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URBAN MORPHOLOGY AND SPATIAL OPTIMIZATION STRATEGY OF INDUSTRIAL SMALL TOWN IN CHINA UNDER "NEW URBANIZATION MOVEMENT" – A CASE STUDY OF TANGZHA

Abstract: *China has experienced the largest and most rapid urbanization process for the past 50 years due to the large amount of rural population and booming economy. Overcrowded mega-cites, polluted environment and "hollowed" villages are the consequences. The Chinese government introduced a movement called "new urbanization" to promote green, efficient and people-oriented urbanization strategy. Small town plays an important role in urbanization as the lubricant and linkage between cities and villages. Industrial small town is one of the key elements in the city system. However, many Chinese industrial small towns lack of professional planning to respond to the industrial and social restructuring. Characteristics in urban form is the core value of industrial small towns but some of them lost their characteristics by simply copying big cities. This article used space syntax to analyze the spatial structure and urban morphology of the first industrial small town in modern China, Tangzha, to find the law of its spatial development and its connection with other social factors including household income, government policies and public service, trying to provide optimization strategies to guide the development of industrial small town under "new urbanization".*

Keywords: *industrial small town; urban morphology; space syntax; Tangzha; space development; spatial optimization strategy.*

Introduction

For the past few decades China has experienced the largest and most rapid urbanization. In 1986 distinguished sociologist and economist Mr. Fei Xiaotong published his book "Small Towns in China" and drew the public attention to small towns. The communist party of China (CPC) central committee put forward the strategy of "small towns and big plan" in 1998 to deal with several major problems in agriculture and rural areas. The small towns played a significant role in the urbanization process in China. However, with the deepening of the reform, the problems of "inefficient land use, chaotic planning and environment pollution" were gradually recognized by the public and government. The "new urbanization theory" and "characteristic small towns" proposed by the 18th national congress of the government have brought the marginalized small towns back into view.

Nantong is a medium-sized city, across the Yangzi river from Shanghai, with good economy and cultural deposits. In 1895, educator, politician, industrialist and former minister of industry and commerce Mr. Zhang Jian set up a large textile factory in Tangzha, a small town 8km from Nantong city center. In Zhang's plan, three towns including Tangzha, Tiansheng harbor and Langshan surround Nantong city for the functions of production, transportation and tourism, formed a unique city-town system. Every "pole" in the system is connected by highways and canals, therefore they create a complete and efficient industrial chain and urban functional network. All the towns in the network are linked but also independent with complete production and living system. In the case of Tangzha, there are not only a series of factories, but also staff dormitories, schools, hospitals and orphanages for the workers and their families. More importantly, Zhang invested in the infrastructures like municipal pipelines, tap water and power

grid to help the new residents adapt urban lifestyle. It is this efficient and long lasting urban-rural relationship that makes Nantong standing out in the urbanization process of modern China.

Studying the urban morphology of the continuous urbanization process of this historic town for the past 50 years (from 1967-2017) will surely help us provide series of spatial optimization strategies for the developments of small towns to meet the goals of the "New Urbanization" - green, efficient and people-oriented.

History and spatial development

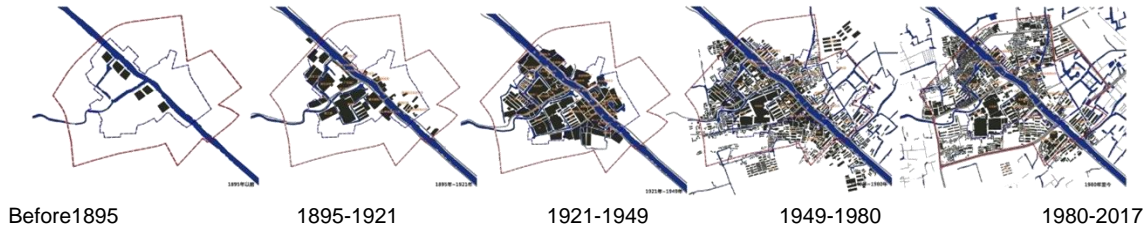| Before1895 | 1895-1921 | 1921-1949 | 1949-1980 | 1980-2017 |

Figure 1. Town development

Before the year of 1895, Tangzha was a small agricultural village with only a few houses, the major household income was from cotton cultivation. In 1895, due to the convenience in waterway transportation and the abundant cotton production, Zhang Jian started the construction of the Dasheng textile mill here. Since then, a series of ancillary industrial groups and related supporting service facilities have been successively established, such as rapeseed oil, mill, iron, silkworm and dyeing, etc. It formed a modern regional industrial capital group and the whole textile industry chain. 1921 was the turning point of Zhang's business, the textile industry crisis struck the town and was followed by 11 years of war, stopping the industry development. In 1960s, the CPC conducted a revolutionary movement call "the Great leap forward". Because of the movement and the new policies, the original social structure and industrial systems were reformed, so the traditional urban spatial structure had changed dramatically. By 1979, the old industrial Tangzha had developed into an industrial town with nearly 40,000 industrial workers and more than 30 enterprises. However, with the deepening of the "reform and opening-up" and shifting of the city's development focus, this historic town became an "island". In the 1980s, the contradiction between historic preservation and township reconstruction was increasingly protruding. The town development and old enterprise encountered many problems, such as traditional industry chain rupture, economic recession, factories closedown and laid-off workers, all resulting in poverty of life, living environment deterioration, the town falling in the position in the urban development. 2005 was a starting point for the new era for Tangzha, the city expanded rapidly and the town became a subdistrict. The city government took over the dilapidated factory buildings and established "1895 cultural and creative industry park" to restore energy and introduce new business to the town. The "new urbanization" movement in 2017 is a great chance for Tangzha to find its own way of development and take another great step forward.

Tangzha township urban space expanded along the Tongyang canal, fan divergent to the northeast and southwest direction from the two major roads-Hedong street and Hexi Street. The canal divides town into "West" and "East", two districts called "Hexi" and "Hedong". According to this topographical feature, Mr. Zhang Jian had a clear plan for this industrial town, the west side is industrial production area mainly with the textile factory; the east side was used as the living area which contains residential buildings, schools, hospitals, charities, parks, stacks, etc. The production area and the living area are clearly divided, so the production in Hexi can be orderly arranged and the interaction between the factories can be efficient, while the east side obtains a better living environment. There are two bridges connecting the two sides, each side has a one-side street, which are the main roads of Tangzha. This kind of "river road" inherits the way

of the traditional road construction in the water network area of the middle and lower reaches of the Yangtze river in China.
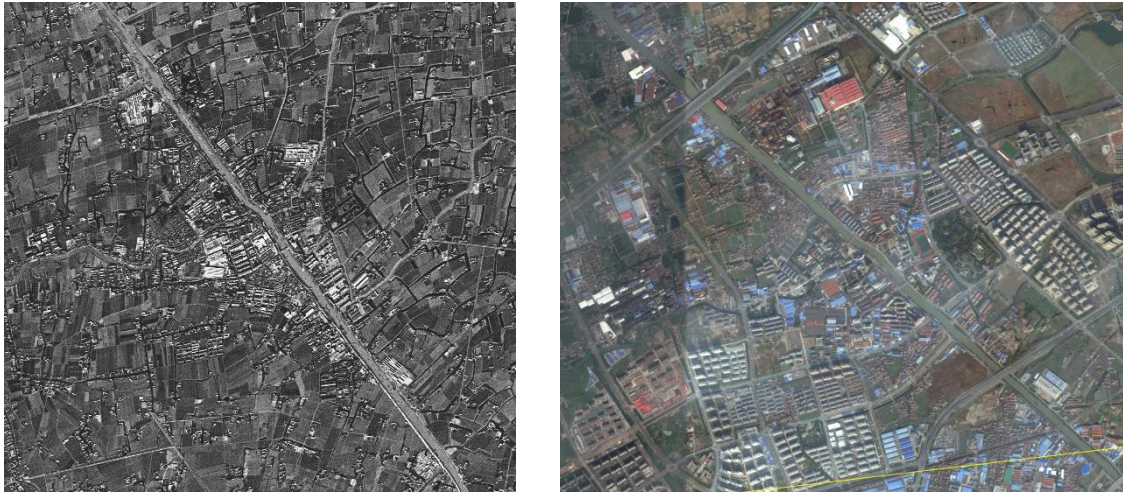

Figure 2. Image of Tangzha 1967(left) and 2017(right)

Integration analysis

Figure 3. Spacial Integration of Tangzha 1967(left) and 2017(right)

The space structure of Tangzha is a good continuation of that in the late 19th century when Zhang first planned. Along the canal, there are two major pathways at both bend through the township. Figure 3 above shows the overall integration of Tangzha in 1967 and 2017, which mainly reflects how a certain axis closely associated with all the other axis, the diagram reflected the accessibility and permeability in the whole space. In space syntax analysis software, the overall integration of numerical axis with the highest valued segments (usually about 10% of the total of the overall integration) is known as the integration core of the axial system, the axis due to its accessibility and the decisive position of permeability, therefore tend to be in the heart of the settlement as an important public node and became the center of traffic activity. The axial form of the integration core can also reflect the basic topological form of the town, thus reflecting the deep fabric configuration.

As shown in Figure 3, the color of the axis shows the strength of the integration degree, among which, the red and orange line segments represent the region with the strongest integration degree, which is the integration core of the township space. Both diagrams demonstrate that integration cores are located at Hexi street near the front gate of Dasheng Spinning Mill factory and Dasheng dock. It is

amazing that with time, in the absence of modern scientific analysis methods, Jian Zhang chose this area of the township to build the textile factory. The factory benefits from the convenient land and water transportation and acts as the engine of development for the town.

Comparing the two diagrams, the township space area has increased obviously during the past 50 years, but the spatial integration core remained in the same region. From 1967 to 2017 the east district developed the most, the integration degree of the Hedong street has increased and some parts have become the core area. This is because many residents who used to live in the worker's dormitory got relocated to new government funded apartments at the east side, schools and parks were also rebuilt there to provide better living conditions, as the result, the east district has now become the new center of the town.
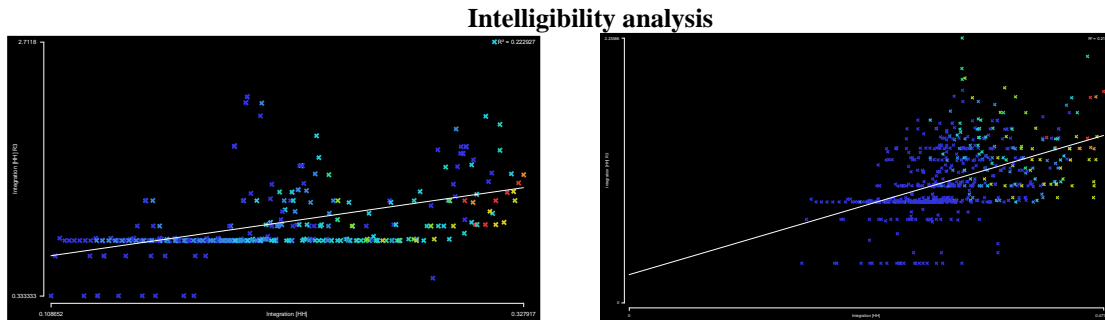
Intelligibility analysis

Figure 4. Intelligibility diagram 1967(left) and 2017(right)

The global integration (integration HH) and partial integration (integration R3) was selected for intelligibility analysis, using linear regression analysis, get the XY scatterplot, which was used to measure the relationship between local and overall integration. The interaction of these two is called the degree of fitting R^2, which represents peoples' understanding of the township space as well as the presumption and perception of the whole populated space form, based on behavioral activity in the local space. The R^2 of Tangzha is 0.22 in 1967 and 0.21 in 2017, the value is relatively low, indicating that the correlation between the two factors is poor. It means that people have a limited understanding of the space morphology of the entire township in accordance with the local streets and alleys. On the one hand, it is because there are quite a few gated factories in the township, the general residents cannot travel through, creating the barriers of spatial understanding. On the other hand, the value of R^2 dropped by 0.01, even though it is not a significant decrease, but it shows that the intelligibility of town space did not get better through more professional planning within the past 50 years as people wished. Instead, during the process of space expansion and urban renovation, the traditional space pattern and the new regional pattern are not connected in a coherent way, which has lead to the residents' confusion of the spatial form of the town.

Choice analysis

The most basic purpose of overall choice analysis is to investigate the number of times that an axial segment appears in the shortest topology path. Therefore, the high degree of choice indicates that this axial segment has a large potential to attract traffic. Figure 5 above is the overall choice analysis diagram of Tangzha in 1967 and 2017, from which we can see that the axial form of choice and integration with higher values has high fitting degree. The core region is still the two bridges and the parts of Hexi Street. Apparently, since the bridge is particularly important in the transportation, its high value in choice of road is certain. Hexi street has both very high space integration value and choice value which means the street is easy to be accessed from every corner of the town and convenience to travel to any location in the shortest path.

Figure 5. Choice analysis of Tangzha 1967(left) and 2017(right)

The both diagrams appear that the axial segments with high level of choice are connected and in the trend of forming loops. Especially in the 2017 diagram, the loops are found at both west and east districts. The spatial pattern has changed from two major roads radiating outwards to a more matured urban form with two closed loops and inner streets network system.

Spatial optimization strategy

The goal of spatial optimization strategy is to meet the requirements of the "new urbanization" movement: green, efficient and people-oriented.

Firstly, there should be further enlargement of the integration core area, not only the region near the canal and factory, but also newly populated spaces, especially in the east district where public service buildings such as schools, hospitals and parks are located. In order to be people-oriented, the town center should be shifted from the factory area to the neighborhood center. A better living and working environment is the emphasis of the next step of urbanization and town development.

Secondly, it is further development of the connectivity of the streets network system, the main transportation system of the town has changed from water to ground, more and more auto vehicles become the new challenge of the town planner. An efficient road system is the key to achieve efficiency in town space planning. Since the loop has appeared in the choice analysis diagram, it should be used to deal with transit and high-speed traffic. The current width and capacity of the roads are no longer sufficient, higher-grade roads are needed urgently. Inside the loop there is the historic township area, with architectural and cultural heritage, a non-motorized traffic system is a great solution to handle the conflict between the existing narrow streets and alleys and the growing traffic pressure.

Finally, the low intelligibility of the township space is partially caused by gated factory areas. For those which have already closed down, the government may purchase the land and build green space or plazas to return them to the public. For factories which are still in business, it may not be possible to make them tear down the walls and fences and open to the public. Since water transportation is not the significant factor for the factories anymore, agreements can be made between factories and governments about giving up some of the private waterfront spaces for the public green land. Thus, the existing canal water transportation network can be transformed to a continuous "green belt" system. With the all connected green spaces, general residences can move
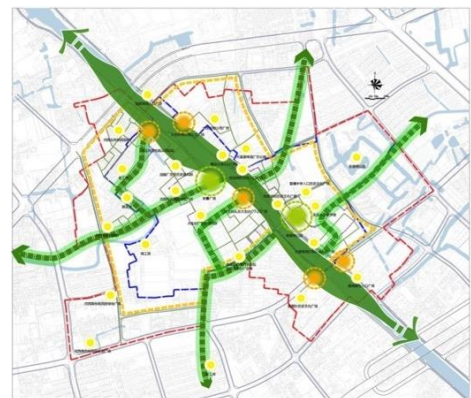

Figure 6. Green system of Tangzha

around the township space freely. While providing more urban green spaces, the space intelligibility can also be improved.

Conclusion

This article used space syntax to analyze the urban morphology of a typical industrial small town in China, Tangzha. The study took data from 1967 and 2017, to expose the achievements and problems of the town during the development for the past 50 years. The research was focused on three ways: "space integration, space intelligibility and space choice" corresponding to the three requirements of the "New Urbanization" movement: people-oriented, green and efficient. Thus, it provided spatial optimization strategies to guide the future development of the township. The case of Tangzha may be unique but the method of urban morphology analysis and process of dealing with problems which occurred in town development are universal.

References

1. Desyllas, J., Duxbury, E., (2001) '*Proceedings of the Third International Space Syntax Symposium*', *(*Atlanta: Georgia Institute of Technology Press*)*.
2. Duan, Jin (2008). '*Urban Space 3: Space Syntax and Urban design*' (Nanjing: Southeast University Press).
3. Fei, Xiaotong (1984). '*Small Town Big Problem*' (Nanjing: Jiangsu People's Publishing Ltd).
4. Hiller,B. Hanson,J. (1984) '*The Social Logic of Space*', (Cambridge: Cambridge University Press), 58-126.
5. Hillier, B., Yang, T., Turner, A. (2012). '*Advancing DepthMap to An Advance Our Understanding of Cities: Comparing Streets and Cities， and Streets to Cities*'(Eighth International Space Syntax Symposium, Santiage de Chile) 135-142
6. Lynch, K. Fang, YP., (2001). '*The Image of City*' (Beijing: Huaxia Publishing House).
7. Salat，S. (2011) '*Cities and Forms: On Sustainable Urbanism*', (Beijing: China Architecture & Building Press)
8. Xu, GW. (2015). 'Small town Spatial Network Research Based on Space Syntax*'* Unpublished Master Thesis, Dalian University of Technology.
9. Yang Y., Zhu JD., 'The economic mechanism of spatial form evolution in small towns of Suzhou city*' Development of Small Cities and Towns Journal* (5), 35-37.

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