

# Exploring the Morphological Process of New Districts in China: the Case of Nanjing

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**Keywords:** newly-built district, morphological process, structure, social economic demand.

**Abstract:** Morphological research enables better understanding of the urban physical form through studying its generating process. In the past 3 decades, urban expansion leads to a rapid construction of new districts recognized by scholars as a “top-down and one-shot” process, which is believed to have caused a high degree of similarity in their structures and fabrics. In fact, in parallel with urban expansion, the market economy has integrated with former planned economy, which means the bottom-up forces have started to play an important role during this period. Thus, it is meaningful by focusing on newly-built districts to investigate two interwoven forces with morphological tools.

Hexi Newly-built District, a new developing zone of Nanjing, used to be farmland before 1992. In 2004, due to the upcoming National Olympic Games, a new developing plan for Hexi was founded and growing. This paper reviews the morphological process of Hexi to analyze the way of its morphological changing, the pattern of the structure and the idea behind. Focusing on the center area of Hexi, the paper carefully draws out the land changing step by step, and the morphological changing process is clearly shown, in terms of cultural intension, social activities and commercial values. Based on various planning indicators, the paper characterized the morphological features of the new zone, including building height, arrangement of buildings and street interface. Result shows social economic demand is the main driving force of the development of the area, rather than a top-down planning, which determines the network structure.

## 1. Introduction

Urban morphology studies, especially the Conzenian School, has made some achievements in exploring the urban morphology of classical European cities and modern European and American cities. In recent years, some scholars have begun to study urban morphology of Chinese cities, but most of them focus on old cities or historic districts, such as Pingyao (Whitehand and Kai Gu, 2010) and Huangpu Ancient Village in Guangzhou (Zhiliang Wei and Yinsheng Tian, 2016), while little attention has been paid to new developing zones. The wide construction of new developing zones has been playing a significant role in the rapid urbanization during the past 3 decades in China. Foreign scholars tend to simply recognize the construction of new

districts in China as a “top-down and one-shot” process dominated by strong government power, while within the country, existing studies on new districts rarely set foot in their morphological process. However, if we take a deeper insight into the formative process of these new zones, there are some phenomenon hardly to be explained by “one-off planning”. For a more comprehensive understanding of the features of China’s urbanization after the reform and opening up policy, morphological approach can be applied to fully reveal the driving forces behind the formation of new zones.

Referring to plot analysis, as used in the studies on Alwrick (Conzen, 1960) and well-recognized as a fruitful approach to examining the transformation of urban form (Conzen, 1969; Slater, 1990), the research examines the formative process of streets, plots and buildings in the selected new developing zone. Hexi New Developing Zone of Nanjing, a well-developed new zone located in a city with both long history and relatively high urbanization level, is selected as a representative case. Located to the southwest of the old city of Nanjing (Figure 1), Hexi covers a larger area than the old town. After a brief review of the historical background of Hexi, the paper examines the germination of urbanization in the area, which was reflected through initial growth of road network and expansion of built-up areas. Then focusing on the central Hexi, the core study area is explored from the aspects of streets, plots and buildings, shedding light on the role of social-economic demands in the formative process of the new zone.

## 2. An Overview of the Historical Background of Hexi’s Development

Surrounded by rivers, Hexi takes up an area of 94 square kilometers, of which the land area accounts for 56 square kilometers, while the rest 38 square kilometers is covered by Jiangxin Island, Qianzhou Island and waterbody. It is customary to divide Hexi area into three parts: north, middle and south. In its urban master planning, the middle is considered as the center



Figure 1. Location of Hexi New Developing Zone.

of the new zone; the north part mainly serves as the mid-range residential area; and the leading function of the south part is to upscale community and reserved land for culture and sports facilities.

In the history, Hexi used to be farmland. According to *Thirty Years History of Nanhu New Village*, it can be date back to 1953 when the first residential area appeared in Hexi. A map of land utilization in 1978 (Figure 2) shed light on the low level urbanization in the area at that time, with limited built-up land concentrated in the north and along the eastern border with the old Nanjing city mainly used for industrial purpose.

In 1978, the year witnessed the end of the Cultural Revolution and the start of the reform and opening-up policy, a large number of educated youth and their families returned to the Nanjing city. In order to solve their housing problems, the construction of Nanhu Resettlement House in the early 1980s kicked off the initial development of Hexi area. From the preliminary planning in 1982 to the completion of construction in 1985, the three-year time witnessed Nanhu New Village taking the lead in the urbanization of Hexi. Covering an area of 68.55 square kilometers out of Shuixi Gate, which used to be the most significant gate in the west of the old city of Nanjing, it could accommodate 30,000 people, which means more than 9000 households. In the meanwhile, 114 public and service facilities: large to comprehensive shopping malls and hostitals, small to public toilets and bus stops, were built upcorrespondingly. Due to its incomparable scale at the time, Nanhu New Vilage was tagged as the “first district in Jiangsu Province” by the media. Built under the unified management of the headquarters set up by Nanjing government, this huge modernist residential area can be regarded as a product left by the planned economy.

Following the completion of Nanhu New Village, the construction of residential areas in Hexi spread quickly towards west, in order to make full use of the existing neighbourhood fa-

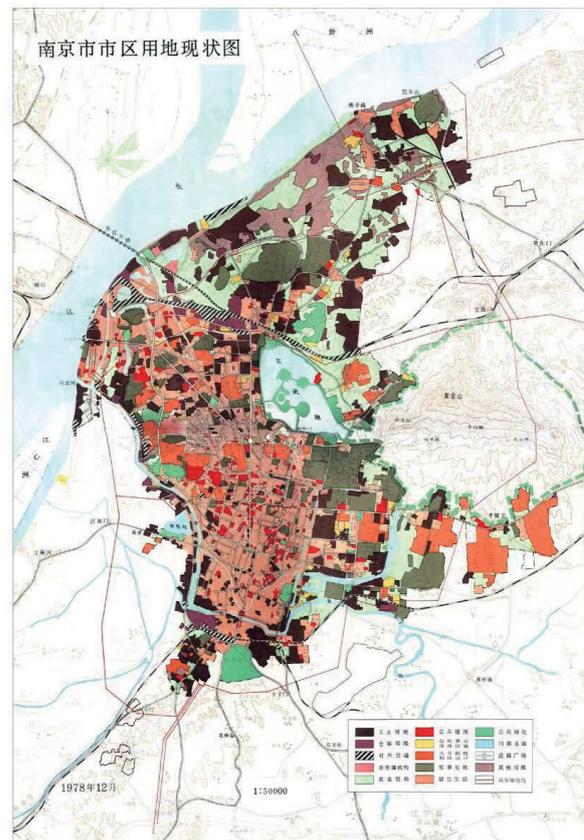


Figure 2. Land utilization status in Nanjing, 1978.  
(Source: <http://js.xhby.net/>)

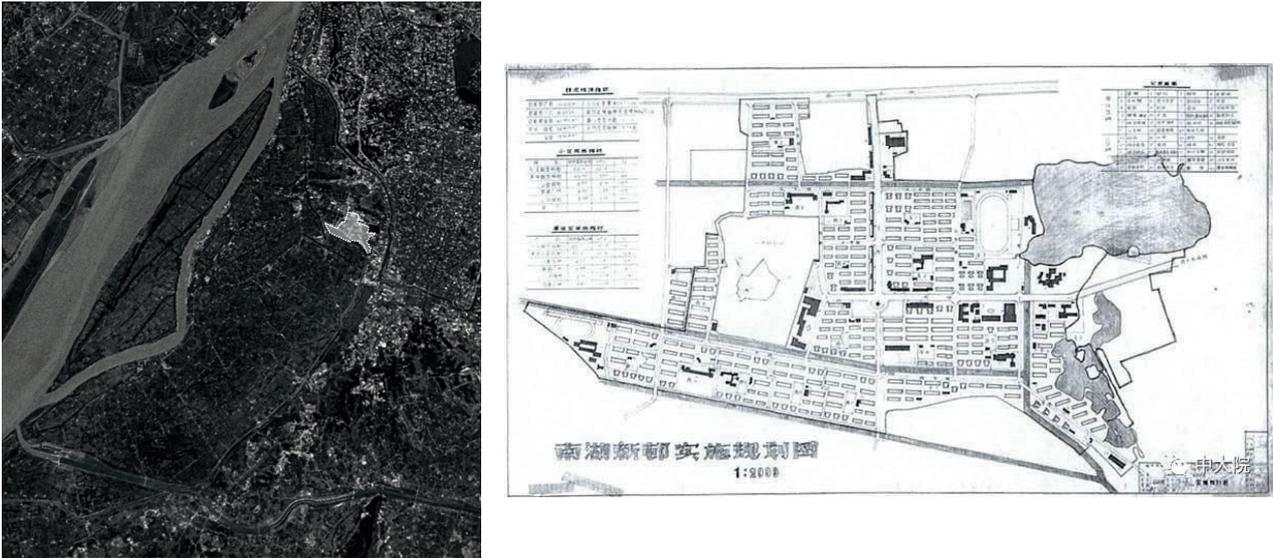


Figure 3. The location of Nanhu New Village resettlement house and its plan (1982). (Source: [http://www.sohu.com/a/148271529\\_290858](http://www.sohu.com/a/148271529_290858))

cilities. From 1985 to 1992, a number of new residential areas have been built around it, such as Chaxi Community, Mochou New Apartment, so on and so forth.

### 3. The germination of Hexi's urbanization (1984-2004)

To get an overview of the urbanization background of Hexi area, the satellite records have been traced on Google Earth from 1984, when the beginning of urban sprawl was already visible in Hexi. From 1984 to 2004, the annual satellite maps reveal the progressive urban expansion spread from the old town of Nanjing, located to the northeast of Hexi, to the west of Qinhu River. This paper picks out 6 years' images in which relative distinct changes can be observed and carefully draws out how the preliminary road structure gradually formed accompanied by continuous expansion of urban built-up area.

Due to its geographical proximity to Nanjing old town, the initial urbanization of Hexi started from the northern and eastern parts of the area in 1984, while a road extending from the northernmost to the interior appeared. This road was actually the prototype of Jiangdong Road, now the largest arterial road in Hexi, which has five lanes in both directions, with a width of 60 meters including auxiliary roads.

Although 1988 witnessed no distinct growth in structural road visible in the map, however, the urban expansion kept extending to the west bank and the two initial built-up areas at the north and east side developed into a continuous one. In 1994, the roads extending from east to the west coast appeared and the north of Hexi had been basically urbanized.

When it came to 1997, the central primary road outstretched further towards south, accompanied by several transverse access roads stretching to northwest towards the west bank of Hexi. In the meantime, still being confined within the north area, the built-up area had not followed in the footsteps of the road expansion to the central and southern Hexi. In this year, faced with the housing problem of college teachers, the government decided to build the largest high-rise residential community in Nanjing-Longjiang Higher Education

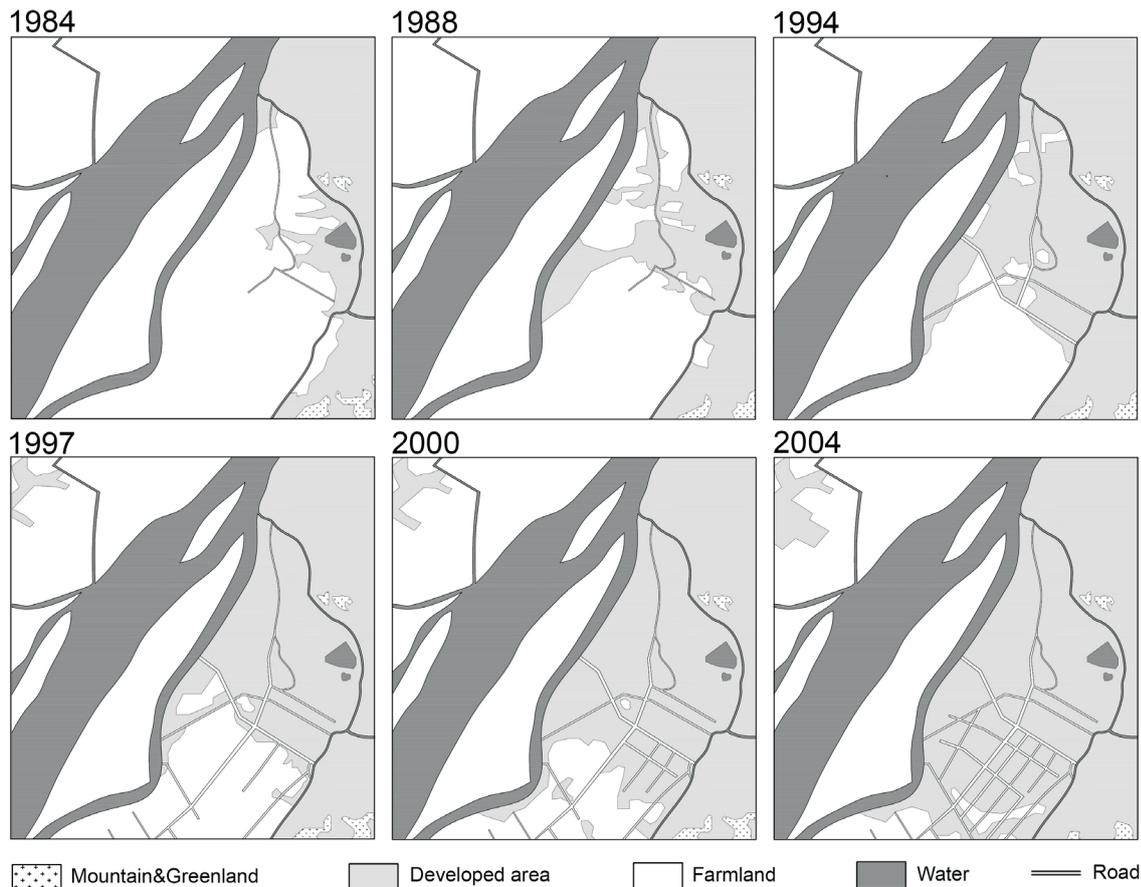


Figure 4. The changing process of road network and built-up area in the urban expansion of Hexi

Apartment, in the northern Hexi, which was also the prelude of large-scale construction in the north of Hexi.

In the *Nanjing City Master Plan (1991-2010)*, compiled in 1992 and started being implemented in 1995, the Nanjing Planning Bureau proposed the concept of Hexi as a new developing zone for the first time. The scope of the main city of Nanjing in the new plan also expanded by more than 1/3 to the southwest compared with 1983, which means the north and middle parts of Hexi were included in. It also positioned Hexi as a new urban area with residence as the main function, to accommodate the increasing population and people evacuated from the old city.

By the end of 2000, with the completion of several residential areas, a great number of residents, mainly college teachers, had moved in, thus promoting the emergence of large-scale commercial facilities. Around 2000, the 20 square kilometers in the north part of Hexi New Developing Zone was almost completed. There is no wonder why the road grids began to be observed in 2000. At the same time, the developed area kept expanding towards south, which continued into 2004, when a relatively regular road network took shape in the central part, and the urban expansion almost covered this region.

Overall, the road expanded from the north to the south, from the middle of the region to the west bank and east bank, while the developed area spread from the northernmost point as well as the east bank to west and then to south. 1994 marked the watershed year -- before that, the sprawl of built-up areas pushed roads westward, and after that, in the contrary, the growth of roads led the expansion of built-up areas.

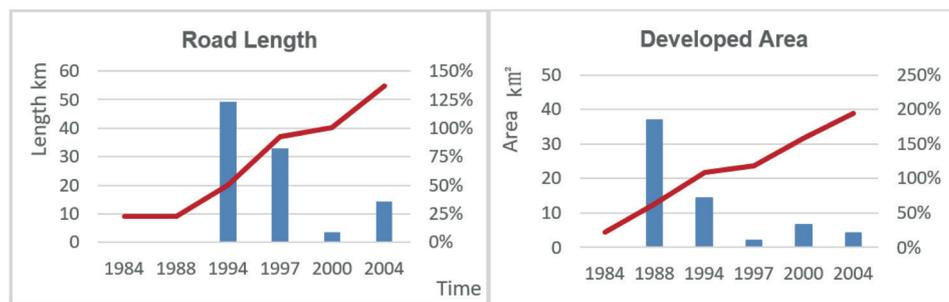


Figure 5. Changes in road length and built-up area during the initial urbanization of Hexi.

The largest growth in the road length was in 1997, with an increase of about 16.7 km, followed by 1994, with a figure of 11.2 km and the highest growth rate of 123%. The growth rate of built-up areas peaked earlier than the length of road, at about 180% in 1988. This phenomenon possibly resulted from the large-scale construction of resettlement housings in the northern Hexi during the period of 1985-1992, as mentioned above in the historical background.

It is interesting to see that follow up a significant decrease in the urbanization rate in 2000 after more than a decade's urbanization, the figures showed a clear rebound in 2004 reflected in the growth rate of road length. This was largely due to the new development opportunities brought by government's decision making. Dating back to 2001, in June, Jiangsu won the right to host the 10th National Games in 2005. After that, the *Partial adjustment plan of "Nanjing City Master Plan (1991-2010)"* was approved by the Standing Committee of Nanjing Municipal People's Congress, in which Hexi was listed as the key developing new zone of Nanjing main city. At the same time, Hexi was designated as the major venue of the 10th National Games. In the same year, the Nanjing government approved the *Hexi New Town Master Plan*.

In 2002, Nanjing City compiled the *Nanjing Construction Plan (2003-2007)*, in which stressed the priority of Hexi New Zone in Nanjing's urban construction. The same year, the Nanjing Municipal Party Committee and the Municipal Government approved the establishment of the Hexi Construction Command, which announced the official launch of Hexi New Developing Zone's construction. The year also saw the Olympic Sports Center start being built. As an important catalyst of the area, this large-scale public building was completed with high efficiency by the end of 2004.

It can be concluded that the germination of urbanization in Hexi New Developing Zone was a gradual process evoked under the influence of planned economy, and then triggered further development through large city events promoted by government policies.

#### 4. High-speed development in central area (2005-2018)

In 2005, with the successful hold of 10th National Games, Hexi ushered in the beginning of its rapid development phase. However, the pace of construction once slowed down a bit in 2006, in the background of national macro-control. In the second half of the same year, the 4th World Urban Forum was settled in Hexi, which brought it the second valuable development opportunity. In November 2006, the Hexi Convention Center (now called Nanjing International Expo Center) prepared for the Fourth World Urban Forum in 2008 broke ground, and the construction intensity in Hexi was upgraded again.

In 2008, with the relocation of municipal authorities such as Nanjing Quality Supervision Bureau, Environmental Protection Bureau and Civil Affairs Bureau in Hexi, its popularity was further boosted. In November, the Fourth World Urban Forum was held as scheduled. Till then, the 21 square kilometers in the central Hexi had taken shape with the promotion of the two large-scale cultural and sports activities. After the Forum, Hexi's construction trend headed towards the south part, where is positioned as a new high-grade urban area mainly for living and leisure. The construction of 15 square kilometers in the south was fully launched before the 2014 youth Olympic Games.

From 2005 to 2018, Hexi Newly-Developed District experienced the most concentrated stage of construction. We chose the most representative part, the core area of Hexi centered on the Olympic Sports Center, as the research object in this section to present its formative process.

#### 4.1. The formative process of road network

Through the annual road network drawn on the basis of the satellite images which can be traced on Google Earth since 2005, it can tell that the traffic structure was not formed at one time. We separate the arterial roads (here we refer to all of the expressways, arterial roads, sub-arterial roads as arterial roads) and branch roads with lines of different thickness, and highlight the newly-appeared roads as well as the removed roads in each year in these two categories respectively. An example of 2007 and 2010 is given (Figure 6).

By 2005, the arterial road frame was basically in place, except the part in the southwest, where several half-built dead-end roads left. Even Jiangdong Middle Road, the current broadest trunk road running from north to south through Hexi, also stopped at the southern edge of the study area before 2014, when it extended to the south of Hexi. During this period, a few changes happened. The connection between Yangtze River Avenue and the south end of Jiangdong Middle Road was firstly constructed in 2010, but then demolished in 2012, after which this interval of Yangtze River Avenue was rebuilt into an urban tunnel. Even though by 2015, the main road

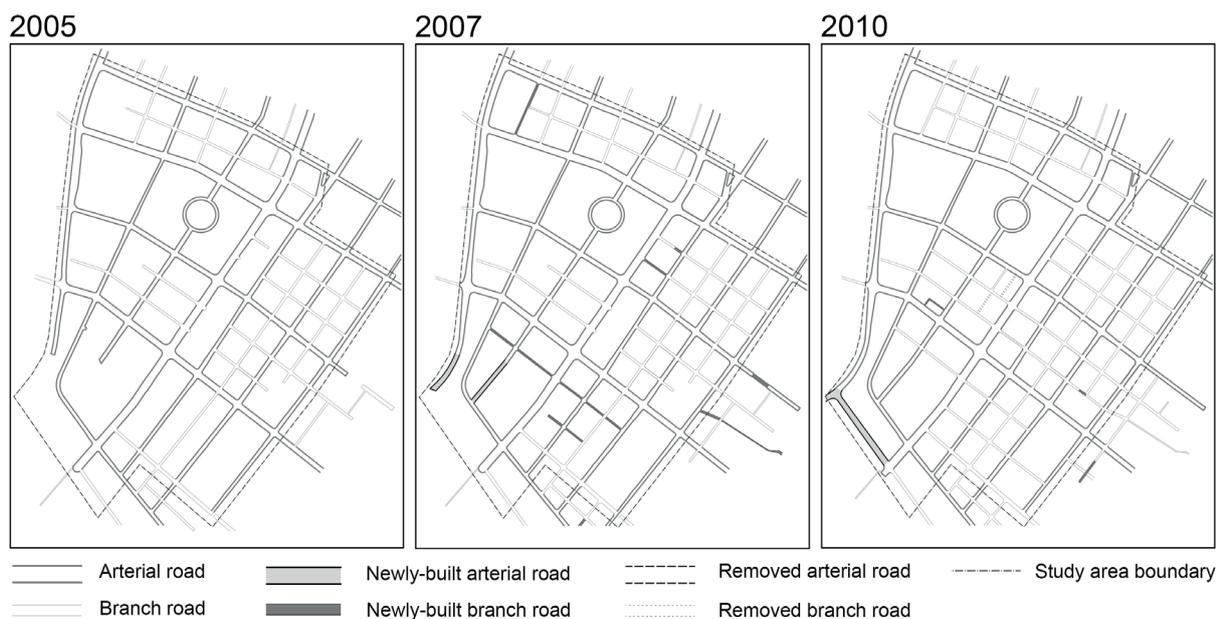


Figure 6. Development of road structure in central Hexi area

structure had basically stabilized, there was still a tiny change in the connectivity of Yanshan Road, due to the late completion of Nanjing Youth Olympic Conference Center located on its west side.

The gradual process of construction is more obvious on branch roads. There were considerable newly-built branches in this period, especially in the year 2007 and 2009. A very interesting phenomenon shown through the figure is that some roads, rather than being constructed at one time, were suspended somehow for several years before they were fully finished. Let's take a section of Fuchunjiang West Street as an example (Figure 7). For convenience, we refer to it as "A", and other changed roads involved in the discussion are also represented with different capital letters, while the relevant plots are named after numbers.

Looking back from 2008, it is easy to find road A had been remaining a half-built dead-end road for at least four years until it was opened up in 2009. The reason leading to this situation can be revealed if we check to which developers each plot was transferred by browsing through the completion status of the four plots in 2012. Actually, plot 2-2, 3-2, and 1-1 shared the same developer called Rongqiao Real Estate Group, and they were three phases of one residential project. Differently, plot 2-1 and 3-1 were sold to different developers. The earlier built interval of road A was an "expropriated road" constructed by the developer commissioned by the government, so was the interval between plot 2-1 and 3-1, just different developers. So Rongqiao Real Estate Group just paved the way within the scope of land it had purchased, leaving road A unfinished until the other developers built up the part they were responsible for. If we zoom in to check to mappings above in detail, it would not be hard to find this is not an isolated case.

Another phenomenon worth noting is that some roads disappeared somehow after their construction. For instance, in 2009, road B, C and D were built up, which was consistent with

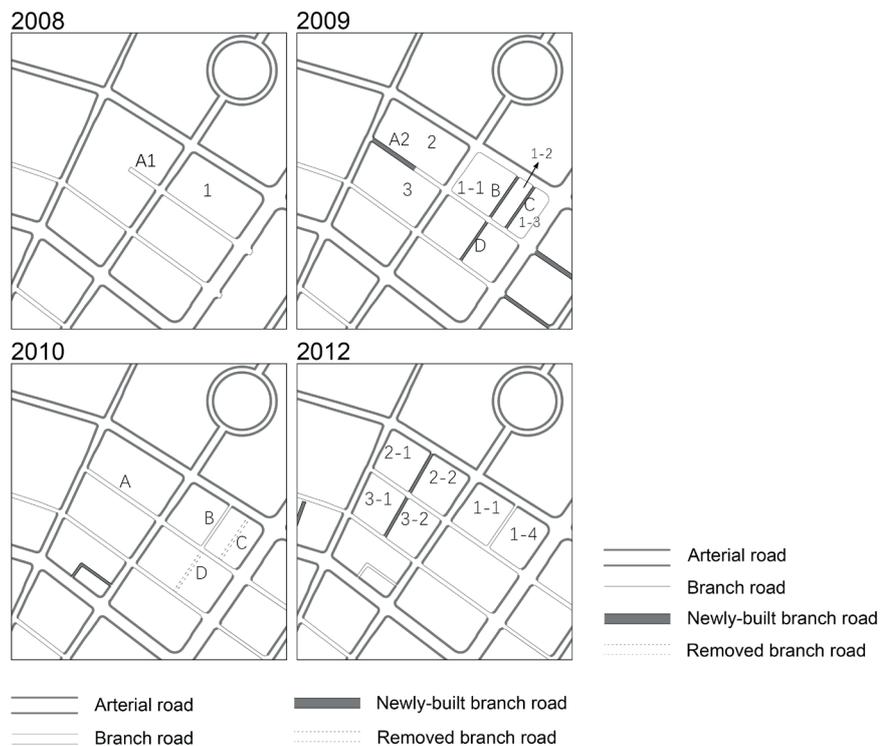


Figure 7. A case of changes in branch roads.

the initial urban planning. However, one year after, road C no longer existed. This also reflects the active participation of social economy in the realization of the new zone. The road B and C was firstly implemented, thus formed the three plots marked 1-1, 1-2 and 1-3 in the figure of 2009. Among them, 1-2 and 1-3, both initially intended for commercial use, were later sold to the same company. After the road being demolished in 2010, it could be observed on the satellite map that the reassembled plot 1-4 in figure of 2011 started being constructed as a whole. In this case, the land ownership had an impact on the shape of the road network.

Although the changes in road network seem to be relatively subtle, and sometimes the final results showed no distinct differences from the original planning, it is important to see from the several cases that except for the government, various stakeholders like developers also played negligible roles in the formative process of traffic structure in the new zone.

#### 4.2. Development of Plots

##### *The Plot Division*

Closely related to the construction of roads, the division of the plots was not done overnight as well (Figure 8). The histogram below shows the annual change in the plot numbers. It can be seen the figure has been on the rise steadily before 2014 and almost keeps stable after. Among them, the year 2007 and 2009 experienced the most distinct increase.

If we calculate the total number of changed plots in the period, either divided or consolidated, in each land utilization category, it can be clearly seen that residential takes the majority with a portion of more than 50%, followed by commercial office accounting for a quarter (Figure 9-B). Let's take the following case as an example to explain why residential land experience the most changes. The division of block 1 experienced several stages (Figure 10). In 2008, block 1 as a whole was still a vast tract of undeveloped land. According to the Announcement of the Public Transfer of State-owned Land Use Rights in Nanjing, plot 1-1 was sold in March 2007. It was the first plot to be separated from the entire block in 2009 and developed into a residential

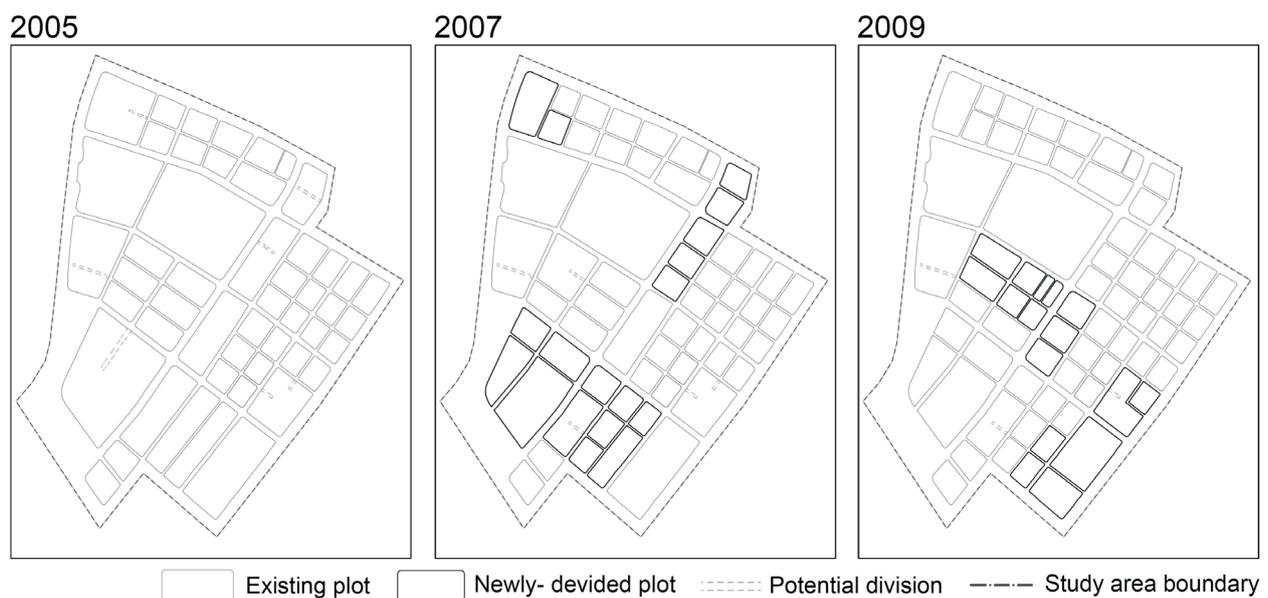


Figure 8. *Plot division process.*

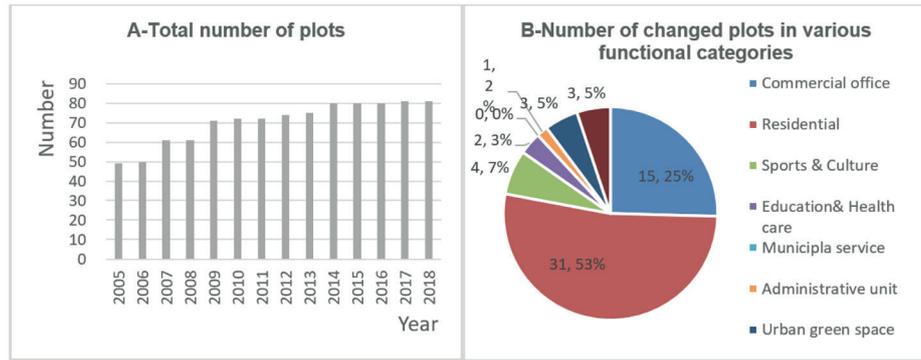


Figure 9. Changes in the total number of plots(A), and distribution of changed plots in various functional categories (B).

area. Following on that, plot 1-2, which also belonged to residential land, was transferred out in October 2007, then started building in 2010 and was separated from plot 1-3. This reflects that the division of residential plots partly relies on the land transfer sequence, since it is not necessary to complete the division at one time when the ownerships are not clear.

The division of commercial plots was concentrated on the “Commercial Axis” – the list of plots adjacent to the east of Olympic Center. The axis consists of two construction phases in our study boundary, the part in the north of Hexi Avenue was planned as phase I and the one in the south was phase II. The construction of the projects in phase I started ahead of the further division of the plots, in the contrast, for the second phase, plots division generally went before the construction. The reason led to this difference roots in the economic pattern changes, also political and cultural intentions.

In preparation for the upcoming national games in 2005, the supporting facilities around the main venue-Nanjing Olympic Center, went all out to speed up construction. The first phase of the CBD, adjacent to the stadium in the west, was of great importance to present a glorious image of the new zone, so its construction process was vigorously promoted. The media once reported, “Sixteen high-rise buildings in Hexi CBD are being built at the rate of one storey within three days”, and addressed this high efficiency as “Hexi speed”. In this atmosphere, the construction of buildings was prior to the branch roads among the plots, since these roads need not be put into use by the National Games, while the high-rise commercial buildings need to be erected to display a better urban landscape to the whole country.

Similar to the construction background of phase I, phase II was also promoted by an important city event- the 2nd Youth Olympic Games held in 2014. After Nanjing’s successful bid in 2010, the construction of major projects of phase II was accelerated to meet the upcoming Olympic event. Different from phase I’s strategy of “buildings come first and industries are introduced later”, phase II aims at the simultaneous promotion of construction and industry, so as to achieve the higher positioning and better project quality than phase I (Nanjing Daily, 2011).With the golden decade of Chinese real estate, the commercial value of Hexi has greatly increased by then, which can be seen from the rise of average new house price in Hexi (Figure 11). On the basis of economic accumulation beyond original expectations, Hexi CBD elevated its positioning to “a high-standard financial center”. Actually, most plots of phase II had been transferred out between 2007 to 2009, mainly to financial institutions and corporate headquarters, to enhance “headquarter economy”. In this new situation, the improvement of supporting facilities became the basic condition to attract more high-quality investments.

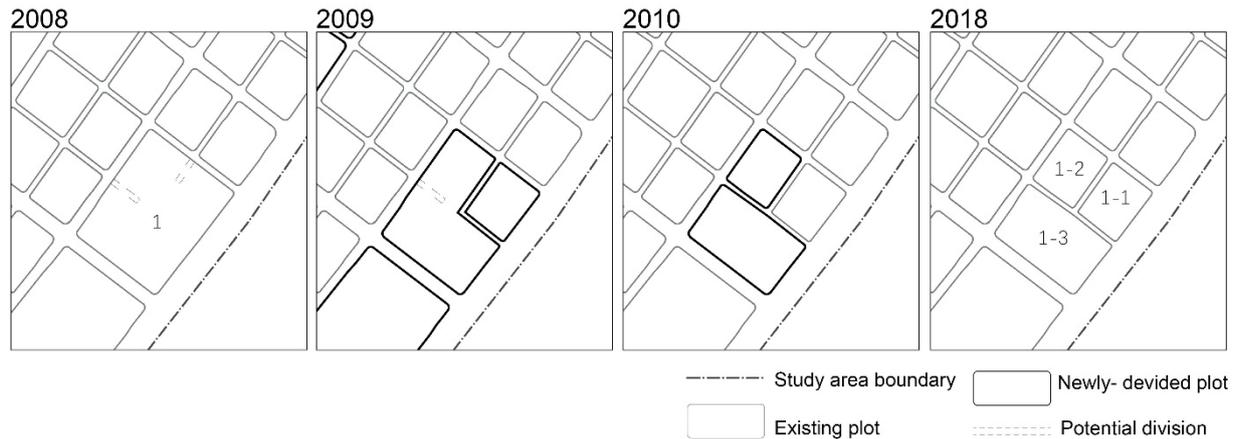


Figure 10. An example of the deviation of residential plots.

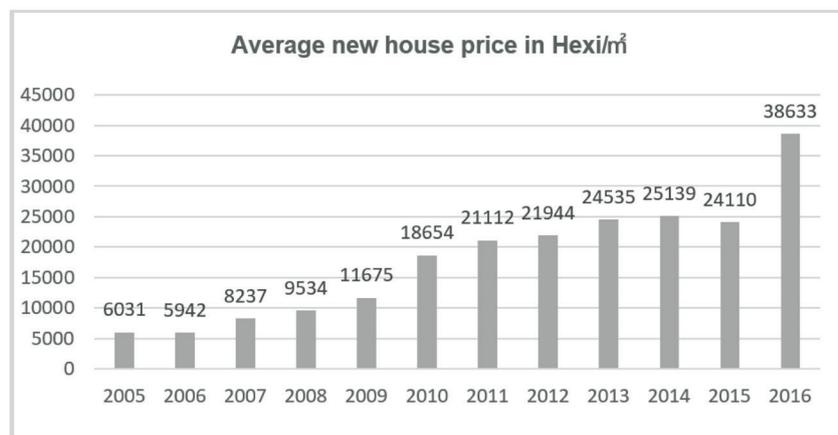


Figure 11. Changes in the average price of new house in Hexi. (Source: <https://blog.csdn.net/kwame211/article/details/86489571>)

### Construction time sequence

In order to get a clearer view of the construction time sequence, the boundary of built-up area was outlined annually. The developed zone showed an overall trend of spreading from north to south, which is coincident with the original plan. More specifically, the progress can be described as three phases. In phase one, the north side surrounding the Olympic Center was developed firstly, then it jumped to the south where some large plots for public facilities followed up. In the last, the two developed regions spread out gradually into a continuous and relatively complete one.

However, in the built-up area that rapidly expanded and gradually stabilize, it should not be ignored that some plots were lagging in development, leaving some gaps, the existence of which is solid evidence to prove that the implementation of the new zone should not be easily defined as a "one-shot" process. Let's take an example with a gap in the center of the study area, which has been left undeveloped yet until 2018. In the original planning, it was a part of the planned "Commercial Leisure Axis", which consisted of a row of plots stretching from the west border of our study area to the east side (Figure 12). The plots within the axis were initially designed to be of relatively low floor area ratio and serve the neighborhood as a center for leisure and

entertainment. As we can see in the land use plan, the “gap” plot in our discussion was planned to be a green space with a strip of commercial land around it. Actually, it was in the early 2005 when the whole piece of land, with a specified FAR of no more than 2.5, was transferred to a Taiwanese developer, together with the two residential plots and a commercial plot in the north. However, after having been barren for more than a decade, the majority of the land was still unused except the two high-rise commercial office buildings built up respectively at the northwest and northeast corner of the plot in 2017. The media reported this stagnation in this way, “The project, which took more than a decade from land acquisition to finalizing the design, was once announced to start construction in 2010 but soon stalled. (Sohu News)”

On the satellite map of 2018, it can be seen the early stage of the construction has started. When the author went on a field investigation there in April 2019, a large-scale urban complex, which was seen just start from scratch on the satellite map of 2018, was about to be completed (Figure 13). Only a month after, by the paper was finished, the complex ushered in its opening ceremony. What happened during the 12 years in between was supposedly a negotiation between the developer and the government. On the one hand, the developer deliberately slowed down the pace of development to earn a premium by hoarding the land. It also negotiated with the authority to make changes of the original planning, for example to raise the planned FAR. This can be easily tell from the final implemented plan – with a construction volume of 0.73 kilo squaremeters in total, including four commercial office buildings over 100 meters, the actual FAR reaches around 8.5, which is much higher than the initially planned figure. On the other hand, the government realized, in all probability, that low FAR is not suitable for presenting the image of the business center, and more importantly, they could not achieve break-even by selling the land at a low price. The increase of FAR can bring supplementary land revenue to the government and also a wider profit margin to the developer, which is a win-win situation. To sum up, what led to the phenomenon of the white space was the game between government planning and social capital needs.



Figure 12. The “Commercial Leisure Axis” in the original land use plan of central Hexi. (Source: Analysis on the urban design of Hexi riverside center of Nanjing, Design Institute of Southeast University).



Figure 13. The recent status of the plot shot in April, 2019, a shopping mall was in construction (author's photograph).

As for the respective construction time sequence of various functional land, attention is mainly paid to residential and commercial plots, since they take the majority and impressionable. For residential areas, the overall trend of development is from the east to west, from the vicinity of the central stadium to further areas. The building sequence of commercial land also presents a similar trend in spatial distribution. Overall speaking, both residences and commercial land were developed from the places close to old city of Nanjing and the Olympic Sports Center.

#### *Construction volume of various functional plots*

The construction volume of different functional plots various. Figure 14 uncovers the changing process of the total area of built-up plots and the proportion of each functional plots takes. It is obvious that residential land always takes the lead in the proportion, and its development was relative earlier – most of the increment was concentrated in the period before 2009. Sports and cultural land has been accounting for the second largest proportion and its growth is phased. Land for neighbourhood facilities such as education & health care and commercial office show an increasing trend since 2009.

Through the separate charts showing growth rates of several major functional land-uses (Figure 15), it is easy to conclude the relationship between the construction time sequences of residence and other supporting facilities. A great volume of residences had been built by 2009, while other supporting facilities were not sufficient yet. When a sharp decline appeared in the growth rate of residence after 2009, the construction of supporting facilities such as commercial office, education and medical facilities started experiencing a considerate increase.

If we mapping the distribution of the planned residential plots and commercial plots, as well as the actual built-up ones by 2009, we can see that there were still quite a few unbuilt planned residential plots, and most commercial facilities around residence areas were undeveloped. The most possible reason that led to the distinct decrease in the residence construction could be that the developers were waiting for the improvement of the neighborhood facilities, which would definitely raise the housing prices. It is especially obvious for an upscale residential areas along the west riverside – Renheng River Bay City. The large piece of land was transferred to the developer as early as 2006, but it was not until 2009 when the first phase of the project was started. The construction of the four phases lasted for 7 years until 2014. During the period, the opening prices of the property have undergone a tremendous rise, from 16153 RMB/m<sup>2</sup> for the first phase, to the second phase of 22765 yuan, then to the third phase of 26896 yuan, and finally

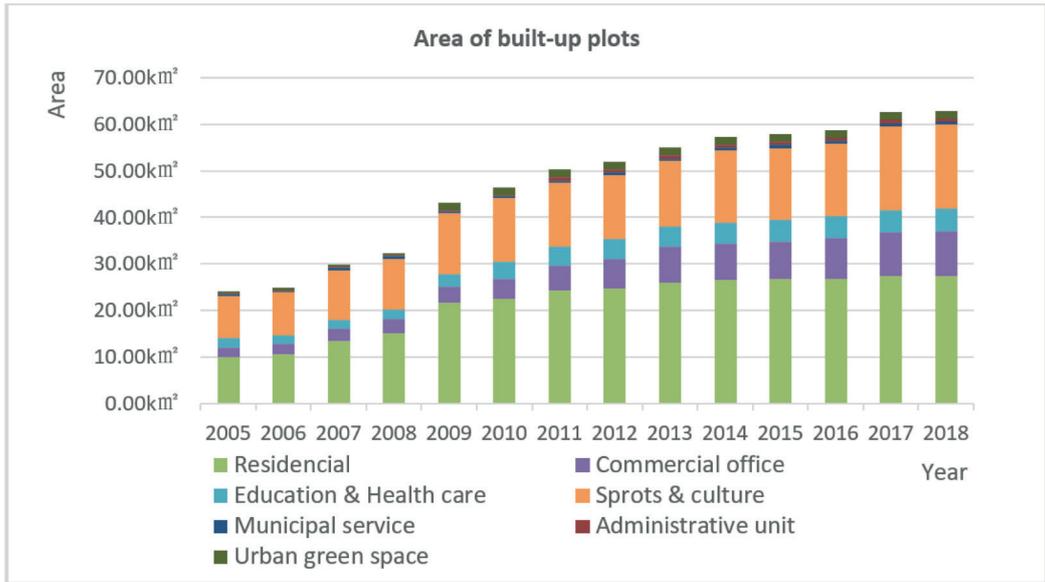


Figure 14. Area of built-up plots in various functional categories.

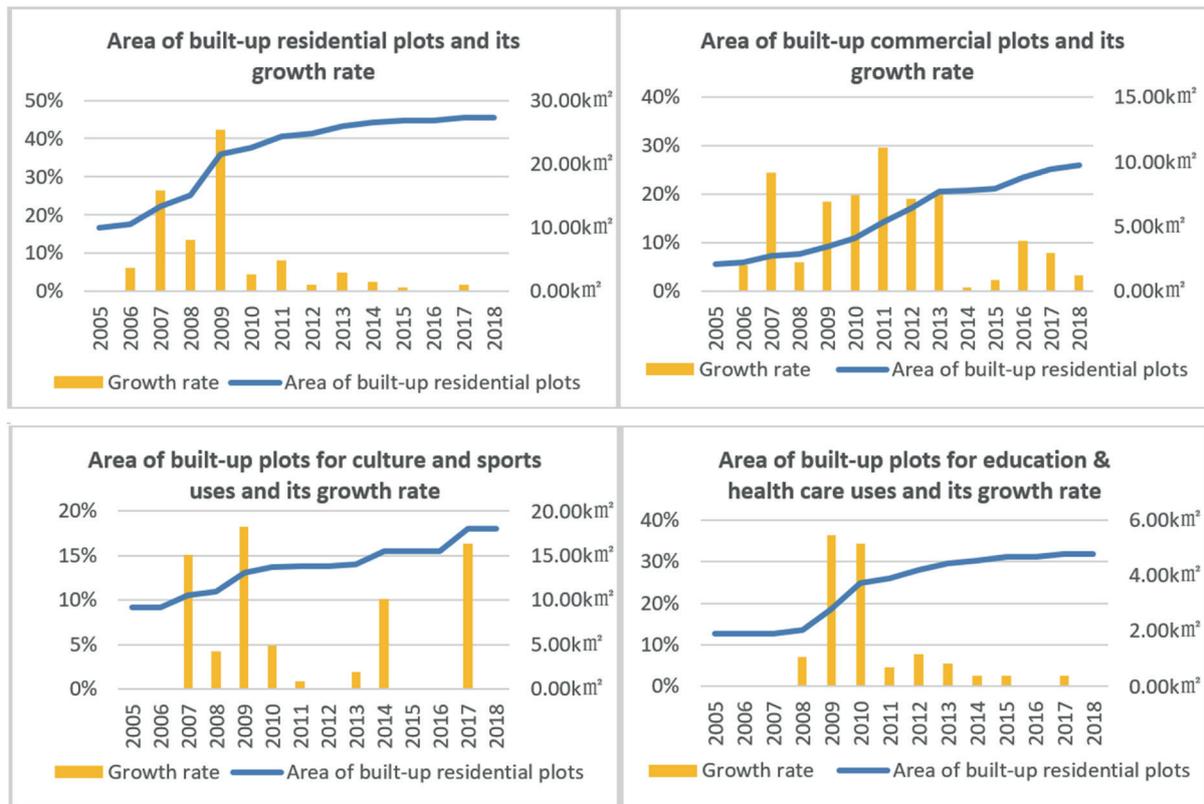


Figure 15. The respective annual growth rate of built-up residential areas and commercial land.

40340 yuan for the last one. It cannot be denied the developer's pursuit of maximum interest has affected the development process to some extent.

### 4.3. Buildings

In the urban planning context of China, a regulatory plan is important in controlling land rent and remise through hard rules on the capacity (mainly reflected in height and floor area ratio) and function of the land. Then at the phase of urban design, the basic plane form of each plot, including property line, fire fighting access and even the position of towers are further stipulated. Regulatory plan and urban design constitute the upper planning, which means there is no more other control to urban form from "the top". Land transfer and construction implemented under the restriction of this framework can be regarded as the operations at the "bottom", but there is still room for changes. In this case, through the analysis of the actual layout, height distribution, FAR and coverage distributions of buildings, it can be revealed to what extent the urban form of Hexi has been determined by the upper planning and influenced by the "bottom" operations. Here we chose residential buildings as a presentative object, because it is more sensitive to the market, cultural environment and other external conditions.

#### *The layout of residential buildings*

The orientation and arrangement of buildings are themselves part of urban form. The layout of residential buildings (Figure 16) shows that buildings with an angle to the streets account for the majority, at around 64%, while those parallel with the streets only takes less than 40%. The residential buildings not parallel to the road network mostly face south. This indicates the lighting requirements is more decisive in the housing orientation, instead of following the planned direction of urban road network. Indeed, the traditional Chinese dwelling culture of facing south is quite stubborn and it is rarely changed by planned road structure.

#### *The building height distribution*

Building height is mainly determined by urban design and also the developer's trade-offs of the interests, they always tend to make the best use of space within the allowed height at the least cost. It impacts people's perception of the street interface. We categorize the buildings into four intervals based on their floor numbers, which are villa /townhouse, multi-storey residence, small high-rise residence and high-rise residence. Small high-rise residential buildings take the largest proportion, approaching a half, followed by high-rise and multi-storey residence with similar figures around 20%. The villa/townhouse account for the least with a percentage of 11% (Figure 17).

The distribution of the heights of newly-built residential buildings changed each year (Figure 18). Small high-rise residence has always been a major component by 2009, while high-rise buildings took the lead from 2013. Among the three years inbetween, villa/townhouse showed a distinct rise and peaked with a percentage of 90% in 2012. Overall speaking, residential buildings tend to be higher over time, which reflects the changes in the market needs.

If mapping the height distribution of residential buildings geographically (Figure 19), we can see the few villa/ townhouses are mainly concentrated along the west river bank. The small high-rise residences, which were built relatively early among the four categories, spread out almost everywhere.



Figure 16. The layout of residential buildings.

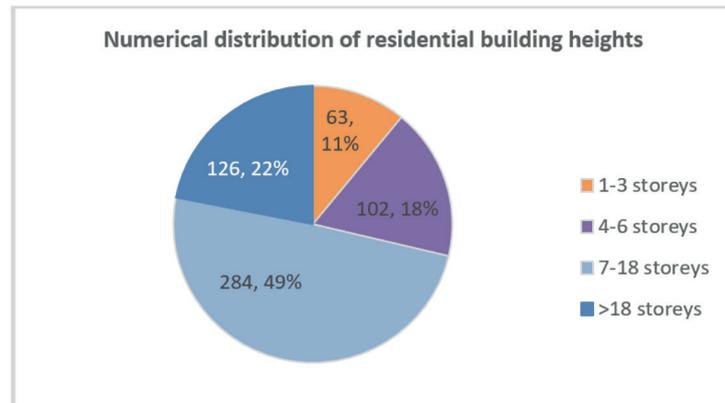


Figure 17. Proportions of buildings in each height interval.

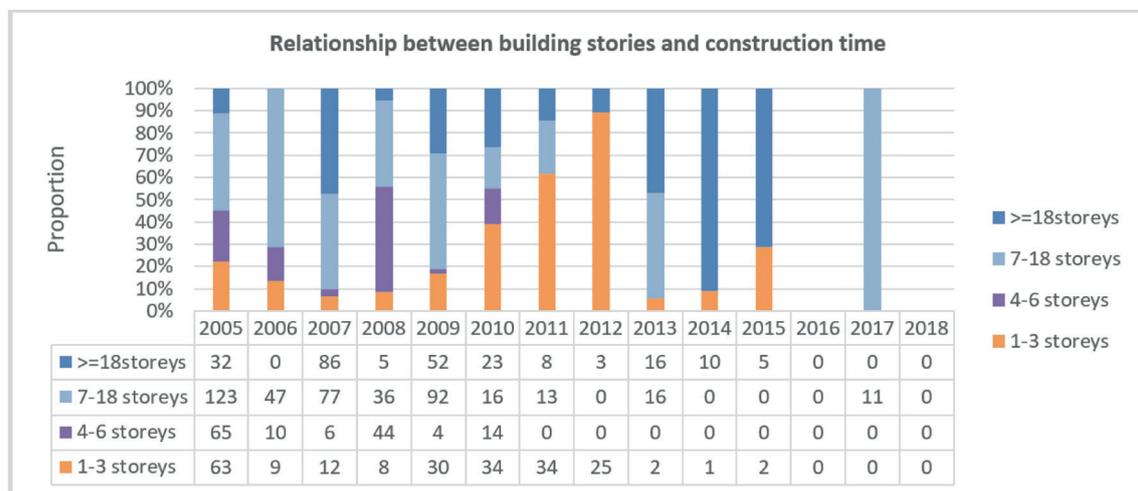


Figure 18. Relationship between building storeys and construction time.

### The FAR and coverage distribution

Floor area ratio is an important dimension of urban spatial form. The number of FAR values falling within the range of 1.2 -2.0 accounts for almost half (Figure 20). Considering the construction time, we note that residential areas with a relatively low FAR within the range of 1.2-2.0 were more popular by 2009 (Figure 21), and this index usually corresponds to small high-rise residential buildings not higher than 11 stories, or sometimes to buildings with 18 stories. Proportions of values in the range of 2.0-2.5 and 2.5-3.0 are very close, about a quarter respectively. The residential areas with FAR in the former interval started to become more common from 2019, while those in the latter range existed almost throughout the period. After 2007, low-density residence, which only takes apart 4% in the total amount, has become an old fashion. In general, FAQs of residential land are mostly strictly in accordance with planning indicators.

When it comes to building coverage of residential areas, the leading position is taken by the value range of 10%-20% , with a proportion of more than 70% (Figure 22). Residential areas with a relative high coverage of 20%- 30% account for a quarter, while there is no figure surpassing 30%. Overall, the coverage shows a declining trend over time, in contrast to the upward trend of FAR.

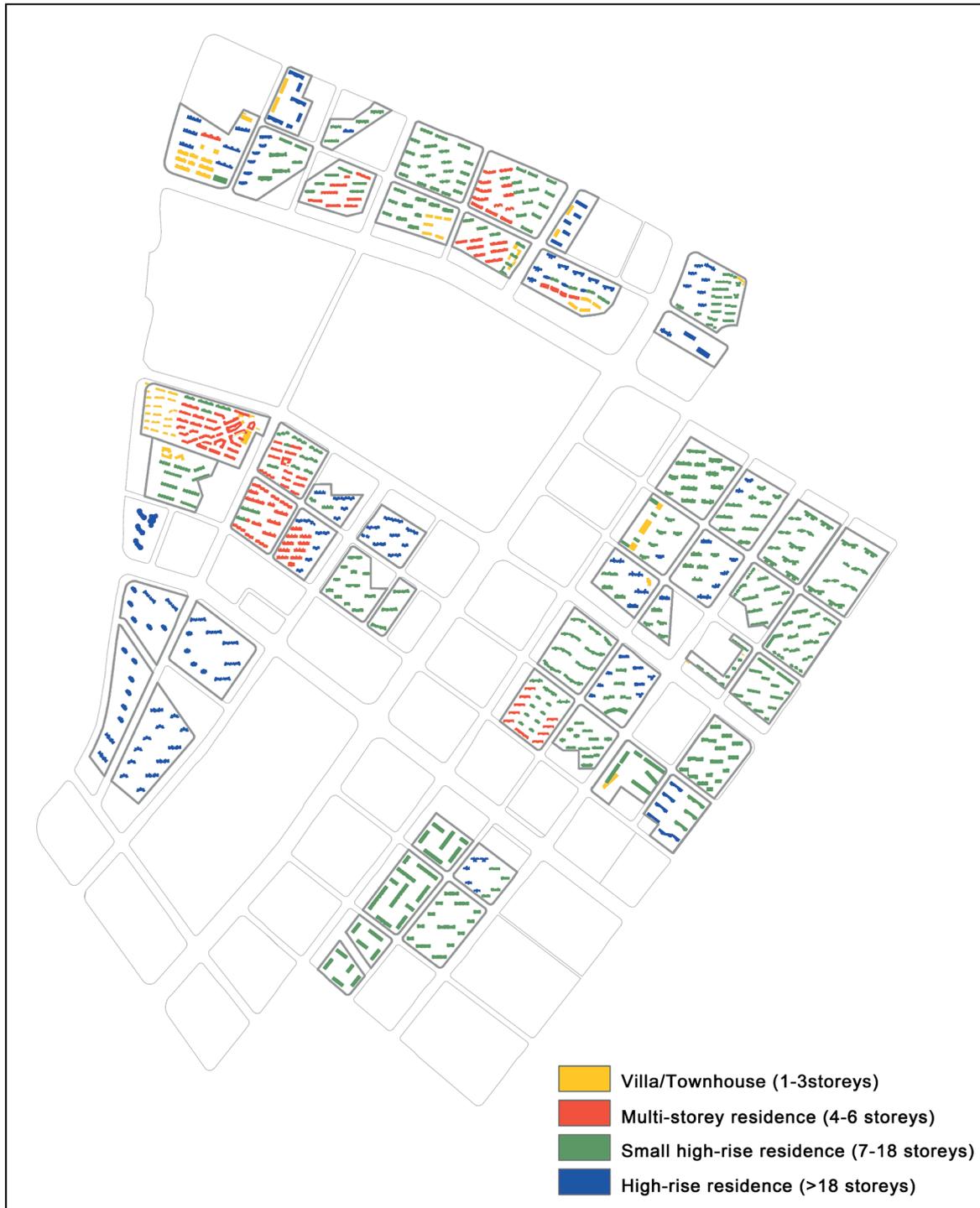


Figure 19. The geographical distribution of residential building heights.

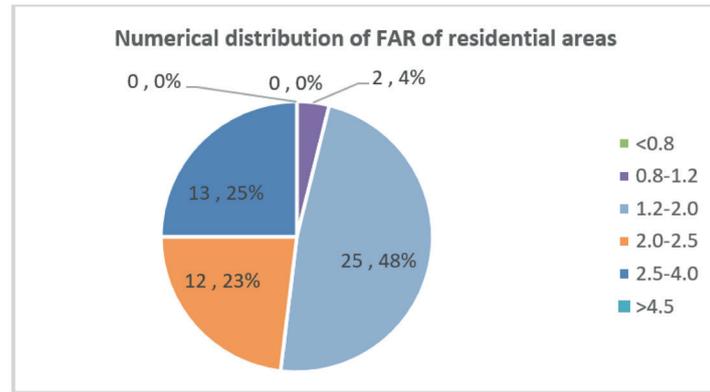


Figure 20. Numerical distribution of FAR of residential areas

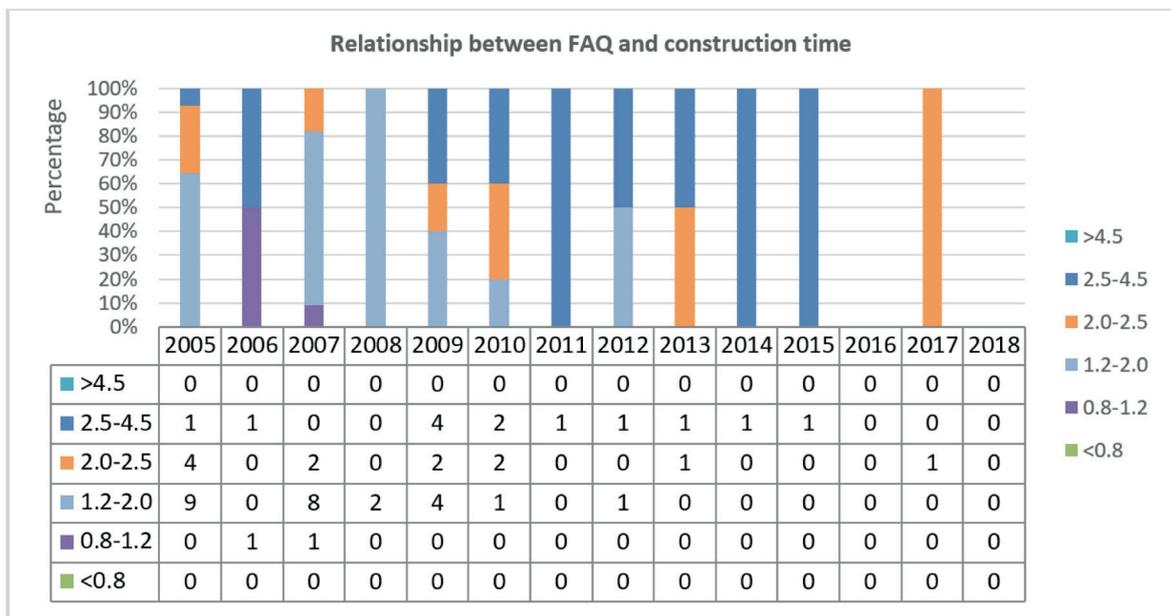


Figure 21. Relationship between FAQ and construction time

### 5. Discussion/Conclusion

Plot analysis has been wildly applied to trace the morphological process of urban forms, but largely in the Western World, and among the limited existing studies aiming at Chinese cities, new developing zones, which play a significant role in the urbanization of the country during the past three decades, have rarely been noticed. In this study of morphological process of Hexi New Developing Zone in Nanjing, progress has been made in rectifying this deficiency. The paper also proves that Conzenian approach can also be taken for reference to the morphological study on new developing zones in China.

Catching up with the early days of Reform and Opening-up, the germination of Hexi’s urbanization was firstly evoked under the influence of planned economy- the construction of the massive modernist settlement, Nanhu New Village, which served as the first step of the development in Hexi. Followed by the first introduction of the concept of “Hexi New Developing Zone”

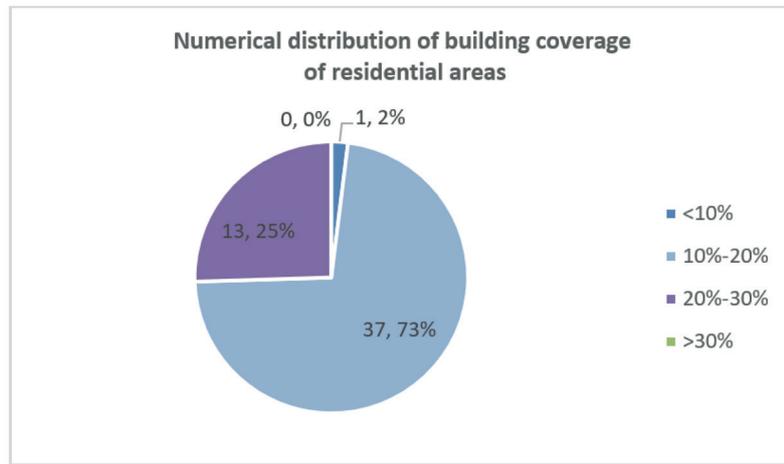


Figure 22. Relationship between coverage and construction time.

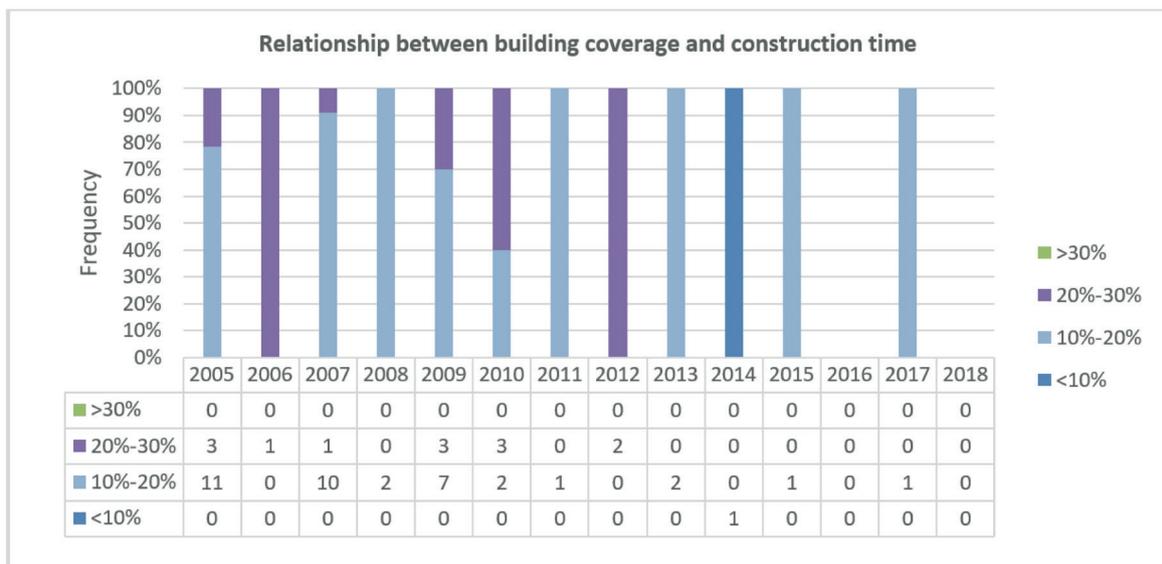


Figure 23. Relationship between coverage and construction time.

in the *Nanjing City Master Plan (1991-2010)* compiled in 1992, Hexi was positioned as a new urban area with residence as the main function, to accommodate the increasing population and people evacuated from the old city. In line with this positioning, the initial stage of the development was mainly concentrated in the construction of the vast residential areas in the north Hexi.

When we take a closer insight into the formative process of the core area, where centered with the Nanjing Olympic Sports Center, it can be seen that the urban master planning led by the government indeed determined the overall urban structure of Hexi, however, the time sequence and implementation degree of construction cannot be completely controlled by the original plan, which can actually be revised to balance the various interests. Geographically speaking, the area was developed from the places close to old city of Nanjing and the Olympic Sports Center, gradually to south. In view of time, the large-scale cultural and sports facility, Nanjing Olympic Sports Center was built first, as a catalyst for the development of surrounding areas. Then residential areas followed up on the construction to introduce households and

increase popularity of the area. The rapid growth in housing mainly occurred between 2005 and 2009, after which other supporting facilities such as commercial offices, education and medical facilities also caught up. When the development of the land for other functions was basically completed and entered a relatively stable phase, the construction of large-scale public buildings reappears, just like a final chapter echoing the opening.

Through the analysis of ground plan of the study area, the following results can be concluded. In terms of streets, the general road structure was founded by planning, while construction order of some branch roads, which were expropriated roads entrusted by the government, was largely influenced by the developers who acquired the land property. When it comes to plots, the division and land use of plots were mainly determined by planning, but the sequence of plot division and the construction cycle were influenced by the developer to a great extent, which was reflected especially in residential and commercial plots. In contrast, the interest game between social capital and government could lead to the revision of the planning to fulfill the social economic needs. In respect to buildings, with a focus on residential buildings, their layout mainly depends on the demand for sunshine and daylighting, which is inseparable from China's deep-rooted living culture. The building heights tended to increase over time, accompanied by the rise in FAR and decline in the coverage, which also indicates the growth of commercial value of Hexi.

The study has revealed that rather than a pure-government-led behavior, the morphological changing process of the new zone is driven by diverse forces as commercial values, cultural intension and social activities. Top-down planning built up the skeleton of the new zone, and the bottom-up social economic demands filled the flesh and blood of it. These interwoven forces complement each other, leading Hexi to where it is today.

## 6. Acknowledgements

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