

Exploration and Prospect of Harmonious Relation between Construction and Environment

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Abstract

With the improvement of public environment consciousness and sense of responsibility, the idea of coordinated development between Construction and environment has gradually become the target of construction industry in new era. However, as environmentally friendly construction has just started, its practice is still in immature stage. Construction design still has the shortcomings of threatening environment and the relationship between man and nature is not optimistic yet. This paper explores current contradiction between construction and environment in China, which refers to high energy consumption, the paucity of environmentally friendly materials and poor quality in construction. Therefore, it is necessary to learn from green and ecological construction at home and abroad, to strengthen the adaptability and initiative of construction, to use scientific and environmentally friendly materials, to establish better supervision system, to analyze the demand of people and design of construction so as to harmonize with the environment and to put forward feasible new project of "sky garden" to provide valuable reference for domestic construction.

Keywords

Construction and environment, coordinated development, environment protection, green ecology.

1. Introduction

While the rapid development of modern architectural technology provides convenience for mankind, it also inevitably brings many challenges. Currently as the skyscrapers are rising in an alarming rate, the contradiction between architecture and environment including the mistakes of location choosing, defects like inadequate lighting and ventilation caused by unreasonable design lead to high energy consumption and pollution such as the long-time operation of home appliances; the large-scale productions of building material consume large amounts of mineral resources and release greenhouse gases into the atmosphere; limitation on construction quality triggers the shortening of replacement cycle, furthermore, repeated construction and demolition waste building materials and exacerbate the damage imposed on the surrounding environment.

One of the core tasks in today's social construction is to explore the coordinated development of architecture and environment. While the rapid growth of China's population and economy stimulates the growing number of domestic buildings, the following environmental problems have become a priority to be deal with. As a responsible big country, China has the duty to undertake the important task of protecting the environment and realize the strategic objective of sustainable development.

Taking urban residential buildings as the study object, and the coordination relation between building and environment as the center of research, this paper reviews the architectural design concepts at home and abroad, and provides theoretical support for formulating architectural strategies according to local conditions. Facing with the contradictions between artificial buildings and the environment, taking the maximum use of environmental conditions as the principle, the use of eco-friendly building materials and structures as the means, and the standards and regulations in the construction industry as the safeguards, this paper proposes to enhance the building's stability and ability of self-adjustment,

to improve the quality of construction, and reduce building energy use and the negative impact of human settlements on natural environment.

2. Brief introduction of concept

City, which is the combination of city and market, originated from the first social division of labor. The early “city” was separated from the “market.” The city was the place where the army was stationed while “market” was the place for exchange of goods, [1]. With the development of science and technology, the functions of the city have changed and gradually transformed cities into a special geographical environment [2].

2.1 Urban construction

As the main body of city, city construction directly reflects the degree of city's prosperity and social outlook, plays the role to meet the demand of production and life of the residents and the social development and as well marks the essential differences between human settlements and the habitats of other creatures.

2.2 Urban construction design

Urban construction design is an important way to save urban land resources, encourage walking, improve efficiency, create low carbon urban environment, and further improve urban living space and the quality of urban life [3]. Therefore, in order to give full play of the multiple roles of city construction, architects should adhere to scientific, efficient, and environmental friendly concepts in design and construction process to make city construction the reform impetus of political, economic, and environmental development. Furthermore, in a highly complex urban environment, this is also the opportunity and challenge that the city construction design faces now.

2.3 Architectural design coordinated with the environment

The environmentally coordinated construction ensures the sustainable development of human beings as well as the environment. To achieve this goal, the construction should manage to opt for reasonable materials, using eco-friendly and durable building materials. Also, wise use of the inner systems of the construction is another effective approach. It should follow the principle of making full use of environmental conditions combined with energy-saving emission to reduce pollution. Finally, construction quality control can not only ensure the safety of the residents, but also avoid the loss of construction material caused by repeated constructions and demolitions due to quality problems.

3. Demands that architectural designs coordinated with the development of the environment should meet

3.1 Human's needs

Architectural design should not only take into account the needs of the city, functional requirements, objective environment and other proprietary social, cultural and historical background, but also meet human demands [4].

The basic purpose of architecture is to provide comfortable space of production and living for mankind. Therefore, the primary requirement of mankind for architecture is to satisfy the demand of using it. Therefore, the use value of buildings is always the focus of attention ranging from the consolidation of basic security, shelter, water, light, a stable supply of electricity to the use of air conditioning, heating, humidifiers and other household appliances to achieve comfortable indoor environment.

In addition to the demand of using, people also seek for spiritual satisfaction from their living environment. In bustling cities, home is the harbor for everybody who is struggling for a living. Because of the scarcity of land resources and the rapid growth of the population, the shortage of urban housing has risen to be one of the biggest livelihood issues. Although the dense "honeycomb" structure effectively alleviates housing problems in urban areas, it has made most urban residents

subject to crowded and depressing housing conditions. Living in compacted urban buildings, people lust for spacious and bright places which can afford them a sense of belonging.

3.2 Design Requirements

With the restrictions on urban land resources, rational planning of urban residential sites is particularly important - it neither allows waste land nor densely-built homes.

Sustainable construction should be based on the improvement of comprehensive environmental benefits, providing an economic and comfortable residential place with environmental and cultural feeling [5].

Building designs should take into account the natural outlook on life and build a highly diverse, adaptable, vibrant and self-regulating living environment featuring a development mechanism of intense competition, symbiosis and self-sustentation [4].

Focusing on the use of green energy, green energy includes two aspects: energy consumed in building is green, such as solar, wind, hydro and geothermal energy and other natural resources; building energy consumption is minimal, namely energy-saving, such as the use of natural lighting, ventilation, temperature and humidity control for a cozy micro-environment [6].

4. Solutions for Building Defects

4.1 High Energy Consumption

The wisdom of nature gives rich inspirations for architectural designs, such as the ventilation system of the mounds of termites, phototropism of green plants, strong insulation of polar bear furs, etc., which can all act as a reference. Incorporating biological features into architectural design enables buildings to make efficient use of natural resources and conduct self-regulation, greatly improving indoor environment in natural conditions and reducing reliance on household appliances.

4.1.1 Ventilation System of Termite Mound

The interior consists of a large central core in which the fungus is grown, below it is "cellar" of empty space, above it is an "attic" of empty space, and there are many small tunnels that connect the cellar and the attic. Such space structure allows the termite mound to automatically exchange the air within the nest with the outside and stabilize the internal temperature. The ingenious space structure and self-regulating mechanism substantially strengthen their control capability over the flow of internal air, which not only ensures the supply of oxygen, but also plays a role in heat preservation and insulation.

Mike Pierce, a great architect, applied such system to the commercial office complex of Zimbabwe Eastgate Center. In this system, cool air produced by green plants in the atrium get pumped up, and then is transmitted to the offices through the central air shaft; the hot and turbid air is thus emitted to the outside by the central air shaft via the ventilation on the ceiling. The complete ventilation system spares the need for artificial equipment, making the power consumption of the building only 10% of that of the conventional counterpart of the same size; besides, the indoor air quality is much better than that of the air-conditioned buildings.

4.1.2 Heliotropism of Plants

The building drawing inspiration from "Heliotropism plants" and designed by German Rolf Disch Solar Architecture allows buildings to rotate like plants so as to track the sun for more light and heat. In order to resist the cold weather, architects give full play of their imagination and imitate the heliotropism of green plants, which enables the building to scientifically employ natural resources, improve light and heat conditions and overcome the problem of insufficient heat by means of adapting to the environment via self-adjustment.

4.1.3 The Staggered Structure of Buildings

The Urban Cactus in Amsterdam serves as an exemplar for the use of eco-light adaptation to optimize lighting conditions in buildings. Its adjacent floors stack with a small rotation angle, providing every household with an open outdoor garden platform, ensuring the indoor space takes in as much natural

light as possible, while promoting the photosynthesis of plants on the platform. While conserving energy by reducing the use of artificial lighting, the building also lowers the carbon dioxide concentration in the atmosphere and mitigates the heat island effect by giving play to the purification of plants.

4.2 The paucity of environmentally-friendly Building Materials

The choice of building materials is an overarching component of architectural designs. Environmental construction should allow for the selection of materials, production & processing, maintenance & demolition, waste treatment and other procedures closely related to energy and environment, such as using green building materials, recycling used materials, reducing pollution during material productions as well as the energy consumption during housing systems operations on the basis of building materials [6]. The suspension structure, the shell structure and the honeycomb structure can all reduce the consumption of material and energy resources by optimizing the supporting structure of the building and enhance the flexibility as well as the safety of the constructions to which they are applied.

4.2.1 The Suspension Structure

The economical design of the suspension structure with a high sense of space minimizes the demand for raw materials and grants the roof an excellent toughness. The lightweight and flexible performance of a suspension structure allows the supporting roof to sprawl broadly without additional pivot points in the center. As a result, the suspension structure finds wide application in gymnasiums, expo halls and long-span bridge projects.

4.2.2 The Thin Shell Structure

A thin shell structure is a thin-walled structure consisting of two curved surfaces at the top and the bottom, with the thickness of the shell negligible compared with the size of other dimensions of the object. The geometric construction of a thin shell structure spreads the pressure evenly over every part of the shell so that such a thin shell can support a tremendous weight. The corrugated roof of the pavilion at National Industry and Technology in Paris greatly increases the strength of the shell structure with a thickness of only 120mm, whereby achieving the goal of maximizing usable areas and minimizing the use of building materials.

4.2.3 The Honeycomb Structure

The honeycomb creates an enormous space out of a small amount of materials. Numerous hexagonal houses of the same size in the honeycomb are tightly pressed together to form a strong and stable structure.

In the aspect of architecture, honeycomb composite board is made of thin artificial boards, cardboards and recycled paper honeycomb cores, characterized by such properties as light in weight, heat-retaining, sound-proof, fire-proof, damp-proof and anti-seismic, making it very suitable for sandwich material. For lightweight walls made of honeycomb composite materials, honeycomb core materials only accounts for one to five percent of the total weight, and yet they are the mainstay of the wall.

Modern buildings made of honeycomb composite materials are warm in winter and cool in summer, which can effectively reduce energy consumption.

4.3 Poor Construction Quality

The high-rise urban buildings accommodate a large amount of residents; therefore, the safety of the buildings should be placed as the first priority. In addition to the selection of construction materials, the construction process is also a crucial factor that decides the ultimate quality of the construction. The emphasis of this part is on establishing strict criteria and regulations to ensure the quality of construction.

We should improve the professionalism of architectural designers by imparting architectural knowledge to them, which includes the construction industry law, engineering structure, and construction technology. We should also strengthen professional trainings for the department of

architecture and design and enlarge the scale of job training so as to ensure that designers keep pace with the times and could efficiently tackle problems occurred in building designs [8].

Quality standards can help eliminate engineering deficiencies due to confusions among workers and supervisors. China has set up "designated model room" to show contractors and workers quality benchmark in a clear way. In addition, it is recommended that relevant departments make videotapes or CDs about installation and construction methods so as to enhance the awareness of contractors and workers during the construction process [9].

Sufficient field supervision is a strong guarantee of quality. Contractors shall assign supervisors to each construction site to supervise the progress. Once the project is inconsistent with the quality standards, the construction supervisor has the right to re-check and suspend the work.

In enhancing the benefits of integrity in market, we should list integrity into the standard that is used to measure the reliability of construction companies. Integrity will directly affect biddings, capital turnover and credit assessment, which decide the rise and fall of the company. In this sense, construction companies will be facilitated to attach more importance to project quality. [10].

5. Outlook on Environmentally Coordinated Construction Model

At present, dense apartments equipped with elevators are closed, crowded, and high energy-consuming, which is contrary to the theme of harmony and environmental protection. In order to promote the harmonious coexistence between human and environment as well as the coordinated development between architecture and the environment, this paper proposes a new urban architectural model: the sky garden, a solution based on current architectural experiences. While retaining the advantages of traditional buildings, this design is more eco-friendly and could save more space, which plays an exemplary role for current urban constructions and serves as a serene place in a bustling city.

5.1 Green and Comfortable

Both ends of the floor are reserved as "private gardens". According to personal preferences, people can plant trees and flowers or install pavilions and fountains in the gardens to decorate their mid-air private gardens. Residents can take a walk, raise birds and walk the dog in their own garden, making it possible to enjoy natural environment without going out of the buildings. In private homes, a space is reserved for animals and plants, which shortens the distance between man and nature. A large number of plants will transform the apartments into a natural oxygen bar, which also plays a significant role in coping with urban heat island effect and air pollution.

5.2 Save Underground Space

Build parking lots in the air. Thanks to peripheral lanes and intelligent lifting system, both residents and visitors could drive their cars to public courtyards at any floor within several minutes and park their cars in front of the destination. It would be much more convenient for people to park cars when returning home and to pull out when going out. Mid-air parking space also ensures that pedestrians are separated from the vehicles by eliminating the traffic in living areas. At the same time, this practice will lead to an end of the underground parking lot that is dark and foul. It saves the energy consumed by 24-hour lighting and air exhaust devices. It is only necessary to construct air defense system and equipment in the basic part of the main buildings without digging down two or three layers to build parking lots, which thus can save 90% of underground work and shorten the duration.

5.3 Interlaced Floors

Adjacent floors rotate at certain angle to create a wave-like visual effect that resembles a rotating building. The unshielded area formed by angle gaps provides an open outdoor platform for each floor. Ample sunshine and fresh natural wind would greatly enhance indoor lighting and ventilation and reduce the workload of household appliances. Meanwhile, this design promotes the growth and photosynthesis of plants on the terrace and also purifies urban air.

Viewing platforms on the upper and lower floors could be arranged in a random but proportioned way, which means balconies at every four adjacent floors face east, west, south and north respectively. It breaks traditional residential models, enlarges the space above the viewing platforms, improves the open-air effect and also effectively prevents thieves or neighbors from climbing over the balcony.

5.4 Solid and Environmentally Friendly Construction Materials

New types of buildings use honeycomb paperboard and composites as support walls. This construction material requires few raw materials and is featured by its solidarity, light weight, affordability and other characteristics. Also, it is fire-proof, damp-proof and shockproof. Honeycomb materials greatly enhance the safety of the construction; solve the contradiction between volume ratio and extended height; make full use of land resources while creating a feeling of spaciousness. Furthermore, honeycomb materials could stay warm in winter and cool in summer, which is less energy-consuming, green, and environmentally friendly.

6. Conclusion and Discussion

Urban buildings are meant to satisfy people's social demands. People use available technology and skills as well as scientific and aesthetic laws to create comfortable artificial environment. Urban buildings are important places that ensure the efficient operation of urban systems and the high standards of living of all citizens. This paper summarizes the characteristics that environmentally-friendly constructions should be equipped with, that is, to satisfy residents' material and spiritual needs, to meet energy-saving requirements, to use land efficiently and to promote the benefits for the surrounding environment. Through analyzing the contradiction between buildings and nature in urban construction industry, this paper studies current drawbacks of urban buildings, namely, high energy consumption, a lack of environmentally-friendly building materials, and low-quality constructions. This paper comprehensively considers the needs of residents and design, exploring ways of achieving low energy consumption, eco-friendly building materials and high-quality buildings in the field of architecture. It proposes an architectural concept of "the hanging garden", which provides valuable reference for harmonious development between living and natural environment. In the trend of the new century, the rapid development of science and technology and the concept of environmental friendliness have laid a good foundation for the healthy development of buildings which are harmonious with nature and for the remarkable achievements in construction industry. Henceforth, artificial buildings will no longer be incompatible with nature, but instead establish a harmonious and friendly relation with the environment, which is a big step forward in protecting the earth.

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