

An Aesthetic Design Method of Landscape Visualization Restoration for a Rural Highway Around the Nanwan Lake: A Case Study in the Shihe District, Xinyang City, Henan Province

Bojing Liao^{1,a} and Feng Wang¹

¹*School of Architecture and Urban Planning, Huazhong University of Science and Technology, Hongshan district, Luoyu road, No. 1047, Wuhan, China*

Abstract: In this paper, we based our field study to investigate an urban-rural highway around Nanwan Lake, China, and the statistical research results are presented with an ANOVA analysis. For this case study, we collected 80 samples, which we categorized into three groups. Villages and features classify these samples. An ANOVA analysis showed that there is a significant difference between the facility samples. The data analysis of our results showed that the problems of the urban-rural highway landscape are constituted by multiple factors in this area; therefore, we built two visual models to illustrate the problem, and we eventually constructed a model of a methodology to attempt to solve these problems.

1 Introduction

The economic growth rapidly of China promoted the integration of urban-rural development since 1990, and constructing the urban-rural highway is necessary as an essential part in this processing. Urban-rural highways across the city and region's ecological system as the bridge connecting cities and villages, and meet the peripheral natural environment to construct a metabolism cycle [1]. In these areas, which often include valuable protected biotopes, forested hills, preserved woodlands, prime agricultural lands and important wetlands, often provide essential ecosystem services for urban residents [2]. Moreover, land-use patterns, human activities, and their combination strongly influence urban-rural road patterns, that is, the placement of highways in a landscape [3]. Therefore, the rural-highway landscape represent highly complex territorial spaces from economic, environmental and social viewpoints [4].

The quality of the visual landscape is important not only to individual citizens and their health and well-being [5] but also to the rural highway around the lake in the peri-urban. However, the large-scale rural highway development that is a part of urban-rural integration in China often leads to changes in the visual landscape, especially in the lake perimeter of Nanwan Lake. There have been many studies on the environment, geology, atmosphere, noise, community and ecology of this area,

^a Corresponding author: 471584495@qq.com

but there have been no aesthetic and visual studies in connection with the plans for the urban-rural highway around the lake [6]. Furthermore, extensive excavation has brought about severe damage to the natural landscape, such as cutting hillsides, excavating hill-hillocks, filling up ravines, cutting down trees, draining wetlands, segmenting grasslands and so on, which has caused a lack of integration and coordination between the highway and the peripheral environment, and it has also led to the separation of the urban-rural highway with the natural landscapes along the route [6]. These issues separated relevance between topography and natural landscape space and visual landscape space, and it also caused various scars in the natural.

There are three main reasons for these questions: (1) urban-rural highways in China are still at the stage of supplying and demanding, people are not so urgent to the beautiful environment and high visual quality compared with the requirements of commutes for the highway [7]; (2) single goals make urban-rural highways to become a standardized product because of a lack of considerations to coordinate the highway and natural environment; (3) Landscape architecture was no opportunity to study the perspective of relationship between the highways and natural as well as ecological at the earlier stage of urban-rural highway [6].

In China, however, the development of urban-rural highway landscapes has lagged significantly in the area of highway construction, and it has not received the full attention of society during the rapid construction of cities [7]. Moreover, the study of urban-rural highway landscapes has lacked theoretical investigation in its main research areas and on the research level. Applying urban-rural highway landscape theories from the developed countries has also been restricted in the area of landscape evaluation, and there has been a lack of experience with such theories [1]. The discrepancy between theoretical study and the actual construction of highways formed because these scientific theories applied to highway planning design, and, for several years, construction was rare. This caused great damage to the local landscape and led to thousands of highways that were constructed in the same way, repeating the same landscape [8].

This paper focuses on changes in the urban-rural highway landscape around Nanwan Lake and the effects of urbanization on urban-rural highways in the area. The research takes the urban-rural highway around Nanwan Lake as an example to provide a method for the restoration of the urban-rural highway landscape visualization system that would result in the construction of highways combined with landscape environment aesthetics and ecological and mass behavior-psychology [9]. In summary, the aims of this paper are:

- To summarize a landscape visual theoretical framework to repair urban-rural highways;
- Devising a method to repair the urban-rural highway landscape based on the theoretical framework to investigate, analyze and characterize the area of Nanwan Lake of China;
- To offer guidelines for the future to repair urban-rural highway landscape to some extent.

2 Research methods

In this study, we used quantitative holistic techniques [10,11] to assess the current situation of urban-rural highway landscapes. Through practical surveys to analyze the scene, from the view of visual aesthetics, we found that the problems focus on three points, namely the labeling system chaos, slope of desertification as well as the living garbage pollution. Based on the theoretical framework of the LES system, we have carried on the on-site investigation from aspects of the Landscape Environment Aesthetics, Ecological Restoration and Mass Behavior-psychology, and try to analyze the following questions:

(1) In the urban-rural highway landscape, what is the relationship between visual aesthetics, ecological restoration and social activities?

(2) What are the social variables that affect the landscape of urban-rural highways?

Therefore, the study methods followed in this paper can be divided into five distinct parts. First, using geographic information systems [12] to analyze the location, altitude and slope of the area of study. Second, we took photos [12] that were intended to cover the situation of slope and facilities within each unit. Third, we categorized these photos and statistics to analyze the characters of each category.

Four, we will create a methodology model according to the analysis results. Finally, we would discuss the above two questions in the model.

2.1 Samples

Due to the relatively complete industrial chain in the study area and the above theoretical framework, the collection of samples was selected mainly from the three aspects of on-site investigation processing: (1) the waste recycling facility (landscape environment aesthetics): this part was divided into trash cans, the dump and garbage trucks to segment the statistics; (2) slope desertification (ecological restoration): the urban-rural highway of the lake-ring needs repair because the slopes are concentrated mainly in two sections, which, respectively, are Shui-XiangQiao village to Dong-JiaHe town and Shi-HeGang town to Ma-JiaFan village; and (3) signage system (mass behavior-psychology): the main categories of signs in this area are relatively self-contained, and they include four categories: a) brand of place-name, b) signboard of tea-factory and tea-base, c) signboard of rural pleasures, and d) publicity brand.

2.2 Survey methods

To study the current situation of the urban-rural highway landscape in this area, we used the on-board camera to collect sample pictures for four towns (Dongjia-He town, Shihe-Gang town, Tanjia-He town and Shisanli-Qiao town) and seven villages (Shuixian-Qiao village, Huangwan village, Linggang village, Tumen village, Longtan village, Haojia-Chong village, Taoyuan village) along the route. Altogether we collected 194 photos in seven days, of which 111 pictures of the first type sample (53 pictures effectively, the effective rate was 47%), 32 pictures of the second type of sample (23 pictures effectively, the effective rate was 71%), 51 pictures of the third type of sample (51 pictures effectively, the effective rate was 66%).

2.3 Statistical analysis

Statistical analysis and comparisons were done by both parametric and non-parametric methods [11]. First of all, we consolidated the effectively photos, and a resulting total of 80 samples were surveyed, of which 19 in the first kind of sample, 16 in the second kind of sample, 32 in the third kind of sample.

After that, we integrated the first, second and third class samples to analyze the specific reasons in these samples from the level of sociological research. We categorize all of the samples via statistics, and using ANOVA to analyze whether there have significant difference between the sample groups.

3 Results

3.1 The statistical results of samples

We conducted a statistical analysis for the distribution of the facilities of each village, the results are as follows: 27.2% of the village facilities distribution is complete, 27.2% of the village facilities distribution is more, and 45.6% of the village facilities is less.

Meanwhile, according to the nature of the facilities, the classification statistics were divided into color tendencies, materials and recognition degree, and the classification statistics of the slope were also divided into unilateral slope, bilateral slope and slope causes. The results of these sample feature classification statistics are as follows:

The first type of samples: color tendency, 52.6 % green, 21.2 % gray, 15.7 % blue and 10.5 % orange; material, 52.6 % iron, 21 % plastic and 26.4% stone; and recognition degree, 78.9 % high and

21.1 % middle.

The second type of samples: desertification tendency, 62.5% bilateral desertification and 37.5 % unilateral desertification; and causation, 62.5 % to the quarry, 25 % to the quarry and 12.5 % to the sandpit.

The third type of samples: color tendency, 34.3 % green and red, 28.2 % blue and 3.2 % orange; material, 50 % plastic, 46.8 % iron and 3.2 % stone; and recognition degree, 75 % high, 18.7 % middle and 6.3% low.

3.2 Similarity and difference between results of samples

Through the on-site investigation, the comparison of the samples and the analysis of the data we classified to summarize the similarity and difference between the samples:

(1) The first type of sample (the waste recycling facility): (a) The solid waste could receive better treatment in this area, and garbage on both sides of the urban-rural highway could use a good cleaning; most families state that trash is a problem and that there is nobody to dump it on the side of the road or the river. (b) The colour and shape of the trashcans as a mobile facility are unified along the route, but their appearance was too simple to differentiate distinctive features.

(2) The second type of sample (slope desertification): the slope needs repair in two main sections, namely Shuixiang-Qiao village to Dongjia-He town and Shihe-Gang town to Majia-Fan village. To build the urban-rural highway around the lake, they excavate and remove soil, which renders the slopes to approximately 35 degrees to 40 degrees high, from 15 m to 105 m, with the maximum slope at approximately 160 m.

(3) The third type of sample (signage system): (a) The place nameplates are basically complete, and the main villages and resorts are equipped with basic nameplates; however, several villages do not have them. (b) The signboards of the tea-factory and the tea-base have their own characteristics, due to a lack of unified planning.

By summarizing the similarities and differences among these three groups of samples, we found that the villages' daily activities and behaviors are the main cause of these results as well as their own interests and qualities. We gathered the first group samples and the third group samples for a one-way ANOVA analysis because they belong to the facilities. From our calculations, the results of the ANOVA (Figure 1) showed that there was a significant difference ($P\text{-value}=0.036198<0.05$ and $F>F_{\text{crit}}$) between two group of samples. Meanwhile, the color, materials and recognition degree have significant differences and are the summary statistical comparisons of interblock.

4 Implication for practice and advancement of research

This research was conducted to study restoration problems for urban-rural highway landscapes from the perspective of visual aesthetics. First, we interpreted three core elements of the trilism of landscape, which was provided by Prof. Liu [9], and we summarized a conceptual framework to guide our field investigation in the study area. Second, we spent 15 days taking photographs of the three types of samples that we collected, and we counted and analyzed the samples. Subsequently, we classified our summarized results, and we built two visual models to explain our findings. Finally, we established a methodological model according to the investigation results to illustrate the key aspects that are needed to integrate conformance and to facilitate ecological repair. The results of the study show that the restoration of urban-rural highway landscapes requires the repair of seven key points, so that these factors are both in conformance and ecologically sound, namely: color consistency, material consistency, recognition degree of distinction, the embodiment of cultural characteristics, facility appearance consistency, plant shape design and slope greening recovery (Figure 2).

For urban-rural highway landscapes, the aesthetics and artistic charm is reflected mainly in the structures (facilities) along the route. Its appearance (including color, material, shape, and its cultural characteristics) are directly related to the quality of its visual aesthetics. Urban-rural highway landscapes consistently coordinate their style, but different sections of a structure can be changed

under the premise of maintaining the landscape style. This enables better integration of the environmental features of the various sections, enriching the scenic views of the highway, and reflecting the harmony between highway landscape and environment. This is our purpose in building this research method.

	Green	Blue	Orange	Gray	Red	Iron	Plastic	Stone	High	Middle	Low
Total 1	10	3	2	4	0	10	4	5	15	4	0
Total 2	11	9	1	0	11	15	16	1	24	6	2

Analysis of variance: single factor analysis of variance
SUMMARY

Groups	Quantity	Summation	Average	Variance
Green	2	21	10.5	0.5
Blue	2	12	6	18
Orange	2	3	1.5	0.5
Gray	2	4	2	8
Red	2	11	5.5	60.5
Iron	2	25	12.5	12.5
Plastic	2	20	10	72
Stone	2	6	3	8
High	2	39	19.5	40.5
Middle	2	10	5	2
Low	2	2	1	2

ANOVA						
Variance	SS	df	MS	F	P-value	F crit
Interblock	644.4545	10	64.44545	3.157684	0.036198	2.853625
Intraclass	224.5	11	20.40909			
Total	868.9545	21				

Figure 1. The one-way ANOVA results.

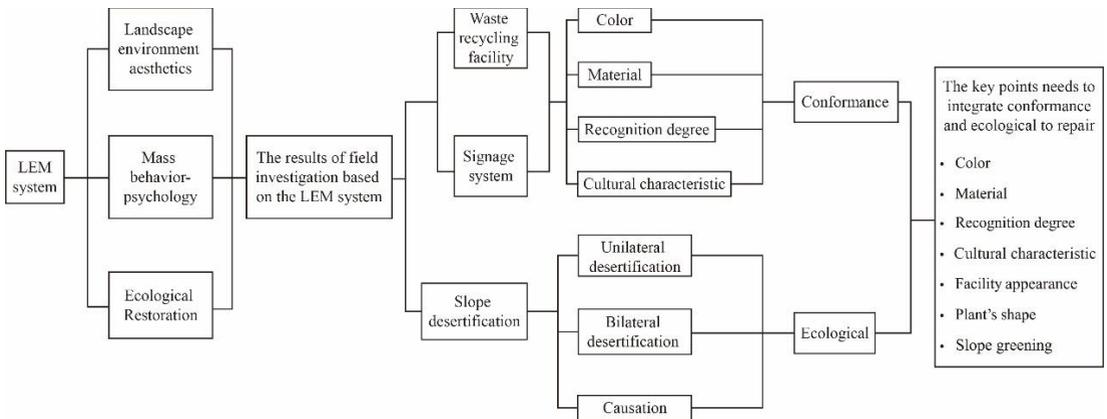


Figure 2. A methodological model from the perspective of visual aesthetics to repair the urban-rural highway landscape systematically

5 Conclusion

Urban-rural highway construction poses particular challenges to agriculture, forest conservation [13] and local industry. This is a double-edged sword because it can create conveniences for local populations and it can also adversely affect local ecology and culture. Maintaining cultural characteristics and protecting the ecological environment have become particularly important. The results of this study indicate that the landscape is mainly affected by government willpower, villager’s preferences and developers’ demands. In the approximately 87 km of urban-rural highway around the lake, we selected the three most representative samples to count and analyze. The results of our analysis indicate that they have separate problems that are not related to each other. It is also significant that the highway landscape in this area lacks a systematic design. According to the results, we built a visual model to explain this point, and we also built a methodology model to attempt to solve the problem. From the perspective of visual aesthetics, this study provides strong evidence that

the area of urban-rural highway landscapes in China can benefit from the perfect combination of theory and practice.

References

1. W Deng, L Ning (2010) Highway traffic science and technology (05): 141-143.
2. I Douglas (2006) Peri-urban interface: Approaches to sustainable natural and human resource use: 18-29.
3. R Forman, D Sperling, J Bissonette, A Clevenger (2003) Ecology.
4. Y Lee, J Ahern, C Yeh (2015) Landscape Urban Plan. 139: 137-148.
5. SMEV Dillen, SD Vries, PP Groenewegen, P Spreeuwenberg (2012) J Epidemiol Community Health 66(6): e8.
6. Z Tang. (2008). Research on Harmony between Expressway and Landscape along the Route. Ph.D, Beijing Forestry University.
7. W Cui. (2003). Study of Expressway landscape. Nanjing Forestry University.
8. D Wang. (2012). Landscape restoration of Scenic Area highway landscape——Take Landscape restoration of the Junfu Road for example . Tsinghua University.
9. B Liu (2001) New Architecture (05): 1-3.
10. TC Daniel, J Vining. (1983). Methodological issues in the assessment of landscape quality Behavior and the natural environment (39-84): Springer. (Reprinted).
11. B Chen, OA Adimo, Z Bao (2009) Landscape Urban Plan. 93(1): 76-82.
12. M Arriaza, JF Canas-Ortega, JA Canas-Madueno, P Ruiz-Aviles (2004) Landscape Urban Plan. 69(1): 115-125.
13. C Wu, Y Lin, L Chiang, T Huang (2014) Landscape Urban Plan. 128: 60-71.