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The Construction of Engineering Ecological Civilization Based on the Life Cycle Concept

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Abstract. The decision of ecological civilization construction was put forward in the 18th CPC National Congress. The building industry should start from its own, explores the corresponding methods and measures. Under the direction of the life cycle management concept, this paper explores the basic point and thought in each stage of engineering construction, then analyses the guarantee measures of the government, enterprises and society.

Keywords: Life Cycle Management, Engineering Ecological Civilization Construction, Guarantee Measures

Introduction

From the new starting point in history, the 18th CPC National Congress made the strategic decision that “we should give great impetus to the ecological civilization construction”, and drew the magnificent blueprint about the ecological civilization construction. Currently, our country is faced with serious challenges that the environment polluted seriously, the resource constraints tend to be tight, the degradation of the ecosystem and so on. In order to improve the condition, the building industry should set up the ecological civilization concepts of respecting nature, complying with nature and protecting nature particularly. They also should insist the concept of engineering life cycle management and combine this concept with the ecological civilization construction.

Thoughts of Engineering Ecological Construction Based on the Life Cycle Concept

The pre-planning of engineering

The conception of engineering. The main purpose of construction engineering is to provide the products or services, so as to realize the corresponding value goal. We should pay attention to the following points when doing the design.

The engineering decision should be very careful. The modern engineering affects the nature and society greatly. It requires huge tracts of land, filling the river, cutting down the trees, tearing down the buildings, removing the people and so on. There’s no doubt that such type of construction mode would waste a large amount of resource. Therefore, based on the social and development issues, we can’t pursue the unnecessary size and luxury[1].

The construction of engineering should be rational. Nowadays, the engineering construction is neither the frontier of science nor the symbol of the national power. There is no need to pursue the so-called “world first” and show a nation’s ability by the engineering. The purpose of engineering construction should not only be stimulating the economic growth, improving the image of the city or region, or demonstrating the achievements of some departments or leaders.

Respect the buildings. The constructors should pay more attention to the engineering they participate in, help them grow healthily and try their best to protect them. For the buildings built by predecessors or others, we should also maintain their service life in reaching the design life, and can't tear them down at will.

Above all, the concept of engineering construction based on the ecological civilization must obey the overall development strategy and the whole guiding ideology of social development in our country.

The overall objectives of engineering. The concept of engineering construction based on the ecological civilization should persist in the scientific and rational goal of engineering construction.

The scientific, healthy and rational construction objective is the basic starting point of a successful project[2]. The decision maker must hold the future development with the long-term strategic vision, take the social responsibility and historical responsibility for their mission, establish the construction objective that can satisfy every aspect, and confirm the relationship between the function and cost of the engineering rationally from the perspective of life cycle concept, so as to balance the short-term profit and long-term interests.

The construction of engineering is for the sake of satisfying people with the need of economy, culture, science and lives. For a specific project, the objective is supplying the products and services that can meet the requirements, and meeting a kind of people's need, which may be the request about strategy, social development or scientific research.

During the engineering construction, we should revere the nature and strive for "the unity of heaven and man". That is, based on meeting the need of the function, we should make the construction and operation of engineering to be low power consumption and low carbon, make the resource of engineering be recycled as far as possible, balance the interests of every aspect in order to promote the harmony of society, adjust measures to local conditions and in pursuit of ecological balance and maintain biodiversity,and make the engineering has the ability of resisting disasters.

The fundamental objective of engineering construction is knowing nature, transforming nature and using nature[2], meeting the material and culture need, and realizing the sustainable development of society in the end. Therefore, when making the decision about the engineering, the relevant government departments should be cautious, the relevant parties should take appropriate measures during the stages of project planning, design and construction, so as to reduce the waste of resource and protect the environment.

The planning management of engineering. The project planning should has foreseeability on the development of the city. The effects that the project planning has on the engineering life cycle are listed as follows.

The project planning is in the early period of the construction stage and affects the engineering life cycle a lot. Therefore, the concept of engineering life cycle must firstly be reflected in the project planning. We should set the target that accords with the sustainable development of the city and make the project planning that accords with the optimum economic benefits, social benefits and environmental benefits. In recent years, the project planning in our country affects the project service life most. The reason of the fact that a large amount of buildings have been torn down is neither they had reached the designed life, nor the aging or the recession of function, but the change of city planning. And the fact that a large amount of buildings have been torn down has brought a mass of construction wastes, which leads to the waste of a great quantity of resources.

The planning land should be strictly controlled. A few cities are in the development stage, they are eager to absorb the foreign capital, so they often delimit and ratify the land to be used for engineering construction according to the requirements of the investors. Then the urban master planning had been ignored.

The expandability, the ability of disaster prevention and resistance and the sustainability of engineering, and the harmony between the engineering and environment also should be taken into account[3].

The design management of engineering. With regard to the specific project, we should research and spread the design criteria first, then implement them to the specific engineering technology[1]. The details are listed in the table 1 below.

Table 1 The Meanings of Four Engineering Designs

Concepts	Characteristics	Specific Approaches
Environmentally Friendly Engineering Design[4]	choose the proper location	Take full consideration of the conditions of the local climate, hydrology and geology, and do the environmental impact assessment according to the requirements of environmental protection department.
	complete the space planning	Make full use of the natural conditions such as the terrain, vegetation, etc. Make the planning reasonable so as to make the building and nature have a symbiosis.
	meet the requests of the laws and regulations	The engineering should accord with the local laws and regulations, such as the forcible environmental approval, the use of underground water, the emission requirements of air or water, the choice of contaminated area and so on.
	pay attention to the regionalism	The local historical and cultural characteristics should be paid attention to. We should try to fit the engineering with the local architectural style and maintain the continuity of history and culture.
Resource-saving Engineering Design	energy conservation and emission reduction	Adopt some effective means, such as paying attention to the use of natural light, controlling the orientation and shape coefficient of the building,,etc. Control the window-wall ratio, use the energy-saving windows and doors, reduce the area of doors and windows and the heat transfer coefficient. Use the self-adhesive sealing strip to reduce the permeating of cold wind. Use the heat preservation outside curtain, improve the thermal insulation property of the building envelope such as the wall and roof, and reduce the heat transfer coefficient. For example, we can set the thermal insulation layer for the wall and roof, use the insulation treatment for the beams, columns, nodes, joint, etc. of the outer wall and roof. Choose the renewable energy sources such as the solar energy and wind energy. Choose the energy-efficient equipments, and start from the details such as the power supply system and ventilation system.

	material-saving	Firstly, choose the new type building system. The building materials which are high-performance, low-consumable and reproducible can improve the convertibility of the building so as to make full use of the building, then the materials can be saved. Secondly, choose the new type wall materials. By doing so can we save the energy consumption during the production process and achieve the effects of energy-conservation, soil-saving and cyclic utilization of the wastes.
	land-saving	Try to optimize the layout. Reduce the land expropriation, make full use of the wasteland, reduce the demolition and choose the location reasonably. Take full consideration and use of the existing resource. Develop and use the underground space of the city. Optimize the technology and process, and reduce the energy consumption under the precondition of satisfying the operation function.
	water-saving	When doing the engineering planning, we should arrange the water supply network reasonably, use the water-saving instruments, use the technology of the effluent treatment and recycling, the reclaimed water reusing, the rainwater recharging,etc.
Green Design[5]	do not pollute the environment	Try to reduce the negative effect that we bring to the nature. Take measures to reduce the emission of the harmful gas and the destruction of biosphere. Ensure the indoor air quality, use the environmental protection materials to afforest the indoor space, make use of the natural ventilation and air conditioning system.
	maintain the biodiversity	Make full use of and protect the intrinsic wetlands, green land, trees,etc. And take measures to protect the species which are dying out.
	low carbon	Use the materials and construction technology which are low carbon and low discharging.
Retrievability Design	pay attention to the retrievability and the ability of being dismantled	This is the design method based on the circular economy aiming at making all the materials be recycled and realizing the coexistence of engineering and nature.

The purchasing management of engineering. The purchasing management here refers to the purchasing of materials. It is better to meet the following requirements.

Choose the materials which are low carbon, environmental and energy-saving, namely the ecological materials. Many design criteria are met by the materials, so we should try to fit with the engineering design when purchasing the materials.

Consider the influence the engineering materials bring to the environment. Think about the influence that may be brought to the environment and the corresponding energy consumption when

the raw materials are being produced or exploited. Improve and weed out the manufacturing techniques that are high energy consumption and may cause the heavy pollution. Try to choose the materials produced locally in order to reduce the energy consumption during transportation.

Consider the handling problems about the wastes from the building that has been torn down. And choose the engineering materials which can be recycled and degraded in a short term.

The construction management of engineering. The construction stage is the process that the engineering entity being formed and the life cycle concept being realized. A large amount of natural resources are consumed in this stage, which affects the surrounding environment seriously. The construction quality determines the durability and reliability of the engineering and the energy consumption in the operation stage. Therefore, the concept of ecological civilization should be implemented during the construction stage and the construction quality should be controlled strictly. We should reinforce the safety, health and environment management in the construction stage, renovate the traditional construction method and technology, and try our best to achieve the "green construction"[6].

We should try to achieve the clean construction and the environmental construction at the same time we meet the request of the quality and safety. Try our best to reduce the negative effects we bring to the environment and reduce the pollution to the environment.

By making the scientific construction organization, we can choose the equipments whose type, quantity and efficiency matching best with one another so as to reach the high efficiency and low energy consumption construction.

Protect the biodiversity in the construction site. We should try our best to protect the original vegetation. The construction organization of many projects has serious problems in this aspect. For example, when doing the "three supplies and one leveling", they would firstly cut the original trees and vegetation in the construction site, then transplant trees from other places to do the landscape after the construction. Such behaviors may waste a lot and devastate the original ecology biont.

Prevent the damage to the ecology. The damage to the ecology, such as causing the geology instability. In our country, plenty of the highway construction could damage the vegetation and the massif instability.

Save the resource and energy. Implement the concept of "4R" during the whole construction stage. We should save the resource by reusing the waste materials of the engineering. See the table 2 below.

Table 2 The Meanings of "4R"

Concepts	Meaning and Characteristics
Reduce	Refers to reducing the pollution to the environment and the consumption of the resource. A large amount of building envelopes are not finally necessary, so we should use the new technology and craft to reduce the number of the building envelope. The water should be saved during the construction stage.
Reuse	Refers to making full use of the natural resource. The wastes from the building that has been torn down should be reused. Take measures to improve the turnover and usage rate of the revolving materials such as the template and scaffolding.

Recycle	Refers to the recycle of construction wastes, reducing the emissions to the environment, and considering the retrievability of construction materials.
Repair	Refers to trying to repair the materials, components and equipments so as to reduce the waste.

The usage of ecological engineering methods. We could reduce the interference and damage to the environment and ecosystem during the construction stage by innovating the construction craft and technology. When doing the sewage treatment, some cities in our country used the stones to close the riverbed, which had led to the ecological functions losing, then the river was no longer limpid.

The operation management of engineering. In modern society, the operation security of engineering, especially the infrastructure engineering has become the society problem and a part of the government management. Because of the complexity of the project itself, the using abrasion and the disturbing of external environment, some problems would appear and lead to the stop of the whole engineering. This would bring huge loss to the users of the engineering and even the society. In recent years, the serious quality and safety accidents of the construction engineering have happened frequently, which affects the society greatly.

The operation maintenance of engineering. Along with the end of large-scale construction stage, the work emphasis of the engineering community in our country will change the fact that the construction stage being focused on into the operation stage being focused on. The operation maintenance of engineering refers to the regular inspection, maintenance and necessary repairs in order to maintain the good working performance of engineering.

The measures of inspection and maintenance can prevent the happening of the accident, so the risk can be reduced. If there are accidents, we can control them quickly and try to rule them out. By doing so can we reduce the damage to people and environment.

Improve the maintenance efficiency to enhance the operation efficiency. The fact that the service life of the project being lengthened is also a kind of resource-saving.

The good maintenance can delay the time of engineering renovation and the replacement cycle of professional engineering systems, then the use value of the engineering could be improved.

The health management of engineering. In our growth process, in order to ensure our healthy, we should do the regular checking so as to prevent and find the lesion timely, and if we do find the lesion, we can treat it timely. The engineering and the human body have many in common in the aspects of structure, function and life cycle. If we see the engineering as a life entity, the problems of the operating state of the engineering can be called the healthy problem from the perspective of the medical science. We can absorb some new thoughts from the health consultation concepts of the medical science to solve the problems in the operation management of engineering, wipe out the hidden danger in the bud, and reduce engineering accidents eventually. Therefore, we should do the health monitoring regularly and analyse the operation state of the engineering during the operation stage[7].

The engineering demolition and recycle

The final demolition of engineering. The reasons of engineering demolition generally include the normal loss demolition, which refers to the demolition when the buildings are near scraped and the use value is lost. The function outdated demolition, which refers to the demolition that the original function can no longer meet the requests because of the reasons such as the technology

progress when the use value still exists. The commercial profit demolition, which is in pursuit of the value of the land of the original engineering.

From the perspective of the ecological civilization construction, the normal loss demolition can't be avoided, but the other two should be avoided. Such as the function outdated demolition, we can transform such engineering in order to reduce the waste of the resource.

The problems that the engineering demolition brings in. Most cities in our country have had a large area of demolition, which has reduced the average useful life of engineering. And the random demolition has led to the huge waste and immeasurable social contradictions. At present, the number of construction wastes in our country has reached 30% to 40% of the total municipal refuse, people had done the rough estimate on the construction material loss of the brick-concrete structure, the full cast-in-place structure and the frame structure, the result is that the construction wastes are 500 to 600 tons per square meter, and after the ten thousand square meters old buildings being torn down, the construction wastes are 7000 to 12000 tons per square meter[1]. Therefore, on the basis of trying to reduce the number of demolition, we should also consider the recycle of the engineering.

The recycle of engineering. The recycle of the building refers to the recycle of time and space, including the handling of engineering site, the ecological rehabilitation and the recycle of the materials from the buildings that have been torn down.The recycle of the construction wastes. Take the metal materials for example, they have high value, so they often be reused after the demolition. If they are in good condition, they can be used directly. If they are rusted or twisty, we can clean and straighten them, then use them after reducing their use level. If they can't be used directly or after being processed, we can concentrate them and melt them down, after doing this can we use them again. The rubble after the demolition can be used to make up of the footing of wall, cushion and the filling material of the site, which can save much money. The cracked concrete, rock and stone can be used as the crushed stone or concrete aggregate after being attrited[8].

Ecosystem revivification. Ecosystem revivification includes the natural ecosystem revivification and engineering ecosystem revivification. The latter mainly refers to the ecosystem revivification after the building being torn down or the the demolition of the remaining dam. The ecosystem revivification should be paid attention to the following three principles. The principle of ecological benefit maximized which means the optimization of the functions of the engineering ecosystem. The principle of environment admissibility which means we should adjust measures to local conditions, do the optimized design about the function of the ecological system within the limit of the admissibility of the environment condition such as soil and climate, at the same time, we should do our best to improve the local ecological condition so as to expand the scope of ecotope admissibility. The principle of enforceable engineering, namely the economic and practical principles, for example, the plant seeds which are used for the ecosystem revivification should be collected, survived and maintained easily[9].

The Guarantee Measures

In order to boost the ecological civilization construction, the 18th CPC National Congress had put forward the thoughts of depending "the green development, the cyclic development and low carbon development", which showed that our country would develop the environmentally friendly industries so as to reduce the energy and material consumptions, protect and repair the ecological environment and develop the circular economy and low carbon technology to make the economic

society development and the nature be harmonious. In consequence, the government, enterprises and society should establish the systematic and effective guarantee measures actively.

The policy orientation of the government. The traditional policies about the resource and environment were usually the order and control. But for the real estate development enterprises, though there are many entrepreneurs who have the sense of social responsibility, they would donate to the society rather than use the money for the energy conservation and emission reduction[10]. As a result, the government should use the policies to guidance them, establish the incentive mechanism, and change the passive adaptation to the active behavior of the enterprises. The specific approaches are shown in table 3.

Table 3 The government policies and the specific approaches

The Government Policies	The Specific Approaches
The Technical Innovation of Low Carbon	Do the research of the low carbon technology and the promotion effectively, and make the long-term development plan. Encourage the enterprise to develop the new and efficient low carbon technology[11].
The Low Carbon Stimulation for the Enterprises	We should make the enterprises see the tangible benefits of performing environmental policy consciously. For instance, the government could make the stimulation policies about the finance, revenue, credit and loan that based on environmental protection so that the enterprises would participate in energy conservation and emissions consciously. Establish the classification system of the eco-mark of the enterprises, use the different colors to label the enterprises that have different environmental behaviors, and make public in local media to help the enterprises enhance their popularity. Award the enterprises that do the energy conservation and emission reduction well with spirit and material rewards[12].
Collaborative Governance	The enterprises should be the subject of participating in the formulation of related policies. For example, the government and the enterprises could sign the emission limitation agreement to govern together. The government and the enterprises could establish the process of testing, statistical analysis, evaluation and assessment of the pollutant emission together. The government could use the proper policies to realize the technology cooperation with the related enterprises, then they can transform the traditional high-carbon industry and develop the clean, high efficiency and low emission energy technology together[13].

The influence of enterprise culture. The ecological civilization construction of engineering is same to the life cycle management, and each of them needs the support of good enterprise culture. There are many management problems in the engineering construction currently, the main reason is about the people, and the people's problem is resulted from the cultural issue[14].

As the ecological thought of engineering construction based on the life cycle, only if the decision maker has the concept of resource-saving can the whole process be moved to the right direction. As the planning aspect, though there are the leading of the government, the enterprises should have their own responsibilities. Only if the real estate development enterprises have this concept can they consider the chain reaction of low carbon and energy-saving from the perspective of the project

planning[10]. The design, procurement, construction are closely linked to the operation stage, if the executors of every stage do not have the concept of saving and environmental protection, the others can't help. So we should make the enterprise culture infect the workers deeply. After the buildings being torn down, a large amount of resources that can be recycled are wasted, so the operators must from the perspective of the whole situation and recognize the importance of recycling. Attach importance to every worker and make them know that everyone of them is of great importance for realizing the goal of life cycle.

The positive responses of different levels of the society. The related departments should enhance the propaganda education, make the people realize that the ecological civilization construction is closely linked to their own interests. For instance, when purchasing their houses, they could choose the low carbon and energy-saving houses, and make them know that though the price is a little high, they can save a lot of money after they living in and it's good for their health and safety. The citizens should take active part in making the related policies. The advantage of that the citizens participate in the policy making process in the form of organization or individual is, they are not for the political power or economic profits, from the ideal state, they are standing for the concepts of public welfare and mutual aid, this is an important value orientation. Furthermore, to make the citizens have more speaking right in policy planning, we should take the advantage of their high flexibility[13].

Summary

The building industry should fully understand the urgency and importance of ecological civilization construction, take the history and society responsibility of their own industry, explore and take effective measures actively during every stage of the engineering life cycle to improve the original construction mode and reach the goal of "resource-saving, environmental protection" and ecosystem protection. For this purpose, the government, enterprises and society should establish a series of effective supporting measures as soon as possible, cooperate with each other actively, and take efforts to achieve the harmony of man and nature.

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