

# Ecological architecture system based on landscape ecology

**Fengquan Ji, Yuanyuan Jia**

*College of Architecture & Urban Planning, Anhui Jianzhu University, Anhui, 230022, China*

*Corresponding author's e-mail: jfqxdp@163.com*

*Received 10 October 2014, www.cmnt.lv*

## Abstract

This paper briefly summarized the concept of landscape ecology and ecological architecture and the current research status of ecological architecture both at home and abroad. It also analyzed ecological architecture system based on landscape ecology, and studied the construction of ecological architecture from the aspects of the construction of ecological architecture system and space structure. In addition, this paper reviewed with the green building demonstration in University of Logistics for instance.

*Keywords:* landscape ecology, ecological architecture

## 1 Introduction

Ecological environment crisis has become a worldwide problem, especially in developing countries. Due to the weak ideology on sustainable development, the pursuit of economic and social benefits at the cost of wasting ecological environment resource, and the ignorance of the natural environment and resources protection, it is increasingly threatening the survival and development of human society.

The principle of landscape ecology is adopted to bring natural ecosystem and landscape planning into architectural planning, thus to change the traditional planning and design mode and build ecological architecture. In ecological architecture, ecological corridor serves as a link and connects with relatively independent landscape patch, thus continuous and perfect ecological network is embedded on the basis of ecological architecture and the natural skeleton of architecture is formed. Ecological architecture with functions like natural ecological service, reasonable development of ecospace, etc has become one of the trends of current architecture development.

## 2 An overview of landscape ecology and ecological architecture

International association for landscape ecology defines landscape ecology as: landscape ecology is the researches on the change of landscape space of different scales, which include analysis of biology, geography and social cause of landscape heterogeneity. It mainly studies the relation among landscape spatial pattern, landscape pattern and ecological process, the influence of human activity on pattern, process and change, the function of scale and interference on landscape. Landscape ecology refers to bring landscape into ecology, and to combine the "horizontal" analytical method for representing space adopted by geographer and "vertical" analytical method for representing function used by ecologist, thus to study the influence of landscape space structure and morphological characteristics on biological activity and human activity [1]. The main research objects of landscape ecology are shown in Figure 1.

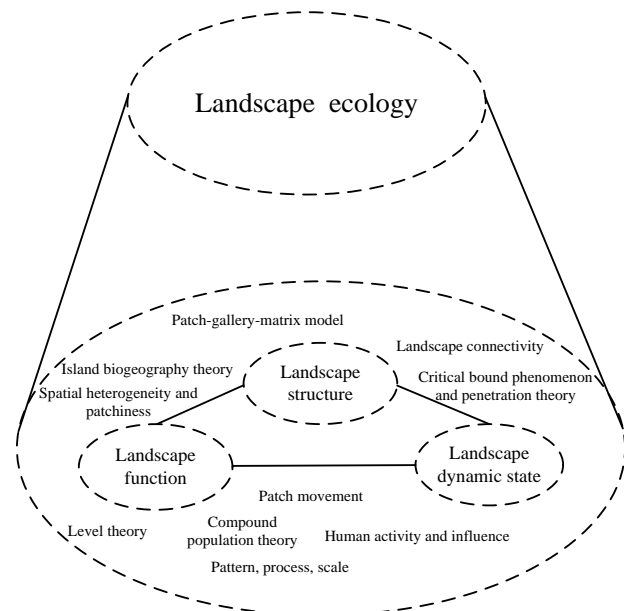


FIGURE 1 Main research subject of landscape ecology

Ecological architecture refers to use the basic thought and technological means of ecology and architectural technology science based on the basic principle of harmonious development of man and nature, thus to coordinate the relationships among human, architecture and natural environment and to make them become an organic coalition. Ecological architecture is the combination of artificial beauty and natural beauty [2].

Principle of landscape ecology is brought into the planning and design of ecological architecture. By means of improving the landscape structure of architecture and reasonably setting the number of landscape elements like patches, gallery, matrix, etc and their spatial distribution, principle and method of architectural material is integrated with ecological architecture for research. Stress on the rationality of spatial structure and environmental protection property of architecture material can more effectively enhance green structure function and environmental quality of residence zone.

**3 Overseas and domestic research status**

**3.1 APPLICATION PRINCIPAL IF WIRELESS SENSOR IN MIDI PRODUCTION**

Ecological architecture is the option and response of architecture to positively meet the challenges of sustainable development and to cope with energy crisis and ecological crisis. Compared with China, foreign countries have experienced

long time of theoretical researches and practical explorations on ecological architecture, and they have obtained plenteous achievements. However, the development degrees of researches in various countries are different. Theoretical research and time exploration of ecological research in China is later than developed countries for at least 10 to 20 years. Research statuses of ecological architecture at home and abroad are shown in Table 1.

TABLE 1 Research statuses of ecological architecture at home and abroad

Country	Research status
Germany	In the 1970s, architecture, college scientific institution and ecological protection organization carried out effective cooperation on theoretical research and practical exploration of ecological architecture. In architecture design, recently various of developed energy-saving technologies and equipments have been extensively used; progress of many researches and experiments have become the frontier in this field, like water-saving architecture, solar energy utilization, treatment of domestic sewage, etc; in addition, for the formulation of laws and regulations in aspects like the application of architecture materials, architecture heat insulation, energy-saving technology, Germany has become the leading country in aspects like ecological architecture research, design, development of energy-saving technology, formulation of laws and regulations, etc.
Japan	Japan is the country that comparatively earlier adopting recycle water technology. It is always engaged in researches of architecture research system of maximize space and extremely reliable that are obtained with minimum energy consumption.
America	Silent Spring (1962): initially awakened human strong awareness of earth ecosystem and environment; Design with Nature (1969): first put forward the application of ecology and ecological design method in research of urban planning and environmental evaluation; in 1995, green architecture committee put forward a set of Questa Vanguard Program of energy and environment design, and its version of 2.0 was released in 2000; in 1999, architects association selected ten blocks of local architectures as examples of ecological architecture creation at present stage for popularizing ecological architecture. Energy and environment design guideline is put forward in the evaluation of ecological architecture, a set of self evaluation system, which is used for the construction of commerce of newly built and built, public buildings or high-rise residence, including six items of evaluation. Namely sustainable development scene, energy and atmosphere, water efficiency, indoor environmental quality, material and resource, innovation and design.
France	A kind of brand new idea of ecological residence will be published recently.
Canada	“green architecture challenge” is put forward in ecological architecture evaluation: total process is divided into two stages in four years, users regulate indicator weight and metewand according to local status, and develop GBTOO1 with features of regionalization, then input the feature and performance data of for evaluate architectures to GBTOO1, and then get the evaluation result of software automatic calculation. At present, at least 19 countries have involved in GBC process.
Britain	“Building research organization environmental assessment mode” is put forward in ecological architecture evaluation: then environmental mark provided by the system is suitable for marketable development project. At present, 15% to20% of Britain newly built office building market accept and participate the evaluation mode.
China	In the 1980s, the idea of ecological architecture burgeons in China; researches on architecture energy saving were mainly focus on energy-saving design, development and application of energy-saving product, green construction, etc; in recent ten years, our specialists have carried out studies on ecological urban planning, building energy conservation in hot in summer and cold in winter region, earth-sheltered buildings, solar house, etc, and held some ecological city construction forums.

**4 Researches of the construction and spatial structure of ecological architecture system based on landscape ecology**

Patch, gallery and matrix are the basic elements of landscape. Numerous green galleries intertwine and form network, so landscape ecology names this objective exist natural landscape phenomenon as ecology network. Ecological construction can make full use of natural resources, and construct a kind of healthy architecture that is suitable for living under the condition without destroying ecological balance. Within life cycle of whole architecture, ecological architecture also focuses on the production, transportation, design, construction, operation, maintenance and recycle of materials after demolition, etc of material equipment, thus to reduce its consumption and influence on environment [3].

**4.1 ECOLOGICAL DESIGN OF ECOLOGICAL ARCHITECTURE**

The basic principles of ecology include entirety and orderliness, cyclic regeneration, mutually reinforcement and neutralization of each other, self-regulation and layer

transfer, and promotion. Ecology has provided theoretical basis for ecological architecture, generated new mode of thinking and research method, which mainly reflected in the following aspects: intention of coordinating relationship between human and nature; ecological architecture and its existing environment is an organic whole; it is a segment of whole ecological environment; ecosystem of the architecture has certain abilities of self regulation; ecological architecture should make the whole ecological ecosystem in balanced status of virtuous cycle. Therefore, ecological architecture has the characteristics of strong system idea and whole awareness, high energy usage efficiency, no pollution and flexible adaptation.

**4.2 RESEARCH ON LANDSCAPE PATCH OF ECOLOGICAL ARCHITECTURE**

The location, size, shape and amount of patch have influence on the network distribution of patches in ecological architecture. Fu Man divides the most common landscape type into four types: residue patch, interference patch, resource type patch and artificial patch.

The network node of ecological architecture is generally

made up of artificial and natural patches together. Combined with the classification method of ecological patch in ecology and according to the distributed location of ecological element, the network node of ecological architecture is divided into three types: cross type, affiliate type and independent type. In addition, due to its different performances, node also can be divided into native type, symbiotic type and regenerative type [1]. Cross type node is the ecological patch node that locates in ecological venation

overlapping areas; affiliate type ecological node refers to node that adhere to the ecological gallery context in ecological network system, and the most common type is the greenbelt or woodlot beside the road; independent type ecological network node refers to the natural ecological patch that is not in ecological venation overlapping area, nor adhere to ecological venation. According to the different node performances, the corresponding planning proposals are shown in Table 2:

TABLE 2 Planning proposal under different ecological network node

Types of ecological network node	Planning proposals
Cross type	Native type: increase ability to withstand interference, properly enlarge scope of patch node, and set relief area for protecting the living condition of original inhabit species within landscape patch nodes. Symbiotic type: center on maintaining the stability of original species living condition within nodes, and to have certain degree of integration with its staying venation under the premise of guarantee the heterogeneity. Regeneration type: mainly consider the temporary habitat features of migration species in venation.
Affiliate type	Native type: select venation that is similar or not conflict to ecological situation to adhere to, and not bring into competitive species and interference species. Symbiotic type: increase the variety and heterogeneity of species at the same time of considering the original ecological stability of node patch. Regenerative type: establish brand new environment that fit in with the type and attribution of venation
Independent type	Pay attention to the reasonable combination arrangements of native, symbiotic and regenerative type, to keep proper distance with other ecological components.

4.3 RESEARCH ON THE GALLERY VENATION OF ECOLOGICAL ARCHITECTURE

Gallery is differing from the linear or strip landscape elements of the surrounding landscape matrix. In ecological architecture, gallery not only has the ecological service functions of protecting biological diversity, species habitat, species

distribution and species filter, but also should have the function of resident’s leisure, recreation, regulation, etc. It is mainly made up of ecological elements like vegetation, water body, etc. Landscape ecological gallery can be divided into linear gallery, strip gallery and riverway gallery. Its planning construction proposals [1] are shown in Table 3.

TABLE 3 Construction proposals under different gallery venation types

Gallery venation types	Proposals of gallery venation construction
Water body venation	Graphic design of water body: first, not to destroy natural conditions; second, to keep the natural curve of waterway as much as possible; in addition, to keep the bottom of waterway maintaining natural status as much as possible; final, as far as possible to promote the intercommunication of water body ecological venation. Section design of water body: under the basis of not destroy the natural distribution of river, to recover the integrity of cross section of river.
Vegetation venation	Road ecological gallery: to pay attention to lower the side effects on ecological system division. Through the construction of green gallery on both sides if traffic line, to improve the functions like transportation, zoology, service, etc of road gallery. Strip greenbelt gallery: first choice for regional vegetation, and consider the elements of strip greenbelt of different level, size, function, etc; pavement design should select flooring of good differential permeability so as to guarantee the continuity of venation.

4.4 RESEARCH ON THE SPATIAL STRUCTURE OF ECOLOGICAL ARCHITECTURE

The planning and construction of ecological architecture are considered from multiple aspects, levels and dimensions and studied from spatial structure. According to planning structure and planning of green spaces system of ecological architecture, its spatial structure is divided into core type,

axis type and complex type of ecological network structure. These three types of ecological network structures are divided respectively centered on the ecological matrix dot form and group form ecological elements, linear and strip form ecological elements and dot, linear and strip form compound ecological elements. The corresponding construction proposals are shown in Table 4.

TABLE 4 Construction proposals under different ecological network structures

Types of ecological network structure	Construction proposals
Core type	Location: construct according to the angle of city and region. Scale: reasonably allocate core type landscape patch and scattered small scale landscape patch. Shape: partially present many tentacle shape, but on the whole present structured and closeness shape Number: if conditions permit, we can construct multi-core landscape patches
Axis type	Location: plan as a whole and consider the construction of landscape ecological gallery in city and region, and galleries must be continuous. Scale: under the basis of meeting minimum width, it would be better if the scale is wider. Shape: it is not proper for excessive straight or curve, and to shape according to the double need of ecology and landscape shape. Number: under the basis of meeting the basic function requirement, it would be better if the number is larger.
Complex type	Location: combine with the layout of region and city ecological network, to reflect the construction of strategic point and city gallery. Scale: to level “point” and “axis”, and meet the dual factors of ecological effect and social effect. Shape: start from the double perspectives of landscape ecology and urban design, set “point” as to maintain partially present many tentacle shape and totally present structured and closeness shape, set “axis” as to avoid straight type, and mainly in curve type. Number: to set as much as possible.

5 Cases

The green building demonstration in University of Logistics is located in the southwest of new campus in University of Logistics of university town in Chongqing. It is leaning against Jinyun Mountain. The original ecology vegetation around the site is better. It is the building complex that integrates teaching, work, reception, etc together. The total area is 11609 m2, five storeys aboveground and one storey underground. Figure 2, 3, 4 and 5 are respectively the surrounding mountain slope protection greening, slope greening that meet the basement lighting requirement, roof garden and south side outer wall vertical greening [4, 5]:



FIGURE 2 Massif slope protection greening around demonstration building



FIGURE 3 Slope greening that meet basement lighting requirement



FIGURE 4 Roof garden



FIGURE 5 South side outer wall vertical greening

This green demonstration building is belonging to one part of campus ecosphere. Greening pattern is coincident with the whole campus. In massif slope protection planning, slope greening is used to combine with roof greening, thus to create spatial level and good landscape effect. In the basement lighting, the application of slope greening not only obtains good atmospheric conditions of lighting, but also transfers flat greening into vertical greening. The setting of roof garden will integrate with the surrounding massif greening. Warm in winter and cool in summer fully embodies the role of heat preservation and heat insulation of roof greening. South side outer wall vertical greening makes an integration design of architecture maintaining structure,



sunshade component and vertical greening. At the same time of meeting shaded effects, it has fully considered model of construction elevation and requirement of picture composition [6].

**6 Conclusion**

Besides bringing us wealth and employment, the rapid growth of economy is also bringing us tremendous ecological environmental crisis. This paper took ecological architecture as research subject, and also applied landscape ecology. Through the organic combination of man and nature, sustainable development architecture with characteristics like energy saving and emission reduction, environment beautification and enhancement of people’s living comfort will come true. Started from green ecology, aimed at livability, and supported by effective engineering technology, the

new healthy architecture with advantages of maximizing environmental benefit, economical benefit and social benefit is the main development tendency of current ecological architecture. Based on the discussion of the ecological architecture of landscape ecology, this paper has provided certain theoretical bases and technical support for ecological architecture [7].

**Acknowledgement**

Key Project for Natural Science Fund of Anhui University (KJ2013A070).

Science and Technology Plan Project of Construction Industry of Anhui (2012YF-11).

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Authors	
	<p><b>Fengquan Ji, born 1976, Anhui Province of China</b></p> <p><b>Current position, grades:</b> associate professor  <b>University studies:</b> Master’s degree was earned in major of Landscape Architecture, Huazhong Agricultural University in 2004.  <b>Scientific interest:</b> landscape ecological planning, city greening quality and quantity, urban green space system planning, water landscape, rural landscape</p>
	<p><b>Yuanyuan Ji, born 1989, Anhui Province of China</b></p> <p><b>Current position, grades:</b> master student  <b>University studies:</b> Bachelor’s degree was earned in major of urban planning, Anhui JianzhuUniversity in 2010.  <b>Scientific interest:</b> city grass land planning</p>