

# Architectural Design of Tourist Areas from the Perspective of Ecological Environmental Protection

Yanjun Meng

Guilin Tourism University, Guilin 541006, China

dreamy\_meng@163.com

**Abstract.** In order to explore the relationship between the architectural design and ecological environmental protection in the tourist areas and realize the sustainable development of tourism industry, the architectural design and design content of the tourist area are elaborated. In terms of design and planning, the reference standards for building dimension design and the modifications of building dimension as the variations of tourist flow are determined. In terms of design content, the corresponding measures are proposed by analyzing the aspects of patterns of architectures, resource utilization, waste and disposal emission, and building materials. Afterward, the architectural design of the Nankunshan Tourist Attraction is analyzed. In summary, it has important practical significance for the current growing architectural design of tourist areas.

**Keywords:** architectural design; ecological environmental protection; design and planning; design content.

## 1. Introduction

Since the 1980s, with the continuous improvement of the living standards of people in the period of rapid economic development, the demands for traveling have also increased. The development of tourist attractions helps to prevent natural resources from the invasion of social activities, creates employment opportunities, and brings economic benefits [1]. In the course of tourism activities, people need to provide services through the various buildings of the tourist areas. With the increase of tourist flow in tourist areas, the number of buildings is also rising; in addition, at the same time, it has caused a series of problems such as ecological damages and environmental pollution [2]. In order to solve these problems, the architectural design of the tourist area is also constantly improving. Given the current conditions of diversified tourism resources and fixed tourism products, the quality of the building has a profound impact on the operation of the tourist area, and architectural design plays an important role in the development of tourist attractions [3].

The strategy of sustainable development requires human beings to protect the ecological environment while developing tourism, which is a problem that must be considered in the design of tourist areas [4]. As a material carrier for people to travel, the construction of the tourist areas controls the above-mentioned contradictions, which may develop in different directions. If these problems are well-handled, the harmonious development of architecture, tourism, and the environment would be achieved; otherwise, it would make the contradictions intensify and cause various problems [5]. Therefore, the improvement of the architectural design in tourist areas to promote the development of tourism industry and alleviates the tension between supply and demand is a problem that architectural designers should consider [6]. Based on the benefits of tourism, architecture, and ecology, the architectural design suggestions are put forward for the protection of ecology and harmonious development to realize the mutual benefits and joint development of the tourism industry, architecture, and ecology.

## 2. Design and Planning of Architectures in Tourist Areas

### 2.1 Design of the Building Dimension

The design of the building dimension in the tourist area should be carried out in four aspects. First, the ecological capacity should be controlled; second, the tourist flow capacity on the basis of the previous steps is calculated; third, based on the tourist flow capacity, the building dimension is

obtained; fourth, the number of tourists that buildings in the tourist areas could carry is calculated to decide whether it satisfies the requirements of tourist flow.

First, control of ecological capacity. Since no ecological component is involved in human landscaped, no ecological capacity problem is found. For natural landscapes, ecological capacity is the natural environment that can be restored after degradation or degraded within a certain tourist flow. According to the survey statistics for many years, the *Specifications for Scenic and Historical Areas* has clearly defined the ecological capacity, as shown in Table 1.

Table 1. The ecological capacity of the tourist areas

Types	Tourist capacity (per tourist/hectare)	Standards of land use (m <sup>2</sup> /per tourist)
Coniferous forest	2-3	4000-3000
Broad-leaved forest	4-6	2000-1200
Forest	<15-18	>650-600
Open forest	21-23	450-400
Lawn	<65	>130
Town	40-150	300-50
Outdoor bathing place	<400	>15
Water	1000-1500	20-5
Beach	1000-1500	10-5

Second, calculation of tourist flow capacity. Since the factor that determines building dimension is human, the calculation of tourist flow capacity should be measured by per tourist. Therefore, the tourist flow capacity is calculated through the tourist area zoning method. The specific calculation equation is as follows:

$$C=C_c+C_b+C_u \quad (1)$$

In the equation, C is the daily environmental capacity, which is measured by per tourist; C<sub>c</sub> is the core area capacity; C<sub>b</sub> is the buffer capacity; C<sub>u</sub> is the construction area capacity. After the calculation of the environmental capacity is completed, the tourist flow capacity is calculated. The calculation equation is as follows:

$$G=t \times C/T \quad (2)$$

In the equation, G is the daily tourist capacity, which is measured by per tourist; t is the time required to complete the tour in the tourist attraction, which is measured in hours; T is the most suitable time for tourist to visit, which is measured in hours.

Third, conversion standards for building dimension and tourist flow capacity. The conversion standards for building size and passenger flow capacity can be considered both in terms of area and quantity. In addition to the total site area and volume, the area conversion should also consider the number of tourists and the per capita area. For example, the calculation equation for the area of a hotel is as follows:

$$S=N \bullet P \bullet S_a \quad (3)$$

In the equation, S is the floor area, N is the daily tourist reception, P is the proportion of people, and S<sub>a</sub> is the per capita area (m<sup>2</sup>/per tourist). As for the number of building facilities, it is directly related to the received tourist flow. For example, the calculation equation of hotel beds is as follows:

$$Q=(D_a \times P_y)/D_y \times V_b \quad (4)$$

In the equation, Q is the number of beds, D<sub>a</sub> is the number of days that tourists stay, P<sub>y</sub> is the total number of stays per year, D<sub>y</sub> is the number of days of travel per year, and V<sub>b</sub> is the proportion of

bedding used. Besides, according to the experience of previous years, the use of bedding is calculated from 70% to 80% of the tourist seasons.

Fourth, calculation of the number of daily received tourists. The number of daily received tourists is related to the instantaneous tourist reception capacity and the reception coefficient. The specific equation is: the number of daily received tourists = the instantaneous tourist reception capacity × reception coefficient. Since the building dimension is regulated by the Urban Planning Bureau, it is necessary to calculate the number of daily received tourists after the completion of the construction plan. These data can be used as an important basis for controlling tourist flow.

## 2.2 Modifications of Building Dimension with the Variations of Tourist Flow

Since the tourist flow is unstable, the architectures in the tourist area need to adapt to the variations and respond to them. The specific methods include the construction of temporary architectures, the combination of indoor and outdoor venues, and regulation of room size. The construction of temporary architectures refers to the construction of architectures that are easy to construct and disassemble in addition to the current permanent architectures. Temporary architectures can control the building dimension to accommodate changes in tourist flow and cause no damages to the environment of the tourist area, such as temporary toilets, outdoor tents, etc. (Figure 1). The combination of indoor and outdoor venues makes full use of space resources, most commonly in catering buildings. The expansion of the indoor and outdoor business area enriches the sense of hierarchy and provides visitors with a variety of options. The regulation of room size mainly relies on intelligent means to set up compartments, and electronically monitors the density of tourists in different areas in the existing room; therefore, different areas can be planned to change into corresponding compartments.



Figure. 1 Temporary architecture in tourist areas

Meanwhile, the construction of temporary architectures should also consider the natural ecological environment of Nankunshan Mountain Tourist Attraction to perfectly match with other architectures in the area, as well as the natural ecology of the tourist attraction.

## 3. Design Content of Architectures in Tourist Areas

### 3.1 Patterns of Architectures

Architectures are important facilities for people during their travels, and architectural patterns are the most intuitive impressions of the tourist area for tourists. Therefore, the patterns of architectures in the tourist area should protect the ecological environment and show humanistic care at the same time. The design of architectural patterns in the tourist area includes the comprehension of humanity, the extraction, and transformation of natural elements, the complementarity between architectures and the environment, and the bionic architectural patterns. If the tourist area has a unique architectural style, it should be applied to the architectures in the tourist area as much as possible so that tourists can better understand the local folk customs. Entertainments and attractions in the Nankunshan

Mountain Tourist attractions are various, mostly the humanistic landscapes; therefore, for such natural landscapes, natural elements are extracted and used to design patterns, which are then transformed into abstract art crafts for the construction of architectures in the tourist area, which can bring obvious tourism economic benefits. Some natural landscapes cannot be restored after long-term weather erosion or man-made damage. Therefore, if they are reflected in the architectural patterns, it would be inevitably important for ecological protection education. The bionic architectural pattern applies the biological forms and laws to the shape design of the architectures, which should not only imitate the nature in the exterior design but also coordinate with the natural ecology.

### **3.2 Resource Utilization in Tourist Areas**

As architectures continuously consume energy, the corresponding resources should be rationally developed and utilized in the construction of tourist areas, including the utilization of bio-energy and water resources. Biogas (methane) is the most commonly applied bio-energy in tourist areas. The sources of biogas are abundant, dead branches and leaves and domestic wastes can be used for biogas fermentation. Tourist areas with rich biogas resources should pay attention to the design of biogas digesters. Under normal circumstances, the biogas digester should be built in an open area, keeping the sunlight fully exposed to generate a large amount of biogas. For the tourist areas with abundant precipitation, the architectural design must take the rain-proof function into account and also have certain facilities to collect and treat the rainwater to achieve the full utilization of water resources.

The annual average temperature of Nankunshan Mountain is 23°, the annual average precipitation is 2700mm; besides, the area of Nankunshan Mountain is large, which provides sufficient places to process the biogas and rainwater. Rainwater is generally collected by the design of sloped roofs, gathered by water pipes, and sent to a collection pool. After the rainwater is purified and disinfected, it can be used for cleaning, watering, and other purposes.

### **3.3 Architecture Emissions in Tourist Areas**

The emission of architectures in tourist areas is the most important factor affecting the ecological environment. Nankunshan Mountain Tourist Attraction is the National AAAA Tourist Scenic Spot, which is the habitat to various plants and animals; therefore, the requirements of drainage emission are relatively higher. Pollution caused by emissions is an important issue to be solved in tourist attractions. The most common way to treat the wastes is to use it locally. For example, human feces could be used to produce methane; after the fermentation is finished, the feces could be returned to the land as fertilizers. At present, the waterless toilets used in some tourist areas are new devices of waste conversion. By degrading the organic matter in the excrement and producing fertilizer, the harmless gas and moisture are directly discharged to the environment. Sewage treatment can be achieved by constructing artificial wetlands (Figure 2). Artificial wetlands are technologies that discharge sewage into artificially constructed wetlands and use organic matter decomposition treatment. The processed sewage can be used for flushing toilets, irrigating farmland, and arranging water curtains.



Figure. 2 Water treatment system of artificial wetland

### 3.4 Selection of Building Materials

The selection of building materials should take many factors into account. In order to meet the needs of travel, environmental protection, and construction, the overall concept of building material selection should be beneficial to the environment, the promotion of the tourist areas, and the construction and maintenance of the architectures. In addition, during the construction process, attention should also be paid to the impact of the construction process. In addition, considering the ecological particularities of Nankunshan Mountain Tourist Attraction, the selection of materials should be more precise and careful. Table 2 lists the environmental impacts of building materials during various periods. The impacts of building materials on the environment are not only generated in the construction periods but also in the entire process from acquisition to retirement. Therefore, in the selection of building materials, it should not be concerned only for the construction period; instead, the overall periods should be integrated to achieve the real ecological environment-friendly construction.

Table 2. Impacts of building materials on the environment in different periods

Periods	Impacts
Collection	Environmental disruptions of raw material acquisition
Production	Toxic disposals during manufacturing and processing
Transportation	Energy loss during transportation
Construction	Environmental disruptions of constructions
Application	Toxic disposals generated in application
Processing	Energy loss of abandoned building materials

## 4. Application Example of the Architectural Design of Nankunshan Mountain Tourist Attraction

### 4.1 Requirements of Architectural Design from the Ecological Environment

The building materials used in Nankunshan Mountain Tourist Attraction are mainly moso bamboo wood, which comes from nature and is renewable and green. In addition, bamboo grows faster and is suitable for long-term use. The roof is covered with tiles, which can reduce the energy consumption of the building materials during the production process and improve the utilization effect. The outer walls of the architecture are made of bauxite, which is easy to use, does not pollute the environment, and can be reused. However, bauxite has low load-bearing properties and is not easily bonded to the roof. The architectures in the tourist area are mostly suspended on the ground so as not to change the features of the landforms, which also control the moisture intrusion. The bottoms of the architectures

are supported by columns, and the supporting materials are mostly masonry, which not only facilitates the maintenance of the house but also looks beautiful and gorgeous. The electricity of the tourist area comes from the power grid, and the water comes from the unpolluted mountain springs. A special reservoir is built to the upstream of the water source, which is used to collect, clean, and filter the water before utilization. At present, the tourist area has constructed a biogas digester to replace other energy sources for cooking. Since the Nankunshan Mountain is far away from the urban areas, the pipeline connection is inconvenient; therefore, the sewage is concentrated and treated by the septic tank, then the processed sewage is used to water the forests. The Nankunshan Mountain is home to a large number of wild animals, and the architectural design of the tourist area also fully considers the animal habits and has done detailed treatment in terms of architectural colors, noise reduction, and lighting control. The bottoms of the architectures also have accesses for animals to migrate.

#### **4.2 Requirements of Architectural Design from the Natural Landscape**

During the design of the Nankunshan Mountain Tourist Attraction, both architectural pollution and visual pollution have been considered. The influences of natural landscape on the experiences of tourists are multi-faceted, which fully mobilize the feelings of people. The design of the Nankunshan Mountain Tourist Attraction is very delicate, which reflects the harmony between architecture and nature without any sense of contradiction. The bright colors of the bamboo, the clear traces of the tiles, and the moss on the walls and staircases are all perfect, just like they belong there; the architectural design is full of vitality. All the designs are in line with the harmonious coexistence and long-term development between architectures and ecology.

### **5. Conclusion**

The architectures in the tourist area are the carriers of tourism, which are not only related to the ecological environment of the tourist area but also the travel activities. The contradiction between the limited natural resources and the infinite tourism demands is a common problem occurred in the architectural design of tourist areas. Therefore, the architectural design of tourist areas from the perspective of ecological environmental protection has become an urgent problem in current society. The architectural design of the tourist area from the perspective of building dimension and design content is proposed, and the architectural design of the Nankunshan Mountain Tourist Attraction is analyzed. The research result contributes to the sustainable development of the tourism industry and is significant to the development of tourism in China.

### **References**

- [1]. Roxas B, Chadee D. Effects of formal institutions on the performance of the tourism sector in the Philippines: the mediating role of entrepreneurial orientation. [J]. *Tourism Management*, 2013, 37(10):1-12.
- [2]. Qi H, Liu J, Mei L. Progress of Tourism Area Life Cycle Theory[J]. *Scientia Geographica Sinica*, 2018.
- [3]. Li G Y, Xie H X, Li Y. Explore the Integration of Mountain Tourism Urban Construction Design and Regional Architectural Culture - Taking Shennongjia Shenlin Hotel as an Example[J]. *Applied Mechanics & Materials*, 2013, 357-360:47-53.
- [4]. Seng B. ICT for Sustainable Development of the Tourism Industry in Cambodia[J]. 2015.
- [5]. Jing J, Sun J, Wang Z, et al. The Construction of BIM Application Value System for Residential Buildings' Design Stage in China Based on Traditional DBB Mode ☆[J]. *Procedia Engineering*, 2017, 180:851-858.
- [6]. Min Z, Liu X, Pan B, et al. Effect of Tourism Building Investments on Tourist Revenues in China: A Spatial Panel Econometric Analysis[J]. *Emerging Markets Finance & Trade*, 2017, 53(9).