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Case Study of Elastic Planning and Design of Manhattan Island in New York and its Enlightenment to Macao

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Abstract

As A result of repeated land reclamation and high-density urbanization, Macao faces serious problems in the city's natural environment and living environment, and is in urgent need of ecological restoration.Natural disasters such as torrential rain and rising sea level have promoted the transformation of coastal cities from "resistance" to "adaptation". How to deal with natural disasters and rising sea level caused by climate change is also one of the major issues that Macao must deal with in the future development.This research adopts literature research and comparative analysis, the island of Manhattan in New York in the United States flexible planning and design project as an example, the methods and experiences to analyze its response to climate change crisis, and from the rigid base defenses, soft base defenses, adjust measures to local conditions, public participation activation space partition design the four aspects of Macao recommendations to cope with climate change crisis.This research will provide an important reference for Macao in establishing landscape adaptation strategies, exploring new technologies and methods of landscape construction, and doing a good job in landscape risk assessment and monitoring.

Keywords

Landscape Architecture; Climate Change; Sponge City; Macau.

1. Introduction

As glaciers melt, sea levels rise and extreme weather events become more frequent as a result of climate change, people will be exposed to increasingly uncertain and uncontrollable climate risks[1].The coastal area is the most active area for various processes between land surface and ocean. The rise of sea level caused by climate change will intensify natural disasters such as storm surge, wave invasion and coastal scour, which will have a significant impact on the atmospheric environment and social and economic development of coastal areas.Macau as an island city, there are a large number of marina such, but because of the people to the tension and the shortage of urban development space problem is more and more outstanding, make the government rushed to expand, not only eroded the original natural resources, and there are a lot of coastline is hard, seriously hindered the Marine biological information dissemination, caused the water pollution and other issues[2].Climate change and high-density urban pattern of urban development in the coastal area formed the high-risk areas, according to statistics, at present nearly half of the world's millions of urban population in coastal areas, the regional economic prosperity, densely populated, with regional, national, and even the whole world within the scope of the social and economic development has great significance in promoting.However, the ecological environment system of coastal cities is more complex, and the social economy and resources are highly concentrated. At the same time, due to the increasing frequency of human social activities and the dependence of cities on coastal resources, the

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great pressure of coastal urbanization increases, and cities become more vulnerable to coastal natural disasters. Urbanization has seriously changed the topography and hydrological processes, increasing the difficulty and uncertainty of ecological restoration[3].

At present, more than 42 percent of China's population live in the coastal areas, and the coastal areas account for more than 60 percent of the GDP, showing the characteristics of "regional economic development near the sea", and playing an important role in the rapid development of the national economy in the whole society[4].As one of the core seaports of the Guangdong-Hong Kong-Macao Greater Bay Area, Macao's status is even more self-evident.At the same time, according to the China Sea Level Bulletin 2018, the rise rate of China's coastal sea level from 2009 to 2018 was about 5.5mm/a, and showed a trend of accelerating growth, which put great pressure on the construction of defense facilities in Macao and increased the risk of flood in Macao.Therefore, in order to adapt to the climate environment will bring great challenges to Macao's future development, and to reduce the risk of natural disasters in coastal areas, it will be more and more important to build a flexible and good metropolis environment protection goal. To sum up, this study will focus on the exploration and practice of Manhattan Island in New York to cope with climate change crisis, analyze its main forms and characteristics, and provide reference for the ecological landscape planning of Macao.

1.1 Flexible Planning and Design Strategies for Coastal Cities

Due to the common influence of sea level rise and storm surge, many coastal cities abroad have put forward development countermeasures to adapt to weather change and sea level rise. New York, for example, was hit hard by the Hurricane Sandy in 2012. In order to enhance the city's overall resilience and prepare for future sea level rise and extreme natural disasters, New York launched a development planning measure called "Building a Stronger Resilient New York" in 2013.The plan focuses on the assessment of the direct damage caused by Hurricane Sandy to the city, the prediction of the future risk to the city, and the city waterfront space, infrastructure system, social environment and other aspects of the development of resilience and resilience.London, England in 2011 published the elastic construction and risk control, on the basis of the risk assessment of a variety of extreme weather factors, it puts forward the employment opportunities, investment and economic and social healthy development and improvement of life and so on many control countermeasures, and due to rising sea levels caused by the weather and flood hazard risk countermeasures to resolve the problem.In 2013, Rotterdam, The Netherlands, published "Rotterdam Weather Adaptation Measures", which pointed out the construction of the city's storm and flood management network, urban public space environment and building early warning design elevation, etc., and put forward the city's future development model to solve the problem of coastal weather risk in different regions.For example, the construction of sponge city is a project involving laws and regulations, technology, management system, disciplinary cooperation, transformation of social values, and balance of various stakeholders[5].Generally speaking, the coping and development strategies of these cities mainly focus on strengthening coastal protection, improving flood control standards of buildings, strictly restricting land development, optimizing urban facilities construction and storm water management, etc., which provide important guidance for the effective utilization and development of urban coastal space in the future.In order to cope with the natural disaster risk caused by climate change and rising sea level, many important coastal cities abroad have not only put forward corresponding measures in the overall development of urban planning, but also formed differentiated application strategies in urban landscape construction.However, this strategy has different characteristics in expression form and connotation, including four aspects of coastal land use, defense infrastructure construction, dynamic process of Marine natural environment and application of urban landscape technology.Therefore, this paper selects the Elastic planning and Design project of Manhattan Island in New York as a case study to explore how the Island of Manhattan, New York, with the support of the US national government, can cope with the adverse effects of climate change through the "elastic planning and design Project".

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2. A Case Study of the Flexible Planning and Design of Manhattan Island, New York

The Manhattan Island Resilience Design Project, New York, was the winning entry in a competition to rebuild Manhattan from the Hurricane Sandy Recovery Team and the U.S. Department of Housing and Urban Development.The competition aims to improve the structural and environmental vulnerability of areas affected by Hurricane Sandy, and to design a resilient solution to protect local communities from hurricane flooding and heavy rain.Danish firm BIG took THE top prize with "THE BIG U", a flexible planning and design project in Lower Manhattan (Figure 1).THE BIG U project is located in Manhattan, New York, and is designed to stretch from 54th Street in THE west to 40th Street in THE east and battery Park in THE south.Design team in the area designed a low potential over 16 km long green space, forming a huge "U" shape, flexible planning and design make the city itself has ability to respond to hurricane damage, and to promote the social and environmental benefits of the local community, for the vulnerability of the affected area to increase a high density, dynamic, the bearing capacity of flexible protection system.The project is made up of multiple interconnected design elements that provide each local community with its own set of functions and defense mechanisms for different time scales and investment scales. This not only reduces the threat of storms and floods caused by hurricanes, but also improves the regional ecological environment, enhances community functions, infrastructure and cultural activities, and increases social benefits.

Figure 1. Elastic planning and design project of Manhattan Island, New York
source of the picture: New York City Government website

The Manhattan Island Resilient Planning and Design Project was conceived as a transformative resilient blueprint for effective community and economy maintenance, responsive attention and interaction to the livelihood of the community, and incredible vitality of the fragile high-density low-lying belt.Not only does it protect against floods, but it also improves the public realm and improves social and environmental benefits. A flood barrier is no longer a wall between the city and the water, but a series of different but connected pearls for each community.2016 ALSA Analysis and Planning Honorable Mention Award Evaluation committee; "Using natural processes to deal with the problems posed by natural processes is straightforward and admirable." Therefore, this study summarizes four main strategies of Manhattan Island in New York to deal with the climate change crisis through the understanding of the project.

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2.1 Defense Infrastructure based on Hard Foundation

Hard foundation defense facilities are mainly constructed by artificial hard engineering, usually including shore protection seawall, breakwater, groin and flood gate.The hard-base defense of Manhattan Island in New York City will further enrich the waterfront, create habitat, and strengthen its connection to the elevated community.The landscape design team came up with a series of innovative measures, including a seagrass berm that can serve as an ecological habitat, a bank that doubles as a skate park and amphitheater, and a breakwater that can provide space for a temporary cafe and static leisure activities.The continuous levee space forms a series of "compartments" that keep the floodwater out and protect the scattered low-lying flood areas within, acting as a shield to protect New York's prosperity from the threat of climate change.Under the Roosevelt Expressway, for example, retractable flood defences, along with low walls and berms, form a multi-layered flood protection system that protects the surrounding neighborhood and critical infrastructure. Along the shore, a curved bench stretches from the Manhattan Bridge to the Brooklyn Bridge, four feet high enough to withstand minor flooding events, while a pull-down barrage is strong enough to withstand tidal waves and storm surges.

Although hard landscape defense is an important defense method adopted by many coastal cities, it also has risks and has potential destructive effects on coastal ecological environment.These projects may increase erosion, alter sediment accumulation and affect coastal habitats. At the same time, the change of Marine physical environment and biological system will also cause damage to artificial hard engineering facilities, thus reducing their defense effect and function.With the continuous expansion of coastal space in coastal cities, the contradiction between protection and development is often complex and diverse. Therefore, multi-functional comprehensive defense infrastructure has attracted more and more people's attention.

2.2 Defense Facilities based on Soft Foundations

Different from hard infrastructure defense facilities, soft infrastructure defense facilities are mainly based on the construction of natural systems in coastal zones, including plant landscapes, sand dunes, mangroves, salt marshes and coral reefs.Defense systems built from these natural systems are less costly, have less adverse environmental impact, and may provide equal or superior defense capabilities than man-made rigid engineering facilities.The concept of soft defense infrastructure is a kind of natural protection system built by utilizing natural environment conditions without destroying the original ecological environment of the coast.

In the Highland regions of Manhattan island, New York, landscape architects enhance the spatial experience of the city's streets with ecological wetlands and rain gardens, and guide people to the entrance of the park through green corridors.Green corridors extending from the waterfront to the highlands and ecological wetlands and rain gardens in the social housing open Spaces will promote local biodiversity, improve local water quality, minimize pipe overflows directly into the East River and mitigate the urban heat island effect.

2.3 Zoning Design According to Local Conditions

The whole elastic planning project implements overall planning and step-by-step implementation. The zoning design endows the whole project with more flexibility. Each area can increase specific facilities and capital investment according to the actual situation, while ensuring that the operation of the overall protection system is not affected by local areas.The BIG U project breaks up the 10-mile-long site into different flood zones, like a ship's compartments.The zoning design gives the project flexibility, even if one of the subdivisions is flooded, it will not affect the operation of the entire system. The protective measures, functions and leisure facilities within each area are defined according to the needs and characteristics of the coastal blocks it protects.The design opportunities for multiple connections are now focused on resilient design, which in the longer term will be built as a social infrastructure. The addition of social and economic services has resulted in a more robust ecological habitat, enhanced waterfront accessibility, and the creation of new recreational venues. As

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a result, BIG U is more than just a flood control facility. The zoned design demonstrates a series of adaptive strategies that can be applied to projects at different scales.

2.4 Public Participation Revitalizes the Space

The planning and design of New York's Resilient Planning program requires close collaboration with community groups. The three zones cover three urban communities, two waterfront areas, a ferry terminal, social housing, a motorway, multiple underground infrastructure networks and miles of waterfront corridors.To balance these overlapping interests, the design team spent 16 weeks visiting more than 100 organizations, including city, state and federal agencies, elected officials, and planning commissions. In addition, more than 150 residents of the project area participated in design workshops, guided by landscape architects, to map their visions by hand.The move to include protective measures in the open Spaces of social housing meant the design team had to confront a long-standing debate among residents, developers and the government.Through timely and frequent communication with community members and government officials, open discussions with stakeholders on financial constraints and project choices, and listening to and paying attention to residents' voices in design and functional planning, the final proposal submitted by the team won the support and support of various social groups.Climate change is a complex issue, and in addition to actions taken by governments themselves, mitigating the effects of climate change also requires the participation of the public[6].Guided by landscape architects, participants in the public Engagement program use common design tools such as models, maps and THREE-DIMENSIONAL analysis diagrams to define local socio-economic goals, express their design and functional preferences, and customize landscape interventions for their communities to improve spatial quality.

Together with world-renowned architects and engineers, the landscape design team expands these multidimensional design concepts into sustainable designs that provide leisure and entertainment. Not only can the city recover the potential economic losses caused by climate disasters, but also create new economic, tourism, social service opportunities and leisure and entertainment space, and promote the sustainable development of the city.New commercial space under the Roosevelt Expressway, for example, will create new retail space and potential business opportunities. Community-led functional planning helps stabilize the community for the benefit of local residents. Local nonprofits involved in BIG U programs have opportunities to collaborate with communities on education, job training, and landscape management.Community gardens and market Spaces in the protected structure will make it easier to provide healthy food in these underserved areas. In Manhattan's Battery Park, extended elevations will keep floodwaters out of the financial district, while transformed bike paths, new cultural landmarks and thematic gardens will enhance the spatial experience of this iconic open space.

3. Conclusions and Recommendations

In recent years, many foreign coastal cities have done a lot of valuable exploration in the practice and research of coping strategies, mainly including coastal land utilization, defense infrastructure construction, natural dynamic process and application of landscape technology.Through comparative analysis, it can be found that these coping strategies have different advantages and disadvantages and suitable preconditions. Therefore, the planning and design of different urban coastal landscapes need to comprehensively consider and evaluate the existing conditions and objectives, and then reasonably learn from the existing excellent international experience, so as to improve the ability of urban coastal to cope with the risk of future sea level rise.

The toolbox of community planning resilience strategy and highland planning resilience strategy will guide New York City to improve its resilience at all levels. These "toolboxes" are the key to replicability in the BIG U solution.This project is not only a response to the lower East Side and midtown of Manhattan, but also a flexible solution and design strategy that can be promoted globally.Due to the dependence of cultural path and the restriction of land use, it is difficult to greatly increase the area of green space in Macao's urban construction. However, the overall ecosystem

service level of the city can be improved by improving the quality of green space and the structure of green space network[7].In addition, as one of the regions with the largest population density in the world, Macao's ecological environment pressure is gradually increasing with the development of the city and economy, and people's demand for ecosystem services provided by urban green infrastructure is also increasing[8].Since Macao and Manhattan Island of New York are both high-density coastal developed cities with similar topography, based on the existing experience and achievements of the elastic planning project of Manhattan Island of New York at the present stage, this study puts forward the following suggestions for the future landscape construction of Macao to cope with the climate change crisis.

3.1 Accelerate the Formulation of Urban Landscape Adaptation Strategy

First of all, strategies for Macao to cope with future climate change risks should be formulated as soon as possible, and a comprehensive framework should be formed to integrate it into the overall landscape planning and management of the city. Second, encourage and support Macao to carry out climate change landscape planning and design action plan, and establish design and prevention standards and requirements for urban public space, key landscape infrastructure and buildings.

3.2 Explore the New Technology and Method of Landscape Engineering

Actively improve and innovate the traditional landscape technology means, explore and develop new landscape construction technology and methods to adapt to the future constantly changing coastal environment.On the one hand, new coastal landscape elasticity can be enhanced through scientific research, engineering and technological innovation, such as floating structure and utilization of Marine life. On the other hand, by optimizing the coastal landscape structure and fully combining the natural dynamic change process of the coast, a multi-functional composite model of protection, recreation and residence can be created.

3.3 Strengthening Urban Landscape Risk Assessment and Monitoring

In the context of the era of big data, a comprehensive urban risk assessment and monitoring database can be built by strengthening multi-department cooperation and integrating meteorological, land and hydrological data of different departments.Using computer simulation platform and related data, the disaster risk assessment of sea level rise and storm surge in Macao landscape system was carried out. Regular monitoring of changes and impacts of coastal ecological environment can further provide reference and basis for rational use of coastal space resources.

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