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THE ECONOMY INTERPRETATIONS OF MORPHOLOGICAL TRANSFORMATION OF WORK-UNIT NEIGHBORHOOD IN CHINA: A CASE STUDY OF KUNMING (1960–2010)

Abstract: The work-unit residence is a residential mode formed under the special Chinese "work-unit system" during the period of the planned economy. Since the 1960s, a large number of residential areas have been built to solve the problem of accommodation. Selecting Kunming iron and steel plant in the six time nodes of 1960, 1970, 1980, 1990, 2000, 2010 and the six neighborhoods as the research sample, the author adopts qualitative and quantitative methods to have a comparative study of the six neighborhoods in terms of residential morphology like the plots and street system, block plan, building density, plot ratio, building scale during the six time nodes. The following conclusions can be drawn: the residential morphology only enjoyed minor changes in the first four time nodes, while that has changed gradually ever since 2000 and greatly ever since 2010. According to the concept of a morphological period from the Conzen School, the changes of physical space are closely related to politics, economy and culture. Therefore, the economy should play an important role in the transformation of the work-unit residential neighborhood. Based on the changes of work-unit residential neighborhood in the past 50 years, this paper analyzes the connection between the changes of the neighborhood form and the economy from the two following perspectives: the economic system which transforms from the planned economy to the market economy, and the structural transformation of the economy from the supply side to the demand side.

Keywords: Work-unit, Neighborhood morphology, Economic system, the structural transformation, Kunming Iron and Steel Plant.

Introduction

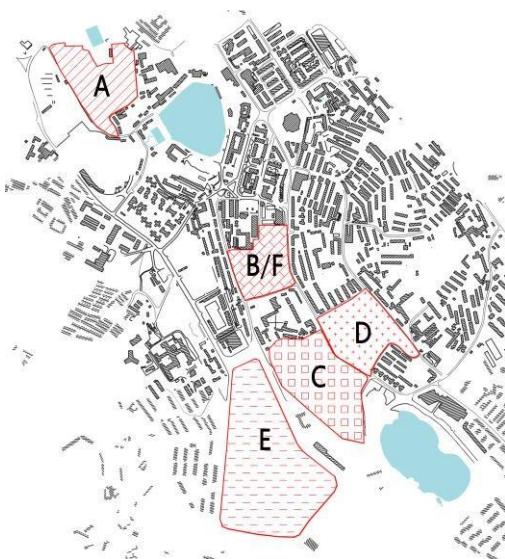
After the People's Republic of China was founded, the work-unit system emerged in the period of the planned economy, and transformed and disintegrated in the period of the market economy. The development of the work-unit residence has undergone different stages of the equal division of the welfare work-unit space, the homogeneous market-oriented residence, and the insurance system accompanying the rise, development and transformation of the work-unit system. In this process, the economy evolutions changed the driving force and the functional mechanism of the work-unit residence development radically, affecting the evolution of the residential space into the work-unit [1]. The economy has become an important force shaping the spatial form of the work-unit residence; the residential form in the work-unit has accordingly shown different morphological characteristics in the different periods. The paper, with a case study of the Kunming Iron and Steel Plant and the perspective of the urban morphology of the Conzen School, analyzes the internal connection between the change of the neighborhood form and China's social systems in different periods from the following two perspectives: the economic system which trans forms from the planned economy tot he market economy, and the structural transformation of the economy from the supply side to the demand side.

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1. Methodology

1.1. Sampling

In this paper, the An' ning Iron and Steel Plant in Kunming is selected as a typical sample of the work-unit system. The sample is located in An' ning City, southwest suburb of Kunming, with the No. 320 National Road in the north, the No. 019 County Road in the west, the No. 215 Provincial Highway in the east and the Kunming beltway. The Plant was built in 1939, and after 1949, it gradually developed into a typical Chinese work-unit society integrating production and life with the impact of the work-unit system. The production, labor, housing and logistical support of the staff and workers are settled within the work-unit. In order to solve their housing problem, the Kunming government has constructed a large number of residential quarters ever since the liberation in 1949. Over time, their shape has also changed. The authors choose five typical quarters of the Plant since the 1960s as a sample: the quarter built in 1960s (A, a residential area of 5.34ha), the quarter built in the 1970s (B, a residential area of 3.79ha), the quarter built in the 1980s (C, a residential area of 7.40ha), the quarter built in the 1990s (D, a residential area of 5.05ha), the quarter built in the 2000s (E, a residential area of 14.44ha), and the quarter built in the year 2010 (F, a residential area of 5.34ha) (Figure1)



A: Work-unit Residence in the 1960s B:
Work-unit Residence in the 1970s C:
Work-unit Residence in the 1980s D:
Work-unit Residence in the 1990s E:
Work-unit Residence in the 2000s F:
Work-unit Residence in 2010

Figure 1. Location of the Research Samples

1.2. Research Methods

Originating from the urban space study in geography, the early theory of urban morphology focused on the connection among various forms of settlements, topography, geographical environment and traffic routes. The study of urban morphology was a common topic until the early 20th century. As an important component of the urban science, the study of urban morphology, engaging the multiple disciplines, is open and comprehensive. Its theoretical research scope includes the research on the urban function, the town planning analysis the research on urban history, the research on urban spatial morphology, the research on environmental behavior, the research on architectural method and so on^[2]. Drawing on the analysis method of the town planning in the Conzen School and the actuality of the Chinese work-unit residence, we design the following research methods in this article. A combination of qualitative and quantitative research methods is adopted, the former playing the dominant role.

Qualitative Research

By using the methods of historical longitudinal comparison, we compare the morphological differences of the residence, the division of residential plots, the street system, the building layout, the building density, the plot ratio, the building scale of the same plant in different time nodes. Meanwhile, we rely on economic policies and systems to analyze the connection between the above mentioned aspects and the structural transformation of the economy, and the change of the economic system. It is hoped that the analysis can shed light upon the change pattern of the urban form and the factors resulting in the change pattern. According to the map of the urban history of An'ning City, combined with typical examples and field survey, the morphological features are delved into the ones based on the existing residentialform.

1.3. Data Collection

The data is based on the historical map of the sample provided by the Planning Institute of the Kunming Iron and Steel Plant and its archive, Google map, and the field survey. All the data is rendered into CAD drawing.

2. Results and Discussions

2.1. Results

Change in the division of the residentialplots

In America and countries of Europe, land plot forms the basic unit for development and construction [3]. Jointly acting with streets and valleys as well as blocks, they play a decisive role in urban physical, spatial, morphological characteristics and development patterns. Due to the occupation of large quantities of urban land, the closed state and not open to the outside world, the work-unit community comprises a layout pattern of the big block. Its division of the interior plot is mainly constrained by topography. The research illustrates that residential plots between the 1960s and the 1990s were distributed parallel to the contour, such as residential plot A divided into 33 plots by the terrain, each with an average size of 0.13ha, B divided into 26 plots, each with an average size of 0.11ha; C divided into 23 plots, each with an average size of 0.27ha; D divided into 22 plots, each with an average size of 0.16ha. Since the 21st Century, the land use is divided in a simple style because of the more intense land development and the reduced influence of topographic factors on the plot division. For instance, residential plot E is divided into 35 plots by topography, each with an average size of 0.36ha; residential plot F is divided into 10 plots by topography, each with an average size of 0.30ha (Figure 2).

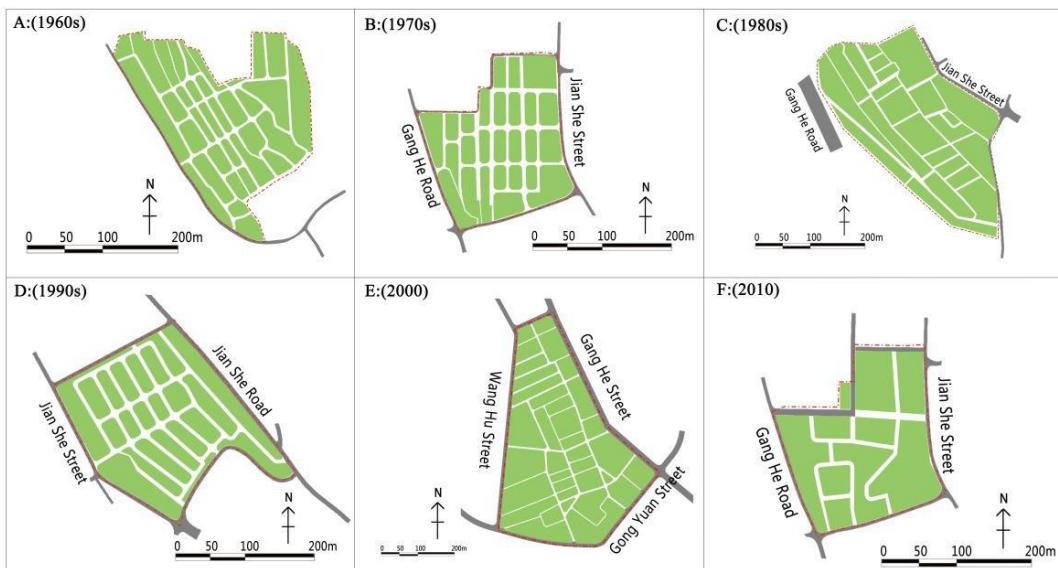


Figure 2. Evolution in the Division of Residential Plots

Evolution of streets and valleys

The system of streets and valleys is an important component of the residence texture, and the skeleton of the residence form. In the sample, the density of the road network was 42.36km/km² in the 1960s, 47.94km/km² in the 1970s, 40.04km/km² in the 1980s, 40.70km/km² in the 1990s, 29.44km/km² in 2000, and 28.31km/km² in 2010. In a word, the density of the road network changed little from the 1960s to the 1990s, and obviously decreased in 2000 and 2010. It can be concluded that the small block mode in transformed into the large block mode (Figure 3).

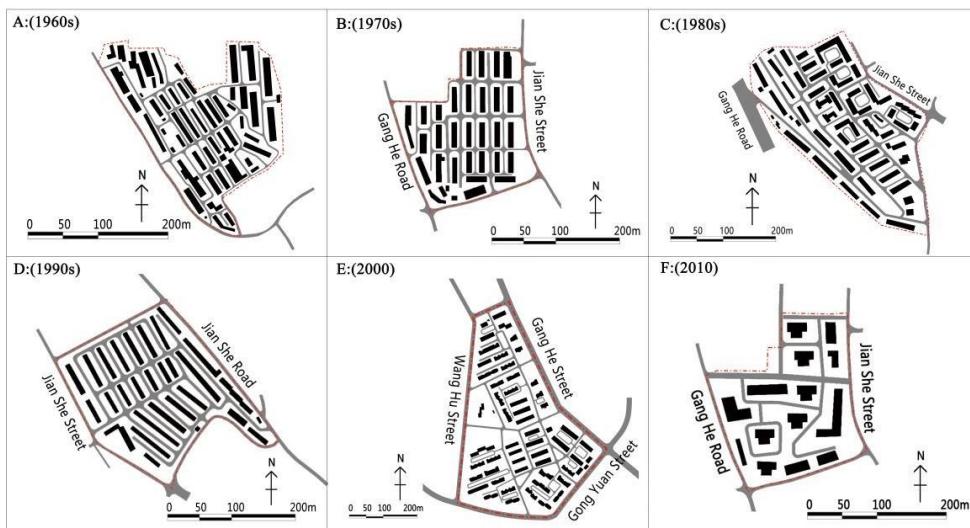


Figure 3. Evolution in the System of Streets and Valleys

Evolution of the building layout

During the period between 1960 and 2010, the sample shows four kinds of architectural layouts: the first is the determinant layout, the second is the determinant and enclosing type, the third is the combined layout of determinant and the fourth is the combined layout of point plus group. The architectural layout belonged to the first type in the 1960s, the 1970s and the 1990s, that belonged to the second type in the 1980s that belonged to the third type in 2000, and the newly built layout belonged to the third type in 2010.

Evolution of the building density

The building density reflects the ratio of vacant land and aggregated buildings within a given land area. The building density of A, B, C, D, E and F in the sample is 30.42%, 28.54%, 24.57%, 21.96%, 19.41% and 23.14% respectively, showing a gradually decreasing trend. At the same time, the scale of the green space and the public space changes from the narrow and small space to the open and largespace.

Evolution of the plotratio

The plot ratio is an important index to measure the intensity of construction land use. The plot ratio of A, B, C, D, E and F in the sample is 0.92, 1.14, 1.23, 1.32, 1.16, and 2.77 respectively, showing a gradually increase trend. In particular, the plot ratio of residential area increased significantly in 2010. It shows that the land use intensity in construction of residential area has obviously strengthened in this period.

Evolution of the building scale

During the study period, the building scale in the first five segments of the sample residence had little change, and the building scale of F changed greatly in 2010. The residence was mainly low buildings in the 1960s, with an average building distance of about 10 meters and a

construction scale of about $30m \times 8m$; the residence was mainly the multistoried buildings in the 1970s, with an average building distance of about 15 meters and a construction scale of about $40m \times 8m$; the residence was mainly multi-storied buildings in the 1980s, with an average building distance of about 20 meters and a construction scale of about $40m \times 10m$ or $60 \times 10m$; the residence was mainly the multi-storied buildings in the 1990s, too, with an average building distance of about 17 meters and a construction scale of $55m \times 9m$ or $38 \times 9m$; the residence was also mainly the multi-storied buildings in 2000, with an average building distance of about 20 meters and a construction scale of $43m \times 12m$ or $60 \times 12m$; the residence was mainly high-rise buildings in 2010, with an average building distance of about 25 meters and obviously larger construction scale of $22m \times 28m$ $15 \times 35m$ (Figure 4).

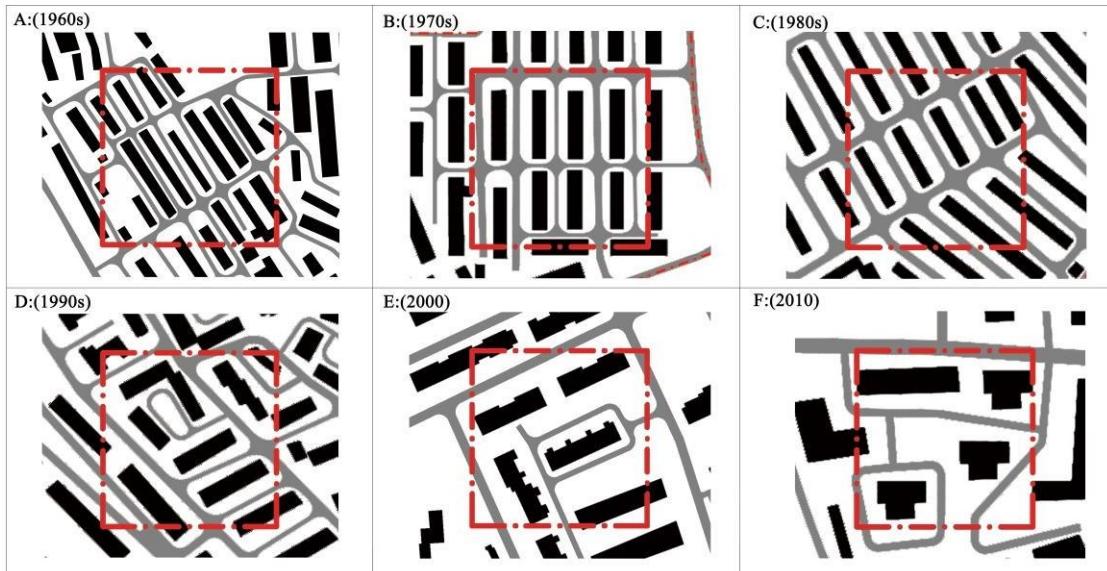


Figure 4. Evolution of the building Scale

Summary

From 1960 to 1990, the work-unit residence, restricted by the terrain, was divided into several small plots, and was built in the small block mode with a high density of road network. The buildings in the residence existed in the determinant as well as the determinant plus enclosing layout, mainly the low, multi-storied and small-volume buildings. In 2000, though the building is also existed in the determinant, the residential morphology began to change. For instance, the division of the residential plots gradually gets larger, the form of building layout is more abundant, and it began to pay more attention to the construction of the surrounding environment. However, the residential morphology changed greatly in 2010. The influence of the topographic factors became small, but the division of the residential plots became large. The buildings were transformed from the stripe and small-scale type into the large-scale single or parallel high-rise type. Consequently, the building density decreased, leaving large areas of green space and public space (Table 1).

2.2. Discussion

The residential morphology only enjoyed minor changes in the first four time nodes, while that has changed gradually ever since 2000 and greatly ever since 2010. Developing from the work-unit residence to the commercial housing, residential blocks are transformed from the terrain-restricted small plots into big blocks with a larger area, from the parallel layout based on the terrain into the cluster layout. Consequently, the building density and road network density gradually decreased, the volume rate within the residential area gradually increased, and the building is also transformed from the small-scale housing like a long strip into a large-scale single building or townhouse. Starting with the research findings, this paper will discuss the

impact of the changing economic factors on the spatial morphological change of the work-unit residence from two aspects, such as the transition from the planned economy to the market economy, and the structural transformation from the supply side to the demand side.

Table 1
Evolution of the Residential Form

		1960	1970	1980	1990	2000	2010
Plot Division	Average Area:0.13 ha	Average Area:0.11 ha	Average Area:0.27 ha	Average Area:0.16 ha	Average Area:0.36 ha	Average Area:0.30 ha	
	Density	42.36km/ km ²	47.94km/ km ²	40.04km/ km ²	40.70km/ km ²	29.44km/ km ²	28.31km/km ²
System Of Streets & Valleys	Volume	Small	Small	Small	Small	Large	Large
Layout		Determinant	Determinant	Determinant& Enclosing	Determinant	Determinant& Group	Point & Group
Density		30.42%	28.54%	24.57%	27.00%	19.41%	23.14%
Plot ratio		0.92	1.14	1.23	1.32	1.16	2.77
Scale		Low and Small	Multiple and Small	Multiple and Small	Multiple and Small	Multiple and Small	High and Large

Evolution of Economic System and Work-unit Residential Form

China was in a planned economy period during the founding of the PRC in 1949 till the reform and opening-up to the outside world in 1978. During the period, the central government played a leading role in the production and living, resource allocation and so on, influencing the land-use form of the city by controlling population, investment, land expropriation and transfer. In terms of residence, fixed assets investment was concentrated on the industrial sector, under the guidance of the policy of “replacing consumption city with production city” and “giving priority to production rather than living”. As a result, a work-unit residence, which was in line with industrial zone construction, became the main form of urban residential development to avoid the diversification of capital investment. The three plots in a, B and C above are the same type of residence.

The residential form during the period appeared to be the building monomer, primarily the low-layer and multi-layer buildings. Among them, residential units of the residential area (such as the previous A, B residential area), that included “equal rooms”, a common kitchen and a toilet in the 1960s and the 1970s. Similar to the dormitory, the building scale was relatively small. In the 1980s (as in the C residential area above), more and more dwellings were aimed for families, the housing function gradually improved, and the housing scale gradually become larger for a single family. The residential buildings adopted the parallel form, the equal spacing between buildings, the same orientation, and no difference in outdoor space. As a consequence, the whole city's living space formed the status quo of a homogeneous convergence. At this time, the housing was distributed to individuals as a kind of work-unit welfare, although there had been some creative exploration in form, yet overall, its type relatively pure.

After the third session of the 11th National People's Congress, China entered the period of transition from the planned economy to the socialist market economy, but the land system did not change accordingly. Thus, the form of an urban residential area was a continuation of the planned economy period. In the case of D residential area in this paper, although it was built in the period of the market economy, there was no obvious difference in the residential form from the former residential area. It lasted till 1990 and 1998 when the State promulgated the Regulations on the Transfer and Assignment of State-owned Land Use Rights in Cities and Towns, and implemented the housing commercialization reform system respectively, the mechanism of the work-unit

residential area gradually disintegrated with the paid and limited-period use of the land. Finally, the city construction entered into a new stage. The market economy began to guide and control the development of urban settlements, which gave birth to rich diversity.

Under the circumstances of the market economy, the residence, as a kind of product, produces a variety of styles targeting different groups of people. For example, F residential area of a collective residence type above is the same as during the planned economy period, but with the increase in the layers of buildings, the architectural appearance and architectural scale of high-rise residential buildings have obvious differences compared to the previous multi-storyed houses. There are various possibilities in the layout of architectural groups in the plane features of the residential area. Especially in mixed settlements, different dwelling types are concentrated in a single space, and the corresponding plane features are fused together. As a result, the morphological types of settlements become rich and diverse.

To sum up, the economic system transition from the planned economy to the market economy has had an important influence on the residential area form. Compared settlement A, B, C and D between the 1950s and the 1990s with one after the year 2000, the planning methods, design and construction patterns of the four settlements were not much different, but the settlements that were built after 2000, particularly the F settlement built in 2010, are diverse and abundant in the architectural form, the road system and the way of residential arrangement. This is mainly due to the role of the market guidance. The implementation of the market economy system stimulates the demand for residential diversification and the housing as a product needs to meet the needs of different groups in order to achieve the greatest benefits. As a result, the living area has been enriched and changed greatly.

Evolution of the Economic Structure and the Work-unit Residential Form

In the process of the transition from the planned economy system to the socialist market economy system, the market power plays an essential role in the evolution of the urban spatial form, especially the spatial form within the residential area. The supply and demand relationship

is the core of the market power, therefore, the relationship between supply and demand of the residential area performs an important role in its evolution.

Before the reform and opening-up, China's urban and rural land belonged to the state and collective ownership, and the state and collectivity were the main suppliers of the settlements. During this period, residents' demand for housing was not affected by their economic ability, and the amount of investment and housing produced by the government was based on its financial resources. Because the government's main investment at this time was used for industrial production, rather than residential construction, resulting in the long-term shortage of housing supply, and depressing the residents' housing needs.

With the contradiction between supply and demand and the shortage of housing supply, the focus of residential area construction lies in improving the living conditions, generally in the existing industrial areas and the remote areas of the old town. For example, in the residential area A above, the construction is primarily "a simple cottage" and "a temporary building" and other low-rise buildings, and the structure is also brick and brick masonry structure. Meanwhile, the residential form is basically the parallel layout, only a very small number of free layout and peripheral layout. The road system within is a network format, leading to various sizes of the neighborhood. Under this general layout, the surrounding environment of each building is roughly in a kind of undifferentiated state, which embodies a kind of "equality", and also caters to the social background of "a communist". After the 1960s, the residence (e.g., B, C, D settlement) gradually changed from low-rise to multilayer, and the architectural scale changed slightly, but there was no significant difference in the overall settlement pattern.

With the increasing number of urban population and the serious shortage of residential area supply, the housing system distributed by the work-unit welfare has been unable to meet the increasing demand, thus promoting the implementation of the system of housing

commercialization reform in the 1998. Then the unified housing supply was gradually changed from the government, enterprises and work-units to the market, and real estate developers became the main providers of residential areas. Driven by the interests, the local developers resorted to a variety of means to meet the diverse needs of residents, reflected by the changes in the residential form. Thus, the form of the residential area began to change greatly.

On the other hand, since the reform and opening up, China's economy has been greatly improved, and the mass construction of large number of residential areas has alleviated the situation of residential tension. In this situation, the residents' need for housing is transformed to a higher level. The diversification of the housing demand has also promoted the diversity of residential forms, and the development of settlements is facing the dilemma from quantity shortage to structural shortage.

At the background, the standard of residence inevitably moves from a single to a multiple one. From the goal of overcoming the dilemma to the pursuit of residential comfort, housing patterns and residential forms are unprecedently rich in the residential design. For instance, many forms of housing gradually appeared in the E, F residential area above, including high-rise residential, small high-rise residential, multi-storied residential, low-rise high-density residential, townhouse and so on. Moreover, the residential form of this period is more changeable, the living area is more beautiful and the road system is freer.

In addition, the residents are gradually looking for the new perspective, such as environmental issues, living environment, which directly affects the residents' choice of residential areas. In recent years, with the implementation of a second-child policy, as well as the increasingly serious problem of aging, the resident structure in our country has undergone great changes that has aggravated the residents' demand for diversified settlements, and also requires more residential forms.

From the changes in the residential supply and demand it is not difficult to find out that the main suppliers of the settlements are transformed from the nation to the property developers. During the early stage of the process, the residential form was single and pure due to the fact of the nation as the suppliers of settlements and the constraints of relevant policies and economic conditions, such as the A, B, C and D settlement above. Subsequently, as a result of the policy changes, developers must design different forms of residential areas for different residents, and the residential forms are increasingly rich due the market as the main supplier of residential areas, and developers pursuing for greater benefits, such as in the E, F residential area. At the same time, when a large number of residential areas met the basic survival needs of residents, the "supply-demand" structure changed in the residential area, the diversification of the residents' needs dominated, so there was more need for the emergence of diversified settlements.

3. Conclusions

According to the longitudinal comparison of the six aspects in the residential area, the plot division, the street system, the building density, the plot volume ratio, the building layout mode and the architectural scale, the residential form has enjoyed evolutions and replacements in the morphological change characteristic in the six different periods of the Kunming Steel Plant since 1960. In particular, the first four periods of settlements have undergone only a slight change, and in the beginning of the 2000s, the form of settlements began to change gradually, and in 2010 the living area, its form changed dramatically compared to the previous settlements. The low-rise buildings in the market economy period are replaced by the multi-level and high-rise residential groups; the density of buildings and the density of the road network are gradually reduced; the layout of the building is changed from the tightly-connected parallel form to the more flexible point-style combination; the spatial scale of architecture has a tendency to become larger.

The change of the above residential form is closely related to the economic transformation of the society. First of all, the economic system affects the construction and development of residential areas. During the planned economy period, our country's residential area construction

is in the secondary position, the housing only plays the role that solves the inhabitant survival problem, therefore the residential form generally is the comparatively economic and parallel layout, and the construction scale is small. Under the market economy system, however, the residential area as a kind of product needs rich residential forms to meet the requirements of consumers to carry out its economic value, so the residential area is becoming rich. Secondly, the relationship between supply and demand of the residential area also affects its form. When the basic subsistence demand of residents is not satisfied, the residential area supply is in the dominant position, and the form of a residential area is unitary in this stage. With the economic development, the amount of residential construction meets the needs of residents, and at this time the needs of residents are the main position. Accordingly, the market must continue to enrich the residential forms to satisfy the needs of residents for the pursuit of greater economic benefits. The residential forms have changed dramatically.

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Illustrations and tables

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