Forestry University, and then use ArcGIS 10.2 software to make noise quality distribution map of Xinyang Agricultural and Forestry College.

1.2.8 Evaluation methods: The average instantaneous sound level obtained from monitoring shall be referred to the Sound Environmental Quality Standards (GB3096-2008) to determine whether the standards are met. Colleges and universities belong to cultural and educational areas and residential areas, belong to a class of acoustic environment function areas, should implement the noise standard: the standard value of 55dB during the day.

3. Research Results and Analysis

3.1 L_{eq} Value for Different Areas and Time Periods on Campus

Table 1 L_{eq} Values For Different Time Periods by Region of Xinyang Agricultural and Forestry University

Survey area	Survey location	Measuring points	Tuesday Leq	Thursday Leq	Saturday Leq
Teaching Area	The Second Teaching Building	1	45.00	45.23	41.53
		2	45.50	45.80	41.97
		3	44.85	45.87	42.52
		6	45.83	46.37	42.25
		7	46.13	45.95	41.48
		8	44.73	44.52	41.42
	Administrative Building	4	43.27	43.02	41.95
		5	43.80	44.45	41.77
	The First Teaching Building.	9	44.78	44.40	41.48
		10	43.82	42.97	40.50
		11	44.37	45.32	41.68
		12	45.52	46.17	41.92
		13	46.70	47.52	42.53
		14	47.03	47.60	42.63
	Experimental Teaching	17	49.00	49.55	44.88
		18	49.65	49.32	45.15
		19	46.23	47.03	42.48
		20	47.82	48.40	43.45
		21	48.57	48.28	43.25
		22	48.72	49.03	43.22
		23	45.85	44.98	41.68

	Library	24	44.77	44.50	40.72
		25	45.12	44.62	40.75
		26	45.77	45.35	41.53
	Science and Technology Teaching	27	46.28	46.58	41.22
		28	47.42	47.65	43.37
		29	47.82	48.33	43.22
		30	46.28	47.20	41.87
		31	45.07	46.40	40.80
		32	46.80	47.53	43.40
Sports Area	Basketball Court	38	60.02	60.60	61.20
		39	60.68	61.78	62.97
		40	62.42	63.67	64.25
		41	62.85	63.55	64.33
	Playground	40	62.42	63.67	64.25
		41	62.85	63.55	64.33
		42	60.70	61.97	61.63
		43	60.73	61.50	61.07
	Tennis Court	42	60.70	61.97	61.63
		43	60.73	61.50	61.07
		44	59.58	60.28	61.02
		45	60.40	60.23	61.20
Student Dormitory Area	New Dormitory Area	18	49.48	49.15	45.15
		33	53.07	52.57	47.17
		34	50.73	51.05	50.02
		35	54.38	57.27	52.43
		36	56.62	58.25	57.47
		37	51.57	52.73	52.40
	Old Dormitory Area	53	56.10	55.02	55.03
		54	57.60	56.35	56.43
		55	55.95	55.52	57.58
		56	54.80	55.17	56.58
		57	54.78	55.27	55.85
		58	51.83	52.02	54.00
		59	56.12	55.17	56.28
		60	55.30	54.98	57.57
		61	54.77	54.45	56.00
		62	55.25	54.97	55.87
		63	56.65	55.00	57.17
Living Service	The Second Restaurant	15	54.80	53.17	52.18
		16	53.32	52.23	51.13
	Biyuntian Restaurant	64	60.43	58.72	60.02
		65	63.00	61.60	62.03
	Ginkgo Restaurant	53	56.10	55.47	55.03
		66	59.75	60.18	61.22
	School Infirmary	50	50.27	48.47	49.58
		51	50.85	48.47	50.03
		52	48.27	47.48	46.62
		46	47.88	47.15	45.67
	Teachers Families (Wenbo Garden)	47	45.60	45.32	43.22
		48	47.32	46.17	44.20
		49	49.38	48.22	47.23

From the above data, we can see that the L_{eq} overscale rate was 33.33% on Tuesday, the highest L_{eq} was 63dB, the lowest L_{eq} was 43.27dB, and the average L_{eq} was 51.79dB. On Thursday, the L_{eq} exceeded the standard by 29.17%, the highest L_{eq} by 63.67dB, the lowest L_{eq} by 42.97dB and the average L_{eq} by 51.83dB. On Saturday, the L_{eq} value exceeded the standard rate by 37.5%, the highest L_{eq} value by 64.33dB, the lowest L_{eq} value by 40.5dB, and the average L_{eq} value by 50.09dB. Considering the mobility of teachers and students and the average characteristics of L_{eq} value, it can be concluded that the overall average value of noise is lower than the national standard value of 55dB.

3.2 Campus Noise Quality Distribution Map

Using Adobe Illustrator software to vectorize the campus plan drawn by hand in school, and then using Photoshop to draw the map according to the final average instantaneous sound level data, we can get the range of noise quality on Tuesday, Thursday and Saturday, which is as Figure 2, Figure 3 and Figure 4 in turn. The calculated noise value is marked by color, and is represented by color depth, so that the noise data can be better visualized and analyzed.



Fig.2 Noise Quality Range on Tuesday



Fig.3 Noise Quality Range on Thursday



Fig.4 Noise Quality Range on Saturday

The noise L_{eq} of the teaching area is lower than that of the working day. The teachers' home and the School Infirmary in the teaching area and the life service area belong to the lowest noise area, and the sports area is the highest noise area.

The Kriging interpolation method in ArcGIS 10.2 software is used to map the three-day noise monitoring data in the campus. Tuesday, Thursday and Saturday are Figure 5, Figure 6 and Figure 7 respectively. Making use of Kriging interpolation method to attach the monitoring noise data to the monitoring points with coordinate attributes, and making visual noise quality distribution chart of Xinyang Agricultural and Forestry University with interpolation data^[4].

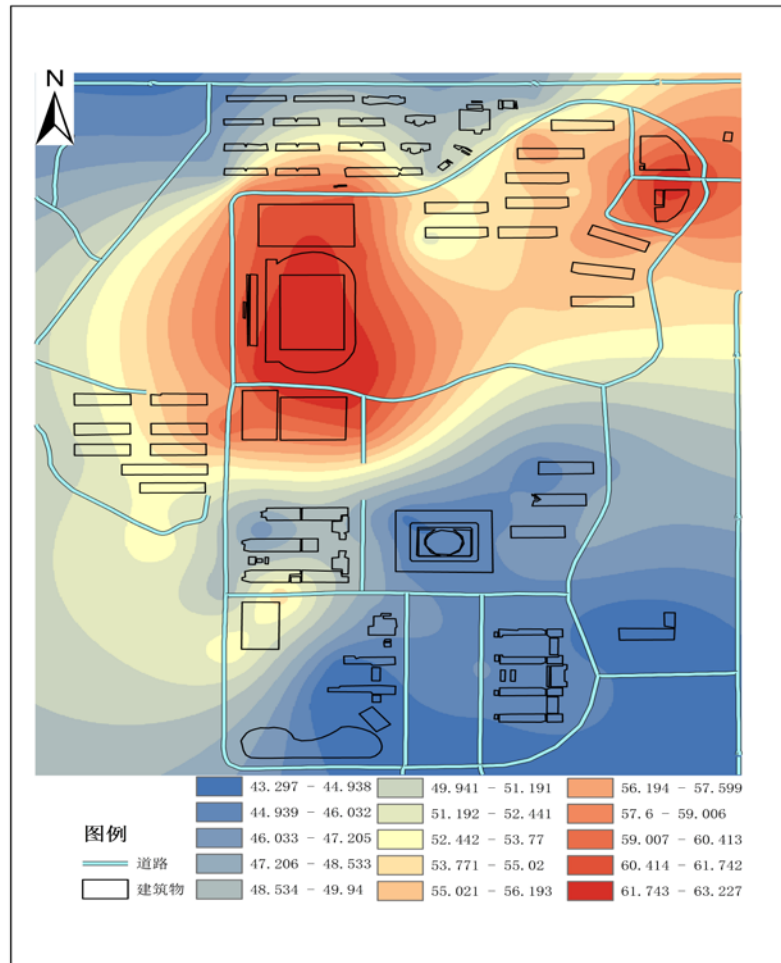


Fig.5 Noise Quality Distribution on Tuesday

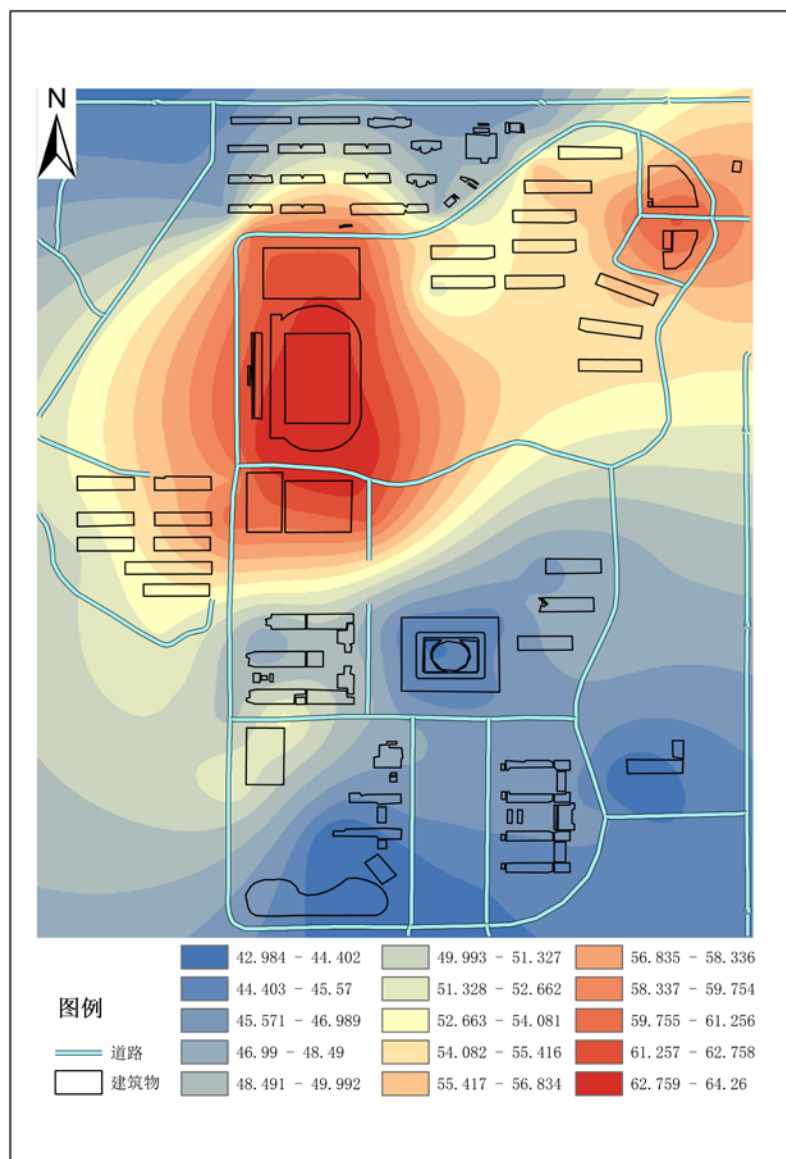


Fig.6 Noise Quality Distribution on Thursday

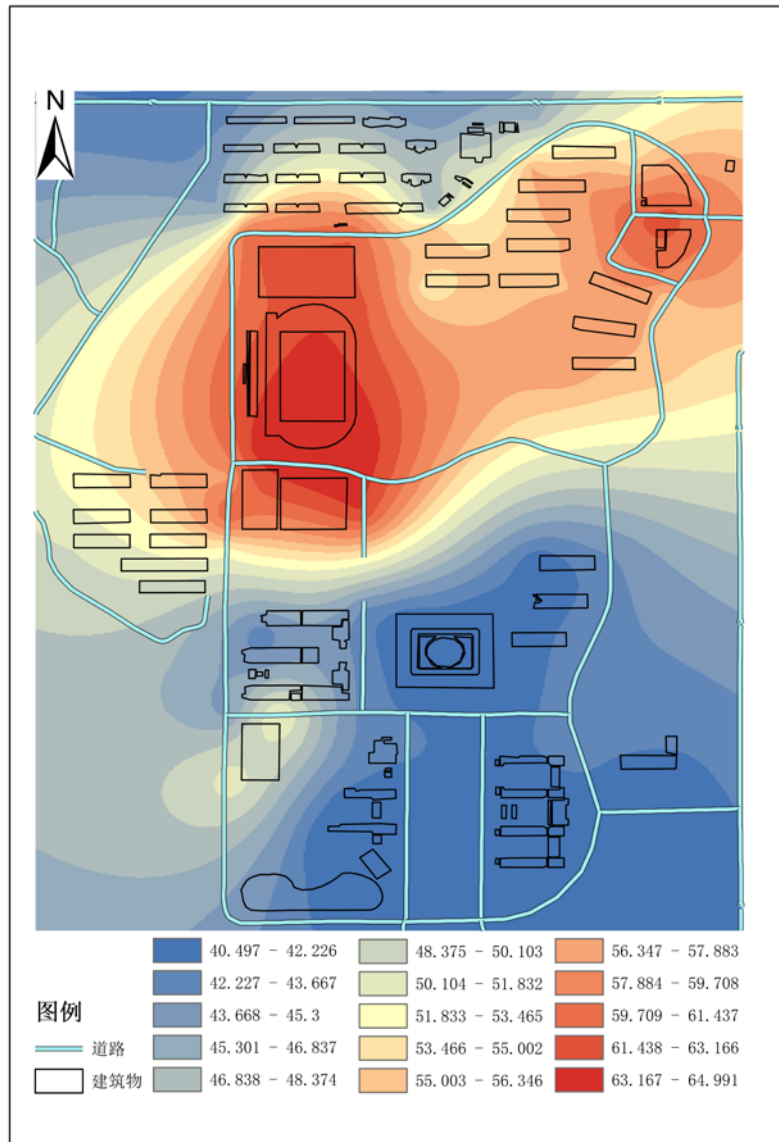


Fig.7 Noise Quality Distribution on Saturday

From the noise quality distribution map, it can be seen that the overall layout of the campus is more reasonable. The northern area of the campus is the sports area, the student dormitory area (the old dormitory area) and the life service area (the Biyun Tian Restaurant and the Ginkgo Restaurant), which are the main concentrated areas of noise, while the southern area is mainly the teaching area. The noise is relatively weak, complies with the national noise standards, and can meet the needs of teachers and students for work and study.

4. Conclusions and Discussions

According to the Sound Environmental Quality Standards (GB3096-2008), Xinyang Agricultural and Forestry University is classified into cultural dioceses and residential areas, which belong to a class of acoustic environmental functional areas. The cultural dioceses are classified as 55dB during the day. Generally speaking, the noise environment of Xinyang Agricultural and Forestry University is in line with the national standards. Among them, the areas with high noise environment quality on campus are the playground, basketball court and tennis court. Because they are far from the library of the teaching building and the experimental building, and there is a poplar forest between the basketball court and the experimental building, there is also a poplar forest

between the basketball court and the library. The forest also plays a good role in isolating the noise. Therefore, the sports place has little influence on the teaching office area, but the basketball court and the playground are near the new dormitory building. Therefore, the daily life and rest of the students living in the new dormitory building will be affected by the noise to some extent. Because there are two restaurants in the old dormitory area, Ginkgo restaurant has a table tennis court in the west, is also very close to the school east gate, so the noise quality is higher.

Next, to reduce the noise of the campus, first of all, through reasonable increase of landscaping, for the campus road lines and areas with more people, you can build some flower ponds or tree ponds, in these ponds, some shrubs and trees can be planted, so that the shrubs and trees can combine with each other and then skillfully make some routes or areas separated from the flow of people, thus playing a role in reducing noise, but also to make the campus to add some landscaping effect, in the campus buildings can be planted some climbing vines, from the facade space level of the campus building to increase some landscaping landscape and play a certain role in reducing noise.

At the same time, several main roads in the campus of Xinyang Agricultural and Forestry University are hardened by common concrete roads. Concrete roads will generate certain tyre noise for driving. Some pavement materials can be selected to reduce the noise during the later transformation. For example, asphalt pavement with certain gaps can be used. Compared with common concrete pavement, this kind of road hardening can effectively reduce the noise value, increase the friction between tires and pavement, and can also make rain water quickly drain away, reduce the water drift phenomenon, and improve the driving safety factor of vehicles in rainy weather.

In addition, in order to increase the diversity of campus landscape, some barrier walls can be added between noise sources and buildings, which can not only reduce noise, but also achieve the effect of landscaping campus.

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