Research on Sustainable Development Relationship Between Energy and Resource Environment in Civil Engineering Buildings

Lingxu Li [1a*], Mingchang Ma [2b], Zitong Ma [2c], Yifeng Sun [3d]

[1] Dianchi College of Yunnan University, Kunming, China
[2] Changchun Institute of Technology, Changchun, China
[3] Jilin University, Changchun, China

[a*] e-mail: llx20082024@163.com; [b] e-mail: mmchangyhy@163.com;
[c] e-mail: mzt_1021@163.com; [d] e-mail: yifeng@jlu.edu.cn

Abstract. With the intensification of global environmental problems, civil engineering construction as the basic industry of modern social development, the construction of infrastructure is an important field, and there is a close interaction between energy, resources and the environment, its energy consumption and resource utilization of huge scale, the impact on the environment can not be ignored. Traditional building methods rely on a lot of non-renewable energy and resources, resulting in environmental pollution and resource depletion. In order to achieve the global sustainable development goals, the field of civil engineering and construction needs to seek new development paths in energy use, resource management and environmental protection. This paper aims to explore the relationship between energy and resource utilization and environmental protection in civil engineering buildings, and put forward relevant sustainable development strategies, emphasizing the importance of energy recycling and resource reuse and the requirements of sustainable development for civil engineering and construction industries. At the same time, it puts forward the application measures of a new model of intelligent and innovative management in energy and resource environment.

Keywords: civil engineering, energy consumption, resource utilization, environmental impact, sustainable development

1 Introduction

With the increasingly serious global environmental problems and the gradual reduction of natural resources, the concept of sustainable development has gradually penetrated into various industries, and the field of civil engineering is no exception. Civil engineering is an important support for social and economic development, civil engineering plays a key role in the process of global urbanization, involving construction,

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roads, Bridges, tunnels, water conservancy and other fields of infrastructure construction. However, traditional civil engineering projects are usually accompanied by a large amount of resource consumption, pollution emissions and environmental damage, resulting in serious impacts on the ecosystem. All aspects of civil engineering are closely related to energy consumption, resource utilization and environmental impact. Under the promotion of global sustainable development goals, it is of great significance to explore the relationship between civil engineering and energy, resources and environment to realize the sustainability of engineering projects. This paper discusses the relationship between civil engineering and energy, resources and environment, and puts forward some sustainable development strategies, emphasizing the importance of civil engineering to achieve green, environmental protection and energy saving goals in modern society. By adopting innovative technologies, conserving resources, reducing environmental impact and improving the adaptability of infrastructure, the civil engineering industry can promote socio-economic development while ensuring a harmonious coexistence with the environment.

However, achieving this goal will not be easy. Sustainable development in civil engineering faces many challenges, including high initial costs, lagging technology development, inadequate regulations and policies, and insufficient public awareness. This paper will discuss the needs and challenges of the sustainable development of civil engineering, and propose countermeasures to provide reference for the future development of the industry.

2 Utilization of Energy and Resources in Civil Engineering

2.1 Current Situation of Energy Consumption

Civil engineering generates a large amount of energy consumption in the production of building materials, the use of machinery and equipment during construction, and the operation and maintenance of buildings. All stages of a building's life cycle, from material production, construction, operation to disposal, involve significant energy use. According to the International Energy Agency (IEA), about 40% of the world's energy consumption is related to buildings, which includes not only the operating energy of buildings (such as heating, cooling, lighting, etc.), but also the energy consumed during the production and transportation of materials [1]. Under the dual pressure of resources and environment, the construction of low-carbon cities has become an important way of national development. Taking Fujian Province as an example from four aspects of economic development, carbon emission, environmental pollution and resource consumption, Huang Mingqiang et al. analyzed the energy consumption and environmental pollution of Fujian Province in depth, calculated the carbon emission caused by energy consumption, and quantitatively studied the construction status of low-carbon cities in Fujian Province by using the "decoupling" theory [2].

2.2 Resource Usage Status

In addition to energy consumption, the consumption of natural resources by buildings is also very significant, especially in the choice of building materials. The production and transportation of concrete, steel, wood and other building materials require a lot of natural resources. The large-scale exploitation and use of these resources will have a serious impact on the ecosystem, including the destruction of land resources, the reduction of forest resources, and the waste and pollution of water resources. V Kaczvinszki-Szabo [3], a scholar from the University of Budapest, Hungary, used alternative pile foundation experiments to solve the problem of resource consumption and impact on the surrounding environment in pile foundation projects, which not only reduced energy costs, but also made full use of resources.

2.3 Improvement of Energy Efficiency

In order to reduce energy consumption in civil engineering, improving energy efficiency is the key. The use of energy-saving technologies, such as promoting the application of green building materials in buildings, intelligent building management systems, and the use of energy-efficient machinery and equipment in construction, are effective measures to reduce energy consumption. In addition, the application of renewable energy in civil engineering, such as solar photovoltaic systems, ground source heat pumps, etc., also helps to reduce dependence on traditional energy sources. In recent years, solar photovoltaic systems have been widely used in civil engineering. Researchers are also looking for improvements in energy efficiency at all stages of design, construction and maintenance. S Momeni et al. [4] modeled a residential energy system for a total of 14 phases, compared it with actual energy consumption, and evaluated potential energy savings. The project explored strategies to reduce heating and cooling needs, implement efficient lighting and improve insulation. Compared with the simulation results, it is found that the electricity consumption and gas consumption of this cell are significantly reduced within 14 cycles, indicating the feasibility of the implementation scheme.

3 Civil Engineering and the Relationship Between Resources and Environment

3.1 Resource Utilization and Waste

The introduction of the concept of green building and sustainable development in civil engineering can, to some extent, save resources and promote renewable energy, thus forming a virtuous circle and ensuring the harmonious development of man and nature [5]. The large-scale construction of civil engineering is often accompanied by the consumption of a large number of resources, including cement, steel, sand and other basic materials. Overexploitation of these resources can lead to unsustainable use of resources and environmental degradation. The large amount of construction waste and waste generated during the construction process has also caused no small

pressure on the environment. In the building decoration materials, such as a large number of green materials, can reduce the generation of construction waste, while playing a healthy and environmental protection role.

3.2 Resource Conservation and Recycling

In order to reduce the waste of resources, civil engineering needs to promote the concept of resource conservation and recycling. In the selection of building materials, give priority to the use of renewable resources and environmental protection materials; In construction, advanced management and construction techniques are promoted to reduce the waste of materials. In addition, the recycling of waste building materials, such as the application of recycled concrete, can also effectively reduce the waste of resources and environmental damage. With the rapid development of science and technology, environmental protection and energy conservation control are strictly required in the construction process, and it is emphasized that unnecessary resource waste and construction pollution should be reduced to the greatest extent on the premise of ensuring project quality, so as to achieve a good balance between engineering construction and resource and environmental protection [6].

3.3 Practical Cases of Civil Engineering and Resources and Environment

Sustainable Building Design - Shanghai Tower.

The Shanghai Tower in China is the second tallest building in the world at 632 meters. The building incorporates a number of sustainable design concepts with the aim of saving energy and reducing carbon emissions. Double glazed facades are used to reduce heat loss and enhance the building's insulation. And the use of wind power systems, reducing the use of conventional electricity. At the same time, the usual rainfall is collected and used in many water facilities such as landscape irrigation, which has become a benchmark for green buildings in China.

Improved Energy Efficiency.

Beijing Daxing International Airport is one of the largest single airports in the world, with a floor area of 1.4 million square meters. Its design not only pursues modernization, but also makes a lot of innovations in energy conservation and emission reduction. Intelligent building management systems are installed in the design, construction and later operation and maintenance stages, optimizing the efficiency of energy systems such as air conditioning and lighting. The roof of the airport uses photovoltaic power generation technology to provide renewable energy. At the same time, combined with the background climate characteristics, the use of groundwater as a source of heat, the installation of efficient central heating system. According to the survey, Daxing Airport reduces tens of thousands of tons of carbon dioxide emissions every year, setting a model for green airport design. These cases demonstrate multidisciplinary integration and innovation in the fields of civil engineering, energy

and resources and the environment, driving the direction of green and sustainable development. Such projects are not only a technological breakthrough, but also a leading example for addressing global energy and environmental challenges.

4 Impact of Civil Engineering on the Environment

Environmental problems such as climate change, air pollution and resource depletion have had a wide impact on human society. As one of the major industries of energy and resource consumption, the field of civil engineering construction must pay attention to environmental protection and ecological balance. The rise of green buildings and energy-saving buildings is a response to this challenge, aiming to reduce the negative impact on the environment during the construction process.

In the process of construction, civil engineering may cause various forms of environmental pollution, including air pollution, water pollution and noise pollution. At the same time, large-scale earthwork projects may also lead to the destruction of land resources, soil erosion and degradation of ecosystems.

In order to reduce the adverse impact of civil engineering on the environment, engineering projects should strictly implement environmental protection laws and regulations and take effective pollution control measures. In the project planning stage, environmental impact assessment should be carried out to design a reasonable construction scheme to avoid the destruction of the ecological environment. In addition, after the implementation of the project, ecological restoration, such as vegetation restoration, soil improvement, and increasing the green area of the project construction area can also minimize the negative impact of the project construction on the environment. Wang Xueping [7] designed a material application management system based on BIM technology to improve the scientificity and rationality of the application of building materials in view of the low economic benefits of construction enterprises and the unreasonable application of green building materials following environmental protection materials. At the same time, the application effect evaluation model of green environmental protection building materials is established, and the application performance of green materials with high scores is comprehensively evaluated. Different comfortable building environments are created in different processes of project planning stage, design stage and construction stage respectively, so as to achieve the purpose of saving energy consumption, optimizing material quality and reducing environmental pollution.

5 Needs and Challenges of Sustainable Development

Sustainable development emphasizes meeting the needs of today's humanity without sacrificing the ability to meet the needs of future generations. For civil engineering development, this means achieving efficient use of energy, reducing dependence on non-renewable resources, reducing carbon emissions, reducing waste generation, and incorporating more environmentally friendly concepts into building design. The civil engineering and construction industry faces many challenges in achieving the Sus-

tainable Development Goals. First of all, the efficient use of energy and resources depends on technological innovation, and the promotion and application of new technologies often require a large amount of capital investment. Second, existing building codes and standards are still inadequate in terms of sustainability, resulting in a lack of incentive for the market to proactively pursue more efficient and environmentally friendly solutions. In addition, the lack of awareness of sustainable buildings is one of the obstacles to achieving this goal. Civil engineering projects usually involve extensive land development, resource extraction, energy consumption, and waste disposal. By adopting sustainable design and construction methods, it is possible to reduce damage to natural ecosystems, reduce greenhouse gas emissions, and reduce energy and water use. Due to global climate change, civil engineering projects need to take into account the increase in extreme weather events (e.g. floods, droughts, storms, etc.), ensuring the durability and adaptability of infrastructure. For example, urban drainage systems and coastal defences will need to adapt to future risks of rising sea levels and increased rainfall.

5.1 Green Building and Low-Carbon Design

Promoting the concept of green building and low-carbon design is an important way to realize the sustainable development of civil engineering. Through reasonable design and construction, energy consumption and carbon emission of buildings can be effectively reduced. Green buildings emphasize the environmental friendliness of the whole life cycle of the building, and have strict standards in the selection of materials, energy efficiency management and waste disposal. Indian scholar M Kalpana[8] conducted an experimental analysis on the potential uses of bagasse ash, rice husk ash, plastic waste powder and municipal sewage sludge as clay substitutes in brick making. The effectiveness test of these materials shows that compared with the traditional plastic waste powder, the compressive strength of bagasse ash brick is significantly improved, the water absorption rate is significantly reduced, and the utilization of agricultural waste residue and industrial wastewater can not only reduce the pollution to the environment, but also reduce the building cost, and achieve the purpose of green building and low-carbon design.

5.2 Intelligent Management and Technological Innovation

The application of intelligent management system in civil engineering helps to improve the efficiency of resource utilization and reduce energy consumption and environmental pollution in the construction process. Through technological innovation, the introduction of intelligent construction equipment, automated monitoring system, and information management platform can improve construction efficiency, optimize resource allocation, and achieve sustainable development of civil engineering[9]. The selection and use of building materials should consider their renewability and recyclability as much as possible, and promote the concept of "building life cycle management". For example, by using sustainable building materials (such as recycled concrete, renewable wood, etc.) and optimizing construction processes, the use of

resources is reduced. In addition, the management of construction waste is also a focus, implementing the recycling and remanufacturing of building materials to reduce the exploitation and waste of natural resources. To achieve sustainable energy use in the construction sector, the priority is to improve the energy efficiency of buildings. This includes the use of advanced building energy efficiency technologies, such as smart building systems, solar photovoltaic power generation, geothermal systems, etc., to reduce the dependence of buildings on external energy sources during use. At the same time, the use of low-energy and low-carbon technologies in the production of building materials is encouraged to reduce the energy consumption required in the production process of materials.

5.3 Environmentally Friendly Design

During the building design phase, it is important to consider the need for sustainable development. Green building design focuses on making full use of natural ventilation, natural light and other factors, thereby reducing the demand for energy. At the same time, the construction of water-saving buildings and vegetation roofs, green walls and other means to improve the ecological benefits of buildings. In the design process, architects should take a global perspective and consider the harmonious coexistence of architecture and natural environment. Zhou Changlin et al. [10] replaced the tents for collecting and burning cow dung with prefabricated low-carbon grazing houses. This paper studied the research trend of green and low-carbon technologies in prefabricated buildings, skeleton and enclosure structures, light-wind complementary power supply system and solar heating system in herdsmen dwellings in cold regions of China in order to improve energy consumption by collecting and burning cow dung, and developed a net zero carbon emission grazing housing technology route, which provided value for releasing emission reduction measures in grazing grassland ecosystem. In the early stages of building design, full life cycle design thinking is adopted to incorporate sustainability principles from the project planning stage, ensuring that the project not only reduces environmental impact during construction, but also reflects energy efficiency during operation and maintenance.

5.4 Policy Support and Market Incentives

Government policies and market incentives are important factors in promoting sustainable development in civil engineering. Through the introduction of relevant laws and regulations, the formulation of green building standards and energy-saving building certification system can effectively guide the industry to develop in a sustainable direction. At the same time, governments can encourage companies to invest more in sustainable building technologies through economic incentives such as tax breaks and subsidies.

6 Conclusion

The relationship between civil engineering industry and energy, resources and environment is close and complicated. This paper discusses the relationship between civil engineering and energy, resources and environment, and puts forward some sustainable development strategies, emphasizing the importance of civil engineering to achieve green, environmental protection and energy saving goals in modern society.

To realize the sustainable development of the construction industry is not only the demand of environmental protection, but also the inevitable choice of social and economic development. However, through measures such as energy efficiency, resource conservation and recycling, environmental protection and ecological restoration, as well as green buildings and intelligent management, civil engineering can make a positive contribution to reducing energy consumption, reducing resource waste and protecting the environment. In the future, civil engineering should pay more attention to sustainable development, use scientific and technological innovation, technological innovation, concept renewal and multi-party cooperation to promote industry progress, and provide strong support for social and economic development.

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