

Research on Sustainable Landscape Design Strategy in the Context of Smart Eco-city in China

Tingting Guo^{1*}

¹ Hubei Urban Construction Vocational and Technological College, Wuhan, China

Email Address

23142174@qq.com (Tingting Guo)

*Correspondence: 23142174@qq.com

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Abstract:

This paper carries on the analyzing aesthetic system and establishing a basic theoretical system of sustainable design through the environmental aesthetic. And also discovers the different design strategies of sustainable landscape in Smart Eco-city. Finally, the paper studies the process of quantitative and qualitative quality evaluation system for sustainable landscape design, and explores the design indicators which provides the solution for urban sustainable development in China.

Keywords:

Smart Eco-City, Sustainable Landscape, Aesthetic System, Design Strategy, Evaluation System

1. Introduction

In the process of rapid urbanization, China is facing on the extremely severe problems of climate change, resources and environmental crisis, which has created the concept of sustainable design. The report of the 18th National Congress of the Communist Party of China (CPC) points out that that we should strive to build a beautiful China and realize the sustainable development of the Chinese nation. The CPC even upgraded the construction of ecological civilization to a “grand plan for millennium”. Smart eco-city is an upgraded version of eco-city. It is also a new conception of urban development which is established by the harmonious coexistence between human beings and nature according to the principles of ecology and the law of information technology. Its design concept integrate the cutting - edge technology into humanistic care and environmental concern. The concepts of smart eco-city and sustainable development have been widely accepted all over the world, Meanwhile, they keep in step with the China’s “five in one” overall layout and China’s new urbanization process

The essence of sustainable landscape design is to meet the needs of human beings and ecology at the same time. It makes maximum utilization of the self-regeneration function of natural systems and tries its best to reduce ecological footprint and the damage to environmental carrying capacity. However, the contradiction between

human and environment in our country is extremely prominent, which leads to China's strong demands for sustainable landscape design. At present, China's informational science and technology and high-tech of environmental protection industry have a certain position in the world, which provides fertile soil for China's sustainable development.

2. The Context of of Smart Eco-city

2.1. The situation of foreign smart eco-city

Since the Industrial Revolution has damaged the environment and health of urban residents in many developed countries, many new thoughts of ecological design have sprouted in the field of urban design since the end of the 19th century, such as Pastoral City of Howard, broad-acre city of Wright and Theory of Organic Decentralization of Saarinen. Among them, Howard's ambition (1898) is to eliminate the contradictions among society, economy and environment in the city with the health effect of rural life. The "Man and Biosphere Program (MAB)" initiated by UNESCO in 1971 advocates the innovative economic development methods that are sustainable to society, culture and environment in order to improve the living environment of human beings and protect the ecosystem. Club of Rome (1972) believed that the limit of growth was affected by population, industrialization, food production, natural resource consumption and pollution. Under the influence of these thoughts and movements, the concepts of urban development aiming at ecological sustainability emerged one by one, such as sustainable city, low-carbon city, sponge city, flexible city, green city, smart city, happy-smart city, etc. Most of them have strong scientific feature, but they lack artistic characteristic. In addition, foreign academic region have studied and formulated various design principles and indexes of eco-city. Among them, the representative ones are: Downton's (1993) Twelve Ecopolis Design Principles based on the theory of "One country, Register's (2006) Most Important Eco-City Design Principles, Ten Melbourne Principles for Sustainable Cities (UNEP, 2002), 10 Dimensions for Sustainable Cities (Kenworthy, 2006), Newman and Jennings (2009) Ten Strategic Steps Toward a Resilient City, World Bank's Principles of Ecological and Economic Cities (Suzuki et al., 2010) and Roseland's Dimensions of the Eco-city (1997)". These principles and indicators basically cover the land use, energy management, economic development, social security, public participation, cultural heritage, ecological balance, health security, urban control, low-carbon transportation, pollution policies and housing policies of eco-city, but there is no in-depth research on the sustainable design method of eco-city landscape. On the other hand, foreign scholars continue to pay more attention to landscape quality assessment. The European Landscape Convention (2000) focuses on the landscape experience, highlighting perception and identification of characteristics. Many European countries have also launched the landscape assessment methods and tools, such as LCA landscape feature assessment method in England and LABES Indicators in Switzerland. These indexes are widely used in quality monitoring and evaluation of landscape design.

2.2. The situation of domestic smart eco-city

Since the publication of "China's Agenda 21-White Paper on Population, Environment and Development in China's 21st Century" in 1994, China has taken sustainable development as the mainstream direction of China's economic and social development. Many intelligent people look for an approach for sustainable

development from traditional Chinese aesthetics and modern western science. Zong Baihua (1981) called Chinese traditional ecological aesthetics "the rhythm of life". Wu Liangyong (1999) believed that the true meaning of sustainable development lies in proposing comprehensive solutions to politics, economy, technology, culture and aesthetics. Liu Guili (2002) proposed to standardize the content and scope of urban human activities with ecological needs, and to strengthen the self-discipline, self-stability and self-circulation capabilities of urban ecosystems. At the same time, China has made obvious contributions to solve the problem of global warming, such as actively promoting the United Nations Framework Convention on Climate Change and signing the Paris Agreement. Under this background, numerous of eco-city projects have emerged in China, such as Chongming International Eco-island, the Sino-French Wuhan Eco-city and Sino-Singapore Tainjin Eco-City, etc. These new urban design concepts and research results have been popularized and applied to a certain extent, but their results are limited and the gap between developed countries and development countries is still vast. At the same time, Chinese scholars have focused on the construction of ecological index system for urban design. Shen Qingji (2000) studied the urban environmental effect and capacity, and put forward a comprehensive evaluation method of urban environmental quality for environmental problems. Huang Guangyu (2002) put forward the construction goal of ecological city, named as civilized social ecological standard, efficient economic ecological standard and harmonious natural ecological standard. Qiu Baoxing (2012) established the evaluation index system of low-carbon ecological city from the four themes of resource conservation, environmental friendliness, economic sustainability and social harmony on the basis of concept definition and demonstration case analysis. All these studies have provided powerful technical guidance and actions for the healthy development of China's smart eco-city. On the other hand, the concept of sustainable design has been paid more attention to in the practice of urban construction. Yu Kongjian (2006) advocated to realize the sustainable landscape design route from the aspects of sustainable landscape pattern, ecosystem, landscape materials and engineering technology. Lu Yongxiang (2014) took the lead in formulating a green, low-carbon, intelligent and sustainable development direction as the development strategy and action plan for China's innovative design.

3. The Aesthetic System for Sustainable Landscape Design

3.1. The construction of aesthetic system

The aesthetic mechanism of sustainable landscape in China's smart eco-city combine the human perception of landscape physical space, psychological space and ecological environment, and integrates ecology, analytical aesthetics, phenomenology and philosophy of existence. The construction of aesthetic system is shown in the Figure 1:

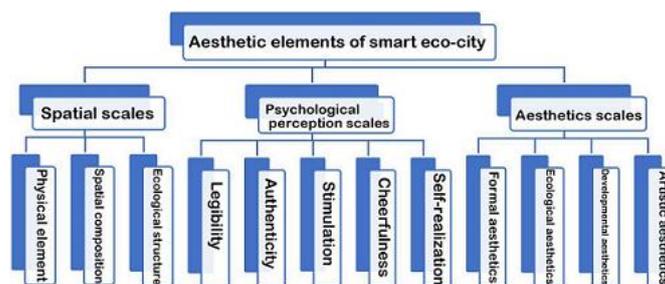


Figure 1. The construction of aesthetic system.

3.2. The compares of urban humanistic and ecological attributions

The philosophical characteristics of “harmony between man and nature” and the existential connotation of “Baohé and Taihé” in traditional Chinese environmental aesthetics are excavated to develop the practical value of traditional Chinese environmental aesthetics theory.

4. The Design Strategy of Sustainable Landscape Design

4.1. Flow and the urban space

The intricate information flow and ecological flow reciprocate in the smart eco-city while exchanging energy with the outside world. Only by ensuring the conservation of internal and external energy can the health of urban life be maintained. So, the radiation range and transmission route of information flow, capital flow, people flow, ecological flow and traffic flow construct the mechanism of urban dynamics, thermodynamics, optics and other physical functions on landscape space.

4.2. Landscape and life city

As mentioned before, smart eco-city is a living body with soul and has witnessed through birth, aging, illness and death. Its fundamental attributes are chaotic and dynamic. The life mechanism of metabolism as the basic principle of city operation. From the microscopic level of urban life, the structural function, life characteristics and regeneration mode of landscape cell contribute to the life cycle design method of sustainable landscape. The life cycle design method of sustainable landscape constitute the positive influence mechanism of landscape on the form and structure of life cities.

4.3. Natural energy and urban virtual space

The soul of a smart ecological city is natural energy. By comparing the similarities and differences in the construction of urban virtual and real space in the context of China and the West can analyzes the flow modes of various natural energy in China's urban space, thus revealing the correct relationship between architectural real space and landscape virtual space in China's cities, all of them can deduces the design method for creating a harmonious pattern of virtual and real space in urban space through the natural energy.

5. Quality Evaluation System for Sustainable Landscape Design

5.1. Select and identify impact indicators

First of all, establish the correlation between the aesthetic theory of sustainable landscape design and the evaluation index, so as to ensure the theoretical direction of the index. For example, the spatial dimension evaluation index will be selected in the corresponding level in the progressive aesthetic process of “physical space→psychological space→image space”. Then, investigate and analyze the aims of design quality, and to compare and filter with the international common index categories and successful models, so as to identify the suitable evaluation indexes for the four dimensions of space, ecology, aesthetics and sustainability of sustainable landscape in China. For example, the spatial form indexes of first lever include line, form, change, unity, color, dominance, contrast, etc. The spatial pattern perception indicators of second layer include openness, depth of seclusion, level, mystery, complexity, pleasure, permeability, etc.) The subject image indicators of

third lever include security, sense of belonging, imagination space, spiritual home, environment with me, environment without me, etc.

5.2. Constructing evaluation system

First of all, the sustainable index of relevant samples can be calculated through the identified indicators and questionnaires. And then, the corresponding spatial and aesthetic indexes can be obtained with the help of big data and GI technology. Moreover, the ecological performance can be counted by ecological parameters. According to the above three kinds of data performance, the corresponding index weight matrix can be determined, and the corresponding evaluation hierarchy model can be established finally in the large-scale system of “human→space→environment→ecological→society”. The process of constructing evaluation system is set development goals →establishing the classification framework of the development goal determination system→establishing the index selection criteria→establishing the potential index database→filtering the index evaluation index→establishing the evaluation model.

5.3. Determine the design scheme and goals

First of all, through the static analysis of their ecological and aesthetic characteristics, and the next dynamic analysis of their sustainable development trend, we can clarify the distribution and trend of landscape texture. Secondly, with using the quantitative model of the sustainable landscape assessment system, we can draw the spatial pattern map, aesthetic value distribution map and ecological value distribution map of the empirical research objects respectively, and then compare and overlying the three painting to obtain a functional compromise scheme. At the same time, the spatial, ecological, aesthetic and sustainable value coefficients of the samples can be normalized to evaluate their comprehensive values, thus determining the numerical set and finding the best balance point, finally deducing the corresponding design optimization solution and condensing the general design target points.

5.4. Develop design templates and guidelines

Firstly, the typical sustainable landscape is taken as the standard scale sample to construct the corresponding prediction model. Secondly, with the application of intelligent science and technology, low-carbon technology and big data technology, optimizing the spatial pattern, improving the ecological service function, increasing the greening rate, rationally utilizing water resources, protecting biodiversity, improving aesthetic value and respecting humanistic connotation as the design guidance, the systematic approach of sustainable landscape design is explored. In addition, formulate visual model schemes and quantifiable design guidelines which can provide convenient, practical and standardized action guidelines and design models for the practical application of sustainable landscape design in China.

6. Conclusions

In summary, the design strategy of sustainable landscape in Smart Eco-city can reveal the internal relationship between sustainable design, ecological benefits and aesthetic values. It also explores appropriate methods and application strategies, which has important theoretical value and application for promoting the sustainable development of urban landscape in China.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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