

ECOLOGICAL COMPENSATION IN URBAN DESIGN OF COASTAL LOWLAND CITY: LINCHENG NEW TOWN

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ABSTRACT: The ecological problem of living environment should be explored to the city extension. Urban design is working at control on the physical form and environments of a town and managing its multi systems. Accordingly, it is with great necessity to emphasize the operation of ecological compensation through out the whole process of urban design. It is especially demanded in the coastal lowland cities in China, which are developing most quickly and breaking the balance of nature most seriously. This paper tries to study four dominating factors (landscape, water system, green space, buildings) of ecological control and compensation in urban design through a serious of urban design projects in Lincheng New Town with consideration of the ecological character of coastal cities.

Keywords: Urban design, ecological compensation, costal lowland cities, dominating factors

INTRODUCTION

The ecological view put forward of McHarg in "Design With Nature" (McHarg, 1969) is operated from a strategically advantageous position. He suggested that we should consider the ecological problem about urban environment to a big range, regarding it as a relatively intact ecosystem. The ecological tactics will be more effective when this range extending. In research about ecology in the past, the architect's sight concentrated on lying in building oneself more, fond of the discussion of the technology of the building and materials, with less ecological thinking carried on from the urban angle. So has caused certain ecological disruption in the urbanization process, such out-of-balance ecology of urban range will need quite a long time and a large amount of manpower and materials to recover balance again.

It is particularly outstanding to rapidly developing coastal cities of China that can be called costal lowland cities. Lowlands were defined as lands affected by fluctuating water levels and where human activity exists already or is being proposed (IALT, 1998). In these cities people's behavior and its features of the settlement have already been linked to these ecological features tightly. But the fast urbanization process will break the already existing independent balance system and the ecological problem in the city is aggravated constantly. So in the course of fast urbanization, how to proceed

from urban angle and coordinate the dynamic relation that the artificial construction activity and gentle pulse of the natural environment pass on effectively, reach the new balance in the ecological meaning, has already become a practical problem urgently to be solved.

As one of the city construction disciplines, the modern urban design is derived from the objective demand for solving the urban environmental quality problem after the industrial revolution. Since the seventies urban design begins to consider much more dependence with the natural environment according to the global environmental changes. Lots of scholars and experts are exploring the urban design of new generation, which is on the basis of the whole and having priority on the environment.

Their monographs have played an important push role to the transitions of the value orientation of the urban design and concept. For examples, they are "Design With Nature" (McHarg, 1969) and "City Form and Natural Process" (Hough, 1984).

Among the above treatise author, the most famous one should belong to Professor McHarg of American Pennsylvania State University. In his book "Design With Nature" (McHarg, 1969), he has proposed the thought of ecological planning from the angle of combination of manmade space with natural environment. He thinks the creation of the urban space must utilize natural environment " naturally ", the adverse effect on the natural environment will be reduced to minimum extent,

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and he puts forward a series of concrete design principles and methods for this. His planning method has a very deep analysis on vertical ecological course. The "Map superposed method" among them has exerted a far-reaching influence on later age.

In addition, professor M Hough of York University of Canada wrote "City Form and Natural Process " in 1984. It described the relationship of the natural gradual progress course of the city and the urban design especially. He suggested we must make a self-criticism on the foundation of the urban form structure at present. It is very important to explore the inherent quality and characteristic of our daily living space from the ecological viewpoint. At first, the urban environment is an essential object of the urban design, but ignored by people for a long time. This unknown natural process takes place around us, provides another choice on the form foundation of the cityscape for us. Secondly, the question in the cityscape of the macroscopic stems from the city must be solved by the city. So our task is to form a global concept of city and natural. (Hough, 1984)

Over the past more than ten years, Chinese academia has carried on unprecedented different angles and levels discussion to the sustainable development problem of the urban construction, made a batch of academy achievements. In these achievements, there is a relative general but outstanding signs. That is gradual setting-up by the architects and city planners of understanding the relativity about the job of oneself and ecological key elements. (Wang, 2002)

Wang (1997) put forward the concept of "Green urban design ". He pointed out "Green urban design " involves environmental quality and ecological problem extensively on the whole. He divided the target and geographical range of "Green urban design " into three levels, namely the Area - City grade, Subarea grade and Sector Area grade. On the Area - City grade we should understand the natural course of the city from essence at first in green urban design and do a good job of the ecological investigation. The city constructors should fully utilize specific natural resources and conditions, make the manmade system and natural system coordinate harmoniously, and form a scientific, rational, healthy and perfect urban pattern. We should pay attention to protecting the natural landscape, natural pattern, species variety and the changes of cityscape caused by this in great engineering construction of the city. And we should create a consistent and effective natural open green spaces system; On the Subarea grade, the content of green urban design mainly concentrates on two respects: The complex ecological problem of transformation and upgrading of the old cities, link up with the principles established by City grade urban

design for the whole environment. The Sector Area grade urban design is implemented to mainly the concrete buildings and environmental construction projects of smaller range. It mainly depends on the understanding and conscientious to the green idea of urban design of architects. (Wang, 1997)

Han (1999) put forward four principles that green urban design and architectural design should be followed: Respect to nature, giving priority to the whole, intensification and localization. On this basis he analyzed six difficult points on carrying out the green design philosophy in the urban construction practice: Obscurity knowing, contradiction between part operation and wholly realization, question of interests drive, question of setting up appraising system, the theory construction disconnecting with real operation, contradictions between ideality and the job interests. (Han, 1999)

Cai (1999) analyzed and researched ecological theory, ecological environment, bionic structure and natural material and aesthetic interest of Chinese local-style dwelling houses. He pointed out that the Chinese local-style dwelling houses are full of ecological spirit under the influence of philosophic theory of the harmony between man and nature. It is represented from the location, total arrangement, internal and external environment design, furnishings and even materials and building technology. They demonstrate its leading and modern ecological idea in many aspects. (Cai, 1999)

Liu (2000) compound with city ecosystem theory as foundation, carried on the research of ecological design method for urban settlements environment and put forward 9 ecological factors: (1) Green space system; (2) Water source system; (3) Process system of offal; (4) Energy sources system; (5) Architectural space environment; (6) Traffic system; (7) Environmental administrative system of living area; (8) Single building layout strategy; (9) Cultural characteristic expressing. (Liu et al. 2001)

Yu (2001) put forward the ecological design idea in the field of landscape planning and design. Regarding ecology design principle which Sim van der Ryn and Cowan. Stuart (1966) put forward as the frame, the human ecosystem designing and recycled design principle that John Lyle put forward, the principle of sustainable landscape and visual ecology and ecological city principle that Robert Thayer put forward, Yu systematically explained the basic ecological principle of landscape and urban design. (Yu et al. 2001)

Urban design is working at control on the physical form and environments of a town and managing its multi systems. Accordingly, its ecological function to the whole city environment is quite important. This function

could be ecological compensation of urban design. This is manifested in two woven environmental aspects: one is to compensate the lost of nature in artificial construction, while the other is to inspire the nature to actively response to the new urban environment. The compensation strategy emphasizes two points: the original ecological system of the city that guarantees the uniqueness, and the city development context that guarantees the feasibility and constant. The concrete process is to make the corresponding compensation tactics and dominating factors with analysis of ecology and urban construction characteristic of the city. During the process phased adjustment should be made based on the changing of the two characteristics to reach the real function of compensation. This kind of change-adjust process is common to urban design.

Because of the above understanding, we have put forward the ecological compensation principle of the urban design to the ecological features of the costal lowland of Lincheng New Town, Zhoushan. And has done long-term research and construction experiment to its principles. Through it we have accumulated more abundant experience and lessons for the ecological design of the lowland coastal cities. This paper will take these five projects as an example as follows to discuss about the ecological compensation principles in the urban design of costal lowland cities (Table 1).

ANALYSIS

Analysis of Two Case Studies of Coastal Cities in China

Urban design for east coastal area of Xiamen city

Table 1 Five serial urban design projects of Lincheng New Town

1	2000	The conceptual design of the city administrative center and citizen cultural square of the center zone in the Lincheng new town (Center Zone project)
2	2001	Research on the governing urban design of the overall city formation in the Lincheng new town (Governing project)
3	2002	The urban design for the commercial and business center of Lincheng new town (CBC project)
4	2003	The urban design of coastal esplanade in southern section of Lincheng new town (Costal Esplanade project)
5	2004	The urban design of citizen cultural square (CCS project)

East coastal area of Xiamen city is a hot area for tourism development. One of the obvious environmental characteristics is the natural forestation. So the strategy is protecting the natural sources when it is developed as scenery travels sources. Based on the analysis of natural geographical environment and existing planning condition the developers put forward two planning principles- Protect the ecological integrality and consolidate the connection between people and nature which is considered in Lincheng project too.

The advantage of this project is the control on the environment to the city extension. Division of the land is used to balance the urban system and natural system. Land use is optimized for scenery travels to weaken the destroying by other functions to the ecological environment. Another valued part is analysis on the connection between people and nature. This kind of connection between urbanism and ecological behavior behave as:

1. Educate citizens that "natural" might not be "beautiful"
2. Make compromise with nature; use miner resources to create more social, economic and environmental benefit.
3. Strive for the ecological diversification
4. Understand the connection between the whole natural environment and the individuals
5. Understand the odder of nature in daily life
6. Discuss the good influences of urbanism behavior on ecological system
7. Visualize the confliction between urbanism behavior and ecological system

The emphasis of this project is city plan not urban design. There are no concrete ecological principles. So "ecology" would just be a word in the developing documents. That is the reason for ecological compensation of urban design in Lincheng project.

Urban design for Shatoujiao coastal district of Shenzhen city

This district will be the political, cultural and commercial center of Yantian borough of Shenzhen in the future. The environmental characteristic is the natural resources (face to the sea and back on the hills) and the humane resources (adjacent to the boundary street).

The developing principle as "small city-big environment" was made. The key words are "ecology, history, intergrowth and restricts". Intergrowth of city and nature, intergrowth of history and creations means to form a kind of pleasant urban structure in which the surround hills and sea are introduced to the artificial urban area naturally.

What deserves to be mentioned is that this project has emphasized the concept of "restricts" and issued the "Detailed blue print of Shatoujiao coastal district". Which is considered as the formal management files of construction and guide principles for every development and construction in the district. It has guaranteed that the interests of the city are maximized, has defined the government with each develops unit's right and obligation. It has also guaranteed the smooth implementation of the urban design.

Ecological Characteristics of Linceng New Town

Zhoushan City is the only island city in China, including thousands of islands within its boundary. The ecological features of the coastal city are very obvious. In order to mitigate the contradiction between development and conservation in March 2000, Zhoushan City government made a strategic decision that the Linceng region 8km away from the old town-Dinghai was determined as the political, economical, cultural, and educational center for the future. After a series of legal technical program of overall plan and zone plan for

the new town development was formulated, committed by the Urban and Rural Construction Committee of Zhoushan City, we were enrolled in the urban design.

Linceng New Town sits between the two traditional boroughs of Zhoushan- Dinghai and Putuo (Fig. 1), face to the sea to the south and back on the mountains to the north. It will be the political, cultural and educational center of Zhoushan in the future. The total area is about 19km² with future population of 65000 in 2005 and 145000 in 2020. The land use structure is: industrial land 10~15%, residential land 20~25%, public facilities 15~20%, green space 15~20%, roads and squares 15~20%. The town is featured with strong sunshine and clear four seasons, windy and foggy in a typical Semi-tropical Oceanic Monsoon climate. This region has abundant species, is the important habitat of island birds and important post for transient to migrate. Originally, flat cultivated lands cover the site, and the height levels between the land, road, and sea-embankment vary greatly. Linceng is a classic lowland coastal city with clear ecological character (Fig. 2).

Four Dominating Factors

During the 5 years urban designing of Linceng which most challenge us is how to well manage the landscape and ecological system in a background of destroy and building. From the practical perspective, we summed up four dominating factors in the design to balance the costal ecological environment and human construction, through a way of weaving natural and artificial procession and structuring the transformation of space mode. They are: Levels, Water System, Green Space and Buildings.

1. Levels is the most essential aspect, not only for the existence of the sea wall making all costal cities face the question of discrepancy in elevation between the sea level and land level, but also for its artificial modification is the most difficult to repair.

2. Water system can be derived into two sub-sectors: Inland water system and marine water system. Water system is important for adjusting climate and flooding, and preserving the diversity of bio-species. We hope that by regulating the water system and establishing the rainwater drainage system, the construction activities will be less negative for the water system.

3. The construction of green space has two aspects: on the one hand, the original plants should be well kept and the destroyed botanic environment should be repaired with the maximum efforts; On the other hand, the new green spaces should be rebuilt to fit to the developing of the city.

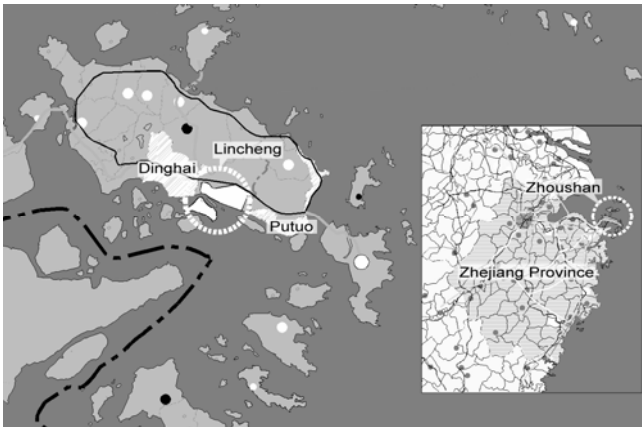


Fig. 1 Position of Linceng New Town

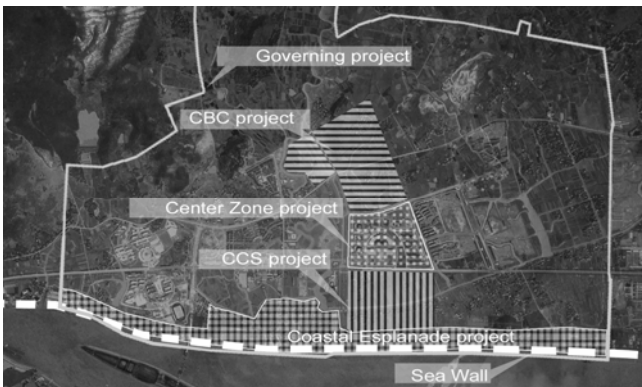


Fig. 2 Linceng New Town under construction



Fig. 3 Sea wall

4. Buildings, as a kind of artificial construction, are ecologically negative to the ecological environment. We hope to fade the destruction to the original ecological environment to the minimum extent through urban treatment to the building colony and single buildings.

Levels

Same with all other coastal lowland cities, the south edge of Lincheng new town is formed with sea wall at a high level of 3.14m, while the inner lands are flat with an average height of 1.5m (Fig 3). It is regulated that the height of roads and building ground should not lower than that of the sea walls. However, if the whole site is filled with earth to reach the 3.14m levels, not only the earthwork would be enormous but also the existing land context would receive little respect. Regarding this problem, planners tried to take three solutions at corresponding levels in the “Center Zone project” (Fig 4).

1. Taking the site as a whole, most land is well kept at the existing height.

The existing land has been reshaped for many times in history for cultivating, resulting in that most land is flat. This sort of character is preserved in most area, such as the proposing lawn and woodland, so that the fertile earth is still used. Along the both sides of the Sea Culture Square, on the other hand, the land is re-shaped in according to the orders of nature, such as rain, on surface track water, loads, and underground water level. The new landscape will be sculpted via filling and piling earth to form a new eco-edge. The essential method to keep the sloping configuration is to control the on surface track water from rain, by applying measures like building water capture channel, sluice pool, barrel-drain and other drainage systems on slope to regulate the

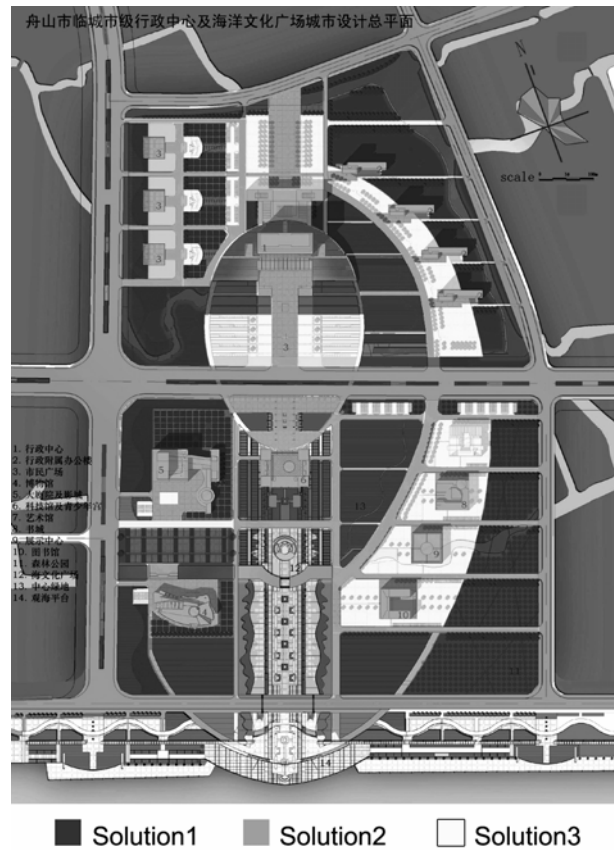


Fig. 4 Three levels solutions in Center Zone project

streams. It is also true that these drainage facilities will hold a certain amount of fresh water, which will benefit the irrigation in dry seasons for a town that is seriously lack of water as a coastal lowland city.

2. At the transportation and functional level, the roads and building ground are raised to 3.14m to ensure the connection to exterior road system.

Pipes and lines are laid under the main roads and building grounds. These piled structures lie across the plain and result in a well-ordered corridor system, which works with the barrier of filled earth to avoid losing deposits. Planting belts at a certain width are laid on both sides of the road for protection.

3. On the secondary transportation and functional level, the roads and landscape platforms are built on stilts to maintain the original eco-flow.

Furthermore, there will be a rich variation at different levels of height between the artificial platform and natural land, which will result into a serious of squares, steps, pavements, and platforms, and therefore various spaces to accommodate different activities from moving to stop. In this way, all of the places will be provided with ‘boundary effects’.

The treatment of the above-mentioned three levels has been adopted by the government and deepened in the

architectural design of the administrative center, having made certain success, these principles have been continued and deepened in the other urban design objects.

In “Governing project”, it was emphasized that the city form should respond the physical setting of Lincheng. It is proposed that the new urban form draw its inspiration from the natural setting, which is characteristic of “mountain higher in the north and sea lower in the south”. At the same time the planners utilize this kind of discrepancy in elevation, regard mountain around the city as the beautiful vision background, and through the control on axis of urban shape north and south, form the visual corridor, which link the ecological landscape communications of the sea and the mountain.

The levels principle has got the deep discussion with many angles in "Costal Esplanade project". The whole esplanade area extends the full length of the new city’s proposed interface with the seafront, a distance of approximately 4.5 km, and the esplanade zone is about 200 meters wide for most of its length. In this project the planners need to meet the complicated function requirements of nine great dividing areas and the levels transition of sea- sea wall- wetland- manmade levels (Fig 5). In the process of urban design it was realized that the sea wall that cause the ecological obstacle is the key itself to solve the problem. So the best way of ecological compensation is to strengthen or weaken the change of

levels according to different function demands.

So on one hand the planners raised some function units scattered in point or line shapes over the sea wall to solve the problem that the sight and the ecology flow is stopped. On the other hand the planners transited the levels by steps in the sea-city direction, make it get organic conversion in function application. At the same time the planners kept most wetlands with proper adjustments, make the ocean and inland ecosystem get the abundant transition (Fig 6).

Water System

Inland water system

The existing inland water environment of Lincheng is very pleasant, river twists, the bank slope vegetation changes abundantly, the belt highland drains off water well. At the same time Lincheng is short of water seriously. Because of island specific physical geography and climatic conditions, the rainwater is mostly available in the rainy season, which is primarily brought by storms. The statistics show, 70% of the rivers flow is the earth surface water, limited parts are collected by the reservoir and most of the water goes to sea. On the other hand, the urbanization will make less water stored by earth surface or penetrate to underground level, which means the amount of rainwater that becomes on surface water will increase. Secondly, as the city plan emphasizing order sense will superpose the artificial net on the natural earth's surface, the conflict between artificial order and natural topographies is unavoidable. So it must be followed by two following principles when carry on the transformation to the inland water system:

1. Guarantee the abundant use of the water body;
2. Preserve and re-frame the existing watercourses, make it reflect the intention of city planning and design better on the basis of keeping original water environment features, fully reflect the ecological image of the city.

Use of the water body is shown in the two aspects as deposit amount of water and water systemic circulation. The former is realized by the ways to, expand water body area, increase artificial underground water storage equipment. The latter put emphasis on choosing of the circulatory system of corresponding water considering the features of terrain. The aforesaid jobs are accomplished with thinking of original water body features and overall plan. It is shown in reshaping the water system and refiguring the riverside, which is the embodiment of the principle two.

In “Center Zone project”, firstly the planners reshaped the river and designed a piece of wide water surface with slow flowing integrated in regular grids to respond the needed atmosphere of grandeur. At the same

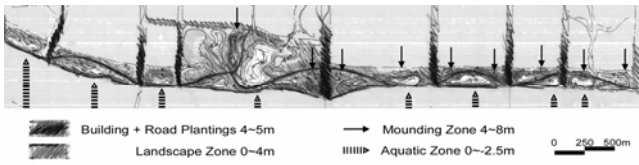


Fig. 5 Coastal Landscape-Earth Modeling Theme Plan

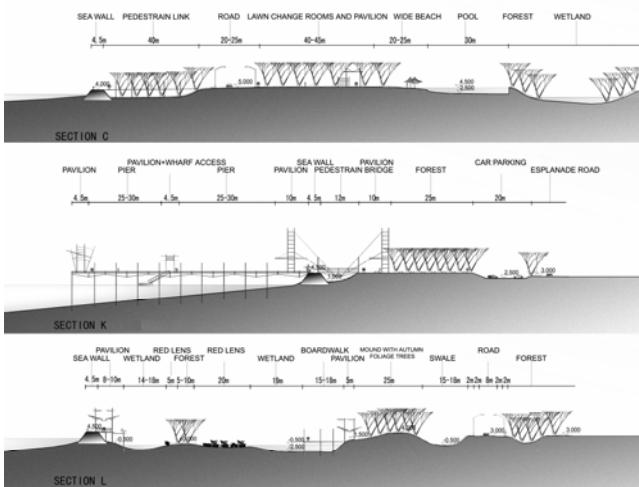


Fig. 6 Coastal Landscape-Section

time the water body was enliven border by variety of means in the design such as natural bank, platform built on stilts, regular boundary and terraced bank. It increase the ability of releasing floodwater when enlarge the area of the water body. In addition, permeable paving materials are applied for ground construction so that rainwater could penetrate the earth to protect the everglade eco-system. In design of governing center project, the planners utilize the grass slope of oblique roof of large area and pond on former square, through such equipment as the appendices, sedimentation, water tank and pump, etc., finish a whole set of water operation scheme of circulatory system while forming urban land mark background and official business center atmosphere. This is a kind of try to that the urban rainwater system carried on ecological compensation of urban design (Fig 7).

In “Governing project”, there was a deeper discussion on the use of the water system of residential area. The planners put forward the methods that make the water bodies connected to the main city drainage system into the pattern of the neighborhood where the hydraulic conditions permit. This imagination happens to coincide with planning ways of the traditional village of local-style dwelling houses, has reflected ecological compensation and agreeing with of the traditional living modality.

Marine water system

The coastline of Lincheng is 7.8km long, accounts for more than 1/3 of the girth of urban area. The city form presents linear expansion along the coastline. This has brought urban design more chances and challenges in marine ecological technology and landscape. On technology the planners must face a series of ecological problems brought of the linking up of the city and ocean, among them construction of the seawall and the organized draining off of water from the city are the most influential; on landscape the planners must solve



Fig. 7 Reshape of Rivers

the problems brought of the resource overexploitation. In fact Lincheng lies along the sea area of East China Sea, the sea water is comparatively muddy when major of the coastline are mud flat. So the ecotype-developing mode specializing in protecting is the main idea. In “Costal Esplanade project” the following compensation tactics have been put forward:

Protect the marine organisms in the sea area. Build recreation esplanade on one side of the sea wall and the pavilion connected with it as the platform for communicating between human being and the sea.

Protect the species variety of the mud flat, limit a large number of artificial facilities, and only offer the space for observing.

Keep the original interface linking up inland and marine water system- the wetland. Enrich the linking form between the city, inland water system and marine water system through the creation of a major waterfront city park with an integrated formal and informal landscape and waterway theme.

Keep the existing outlet positions for waterways and enhance it as the control points for waterways. On this basis reuse the storm water as the landscape resource through the enhancement of the open drainage system behind the seawall. Certainly must renovate the river before this, include passive water arrangement, enacting of upstream water polishing and nutrient stripping technology (Fig 8).

Green Space

Protecting

Lincheng faces the sea in the south and is surrounded

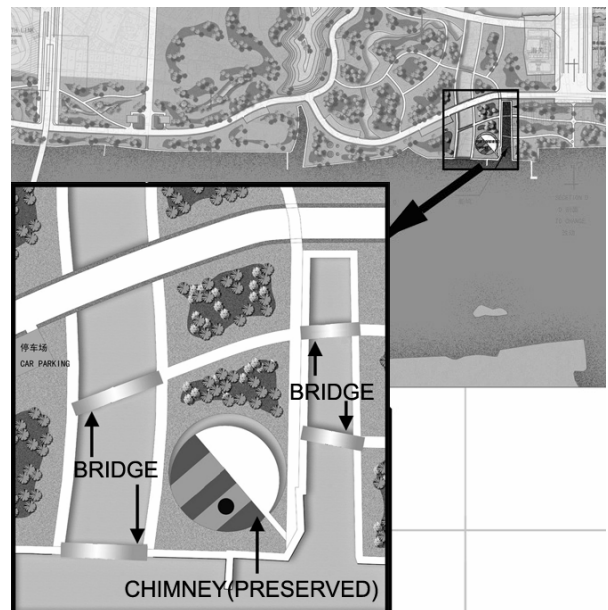


Fig. 8 Outlet Node of Rivers

by the hills in the north. As an important habitat for sea birds and principle station for migratory birds, the green spaces of the city have obvious local features. However, a large amount of original vegetation is being destroyed because of the city's development. The green land is occupied by buildings and other urban facilities on one hand and is cultivated and used as the farmland or the cultivation base on the other hand. It is losing the original ecologic features and ecologic images brought, resulting that urban green space are scarce and stereotyped.

So the planners put forward the measures in the

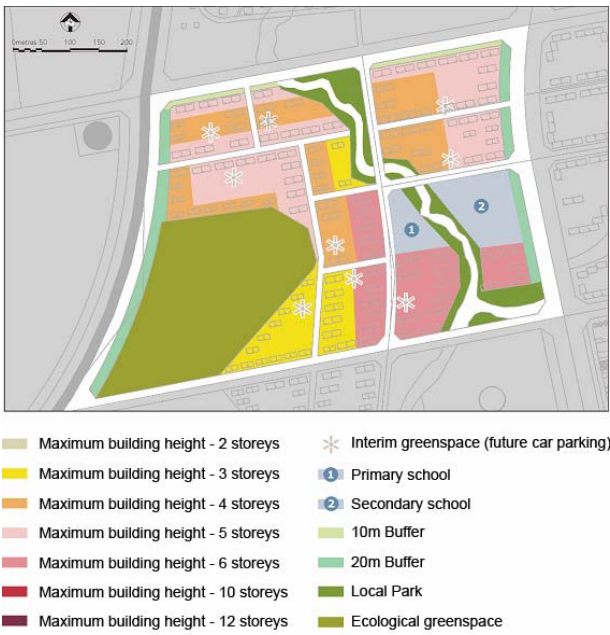


Fig. 9 Precinct Development Control Plan

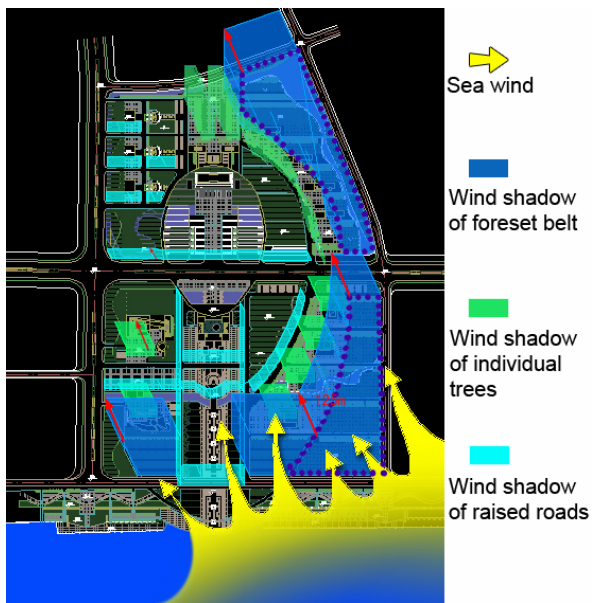


Fig. 10 Wind shadow

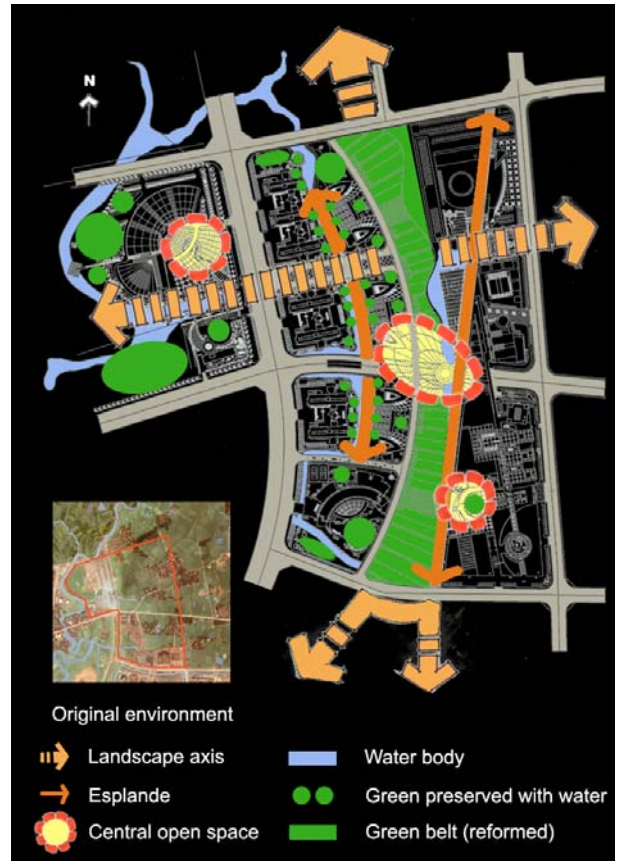


Fig. 11 Green belt of CBC



Fig. 12 Green open space of Cultural Square

“environmental principles” in “Governing project” as follows: (Fig 9)

Protect and enhance the ecologically important environments of the plan and integrate local ecological features into the design of the public green space, waterways and city.

Integrate local and native plant species into landscape design to promote an ecological image for the city.

Redesigning of the waterways should not impact upon the ecological areas of the plan and should only be undertaken to enhance the environment and scenery for the city.

The design of the public green space fronting the waterfront should incorporate a range of ecological design principles to maximize biodiversity, local image, and create a number of scenic themes along the entirety of the waterfront.

Rebuilding

It must be considered as the opportunity that the urbanization courses bring while trying one's best to protect original ecological features. When the original cores of the ecosystem are changing, the new ones are growing. It means that a number of green spaces will be rebuilt to fit for the development of the entire region.

Lincheng is a windy town resulted from its seaside location and semi-tropical oceanic monsoon climate. This is negative as a whole, and the windbreak forest is therefore essential for protection. In the east of the “center zone”, there designed a forest belt, which works with individual trees on all kinds of platforms that are regularly planted to protect human activities. The windbreak forest form a new type of green space, have added beautiful scenery for the city while carrying on ecological compensation (Fig 10).

Open space system bears important responsibility in the ecological compensation in the city. So it was emphasized that the open space system should be based on main ecological green space and incorporate various kinds of local ecological elements in the green recreation area to form an intact continuous system together in “Governing project”. The concrete measures including:

Include continuous pedestrian links through major ecological green space elements, to provide the structure for a connected open space system that extends throughout the city.

Design local green space elements to connect with the main city green space system wherever possible.

Connect the green areas of sites of major cultural and institutional facilities to the city open space system, to allow users to access the green space system conveniently.

The grass slope of oblique roof of the annex of administrative center is one example. It offers the large-scale green space for this area while solving the large-scale-space gathering problem. In “CBC project” an enormous continuous central green belt extend the ecological axis through which the highly suitable public open space image is created in the commercial and business center (Fig 11).

Buildings

At the beginning stage of the urban design, it was realized that the way to improve the relationship between buildings and ecological environments is not only to take certain measure to the single building, but should consider the ecological compensation of the building colony before this. And this is easy to neglect in the course of urban construction. So the ecological compensation for buildings was divided into two design steps: The building colony and single building, the former becomes the main target for study.

Building colony

In Lincheng the northwester prevails in winter, the attack with the typhoon at the same time of southeaster prevails in summer. Because the wind is an ecological factor that should pay great attention, so how to control wind direction and wind speed and utilize it rationally, how to build pleasant wind environment must to be considered to ecologic design. Such multiple research as wind speed gradient, etc. make us define the impact on wind direction and wind speed of different buildings, these impact can be realized through controlling the distribution of different kinds of building colony.

Open green land in the city (Including water body) is the most direct function element of ecological compensation. So the planners reserve the corresponding open spaces to ensure these elements to exist and have good influence on the city in the overall arrangement of the building colony. In “Governing project”, the planners put forward the measure that any housing area of more than one hectare should include at least one communal landscaped open space area that is convenient to the whole area and which is not less than 1200m² in area and with a minimum dimension of 30m. In addition it is emphasized that in large-scale public areas a suitable ecologic image should be created through the integration of substantial areas of public green space. This principle has got very good continuity among " Cultural Square " design of this principle in process (Fig 12).

The space overall arrangements of the building colony must make great efforts to promote the exchanges of people and natural ecosystem. So it was emphasized

in “Governing project” that the architectural scale would not higher than the surrounded hills except in the center precinct to ensure good view corridor. And the retreat behind certain building was limited one by one. It was also emphasized that central open space areas located within residential sites must be connected directly with all public domain frontages that adjoin the site, including roads, pedestrian paths and public open space. In “Costal Esplanade project” a series of tiny recreation buildings are scattered through the whole esplanade area. These open nodes have strengthened the connection between the urban road and sea wall further, lead people to be close to the marine ecosystem more.

Single building

According to the characteristic of the natural ecosystem of Lincheng, the planners have put forward the following measures of ecological compensation in terms of urban design that need to be considered for the single buildings, which are proved to be feasible and useful in construction practice:

Consider of guide of the high buildings to the wind, create through-site ventilation between buildings on development allotments but must pay attention to the adverse effect which strong wind causes, especially the cold wind in winter and typhoon of summer, align buildings and private open spaces to take advantage of prevailing breezes; Separate the placement of buildings on development sites to minimize shadows casts all units and especially to ground floor units and private courtyard areas, built form and placement of openings are to be oriented so the facilitate solar entry through windows or openings during winter; Fully utilize the base characteristic to melt the concept of ecological compensation while conceiving designing, but not only take certain measure technically at the end of designing process.

Due to the large numbers of meeting and exhibition spaces, the Administration Center is unavoidably a massive volume construction and will be an enormous destruction on the original ecological environment. Through the urban design an enormous grass slope was built as the control node of the urban form and arrange these function spaces under the green giant roof. At the same time it has its ecological meanings. Firstly, by placing the parking space under the ‘lawn roof’, more spaces will be released for greenery; Secondly, the planted roof will function as a huge insulation to reduce the radiation heat absorbed. In this way, the indoor temperature is better stabilized and less air conditioner will be required. Thirdly, the slope of the grass has good conservation storage ability, which has certain auxiliary function on the water circulation of the building. At last

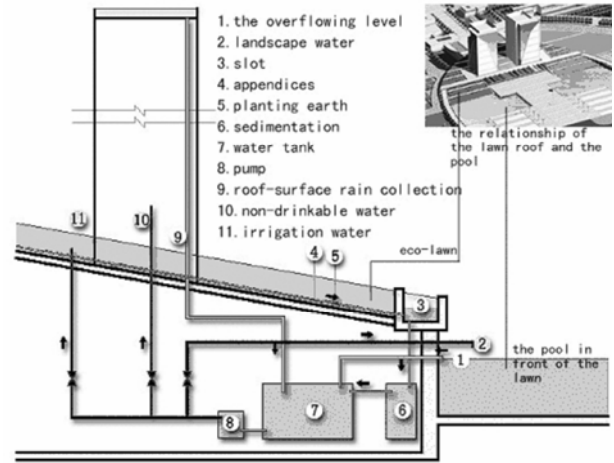


Fig. 13 Water Circulation System of Administration Center

it can form the green protective screen on the vision, and can reflect the change in four seasons sharply through the planting of different vegetation, achieve the goal of creating the ecologic niche (Fig 13).

Stage Characteristic of Ecological Compensation

The five series of projects is rather stages of development concept than the development implementation. First of all Lincheng is a political center, so the Center Zone project was firstly developed. It was definitely new one to the developers as good as planners. The success of administrative center has confirmed the feasibility of the compensation tactics when it offered the developers a large number of implementation experience of concrete ecological compensation measures. At the same time its limitation was realized. Ecological compensation will really play a due role only when it is pursued in the whole city but not just in the center zone. So “ecological guidelines” for the whole city are organized, and then “ecological principles” are worked out to every location.

With analysis and consideration of the overall situation, the following CBC project received comprehensive ecological cares. Destroys of ecological environment by high density development are minimized. The unavoidable parts have received corresponding compensation in other area or been transformed in this built environment. It is important that the commercial and business center was not separated but received the compensations from city extension. In comparison with it, the coastal esplanade has more ecological resources. The common resources have got the maxim protection while compensation tactics exploded more original ones and get the good balance with human activities.

Having these experiences and built environments, tactics and principles of the ecological developing are confirmed. The citizen cultural square is the transition area from center area with high density to the coastal area. The ecological characteristic of transition is emphasized and new measures were experienced in this project.

CONCLUSIONS

The scheme for Lincheng new town is under construction, and the Urban and Rural Construction Committee of Zhoushan city have mostly accepted our conceptions and principles. The tactics made in the urban design has got very good carrying out in the architectural designs. Idea of eco-city and ecological compensation in the urban design has already been generally accepted there.

The effects of four dominating factors applying to the city are obvious. Changes of levels are minimized and abundant urban ecological spaces are created. Water bodies in inland water system get abundant use. Main river ways are persevered; others are reframed to fit the city structure. The marine system is reserved completely. The outlet positions of inland system are managed and pollutions are controlled. Thanks for the "guidelines" and "environmental principles", abundant green spaces are preserved and get good links to the buildings. Others that have to be destroyed get ecological compensations in other places or with other forms. Environmental destructions of buildings are minimized because of the above-mentioned files. Additionally, by these buildings the original ecological resources are exploded and got attention from human activities.

It is considered as a key to turn this idea from the concept into construction practice with deep significance, and this is also the basic starting point that the urban design was carried out in Lincheng.

Examine through practice, it is proved that it is necessary and feasible to the ecological compensation in

the urban design of coastal lowland cities like Lincheng New Town. However it must be realized that the urban design is a course perfected constantly, as McHarg said, the characteristic comes from the cityscape ecosystem and evolves the understanding and feedback of the course naturally (McHarg, 1969). So more challenges will be faced to in ecological compensation in urban designs. More multi-specialized support will be needed; various kinds of measures will get the possibility implemented too with the development of city. The construction of the Lincheng is being launched systematically. The urban design has not been over, the ecological compensation in the urban design has just begun.

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