

The Infiltration Interface Structure of Suburban Landscape Forms in Bimen Township, Anji, Zhejiang Province, China

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Abstract—Coordinating and promoting urban and rural development has been a new round of institutional change in Zhejiang province since 2004. And this plan was fully implemented, which showed that the isolation between the urban and rural areas had gradually diminished. Little by little, an infiltration interface that is dynamic, flexible and interactive is formed, and this morphological structure starts to appear on the landscape form in the surrounding villages. In order to study the specific function and formation of the structure in the context of industrial revolution, Bimen village located on the interface between Anji Township, Huzhou and Yuhang District, Hangzhou is taken as the case. Anji township is in the cross area between Yangtze River delta economic circle and innovation center in Hangzhou. Awarded with ‘Chinese beautiful village’, Bimen has witnessed the growing process of infiltration in ecology, economy, technology and culture on the interface. Within the opportunity, Bimen village presents internal reformation to adapt to the energy exchange with urban areas. In the research, the reformation is to adjust the industrial structure, to upgrade the local special bamboo crafts, to release space for activities, and to establish infrastructures on the interface. The characteristic of an interface is elasticity achieved by introducing an Internet platform using ‘O2O’ agriculture method to connect cities and farmlands. There is a platform of this kind in Bimen named ‘Xiao Mei’. ‘Xiao’ in Chinese means small, ‘Mei’ means beautiful, which indicates the method to refine the landscape form. It turns out that the new agriculture mode will strengthen the interface by orienting the Third Party Platform upon the old dynamic basis and will bring new vitality for economy development in Bimen village. The research concludes opportunities and challenges generated by the evolution of the infiltration interface. It also proposes strategies for how to organically adapt to the urbanization process. Finally it demonstrates what will happen by increasing flexibility in the landscape forms of suburbs in the Bimen village.

Keywords—Bimen Village, infiltration interface, flexibility, suburban landscape form.

I. INTRODUCTION

IN the process of urbanization, a trend can be observed: in order to speed up the production factors such as capital and popularity return, some of the emerging rural industries gradually change into urban industrial developing model. On the other hand, the urban industry in the suburbs spreads, promoting the suburban areas of industrial transformation and upgrading. This study defines the interaction of such industries

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in suburban borders as industrial infiltration. Under the influencing of industrial infiltration, the rural spatial pattern is also constantly changing, resulting in further ecological and life penetration, which is the focus of this paper.

According to landscape ecology, when the density of a media reaches a critical point, permeate can suddenly travel through the media material from one end to the other end [1]. With the development of urbanization between urban and rural areas, industry and space have produced economic, social, ecological and spatial infiltration phenomenon, which can prevent the industry or space from fragmentation. The impact is also regarded as constant dynamic process. In conclusion, the focus of penetration research will be on media and osmosis.

A critical valve phenomenon is the case where an event or process (dependent variable) suddenly enters into another state when the influencing factor or environmental condition (independent variable) reaches a certain degree (threshold). It is often a process from variable to qualitative change, from one state to another different state [2]. Urbanization rate of 70% in the ‘Three Stages of Urbanization’ principle is at the level of second or third stage of urbanization threshold. As for domestic cities where urbanization rate reaches more than 70%, the suburban villages have played critical roles in the process of urbanization, and that is why they do not appear with reverse growth as the western cities did in the past.

II. BRIEF INTRODUCTION OF BIMEN VILLAGE

Bimen village is located in Anji County, Huzhou, in the northwest of Zhejiang Province [3]. The north of it is Shangshu Township and Lingfeng scenic area, and the east of it is Tianhuangping Township (Fig. 1). Besides, the south of Bimen village is Liujia Tong Village, and the west of it is Xiaofeng Township. In short, Bimen Village is in the outskirts of the infiltration interface, and the village’s spatial pattern has also undergone significant changes above the upgrading in the industry.

Bimen village has vast farmlands, and is also rich in land types such as arable land, woodland, bamboo forest, dry land, grassland, garden, etc. While part of the lands have been taken over for the No.04 Provincial Rd, most of the agricultural lands are under well protection, so the overall land texture in Bimen village remains intact and large. In the meanwhile, the total arable lands have reached 892 acres, and per capita farmland is about 0.52 acres. At present, farmers who are growing grapes, strawberries, and vegetables have occupied the dominant farmland, the rest of which is used to cultivate rice as well.

However, because those picking and entertainment activities have not been placed on the farmlands, facilities are scarce on the farm now.



Fig. 1 (a) Location of Anji County in Zhejiang Province



Fig. 1 (b) Location of Bimen Village in Anji County

The prevailing industry of Bimen village is closely around bamboo processing. In the 1990s, with the deepening of reforming and opening up, some Taiwan businessmen came and invested in Bimen village for its great potential. At the same time, villagers started to seize the booming opportunity. They stood on the basis of traditional agriculture, gave full play to the advantages of bamboo resources in the village, and vigorously transformed the low yield forest into high yield abundant forest. Within the deep and sustainable processing of bamboo resources, villagers gradually generated a specific model as 'one village, one product' for local entrepreneurship. Since then, local economy was mainly based on bamboo products, manufacturing, processing, sales, and sometimes was supported by agriculture. The main commercial products include bamboo mats and other fine bamboo handicrafts, which are so profitable that the 2014 annual output value reached 350 million Yuan. Until now, the village has developed 13

large-scale enterprises, more than 130 family plants. It encourages 98% [4] of the labor force in the village to be engaged in the family industry. All in all, the second industry had been the main reason for the flourishing of Bimen village in 1990s, on account that it not only supported the bamboo industry, but also drove the village economy and other rapid and coordinated development, and it helped to form a "to work with farmers, to feed the farmers" pattern in people's mind. But the challenge came soon when the bamboo products gradually became less satisfying and competitive in the global market under the influence of the Internet (Fig. 2).



Fig. 2 (a) Bamboo manufacture



Fig. 2 (b) Drying processing

III. MODULE OF INFILTRATION INTERFACE IN BIMEN VILLAGE

A. Infiltration Motivation

The first drive is the decline of bamboo industry in the village. The village has taken bamboo industry as major industry for a long time. However, the products are at a lower end like bamboo mats, bamboo brooms and bamboo chopsticks. With the gradual decrease of market demand, bamboo industry started to face the dilemma. A large number of small family workshops were closed due to the problem (Fig. 3). Especially in the global financial crisis in 2008, there was a sharp decrease in market share of Anji County and that in profits because of domestic competition with Fujian, Jiangxi and Hunan Provinces. Under this background, Bimen village begins to focus on technical innovation now. It intends to upgrade the quality of bamboo products and extend the chain of bamboo industry. And it copes with the dilemma through several approaches like simultaneous development of internal and external market in order to transform and upgrade local enterprises in bamboo processing.



Fig. 3 (a) Outdated family workshops



Fig. 3 (b) Old factories

The second drive is the contradiction in internal village between production space and residential space. Most villagers in Bimen village were involved in processing and manufacturing bamboo products in 1990s. And they had added new production facilities in their own yards one after another, which were independent workshops for temporary or permanent use. Some villagers took the first floor of the housing as the workshop, while some villagers reconstructed their forecourts into the workshops by adding new awnings. The addition and illegal constructions now are one of the manifestations of outdated bamboo industry. It has destructed the whole view of the village and life quality of villagers to a certain extent [4]. Therefore, many villagers expect to adjust their production types through industrial reform. And their higher demands for living environment are promoting the upgrade of residential space in the village.

The third drive is that urban tourists begin to crowd into rural areas because of the rising of rural tourism. Affected by the economic circle of Yangtze River Delta and Tianhuangping scenic region, the Second Industry that originally led by bamboo production in Bimen village is not able to satisfy the demand of local economic development nowadays, especially after suffering from the depression in financial crisis in 2008. In this circumstance, the great potential of tourism in Bimen village starts to attract more attention. From a geographical perspective, the village is close to Lingfeng Temple, Tianhuangping area and the Bamboo Expo Garden. And it is also the only way leading to the scenic spots above from cities like Hangzhou, Shanghai and Nanjing, which will provide potential passengers to participate in the development of 2.5 Industry and Tertiary Industry in the village. Meanwhile, the administrative region of Bimen village has been put under Lingfeng Street so that there will be driving effect by means of the tourism development in Lingfeng tourist area (Fig. 4)



Fig. 4 Tourism development resource in Lingfeng area

B. Infiltration Media

The infiltration media is in the model of “One Line, One Belt and Double Corridors”

“One Line” is the No.04 Provincial Highway through the village. It closely connects Bimen village with Anji County in the north and Hangzhou in the south. It enables Bimen village to be the only way to the urban district of Anji and Lingfeng tourist area from south to north. And it is the primary external transportation vein of Bimen village. It not only creates favorable conditions for the delivery of bamboo products, but also makes it convenient for tourists to experience and go sightseeing. Therefore, No. 04 Provincial Highway is one of the major mediums in the industrial infiltration between the surrounding cities and Bimen village.

“One Belt” means the Port Creek as the branch of Huxi River running through five natural villages. The flow of the stream continues the green ecological corridor on both sides, which becomes a beautiful landscape belt. There are a series of slow walking systems and green space in theme park on the landscape belt in connection with the villages. Moreover, it will attract the villagers and urban tourists to the riverside. Hence, Port Creek is also the main media for ecological and space permeation.

“Double Corridors” means the two view corridors in the east-west direction. There are neither buildings nor structures on the view corridors so that the infiltration between mountains and the vision between people and mountain will be ensured. Therefore, the two view corridors are the main channels for landscape infiltration to increase the echo of dwellings on both sides (Fig. 5).

C. Infiltration Mechanism

The infiltration in Bimen village includes industrial and space permeation. Industrial infiltration is presented in the coordinate development in Primary, Secondary and Tertiary Industries. It is the process of upgrading of bamboo industry, agricultural intelligence and arts, influenced by urban expansion. It reflects in new industrial forms, such as leisure agriculture, tourism agriculture, maker space and creative industrial parks. Space infiltration is to release space in the village and produce smart growth under the impact of industrial transformation, and to maintain the disheveled living environment in good order (Fig. 6).

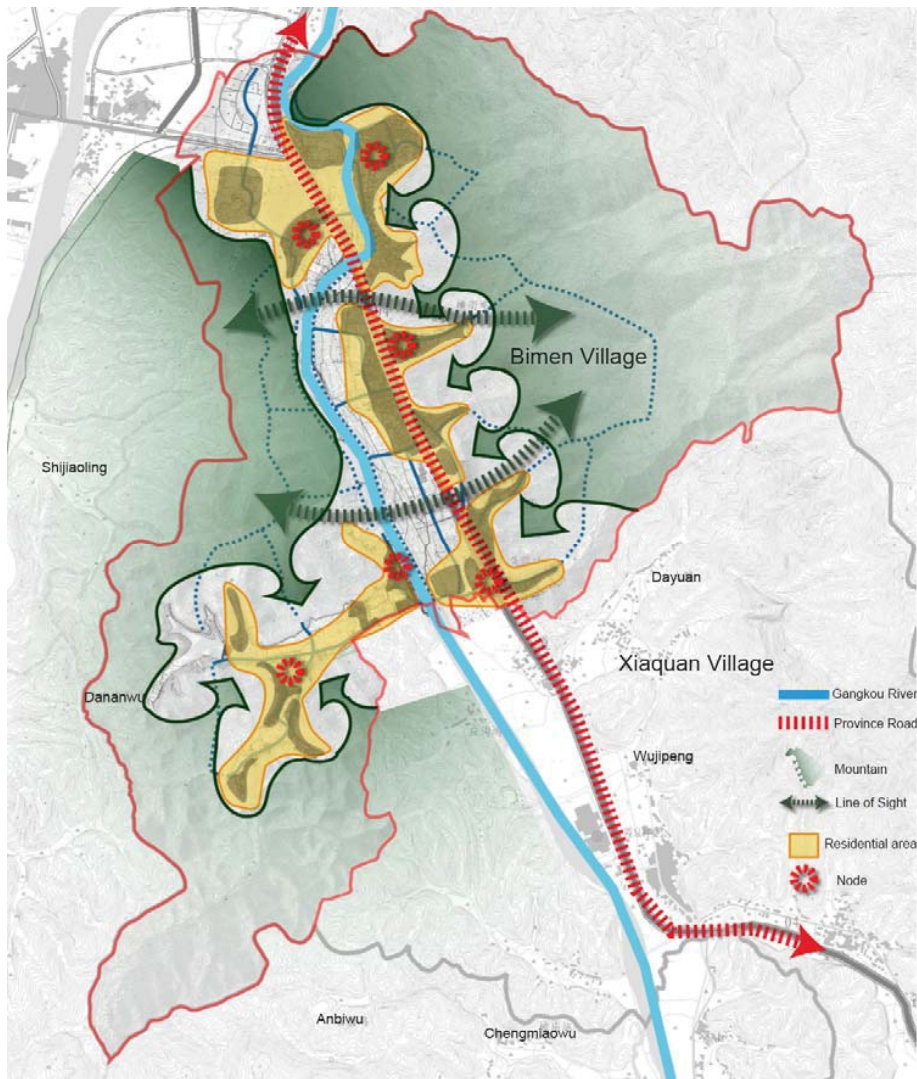


Fig. 5 Penetration media of “one line, one belt and two galleries” of Bimen village

1. Industry Infiltration

Firstly, industrial infiltration is reflected in product upgrading. It is mainly embodied with quality improvement of traditional products and reinforcement of brand building, with promotion of industrial competitiveness and market attraction. Therefore, it can transform the bamboo products from traditional types to dominant and emerging types gradually. For example, large factories can develop bamboo floor, bamboo fiber and so on while small workshops can develop bamboo handicrafts.

Secondly, industrial infiltration is reflected in platform upgrading. That is to implement updating strategy of industrial cluster. The specific implementation is to establish demonstration zones for bamboo industry and micro pioneer parks. Thus, the leading enterprises can drive small and medium processing plants and family workshops. It can step on the road of development in industrial cluster, enhance scale effect and push forward the growth of firms to realize the

reform of bamboo industry in Anji County.

Thirdly, industrial infiltration is reflected in introduction of the Internet. The main method is to establish an E-Commerce system, and encourage enterprises in bamboo industry to register websites or web pages for online marketing on the Internet and support qualified companies to establish the on-line platforms running from procurement of raw materials to product sales in accordance with requirements of supply chain.

Fourthly, industrial infiltration presents as extraction of bamboo culture. In other words, it can exploit the landscape value in manufacturing process in current bamboo industry. For example, as for the unique space or yards for sun-treatment of bamboo products, it can transform industrial process to fancy landscapes, for it can form shocking effects of earth landscape and express local industrial culture. In addition, people can develop catering, home stays and museums under the theme of bamboo culture to provide perfect auxiliary service in tourism for potential tourists.

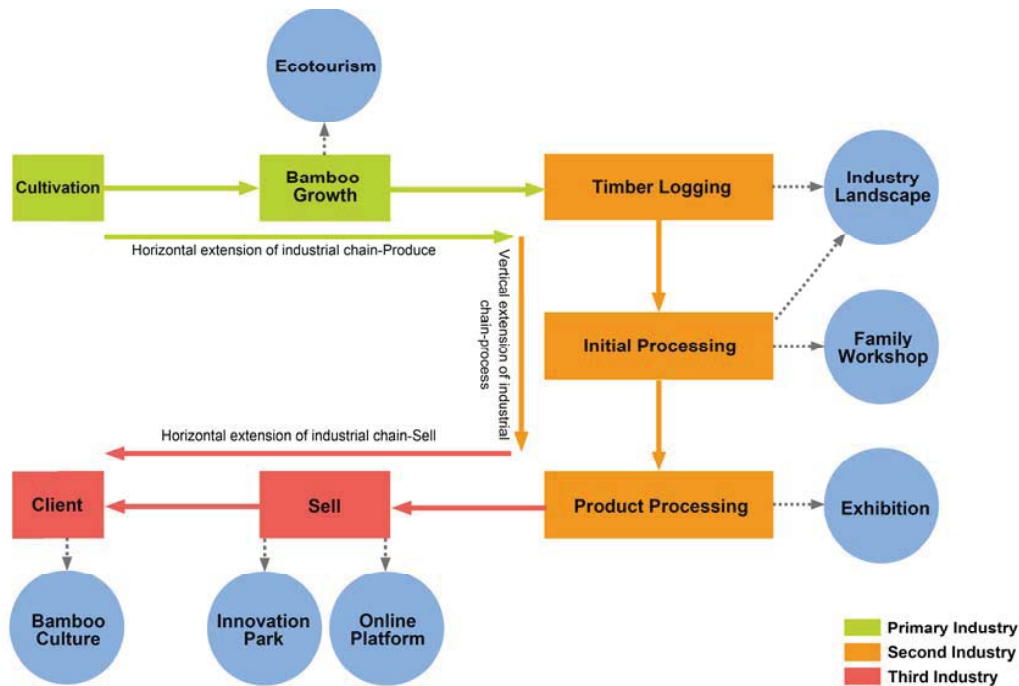


Fig. 6 Three linkages of bamboo industry

2. Space Penetration

Space infiltration means 'releasing and exchanging space in the village'. After evaluation, people can remove the old houses selectively, they will demolish the illegal workers' sheds which have blocked the laneways and clean up the yards. Therefore, it will release the occupied space within the village and replace it with well-designed sites for public activities, social interaction and green space and so on.

Space infiltration is also explained as 'smart growth' of the village. It means to adopt the strategies of stage planning and smart growth in the industrial and space planning in Bimen village. In short-term planning, the strategy is to stress the essentials, to forge the regions and to renovate key industries to set up construction models for the whole village. In long-term planning, the aim is to make integral lifting and to promote industrial transformation, in order to form a beautiful village with adorable landscape and pastoral scenery as well as leisure living environment.

IV. LANDSCAPE PATTERN FORMED BY INFILTRATION

A. Industrial Retreat Pattern

Industrial permeation supports the layout of landscape pattern in Bimen village to undertake gradual change. Industrial upgrading has mixed diversified bamboo culture together, collected small-scale workshops and established the platform of high-quality cooperation in Bimen village. In industrial permeation, people can preserve some of large ideal factories in good architectural form for reconstruction and they can also remove scattered old plants in small scale so that all the emerging industries in the past will be well settled according to their potential. And this action will clean up the polluting area

for residence and will release more space for public activities to enhance the quality for villagers' living. Through the adjustment, there will be a retreat effect in color change representing industrial strength in longitudinal direction from south to north, based on the five natural villages of Bimen village in ribbon pattern, including Qingshan village, Central village of Bimen, Huxikou, Huangmukou and Yanjingwu (Fig. 7).

The Secondary Industry in Bimen will continue the current status, including handicraft industry and processing industry. The intensity of development varies from strength to weakness when it is from north to south along the village. For Qingshan village, the northernmost natural village, it can develop integrated bamboo industry to improve industrial quality and added value. For Central village of Bimen and Huangmukou village, in the middle, they can develop small experiential family workshops. In Huxikou and Yanjingwu, the southernmost villages, it is possible to minimum industrial elements and change scattered industrial remains into new landscapes.

The Tertiary Industry gradually strengthens from north to south along the village, like tourism. Qingshan village forges pleasant waterfront landscapes. In Central village of Bimen and Huangmukou village, they can develop experiential agriculture based on land resources. In Huxikou and Yanjingwu with the best conditions in scenery, they can make full use of excellent natural landscapes and quiet climate to develop tourism for home stays and leisure entertainment (Fig. 8).

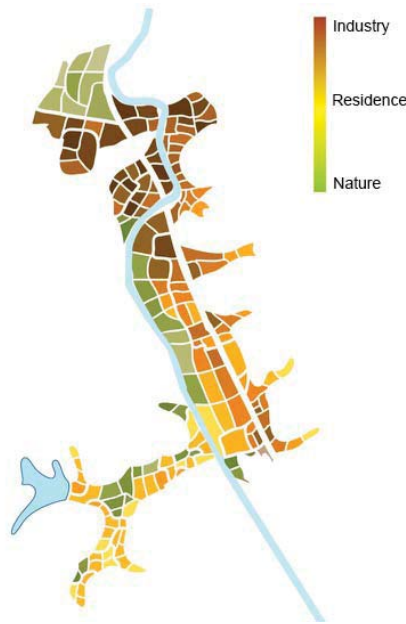


Fig. 7 Total industrial retreat format of Bimen village

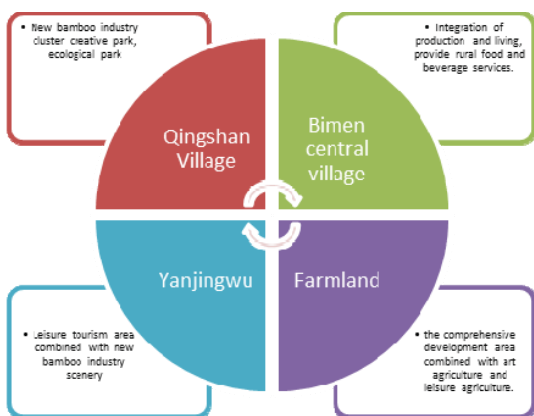


Fig. 8 Four industrial retreat patterns of four regions in Bimen

B. Art Farmland

The land for scale agriculture in ribbon pattern is one of the characteristics in Bimen village, which is also the space carrier for Primary Industry. In industrial and space infiltration, scale agriculture can be developed into art agriculture so that the farmland can transform into art pattern. For example, there are vast areas of farmland in the west of Central village and Huangmukou village. It brings opportunity to establish an experiential base for art agriculture in combination with earth landscape, agricultural planting and recreation, following the natural texture of the village. (Fig.9) Art farmland will focus on vegetable planting and agriculture in earth landscape, including functional projects in exhibition of modern planting and sun-cure of bamboo filament, experience in free farming, agricultural education, sales of agricultural specialties and waterfront recreation. All above can satisfy the demands of tourists for various experiences in picking, planting and

entertaining. In conclusion, it will facilitate the organic fusion in deep recreation and agriculture experience.



Fig. 9 Art farmland pattern and farming experience in Bimen village

The art farmland, as a unique landscape layout, has been proved to increase industrial benefits in many cases of rural construction. For example, by creating experiential parks for strawberries and grapes, tourists can fully taste the rural life and try the freshest fruits so that the added value of fruits will be increased (Fig. 10). The village can also breed bamboo chicken in bamboo forests to develop animal farming in high quality as well as enable tourists to participate in experience activities like chicken capturing.



Fig. 10 Strawberry experiment gardens

Combination of art farmland and the Internet can be developed into the infiltration beyond space restrictions. Based on Agriculture 3.0, it can sell healthy and safe crops to urban groups in middle class and attract customers to take leisure tourism in the village [5]. The tourists can also experience the picking and planting of crops by themselves. Through the interaction, it can realize “ecological agriculture in socialization” with extensive participation of citizens and villagers (Fig. 11).

C. Residents Develop along with Industry Chain

Dominant economy in bamboo industry in Bimen village attracts production factors in the village to permeate into industrial nodes. And it changes the connection direction between industrial structures and then changes the space layout of industries.



Fig. 11 Xiaomei Cooperation as a Third Platform in reforming rural industry

Firstly, industrial patches are distributed closely to industrial nodes, which can form moderate concentration of industrial clusters and markets. Proper enterprise aggregation and business acquisition will play an active role in market development. It will enlarge operation scale, refine product structure and improve utilization rate of service facilities.

After that, dwellings begin to transfer to the neighborhood of industrial nodes, which causes the expansion of residential space. Therefore, the closer the node is to industries, the more concentrated the residential spot is. The phenomenon is relatively obvious in Bimen village.

V. PROJECT PRACTICE – DESIGN FOR DYNAMIC ADAPTABILITY

The project is on an ecological Leisure Park in Correlation with Mountains and Rivers. There is a wasteland in nearly one acre by the river in Qingshan village, in the north of Bimen village. The site is idle after removal of illegal buildings. So the design intends to make full use of the superiority in surrounded mountains, port creek through the belt and embellished pastoral land to reconstruct the open space into an ecological leisure park with dynamic adaptability. Through environment improvement, the park can provide basic functions of recreation and fitness. In long-term planning, the target is to expand the site into a comprehensive waterfront park in multiple functions, and create a park in harmonious coexistence of mountains, rivers, farmland and humans.

A. Construction Purpose

Under the opportunity of the project "Co-governance of Five Waters" in rural areas in China, the focus is on environment remediation and to establish the foundation in harmonious development of ecology, production and life. Meanwhile, the park can provide the basic needs of daily recreation and hydrophilic entertainment, including fitness facilities, an open square and a small mountain park, so as to achieve the infiltration toward the riverside and the harmony between human and nature (Fig. 12).



Fig. 12 Aerial view of the waterfront park

B. Reflection of Dynamics

The dynamic adaptability of the waterfront park is reflected in: Firstly, it is the sustainability of materials. It utilizes bamboo as materials to establish structures in the park, which can meet the industrial excess demand in five-year planning. Bamboo is the most fertile product in Bimen village, for it is cheap in price and easy to acquire. When it comes to culture element, the theme park of bamboo can fit the culture extracted from bamboo industry so that it can play a role in promoting local traditional culture. More importantly, as the lifetime of bamboo is from five to ten years, the update cycle just synchronizes with the planning in industrial development, which can maximize the utilization of natural resources.

Secondly, it is the dynamics in public activities of villagers. According to the characteristics of fluctuation in port creek, the hydrophilic platform can be designed into dynamic space. That is "water enters and human retreats while water retreats and human enters". (Fig.13) It means when the river submerges the first-floor platform by the river, tourists can enjoy the scenery safely on the second-floor platform. When the water is retreated, tourists can get close to water and play on the first-floor platform. The dynamics makes hydrophilic activities of people match the law of fluctuation. And the riverside space can also be fully utilized.



Fig. 13 (a) water level falls and people come.



Fig. 13 (b) water level rises and people leave.

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