

Analysis on the Development and Thinking of Macau's Construction of Green Ecological City

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Abstract

This article discusses and analyzes the characteristics of the compilation of the "Green Building Evaluation Standards (Macau Version)" and the existing green building projects in Macau from three aspects: the development of green ecological urban areas in China, the evaluation system of green ecological urban areas at home and abroad, and the exploration of the construction of Macau green ecological urban areas. The results of the evaluation, combined with the status quo of Macau's green buildings and green eco-city districts, will trigger reflections, hoping to explore reference suggestions for the future development of Macau's green eco-city districts.

Keywords

Green Ecological City; Green Building; Green Building Evaluation Standard; Macau.

1. Introduction

Nowadays, the era of big data is coming, and science and technology are developing rapidly. According to the current urbanization rate, from now to 2025, there will be an increase of 65 million urban populations in the world every year. This is accompanied by a huge demand for infrastructure. The current development and use methods (including disposal of emissions, waste and water use) will determine the degree of sustainable development of cities in the coming decades. Therefore, the green ecological city is actually a new concept statement about exploring sustainable urbanization in the future, and there is no clear definition. Green ecological city refers to densely populated and connected areas in the city, which can effectively reduce resource consumption and pollution through technology and design. All in all, the design principle of the green ecological city is high density, public transportation priority and comprehensive development, while also considering the use of renewable energy.

1.1 Proposal and Development of Green Ecological City in Mainland China

Until 2012, the term "Green Eco-City" appeared for the first time in the "Implementation Opinions on Accelerating the Development of Green Buildings in China", mainly for the "scale development of green buildings" and extended to the urban area: "...actively develop green Eco-city. Encourage new urban districts to plan and design in accordance with the concept of green, ecological and low-carbon, fully reflect the requirements of resource conservation and environmental protection, and develop green buildings in a concentrated manner. The central government supports the construction of green eco-city districts, and the application for demonstration of green eco-city areas should have the following Conditions: The new district has completed the overall planning, regulatory detailed planning, and special plans for buildings, municipalities, and energy in accordance with the green, ecological, and low-carbon concepts, and established corresponding index systems; new buildings

fully implement the "Green Building Evaluation Standards" The evaluation criteria of one-star and above, among which the green buildings of two-star and above reach more than 30%, and the construction scale of green buildings shall not be less than 2 million square meters within 2 years..."

Table 1. Relevant concepts and proposals for ecological city construction

City Type	Concept	Proposer
Healthy City	A whole organically developed by a healthy population, a healthy environment and a healthy society	World Health Organization (WHO)
Green City	Green city is a condensate of biological materials and cultural resources connected in the most harmonious relationship. It is vibrant, self-supporting, and ecologically balanced.	David Gordon
Garden City	An garden city is a city designed for health, life, and industry. Its scale is sufficient to provide a rich social life but should not exceed this level; it must be surrounded by a permanent agricultural zone, and the city's land is owned by the public, Commission in charge	Ebenezer Howard
Shan-shui City	Combine city construction with nature, integrate natural mountains and rivers into the city, attach importance to national historical traditions and cultural context, and reflect the urban environment and culture with traditional Chinese characteristics	Xuesen Qian
Landscape Garden City	Emphasize the amount of greenery, natural environment quality, infrastructure level and corresponding urban management level in cities	Housing and Urban-Rural Development State
Environmental protection model city	Emphasizes a high level of economic development, good environmental quality, rational use of resources, a virtuous ecological cycle, sound infrastructure, and comfortable and convenient life	Environmental Protection Administration
Ecological Garden City	Use the principles of environmental ecology to plan, construct and manage cities, further improve the urban green space system, effectively prevent and reduce air pollution, water pollution, soil pollution, noise pollution and various wastes, and implement cleaner production, green transportation, and green buildings. Promote the harmony between people and nature in the city, and make the environment cleaner, safer, beautiful and comfortable	Housing and Urban-Rural Development
National Forest City	Refers to the urban ecological system with forest vegetation as the main body, and the urban ecological construction realizes the integrated development of urban and rural areas	Forestry Department
Low carbon City	It means that under the premise of rapid economic development, the city keeps energy consumption and carbon dioxide emissions at a low level. The urban economy is required to adopt a low-carbon economy as the development model and direction, and the urban life is based on the concept and behavioral characteristics of low-carbon life, and the urban governance is to use a low-carbon society as the construction specimen and blueprint	United Nations Nature Fund
Low-carbon ecological City	Integrate low-carbon goals with ecological concepts to realize a complex human settlement system with a harmonious symbiosis of "people-city-natural environment". It is a stage in the realization of an eco-city, and it is an eco-city type whose main entry point is to reduce carbon emissions. Sustainable development is defined as a development method that meets the needs of modern people without compromising the ability of future generations to meet their needs. Sustainable cities emphasize the process of urban growth while achieving a balance between environmental, social, and economic factors	Qiu Baoxing
Sustainable City		World Commission on Environment and Development
Resilient City	A resilient city is a city where individuals, communities, institutions, companies and systems in the city have the ability to survive, adapt and continue to develop under various chronic pressures and acute shocks.	Local Governments for Sustainability (ICLEI)

Green ecological city is a continuation of green buildings, and its essence is consistent with the emphasis on energy saving and emission reduction of green buildings. The concept of a green ecological city, simply put, compared with traditional city construction, it should be land saving, environmentally friendly, full use of energy and resources, reduced pollution, and provide people with healthy, applicable and efficient Sustainable urban development model. Since the development of a green ecological city is not a single pursuit of environmental ecology, it is based on the regional economy, society, environment, and resources from the planning stage to build a construction form that balances production, life, and ecology.

Although the concept of "green ecological city" was first proposed in 2012, similar ecological new city construction has started in 2001 (see [Table 1](#)): before 2007, the scale and number were small, and after 2007 Accelerated, especially in the period 2009-2011, 56 ecological new city construction projects have emerged. As of 2011, 44% of my country's 101 eco-city projects were in the planning stage and 56% were in the construction stage, indicating that more than half of my country's eco-city projects have entered the substantive construction stage. The development of green ecological urban areas in my country has gradually developed in the direction of spatial scale along the trend of "building energy efficiency-green buildings-green residential areas-green ecological urban areas".

2. Evaluation System of Typical Green Ecological City in Other countries

2.1 Evaluation System of Green Ecological City Districts in the United States and Japan

Some achievements have been made in the evaluation system of green ecological urban areas abroad. The United States, the United Kingdom and Japan have formed relatively mature systems, namely LEED 2009 for Neighborhood Development Rating System, BREEAM Communities, CASBEE UD, and Germany, Australia and other regions have also issued and implemented The respective evaluation standards, such as DGNB, EcoHomes. The evaluation indicators of different countries have slightly different focuses, but they have formed different frameworks and indicators according to regional characteristics. At present, there are mainly two evaluation systems for the most representative green eco-city or green eco-city in the world. They are the "Green Community Certification System" (LEED) established and implemented by the U.S. Green Building Council and widely used in North America. ND); and the "City Environmental Performance Evaluation System" (CASBEE-City) developed by the Japan Urban Environmental Performance Evaluation Tool Committee and widely implemented in Japan.

2.2 Advantages and disadvantages of LEED

LEED for Neighborhood Development Rating System is an evaluation system for sustainable urban and residential areas that was developed and released by the US Green Building Council in 2009. The system includes five items: smart site selection and connection, community model and design, green infrastructure and technology, innovation and design process, and regional selection, and integrates smart growth, new urbanism, and green building development concepts. LEED ND adopts a graded scoring system, which is composed of basic items that must meet the standard and scoring items of the scoring system. The scoring items include 100 points for basic points, 6 points for innovation and design process, and 4 points for regional preference items. Full score is 110 points. LEED ND is a performance evaluation index that emphasizes that the community meets the green requirements in terms of overall and comprehensive performance. Its advantage is that it has achieved a good balance in the three aspects of science, practicability and operability. It is the most operable index system and has a high market share; the LEED ND index system surpasses the single building and rises to the overall planning of the community At the level, the openness of the community microenvironment is strengthened by evaluating the relevance of the community and the urban environment; LEED ND is a multidisciplinary cross, and the evaluation system includes sociology, ecology, planning and other related disciplines to comprehensively examine the environment, humanities, infrastructure, etc. Coordinated development in all aspects. However, LEED ND still has some shortcomings, such as the inability to evaluate the overall and balanced development level of the project. For the ease of

operation of certification, the LEED evaluation system separates each score point. Not all score points need to be met. They can complement each other. For example, the density of the road network in a community traffic does not meet the requirements, but it can be passed Make up for the score in the use of water resources and pass the certification. This provides a certain degree of flexibility for local governments to design their own LEED ND system according to their own funds, technology and regional conditions, but to a certain extent it violates the principle of striving for all-round sustainable development and may lead to weaker shortcomings to a certain extent. , A stronger development direction for the long board [1].

3. Evaluation System of Green Ecological City in Mainland China

Mainland China has restrictions on the scale of green ecological city evaluation, that is, the scale should not be less than 3-5km², and it has a clear scope of planned land use. It is divided into two stages, planning design evaluation and implementation operation evaluation.

The Ministry of Housing and Urban-Rural Development of the Mainland of China proposed in 2011 six threshold conditions for a new green ecological city, including rejection of high-energy, high-emission industrial projects, compact and mixed land use models, green transportation, renewable energy utilization, and non-traditional water sources Utilization, biodiversity protection, etc. On this basis, the Ministry of Housing and Urban-Rural Development proposed 19 specific quantitative indicators for the new low-carbon pilot eco-city from six aspects, including land use, resource utilization, green buildings, biodiversity, landscaping, and green transportation, which became guidance and evaluation. General standards for various green ecological districts [2,3,4].

In December 2015, the General Office of the Ministry of Housing and Urban-Rural Development issued the "Guidelines for Issuing the Environmental Performance Evaluation of Urban Ecological Construction (Trial)". The evaluation index system in the guidelines consists of land use, water resources protection, local meteorology and air quality, Biodiversity consists of four major environmental impact assessment directions, and 29 recommended assessment indicators such as comprehensive runoff coefficient, water quality assessment pollution index, ventilation potential index, and number of vascular plants. Users can select the corresponding indicators for evaluation according to the four urban types: new urban areas, old urban reconstruction areas, brownfield renewal areas, and ecologically limited construction areas. Different from the evaluation work in other planning and design stages, the guidelines are mainly applicable to the post-evaluation work of environmental performance appraisal of the green ecological city. Effectiveness. At the same time, pay attention to the operability of the evaluation method and the calculability of the evaluation index. Pay attention to the consistency of environmental assessment results with public perception, and coordinate the government, scientific research institutions and public environmental perception. The content of indicators and thresholds are set based on the entire life cycle of urban ecological construction.

Then in 2016, the "Evaluation Standards for Green Eco-Cities" passed the national examination and approval, which is currently the authoritative guidance document for the planning, construction, and selection of green eco-city areas in my country. It mainly includes 9 major areas such as land use, ecological environment, green buildings, resources and carbon emissions, green transportation, information management, industry and economy, and cultural and technological innovation. Among them, technological innovation is a uniformly set bonus item, which aims to encourage technological innovation and improvement in the green ecological city. This document guides the evaluation in stages. It can be used in both the design and operation stages. The indicators can reflect the problems in the design stage, and can also feed back the actual situation after construction. It is also suitable for the construction of different types of green ecological urban areas with regional characteristics. Has strong universality.

On April 1, 2018, the National Standard of the People's Republic of China (GB/T 51255-2017) "Evaluation Criteria for Green Eco-Cities" was formally implemented. Localities have also

established their own local evaluation criteria based on their own urban development. For example, Shanghai City in 2019 The "Technical Rules for Shanghai Green Ecological City Evaluation" was released in September, and the book "From Planning and Design to Construction Management-Green City Development and Design Guidelines" was published in the same year. This book was led by the Shanghai Green Building Association and United China The East China Architectural Design and Research Institute of China Construction Group compiled a compilation. Based on the practical experience of the city's green urban development and construction in the past two years, it summed up a set of development and design methods for green ecological urban areas and other complex integrated areas to promote high quality The construction of a green ecological city. The book advances the concept of later construction management to the planning and design stage, and proposes the concept of "planning and design master control". At the same time, it includes five aspects: statutory planning optimization, special planning integration, development and construction guidelines, management and control method innovation, and institutional mechanism establishment. In all aspects, construct the operation mode and implementation framework of the whole process of regional development [5].

4. Macau's exploration and development of green ecological city construction: the stage of green building evaluation

Since April 2012, the "Circular 167" jointly issued by the Ministry of Finance and the Ministry of Housing and Urban-Rural Development proposes to encourage the planning and design of new urban areas in accordance with the concept of green, ecology, and low carbon, and the development of green ecological urban areas. In November 2012, eight new urban areas became the first batch of green ecological urban areas in my country. The selected eight urban areas were planned and designed in accordance with the green, ecological, and low-carbon concepts, and corresponding indicator systems were established. Under the above-mentioned policies and financial incentives, various localities have actively implemented large-scale construction of green ecological urban areas and green buildings. So far, there have been hundreds of green eco-city projects in various names, types, and sizes across the country. Inland cities have begun practical explorations of green eco-city areas.

After returning to the embrace of the motherland, Macau, under the environment of one country, two systems, and due to Macau's building laws, building types, and urban density all have their own characteristics, directly applying national standards to doors does not conform to the principles of green building evaluation based on local conditions. According to the climate, environment, urban form, standards and regulations of the Macao Special Administrative Region, the "Green Building Evaluation Standards (Macao Version)" (No. CSUS/GBC 07-2015) was formed after three revision meetings in accordance with the conditions of the Macao Special Administrative Region. It will be implemented on April 1, 2015. In the practice of construction, the exploration of the "Macao Standard" for the construction of a green ecological city suitable for the local area has also begun.

In the "Green Building Evaluation Standards (Macao Version)", attention is paid to the average performance of green buildings. There are 44 evaluation indicators for general items, and 11 evaluation indicators for preferred items. The general items include Land Saving. & Outdoor Environment (9 items in total), Energy Saving & Utilization (7 items in total), Water Saving & Utilization (7 items in total), Material Saving & Utilization (7 items in total), Indoor Environmental Quality (7 items in total), Operation & Management (7 items in total)), the evaluation index of each part is relatively average, and the evaluation is more objective. In addition, Macao is located in the hot summer and warm winter area among the five major climate zones in my country. The green building evaluation standards may list non-participating projects due to the location of the building, climate and building type, etc., which is the "Green Building Evaluation Standard (Macao Version))" incorporates a major feature of Macao's regional climate. The biggest difference from the national standards issued by the Mainland is that 60% of the total green area is the preferred item; the energy consumption and cooling efficiency requirements are higher than the national standard; the

development of residential underground space is upgraded from the preferred item to the general item; the super large building complex in Macau In terms of facility management, general items and preferred items that have been certified as a preferred item for energy management systems and a carbon emission audit as an operational management index have been added.

On the other hand, the China Green Building and Energy Conservation (Macau) Association (Macao Green Construction Association) was registered and established in Macau on January 10, 2014. It has been committed to the development of the green The "Green Building Evaluation Standards" has been promoted, and it still provides consultancy work for the Macau SAR government on green buildings. It is currently an important force in the development of Macau to promote the construction of green buildings and green ecological urban areas.

The land resources in Macau are extremely limited. The city is basically in a high-density state that has already been built, and there are few construction projects for reclamation. Therefore, the development of green buildings and green ecological districts is relatively slow compared with the mainland, and overall it is still monolithic. Green building project evaluation and promotion development, but with the efforts of the Macau Green Building Council, the review of 1 3-star public building, 1 2-star integrated hotel building and 1 1-star residential building has been completed in 2016 Certification, details are shown in Table 2 below (Green Building Project Certificate see Figure 1). In addition, until December 2020, the Macau Shek Pai Bay Water Purification Plant was evaluated as a one-star design logo, MGM Grand Macau was evaluated as a three-star green building operation logo, and the MGM Grand Macau project remained in the publicity period.

Table 2. In 2016, three projects in Macau that passed the green building review and obtained star certificates (source: author's compilation)

Project Name	Project Type	Construction Area	Identification star
Macao Science Museum	Existing building renovation project	26,700 square meters	three-star
MGM Macau Hotel Cotai Project, Macau	Integrated Resort Hotel Project	355,000 square meters	two-star
Xinchuangyi Garden Project	Private Building Project	6,800 square meters	one star



Figure 1. Three certificates of green building projects in Macau

5. Conclusion

The construction of a green ecological city does not simply think that "green ecological city = green + ecological city", but should be "green ecological city > green + ecological city". From the indicators of the evaluation standard system, green ecological city should be more important. It is a dynamic construction process for sustainable development. Based on the actual environment of Macau, one can try to learn from the experience of advanced green building projects in the Mainland or abroad, explore local green building design methods, and then introduce advanced green building technologies, and In terms of talent training in universities, research institutes and other talents, we pay attention to the inheritance of technology. In the built high-density urban areas, green renovation of existing buildings in demand is carried out, and new reclamation areas that have not been built are constructed by introducing current new technologies to vigorously promote Only the development of green buildings can effectively promote the construction of a green ecological city in Macau.

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