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Create a Harmonious Environment Together of Ecological Architecture Design Method

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Abstract

Retrospect last century, it is not difficult to find that, while human's living ways and living states are changing enormously, they cost lots of source and energy, which leads to environmental pollutions and resource's shortage and have a bad effect on ecological balance. To urban architectures, the developing mode has to be done from traditional high-consumption developing mode to low-consumption and low-pollution developing mode. Ecological architecture is the essential way for such transformation and also the essential trends to current world development. Ecological architecture refers to minimum affect environment; make full use of environmentally natural resources to realize high-efficiency utilization of resources and energy; satisfy people's demands with healthy, applicable and effective living environment, to achieve harmony between man and architectures; it is a big and complex systematic engineering including nature, society, economy and civilization, etc. Only if in a balanced state, the ecological architectures can be realized in overall significance and realize the object of sustainable development. Ecological construction in the design process should follow the overall design principle, Low-consumption and pollution-free principle, decrease the consumption on materials and energy, improve the utilization of energy. Decrease energy consumption of architectures by smart architecture systems. Designers also have to make reasonable use of sunlight, wind, rain and other natural energy according to various climate characteristics, design properly, decrease waste of non-renewable resources and advocate the recycles and reuse of energy. This paper analyzes design methods of ecological architecture from aspects of water utilization, energy utilization and ecological buildings, etc, and explores relationships of man-nature-environment, so as to start architects' thoughts in resolutions to effects on environment from the source

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Introduction

In June, 1972, first Conference on Human Environment held in Stockholm, Sweden, sounding the alarm over the world for environment protection. It issued the famous human environment declaration, which set "World Environment Day" on June 5th and proposed a slogan "only one earth". Retrospect last century, it is not difficult to find that, while human's living ways and living states are changing enormously, they cost lots of source and energy. Although maximum benefits can be got in a short term,

inevitably, it leads to environment pollutions and resources shortage, which has a bad effect on ecological balance. To urban architectures, the developing mode has to be done from traditional high-consumption developing mode to low-consumption and low-pollution developing mode. Ecological architecture is the essential way for such transformation and also the essential trends to current world development.

In the 1960s, Italian American architect Paolo Soleri combined ecology and architecture into ecology, first proposed famous “ecological architecture”, also called green architecture. Architecture activity is one of important productive activities working on natural ecological environment and costing most natural resources. The statistics demonstrate that 50 percent of global resources is used in building’s construction and usage. At the new start of 21st century, when we consider consumption ways and its ecological significance in the construction and usage again, we have to drop traditional mode and consider ecological architecture, which saves resources, decreases energy consumption and pollution, and improves internal environmental qualities, as a new design direction. So the ecological design has a key effect on urban and global ecology. It is the necessary duty for architects to study on ecological architectures.

This paper will discuss the design methods from water resource utilization, energy utilization and ecological buildings, etc, explore the relationship of man-nature-environment, so as to start architects’ thoughts in the ways to eliminate the effect of energy on environment.

Design principle of ecological architecture

Overall design principles. The ecological architecture must certain corresponding design principles and design objects pointing to various components. From the sites, plan, design, functional set, materials and technical selection and installation in devices to operation, maintenance after accomplishing buildings. The ideas of ecological architectures are centered as man, integrated with nature, thorough the overall life cycle, with the principles of integrated and environmental optimization, simple and high-efficiency, healthy and comfortable and saving resources.

Low-consumption and pollution-free principle. Low consumption refers to decrease the consumption on materials and energy, improve the utilization of energy. Decrease energy consumption of architectures by smart architecture systems. Designers also have to make reasonable use of sunlight, wind, rain and other natural energy according to various climate characteristics, design properly, decrease waste of non-renewable resources and advocate the recycles and reuse of energy. Non-pollution refers to hazard-free building materials.

Coexistence principle. Coexistence was a concept of ecology, which was a intimate relationship of mutual existence and co-evolution in a ecological system. This indicates universal “coexistence”, namely not only among man but also coexistence between man and other creatures, so as to achieve sustainable development. It is to meet contemporaries’ requirements but no harm to next generations. The benign development is the sustainable and long-term development in reality, namely the coexistence between man and nature.

Design methods of ecological architectures

This paper only analyzes and discusses in design methods of individual ecological architectures.

Energy utilization. Energy resources are classified into renewable resources and non-renewable resources. The former includes solar energy, wind energy, terrestrial heat, tide nuclear fusion, etc. The latter includes coal, petroleum, natural gas, etc. Ecological architectures value saving non-renewable resources and utilization methods of new energies. Full utilization and exert on renewable resources is one of the main methods. Current renewable energies in ecological architectures are solar energy, wind energy and terrestrial heat, etc. The solar energy is the most widely used with most mature technologies.

Eco-energy house, designed by Huang Tieyu, selected in “solar houses trips to countries” held by American Solar Energy Association in China. Its solar power generator system can generate more than half of overall electrical quantity at most, and transmit to California power supply network reversely. Under the condition of using no electricity or little electricity, the electric meter is inverted.

German RWE office uses glass in its walls in internal corridors and top, refracting sunlight in offices to illustration; external walls are comprised of double-layer reflection glass curtain wall, to store solar energy effectively; the openable frameless windows in internal layers promise the natural circulation. 70 percent of overall building ventilates in natural ways and saves more than 30% heat. While fully utilizing solar energy, the saving building maintenance structures reduces heating and conditioners. Set cold air system in the principles of natural ventilation, leading to effective utilization in conduct wind direction in summer, so as to make full use of natural renewable resources. In British Nottingham tax center, natural ventilation enters from around exterior walls, and extracts the polluted internal air by stack effect. The partial exposed floors, by use of concrete’s thermal inertia to stack solar energy. The overall architectures use refuse incineration to provide energy for heat pipe network.

In recent years, architectures have made some progress in energy utilization. For example, expansive engineer of Shanghai Hongqiao airport uses the integrated design of solar energy and architectures. Construct huge solar photovoltaic power generator field in roofs of west freight station and make use of solar collector to replace roof coating and insulation layer, which not only eliminates solar energy’s effect on architectures’ images but also avoid the repeated investments. Solar PV grid power system is a material step for China airports in new energy utilization, with scale and high grade. Combination PV generator and architecture changes the old decorative ways which scattering solar energy and small quantity. Centering on that, Hongqiao airport gradually improves and constructs airport PVs, wind power generation facilities, which has become the fine model and example for universal and application of clean and renewable energy, with a fine social benefits and economic benefits.



Fig1 Tent powered by solar energy



Fig2 Solar energy roof

Water resources utilization. Water resources shortage has become the important problem for people in 21st century, in other words, it will become the limited factor for future economic development. Savings and utilization in water resources need to be valued in ecological architectures. Conduct rain collecting, sewage treatment and recycling use, etc.

The scale of ecological ark in Frankfurt, Germany is not big, however with various kinds of ecological technologies such as roof greening, rainwater collection, etc. The collected rainwater, on one hand, is used as watering for interior and exterior and roof vegetation, on the other hand, has an important effect on improving climates and creating indoor and outdoor landscape. A long water surface is between ecological ark and street, by use of collected rainwater. The aquatics such as reed and lotus, etc, combined with various fishes and microbiology generates ecological community. Entering room over the bridge, you can view tortuous indoor landscape generated from elevation difference and greening. The collected rainwater flowing in the given gutter exposes people to the nature.

Although the dealing system couldn't demonstrate the economic advantages in the short term, it still has widely social, environmental and ecological benefits. To large amounts of poor-water and water scarce regions, compared to exogenous transfer and seawater desalination, it has big advantages in economy. Therefore, the utilized value can't be ignored.

Application of architecture materials. Architects have to choose proper architecture materials to meet the demands of energy conservation in building, environmental protection and ecology. Advocate the local materials. Emphasize raw materials in local, respect local nature and local climates. The costs in management and maintenance are least because they are suitable to grow in local. For example, in southern regions with exuberant vegetarians, choose renewable resources to be materials, acting according to circumstances, and design ecological architectures with characteristics. Make use of wasted architecture materials flexibly, reduce the use of materials, use green and replaced products, improve material production technology and reduce polluted process of materials. Recycle materials and renewable materials to reuse, such as recycling obsolete concrete. Generated from pulling down or maintenance, concrete becomes alternative materials of natural coarse aggregates, also used as mattress for ground strengthening, roads and airstrip and indoor floor mattress, etc. If broken steeply, it can be used as fine aggregates, used for mixing masonry mortar and plastering mortar. With the rapid development of knowledge of material and other subjects, the range of ecological materials will be continuously improved and updated. Future ecological architecture materials can not only save energy, be non-polluted, recycle for utilization but also collect various functions to itself, bearing, keeping warm, heat insulation, duration, etc.

The developing trends for ecological architectures. New technology and new devices are the trend. For example, the photo-chromic glass in outdoor protecting glass, under strong sunlight, transforms solar energy into electric energy. Meanwhile, colors become dim with the increasing sunlight. When the sunlight stops, it recovers its original color, which can ensure the stable balance in indoor lighting. The application of smart information technology, by use of computer and micro-electricity, when the exterior environment changes, such changes will be reflected to terminal, changes internal current directions by sending programs, so as to change light transmission efficiency. Rotate angles of bean curd blade and open or close some ventilated grates, so as to reach fine natural illumination and natural ventilation effects.

Construct structural system by smart and light materials. Such materials have optical fiber, by which the glass nerve made has the self-recovery capacity and can prevent disasters. For example, memory alloy fibers can stand vibration in ten-fold intensity of common alloy fibers, saving more resources but increasing energy-consumption. Nowadays, ecological architecture is stepping into smart and informationization. The methods are still studied and explored continuously, which includes multi principles, multi classes and multi occupations, a comprehensive system engineer. It needs global valuation, global participation. It can't be realized by several architects, let alone finished in a day. But it represents the direction in 21st century and it is the object for all architects.



Fig3 Floating eco-cities



Fig4 Gwanggyo green city Seoul, Korea



Fig5 City green skyscraper in Singapore

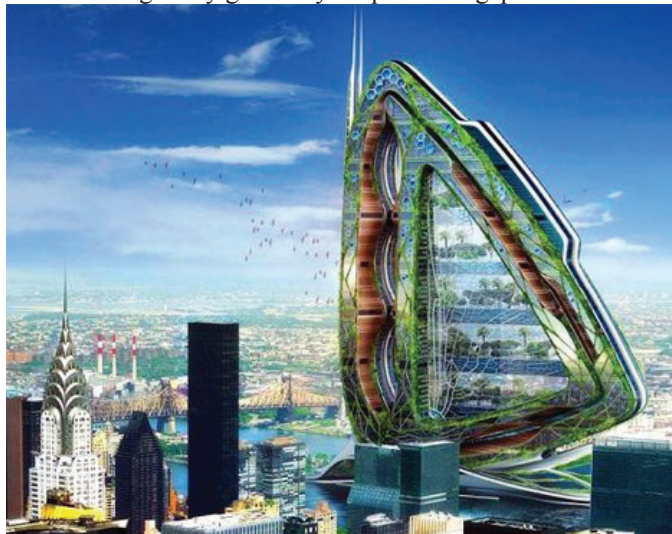


Fig6 Dragonfly vertical farm



Fig 7 "Green harvest urban vertical farm "designed by Romse Architects, Canada



Fig8 "Urban Cactus"Rotterdam, Netherlands

Ecological architecture design is not a strange and new conception, but a principle with the idea of harmony between man and nature. Ecological architectures develop from obscurity to fashion, from ideal to reality, with rapid development and great performance. It is a innovation in construction industry, whose future is doom to change our being models. Nowadays, we may be limited in various conditions, may be impossible to build ecological architectures in wholly significances--- impossible to make every building to achieve the world standard. But we can paraphrase each design in ecological thought again, changing into a kind of modes centered as innovation and based on balance. Architecture style is the representation of external beauty, while the saving energy and environment-protected the representation of internal beauty. Only if achieve the unity of internal and external beauty, form and content beauty, it is a fine architecture performance which fits the demand of scientific development and reflects the progress of human civilization.

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