Analysis of Integrated Design in Green Ecological Architecture

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Abstract: Integrated design is an important principle of modern green ecological building design. The integrated design system of ecological architecture covers six aspects, including architecture optimization, energy optimization, material optimization, environmental optimization, control optimization and economic optimization, each of which contains different subsystems, technical systems and specific technical means. With the green architecture design system, architects would be also to fully grasp the ecological architecture design process.

Introduction

Green ecological architecture is the future development trend of China's construction industry, because it would maximize resources, protect the environment and reduce pollution within its full life cycle. Green ecological architecture requires full consideration of environmental protection, energy saving, economy, comfort and other comprehensive factors in the design, construction and utilization process. Therefore, to a great extent, architecture design capability determine the development of green ecological architecture.

With the development of modern design concept and the popularization of green architecture design consciousness, architects no longer only focus on the plane function, solid modeling and construction techniques of the architecture, but gradually evolved into an integrated design of multidisciplinary integration.

Different from traditional design methods, integrated design guarantees the introduction of various professional information at the initial stage of design, and consider all the factors and the possibilities of the design at the beginning of the design, mainly reflecting in two aspects: one is vertical comparison, that is, think of the architecture itself as a whole with the outside world, and take the building life cycle as the starting point for design decisions; another is horizontal comparison, which requires all the professional designers to work closely together, to integrate sustainable architectural design strategies in terms of functionality, form, performance, and economics.

Green Architecture Integrated Design Process

To achieve integrated design, on the one hand, it needs to design a team of professional designers and other experts at the initial stage of the project. Architects, in general, are team leaders and coordinators, but not the only policy maker. Architects must have the knowledge of technical solutions, and meanwhile, engineers must also have a thorough understanding of the complexity of the building design process. On the other hand, the traditional design process needs to be converted from a linearized process into an annular process, where improvement of program design, preliminary design and construction drawing design process should be focused.

Conceptual design phase

In conceptual design phase, the expertise of architects and engineers integrates and inspires each other, to meet architecture construction demand. At the same time, the following factors should be

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taken into account: requirements for architectural design, work or living environment and visual effects; requirements of function, structure, energy consumption and indoor environment quality; other quality indicators such as building performance, thermal comfort, outdoor landscape and so on.

In this phase, through the deepening of the design scheme, it can meet the requirements of indicators and other requirements in the design process. In the meantime, various professional information related to Architectural design is deeply integrated.

The prerequisites for designing energy-efficient buildings or green buildings are as follows: in conceptual design phase, the design team must continually evaluate the architectural form, plane layout, construction plan, building direction, structure mode used in the program, and according to the requirements for heating, cooling, ventilation and lighting, as well as the impact of climate on building energy efficiency, to optimize the combination of these factors, so as to ensures that these factors are optimal for building function and energy environment.

Preliminary design phase

The target in preliminary design phase is to determine the final form of the architecture, and make it meet the design intent. In this phase, designers must integrate all the factors considered in conceptual design phase, including general layout, architectural form, function, space design, interior layout, relevant specification, indoor environment technology and energy solutions. Various factors in the program should be optimized, and meanwhile simulate and calculate the results of building energy and indoor environmental performance.

It requires types of tools to provide guidance for designers: one is simulation tools, which are used to provide decision reference for the design team for technical integration and optimization of the project; another is design guidance tools, which are used provide guidance for the energy saving optimization of the overall and system parts of the architecture. In addition, materials and equipment parts database should be prepared, so that designers can choose based on optimization results.

Thus, every part of the building can "perform their duties", and even additional performance may be enhanced.

Drawing design phase

In construction drawing design phase, technical solutions should be improved, and work with the engineering contractor, the equipment dealer and the material supplier to determine the specifications and models of the relevant products, and then complete the final drawing. The final construction data and specifications must comply with specifications, measurements and inspection requirements, and it also includes the elaboration and interpretation of the necessary energy and environmental performance. The results of energy and environmental analysis should be consistent with the design implementation process, as well as energy simulation and computation, and comparative analysis of cost and benefit, etc.

In this phase, which is mostly used is comprehensive evaluation tool, whose purpose is to provide decision reference for material parts and technology selection. Moreover, to ensure the quality of the completed project, detailed instructions on the construction process requirements should be prepared as much as possible, so as to avoid raising costs or delaying construction periods.

Construction of Green Architecture Integrated Design System

The basic starting point of eco-architecture integrated design is the concern of the whole life cycle of the architecture, including full cycle process of raw material mining, planning design, transportation, operation, maintenance, until demolition and disposal.

Starting from the sustainable goal of ecological architecture design, in order to facilitate architects to design ecological architecture, we use the method of systematic integration to comprehensively analyze all aspects of the whole life cycle of the architecture, combined with

comprehensive evaluation of environmental benefit, social benefit and economic benefit, so we have initially put forward six systems for green architecture integrated design: architectural design optimization system, energy design optimization system, material saving and waste disposal system, environment design optimization system, intelligent control system and economic balance system, each of which contains different subsystems, technical systems and specific technical means, as shown in Table 1.

Table 1. Green architecture integrated design system

System	Subsystem	Technical system	Specific technical means
Architecture optimization system	Site design optimization	Location optimization	Sunshine, ventilation and terrain analysis
		Traffic optimization	Traffic for vehicles
		Vegetation optimization	Vegetation distribution, plant configuration
		Water utilization	Rainwater collection, treatment and reuse
	Function space optimization	Area saving	Simultaneous combination
		Reuse of function space	Variable internal space
		Rational distribution of functional areas	Passive insulation space
	Structural system optimization	Structural system optimization	Structure selection
		Enclosure structure optimization	Insulation layer arrangement
		Door and window system	Low-E glass
	Equipment system optimization	Pipeline optimization	Pipeline consolidation
		Air conditioning system optimization	Pipeline consolidation
		Water system optimization	Reclaimed water recycling
		Power system optimization	Wireless LAN control technology
	Decoration system optimization	Interior decoration material optimization	Microcrystalline stone and nano antibacterial coating
		Exterior decoration material optimization	Local material usage
	Construction scheme control	Material transportation	Local material usage
		Construction site control	Field environmental control
Energy optimization system	Energy saving	Natural draft	Air pressure ventilation and hot pressing ventilation
		Shading system	Exterior sunshade and inner sunshade
		Natural lighting	Illumination of refracting plate and lighting well
		Natural potential energy	Utilization of terrain elevation difference
		Retaining structure insulation	Hot broken aluminum alloy window
	Clean energy use	Solar energy utilization	Photothermal conversion storage
		Wind energy utilization	Wind power conversion storage
		Geothermal energy utilization	Ground source heat pump air-conditioning
		Hydraulic	Potential energy utilization

		Waste recycling	Combined heat and power
		Biomass energy	Straw combustion heat reuse
Material saving and waste disposal system	Material saving	Material actuarial	Reduce the coefficient of safety
		Local materials utilization	Local material processing
	Waste treatment and recycling	Garbage collection	Refuse classification
		Organic solid waste treatment	Microbial treatment
		Inorganic solid waste treatment	Concrete recycling
Environment optimization system	Indoor environment optimization	Natural lighting optimization	Solar collector
		Artificial lighting optimization	Energy-saving lamps
		Noise source control	Avoid using noisy equipment
		Noise reduction	Noise reduction technology, sound insulation technology
		Air purification	Fresh air technology
		Air quality inspection	Harmful gas detection
		Air comfort	Personalized air supply
		Electromagnetic pollution control system	Electromagnetic inspection technology
	Outdoor environment optimization	Air quality inspection	Air inspection technology
		Vegetation conservation	Forest conservation
		Water conservation	Water microbial control
Intelligent control system	Intelligent building system	Induction system	Environmental information collection
		Device remote control	E-card system
		Network access	Optical fiber, wireless network
	Digital community	Virtual community	Community service support
Economic balance system	Construction cost balance	Material accounting	Material selection
		Construction cost control	Site modification cost
	Operation cost balance	Operation system control	Operation cost optimization
		Maintenance cost	Cost actuary
	Investment recovery	New material cost recovery	Static and dynamic calculation

(1) Architectural design optimization system

Architectural design optimization system is the forefront of green ecological architecture integrated design, as well as the main means to release Passive ecological architecture. Through the implementation of various subsystems including Site optimization, function optimization, structural system optimization, equipment optimization, decoration optimization and construction plan control, it can help the building realize energy saving, material saving and land saving, to a certain extent.

(2) Energy design optimization system

Energy design optimization system is divided into two major parts: energy conservation and clean energy utilization. On the premise of reducing building energy consumption, architects should consider all the renewable energy resources available in the base where the building is located.

(3) Material saving and waste disposal system

Material saving and waste disposal system would provide a basis for architects in architectural design. The manufacturing process of building materials transportation and the energy consumed during construction constitute the embodied energy during building's construction period, and this part of energy needs to be considered in conjunction with the life cycle energy cycle of the building.

(4) Environment design optimization system

Environment design optimization system mainly includes indoor environment such as sound, light, air, etc., and outdoor environment such as surrounding green environment. In the majority of cases, architects should consider to adopt the passive way to adjust indoor and outdoor environment as much as possible. In addition, a small number of high-efficiency systems can be used to cope with indoor climate regulation under extreme climatic conditions.

(5)Intelligent control system

Intelligent control system is the necessary guarantee for the implementation of many high-tech eco technological means. Architects can manipulate complex ecological building systems to achieve electronic control, that is, through a variety of sensor, to determine the changes in the outdoor environment in which the building is situated and then adjust accordingly, so that achieve the best use of renewable energy.

(6) Economic balance system

Economic balance system is to consider the economic rationality in the process of ecological building construction and use, and economic evaluation is also made for the implementation of other systems. For economic evaluation of ecological architecture, we must consider the whole life cycle of the building.

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