

The relationship of building types and plots to changing family structures and land systems in Chinese settlements

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Revised version received 11 June 2020

Abstract. *Through the analysis of plots and buildings respectively, M. R. G. Conzen and the Caniggian school of typo-morphology proposed complementary approaches to the understanding of physical changes in urban form. Understanding the role of building typological processes can contribute to the study of morphological changes. In order to understand the nature of typological processes in the process of changing settlement form, the relationship of plots and buildings to changing social forces requires further investigation. The form of Chinese rural settlements reflected the changing system of landholding and family structure. The typological process and the process of plot change in relation to building activities of individual families are examined in a sample settlement in north China. This study indicates that the investigation of the relationships between building types and plots contributes significantly to understanding the form of settlements.*

Keywords: plot shapes, property ownership, building types, family structure, land system

The seminal work of M. R. G. Conzen and Saverio Muratori has provided the basis for interdisciplinary studies of settlement form (Moudon, 1994, 1997). They suggest that settlement forms comprise three fundamental elements: buildings, plots, and streets at different levels of resolution, which are fundamental components of urban tissue (Kropf, 1996; 2014; Moudon, 1997). From the approach of town plan analysis, a notable early contribution to the study of the forms of British settlements of all sizes, ranging from isolated farmsteads and small nucleated settlements at one extreme to a conurbation at the other, was that of M. R. G. Conzen (1949). From the approach of typological process, the Muratorian school focused on the mechanism by which the building forms created in one phase are succeeded by those created in the next (Caniggia and Maffei,

2001). The former is more about how the forms that make up urban areas fit together, whereas the latter has been particularly developed at the scale of individual buildings (Maffei and Whitehand, 2001). From the approaches of geography and architecture respectively, considerable effort has been devoted to studying physical changes in urban landscape (Whitehand *et al.*, 2014). There has been little discussion among geographers concerning the actual mechanisms, and the process whereby period types arise is largely unexplored (Maffei and Whitehand, 2001). The significance of this typological process is its dialectical understanding of the nature of the continuity and change of urban areas over time (Gu *et al.*, 2019). The idea of typological process has been slow to receive empirical support (Gu *et al.*, 2019). This paper aims to investigate the nature of typological

process in the changing process of settlement form.

In the typological process, the adaptations of existing form are the basis for new types of building (Whitehand *et al.*, 2014). A comparative study using plan analysis in order to address the varying degree of physical changes in the aspect of process has been undertaken by Whitehand *et al.* (2014). As the conceptualization of the typological process poses major problems for empirical testing, the precise nature of the typological process remains elusive (Whitehand *et al.*, 2014). Gu *et al.* (2019) have provided a case study of the typological process in Auckland. A recognizable developmental sequence of the typological process from one period to the next is evident through the inherited and developed plan organization, plot and street pattern. The physical changes were characterized by social-economic conditions and design and planning ideologies. Each building type is developed from the existing building type and the introduced new features tend to accommodate new social conditions (Gu *et al.*, 2019). This research opened up an analytical method of clarifying the typological process.

Two concepts need to be clarified to better understand the idea of typological process: the idea of type and its process. The definition of type can be traced back to French Enlightenment architects. The idea of type in architecture was introduced by Quatremère de Quincy, who indicated that every type began with a first model contributed by the productions of a kind of people in a particular place (Vidler, 1977a, b). Several primitive models including caves for hunting, huts for carpentry and tents for farming were proposed. When there were changes of production mode, the building type might be influenced (Leandro, 1995); resulting in changes to the built form, including ground plan and façade. The changing process of building type can be clarified by the understanding of the changing mechanism of production mode from a particular inhabitant or group of inhabitants in a particular place. An analysis of the relationship between physical form and mode of production is required. The land system is the fundamental

factor in the mode of production and family structure is the social product. Their relationship to the physical changes requires investigation. It is another aspect of the nature of typological process according to the relationship between physical feature and social conditions suggested by Gu *et al.* (2019).

Based on the idea of type and its process, the questions of the precise nature of typological processes of buildings in the changing process of settlement form in relation to the family organism and land system, and their contribution to the understanding of morphological changes of settlement form, require exploration. A case study with clear observed building types and changing process would be helpful in understanding these issues. Chinese settlements underwent a continually-changing process of building types accompanying the changes of mode of production after 1949. Such settlements with observed period characteristics can provide appropriate case studies.

Research on both building type and other aspects of urban form has been undertaken in Chinese settlements. A series of studies has been produced of residential building types in different areas and historical periods. From the mid-1950s, Dunzhen Liu set up the general foundation of typological research on residential buildings from the Ming and Qing Dynasties through the analysis of spatial organization and function influenced by production mode (D. Liu, 1956). From the 1960s, extensive typological research on individual residential buildings was carried out in different areas, based on historical periods, function, construction, material and the organization of space (Chen *et al.*, 1993; Lu and Yang, 1988). Work on Chinese residential building types including 18 volumes on different places was edited by Dingyuan Lu *et al.* and published by the China Architecture and Building Press in 2009–2010 (for example, J. Liu, 2011; Xue, 2009a, b). In the 2000s, typological study shifted from a focus on individual buildings to the urban tissue, where two research approaches were evident. The first is that the building typology was introduced into the field of conservation (Ruan, 2000, 2004) and the second is that building typology has

been incorporated in research into the process of settlement tissue change (Ding, 2001). After about 2000 a number of morphological studies on Chinese historical urban areas were initiated. Investigation of the historical area of Beijing (Whitehand and Gu, 2007a), Pinyao (Whitehand and Gu, 2007b), Suzhou (Chen, 2012) and Guangzhou (Li and Gauthier, 2014; Whitehand *et al.*, 2011) provided the example for morphological research on Chinese urban historical areas. A study of Nanjing (Whitehand and Gu, 2017; Zhang and Ding, 2018) provided a morphological method applicable to modern Chinese cities. This body of research set up the basis for the understanding of the typological process in the changing process of settlements. A detailed study of physical changes of building types and plots in relation to social forces is required.

This paper further investigates the building typological process in the changing process of settlement form through a case study. It is necessary to trace the changes of individual plots and buildings at the micro-scale in all development phases. The selection of a suitable case is based on three constraints. First, the built form of settlements should contain all building types from all phases of change. The clear division of all phases of settlement form change is rarely found in Chinese cities and developed rural settlements in south China owing to the recent period of rapid economic development and urbanization. However, the buildings of a number of historical rural settlements reflecting all different development phases are still evident in north China because of the relatively underdeveloped economy and recent preservation of historical buildings. Secondly, in order to understand the influence of family structure, a stable local community throughout several generations is needed, where residents usually have the rights to build houses on individual plots. Under the dual land system in rural and urban areas, the building activities of each family on individual plots were widespread in rural settlements even after the changes of landholding system in 1949, because each family in rural areas had the ownership of land-use for individual plots (according to the *Notice on the*

supplementary provisions on the issue of residential land for members: Central Committee of the Communist Party of China, 1963; see Yu and Chen, 2009; X. Wang, 2011; Zhu *et al.*, 2012). Thirdly, a research basis including previous research, documentary records and surveyed settlement plans is required. China has a long cartographical tradition, but true urban ground plans showing streets, plots and building block-plans were rare until relatively recently (Gu and Zhang, 2014). To meet the first and second requirements, the appropriate location for this research is the historical rural settlements in underdeveloped areas in north China. Based on research on Chinese residential building types by Y. Lu in 2009–10, there are suitable rural settlements in Henan and Shanxi provinces. In Shanxi there are numerous historical rural settlements, and research on traditional building types and history has been carried out (Xue, 2009a, b; Han, 2010; J. Liu, 2011; Guo and Ding, 2017). Of these settlements, Shangzhuang has evidence of building type and plot changes (Figure 1A, B); individual building activities in a stable community; and appropriate records in all the phases of change. There are residential records from 1949 and 1992, surveyed settlement plans for 1992 and 2006 (Figure 1C, D) documented by the administrative body and a satellite image for 2016 (Figure 1B). Shangzhuang is therefore a suitable case with which to explore the issues identified earlier. The documentation supports research beginning in 1949. From that date there has been socio-economic instability, and change in both family structure and the landholding system.

Shangzhuang: context and sources

Originating in the Ming Dynasty (1368–1644), Shangzhuang is located near the Qin river in Shanxi Province. It has a fairly linear form surrounded by farmland. The mature built form consists of a series of courtyard buildings generally functioning for living and religion during the Ming Dynasty (Xue, 2009a). After about 1949, Chinese rural settlements underwent changes in both the system of

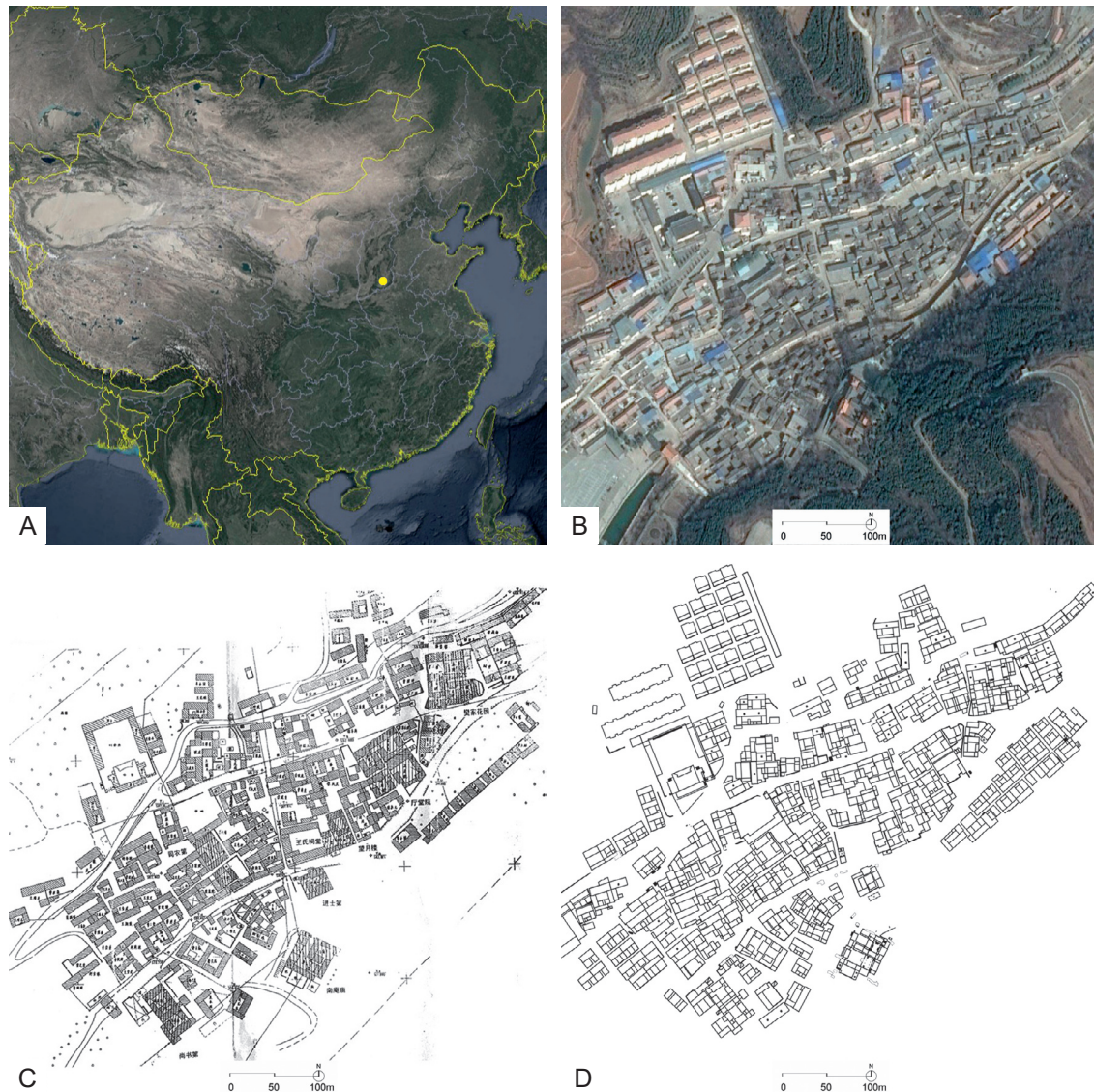


Figure 1. Shangzhuang. A. Location. B. 2016 satellite image. C. 1:1000 plan of 1992 from the administrative body of Shangzhuang. D. 1:1000 plan of 2006 from the administrative body of Shangzhuang.

landholding and family structures. Traditional courtyard houses have continued to serve the changed family structure. However, land ownership gradually shifted to the collective by a series of land policy changes from 1949 to about 1963, and new types of structure were required. Several new house types were developed to accompany various new plot patterns. Research sources contain data for each individual plot.

Previous historical research provides the early settlement plans from the Ming Dynasty

to the Qing Dynasty (1644–1911) (J. Wang, 2001; Xue, 2009a). In the early period, a traditional built form set up a morphological frame for further development. Based on the changes of family structure and spatial organization, the typological study of Shangzhuang indicates that there were four house types in all of the changing phases including the traditional courtyard house type before 1949, a new courtyard house type (1978–2000), a semi-detached house type and a multi-storey flat type (both 2000–2016) (Figure 2; Guo and

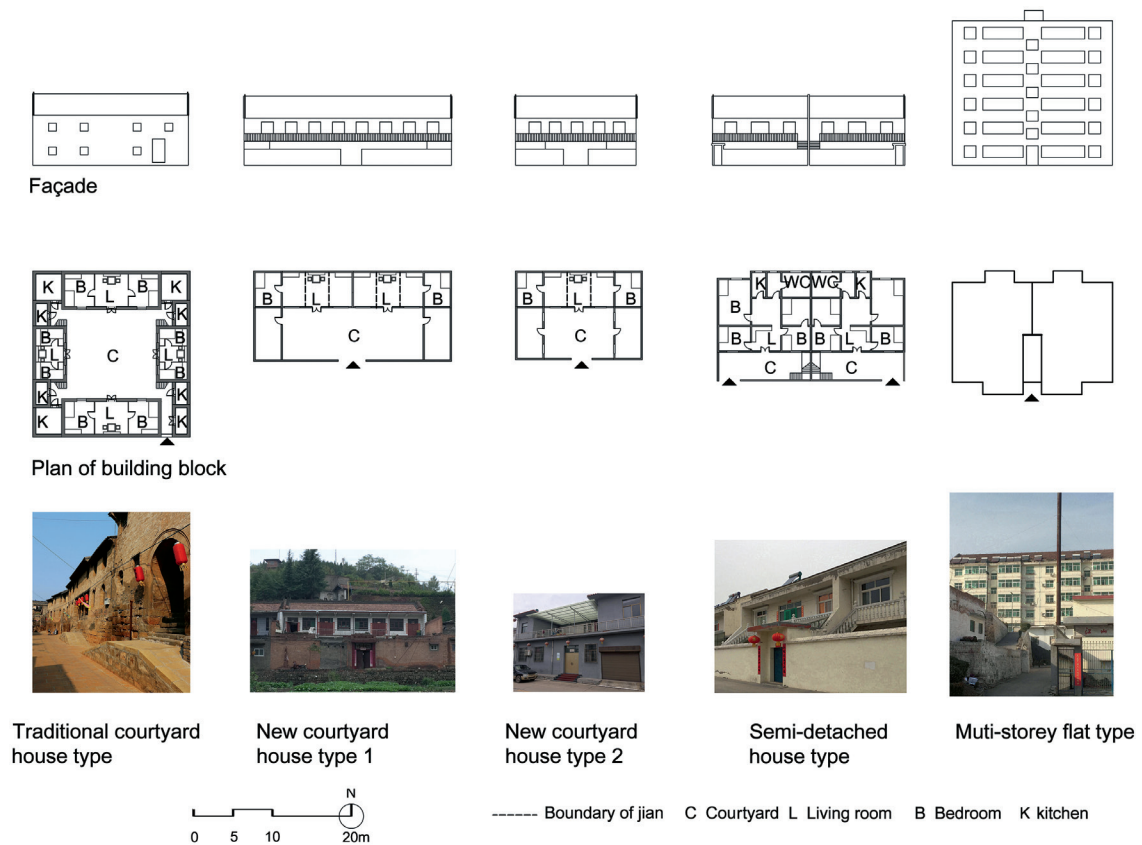


Figure 2. Building types in Shangzhuang (source: based on Guo and Ding, 2017).

Ding, 2017). The clearly-differentiated period characteristics of preindustrial ordinary residential buildings were largely unchanged until the twentieth century (Whitehand *et al.*, 2014). The history of Shangzhuang after about 1949 can be divided into three phases according to building type changes, changing land policy and general social and economic changes (Guo and Ding, 2017). In the period from 1949 to 1978 there were no building activities and the settlement retained its traditional frame according to the historical records (J. Wang, 2001). However, property ownership changed during this period. After about 1978, new house types were introduced (Figure 3).

The three development phases in Shangzhuang are as follows. First is the Communist period (about 1949–1978). After the Second World War, the communist productive mode was implemented in rural areas. Influenced by the Outline Land Law

of China (issued by the Central Committee of the Communist Party of China in 1947) and a further series of land policies, in 1948 property was redistributed to every family in rural areas according to family size (J. Wang, 2001). The Notice by the Central Committee of the Communist Party of China (1963) ended private land ownership in 1963. Then the residential land system in rural settlements changed from private to public ownership. Residents had land-use rights and collective land ownership. Buildings were the only private property. Family structure generally changed from a joint family to a nuclear family in the 1960s and 1970s because of family subdivision (Y. Wang, 2000, 2007, 2008). Family subdivision was influenced by the changing of the family's moral regulation, form of marriage and economic system (Y. Wang, 2008). During that time families became subdivided when the next generation married and formed a new family living in a portion of the original



Figure 3. Built-up area of Shangzhuang (source: based on Guo and Ding, 2017).

house. At this time in Shangzhuang there was little construction owing to the poor state of the economy between 1949 and the mid-1970s (J. Wang, 2001).

The second phase was economic reform (about 1978–2000). This period was characterized by reform of the system for rural farmland, which triggered a large increase in economic prosperity. Meanwhile, according to the household responsibility system at the end of the 1970s, residential construction in rural areas was encouraged by the state through the declaration of the legitimacy of private construction. As a result, much farmland was converted to residential use. A new type of courtyard house was introduced and there were many new houses in new plots in the mid-1970s in Shuangzhuang (J. Wang, 2001). There was considerable land control

between 1982 when new *Regulations on the management of land for building in villages and towns* were issued by the State Council (1982, 1990). As collective property, trade in, rental of and transferring residential land was illegal. Residential construction had to conform to settlement planning. New plots were strictly controlled. However, land-use rights were still separated from land ownership. Before residents built new houses in new plots, plot applications needed to be submitted to the administrative body of the settlement. According to the local land policy, new plots were reduced in size. During this period, family subdivision also accompanied the marriage of the next generation. This led to the redistribution of property. In 1982, the one-child policy was implemented in Shangzhuang (J. Wang, 2001).

In 1990, economic reform occurred in urban areas but there was little new construction in rural settlements, although there was a good deal of refurbishment. In about 1990, some 37 new courtyard houses were built after the submission of new plot applications to the administration. They had smaller plots than in the 1980s according to the new land policy.

The third phase was the real-estate boom (after about 2000). The 1998 Law of Land Administration of the People's Republic of China had declared that one household could only have one house with a limited plot size. Commercial real estate boomed in urban areas after 2000 and greatly influenced the built environment in rural areas. More and more residents migrated to the city. New building type, semi-detached houses and multi-storey flats, were constructed in rural areas.

Documentary residential records for individual plots and buildings for 1949 and 1992 in Shangzhuang can support the detailed analysis of the changes of individual plot and buildings in all the different development phases (Figure 4). The residential records revealed information about one or more ownerships within the same courtyard where property redistribution had occurred. Each ownership was a single family. All the ownerships within the same courtyard were classified by the same plot number in the records. Both the residential records for 1949 and 1992 provide the names of houses, the addresses of householders, register number, property lists, property size, ownership boundaries, building time and dates of family subdivision. The 1992 records provide more specific information about the ground plan of buildings, plots and ownership boundaries and family subdivision. These data cover all the built form of Shangzhuang, and some missing residential records can be supplemented by field surveys. The householder names of the residential records for 1949 and 1992 can be directly linked with settlement maps. Based on the residential records for 1992 and the settlement plan for 1992, maps between 1949 and 1992 can be created in detail according to the date of construction of each house in the residential records for 1992. Information after 1992 can be obtained from

the 2006 settlement plan, 2016 satellite image of 2016 and field surveys. Detailed ground plans of buildings and plots for each family, and family transformations from 1949 to 1992 can be found in the 1992 residential records, which contain all the information from 1949 to 1992. Post-1992 built form data can be reconstructed from field survey based on the 2006 plan. These data can contribute to the inductive analysis that includes 222 residential houses accommodating a population varying from 521 in 1949 to about 1000 in recent years.

The definition of a plot refers to a physical form, a unit of land use and a unit of property (Kropf, 1997, 2018). In a Chinese rural context, plot boundaries were defined as physical entities, demarcated by the exterior walls of courtyard houses. As the focus of movement, the courtyard provided the common space with and access to connected buildings. One or more ownerships might be included within the same plot and the courtyard was owned by all of the families whose buildings opened onto it. It is clear that plots were defined by the spatial organization of the courtyard but not necessarily by ownership, as documentary residential records reveal.

The investigation described in this paper is in two parts: first, the typological process is considered; and secondly, the processes of changing plot and property ownership in relation to building activities of each family and building type in individual plots are investigated. From the perspective of the typological process, the evolutionary mechanism can be understood by considering the relationship between building types and plot shapes accompanying the changing family structure and landholding system. From the perspective of building activities of each family, the changing relation of building types and property ownership (including plot ownership) can be directly linked to family histories. The further changes of plot shapes in relation to property ownership can also be clarified. The relationship between building types and plots over time to the changing social forces can largely be understood in terms of these two aspects. The research demonstrates the mechanism

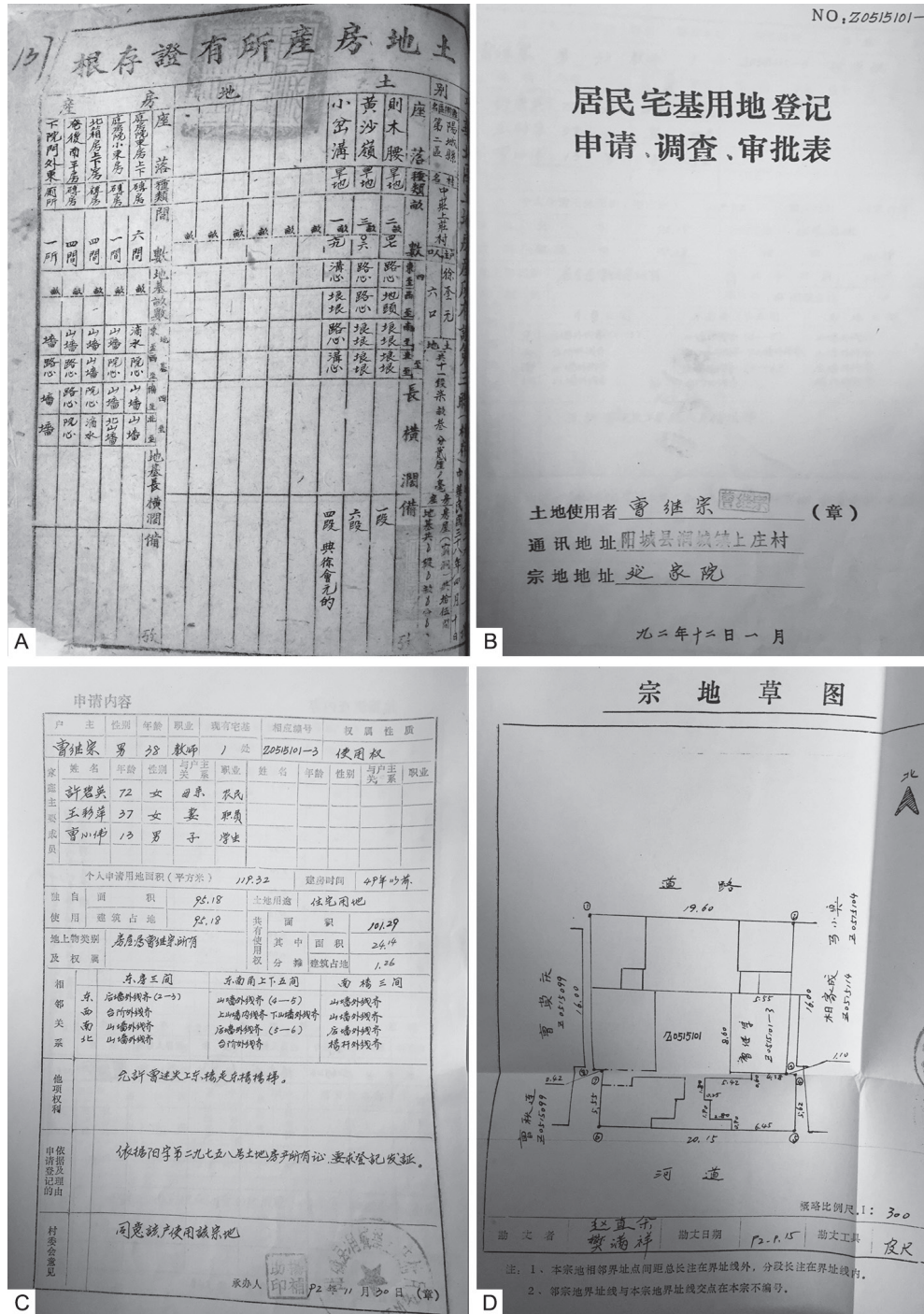


Figure 4. Samples of documentary residential records from the administrative body of Shangzhuang. A. Residential records for 1949. B. Cover page of residential records for 1992. C. Text page of each ownership of residential records for 1992. D. Building plan of each ownership of residential records for 1992.

of the typological process and its relation to plots and three types of plot changes are identified.

The typological process

In the building typological process, a seminal unit that preserved its evolutionary information may still be recognizable (Marzot, 2010). According to Levy (1997), the residential type in its evolution may permit the reading of a given family organism. The understanding of the relationship between plot shapes and building types requires examination, as does the seminal unit, its spatial organization, and its corresponding family organism in relation to the typological process.

Originating before 1949 and functioning for a joint family, the plans of the traditional courtyard houses were measured in terms of the *jian* (间), the equivalent of a 'bay' in traditional western architecture. The *jian* unit was the basic module of living space with one basic room, which constituted the living space between two beam structures. The plan organization of a traditional courtyard block consisted of 3 *jians* in four wings with two floors, several auxiliary buildings of one *jian* in each corner, and a yard. Several courtyard houses could connect to each other to form a large space to accommodate family expansion.

A typological study suggests that the generic character of the traditional building type is 3-*jian* (Ding, 2001). A 3-*jian* width was the typical living unit, consisting of a living room in the centre and one bedroom on both sides, and accommodating a nuclear family. A 1-*jian* building in a corner was a space for a servant, functioning as a kitchen. In the pre-1949 private land system the yard was not only the social centre but also the working place of a joint family in the farming season. Three-*jian* buildings served by 1-*jian* auxiliary buildings were occupied by several nuclear families based on their rank inside the joint family. Parents commonly lived in the northern 3-*jian* buildings and families from the next generation resided in the eastern, western and southern parts. A joint family

was supported by the family-based mode of production, traditional family moral regulation and arranged marriage (Y. Wang, 2000). After 1949, the settlement's economy was underdeveloped. Property redistribution to every family in rural areas was influenced by the collective-based production mode in the communist period (J. Wang, 2001). Although the joint family still existed, its social organization changed. Farming activities were no longer undertaken by families but by large working groups (J. Wang, 2001). This type of building block continued to serve the new social arrangement that consisted of several families with separate ownerships around the 1960s. Each family took possession of some buildings dependent on their family size. The only changes of buildings were their ownership, according to the property information in the 1992 residential records. Family subdivision was influenced by the changing of family moral regulation, economic system and marriage form around the 1960s (Y. Wang, 2007, 2008) and this again had an impact on property redistribution. Family size decreased from an average of 4.2 persons in 1965 to 3.6 in 1980 (J. Wang, 2001). Nuclear families tended to replace joint families.

The traditional courtyard plot boundaries were demarcated by the exterior walls of courtyard houses. The plot shapes of the traditional courtyard houses were generally defined by the combination of 3-*jian* buildings and 1-*jian* auxiliary buildings in 4 wings. In detail, the shape of plots was roughly a square measuring 5 *jians* (1+3+1) by 7 *jians* (2+3+2). It is clear that the traditional courtyard building types defined the plot shapes.

In the second period, from the middle of the 1970s to 2000, two types of new courtyard houses on new plots emerged, one after another, in the outer area of the settlement; accompanying the economic prosperity after rural economic reform in 1978. A family-based production mode was adopted again. However, family size was reduced accompanying the changes of family structure (J. Wang, 2001). The 1992 residential records suggest that it became common for each family to own an entire courtyard. The size of new

plots shrank, influenced by local land policy. From 1980 to 1999, the average family size decreased from an average of 3.6 persons to 3.4 because of the one-child policy (J. Wang, 2001). The new courtyard house types were also measured in terms of *jians*. The first type appeared in the mid-1970s and had two attached 3-*jian* buildings on the northern side of the courtyard. However, this type no longer contained the 3-*jian* buildings on the eastern, western and southern sides of the courtyard, reflecting the size of the new nuclear family. In the following decade, new plot size shrank further, accompanying the continuing reduction of family size. Another new courtyard house type emerged at that time. It had only one 3-*jian* building on its north side, but there continued to be a form of courtyard. The eastern, western and southern 3-*jian* buildings no longer existed.

The new courtyard house types served nuclear families of different sizes facilitated by the nuclear family-based production mode, free marriage and the one-child policy. The north building, containing a single or double 3-*jian* living unit, continued to be occupied as the main living space. The western and eastern buildings were no longer living space for other nuclear families. They became auxiliary parts of varying size.

In the process of change from traditional to new courtyard types, construction material changed from wood to concrete. However, the new courtyard house types inherited the courtyard pattern and the 3-*jian* living unit. The basic living mode, in 3-*jian* units and courtyards, was retained although their organization changed.

As with the shapes of traditional courtyard plots, these new courtyard plots were also defined by the exterior walls of houses. The differences are that the plot width was defined by *jians* whereas the plot depth was defined by the depth of *jians* and the yard (approximately 5 m). In detail, the shapes of plots were roughly rectangular, measuring 5 (1+3+1) or 8 (1+3+3+1) *jians* by 1 *jian* plus the yard depth.

In about 2000, influenced by the new living mode and the limits on available land,

semi-detached houses and multi-storey flats appeared, with much smaller plot sizes, in the peripheral area of the settlement. Their plans were quite different from those of former building types. However, the semi-detached houses still had the elements of the courtyard plan and the 3-*jian* unit. The difference from the former courtyard houses is that the yard was much smaller and a set of functional rooms was added to the back to cater for the increasing demand for modern living facilities. The multi-storey flats lost all resemblance to courtyard houses and their plots. The family structure at this time was a stable nuclear family, but more and more people were migrating to the city. The agricultural family-based production mode changed gradually, as tourism developed. However, the living mode in relation to 3-*jian* units and courtyards was retained except in the case of multi-storey flats.

The width of the semi-detached house plots was 3 *jians* and the depth of the plot reflected a new plan layout. The plot shapes of the multi-storey flats were defined by new planning of the settlement without reference to *jians*, yards and building plans.

During these three phases, the landholding system changed from private to public ownership. The change supported the transformation of the production mode from collective-based farming, to family-based farming and to tourism. The changes to social production and family structure directly affect the building types through the inherited living mode. These changes can be recognized by the evolutionary information in building types.

By tracing the different house types, it is evident that there was a clear distinction between the multi-storey flats and the former building types. It is clear that a stable 3-*jian* living unit and courtyard character were inherited from one type to another, except in the case of multi-storey flats. From the traditional courtyard house types to the new courtyard house types, the organization of 3-*jian* and courtyard varied depending on the family structure. In the case of the semi-detached houses, although the organization of building plan changed considerably, accompanying the

changing lifestyle, 3-*jian* units and courtyards were still available. The spatial idea of the family embedded in the 3-*jian* unit and courtyard concept no longer existed in the multi-storey flats (Figure 5).

The investigation of the buildings in the case study village revealed that the size of new plots generally shrank, accompanying the changing family structure. The width of plots was defined by the inherited 3-*jian* living unit and the depth of plots was defined by the courtyard plan, except in the case of the multi-storey flats (Figure 5). The width and depth of plots varied in different building types. In other words, building types regulated the plot shapes, including the size, depth and width, in

order to meet the requirement of family structure in all three periods (Table 1 and Figure 6). Since the multi-storey flats did not have a 3-*jian* living unit and courtyard character, this relationship between building types and plot shapes did not exist. A number of studies had indicated the relationship between buildings and plot width. In Alnwick, the width of plots was influenced by the building bays (M. R. G. Conzen, 1960). In Guangzhou, there is considerable evidence of a standard traditional plot of 1 *jian* (approximately 4 m) (Whitehand *et al.*, 2011). In Shangzhuang, a continuing influence between building and plot width was observed in the changing process of settlement form. This relationship

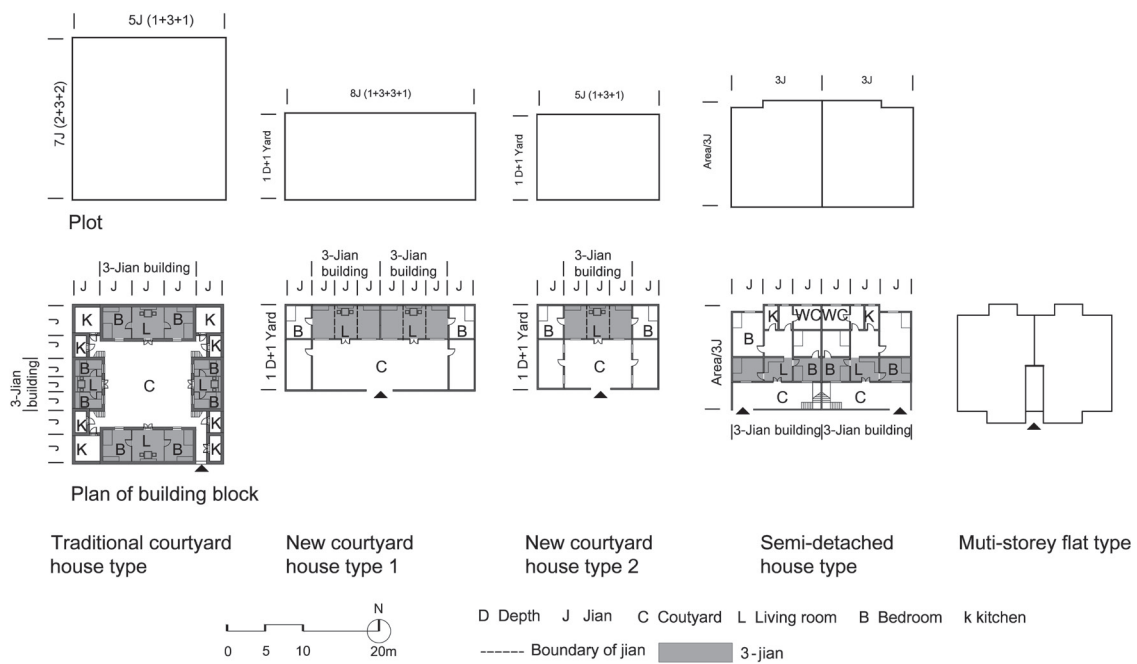


Figure 5. The typological process (source: based on Guo’s field surveys).

Table 1. Building types and plots in three periods. Source: based on residential records for 1949, 1992 and Guo’s field surveys

Date	House types	Plot area(m ²)	Plot depth in <i>jians</i>	Plot width in <i>jians</i>	Number of dwellings
Before 1978	Traditional courtyard houses	300–2100	2+3+2	1+3+1	39
1978–2000	New courtyard houses in 1980s	280–320	1 plus 1 yard	1+3+3+1	53
	New courtyard houses in 1990s	220–280	1 plus 1 yard	1+3+1	62
2000–2006	Semi-detached houses	160	No relation	3	66
	Multi-storey flats	By planning	No relation	No relation	2



Figure 6. Plan of building types. A. 1978 plan (traditional courtyard house type). B. 2000 plan (new courtyard house type). C. 2016 plan (semi-detached house type and multi-storey flats). (Source: based on the residential records for 1949, 1992 and Guo's field surveys.)

indicates the inherited information from one type to the next. It is the 3-*jian* pattern that contains a basic living mode inherited from the changing family structure.

The process of plot change

The typological process is concerned with the relationship between building types and shapes of plots, whereas examination of the relationship between building types and property ownership redistribution and further plot changes requires tracing the building activities in a succession of families in relation to different building types. M. R. G. Conzen's study of Alwnick (1960) pioneered individual plot analysis. By tracing the building activities, Teasdale's yard in Alwnick was studied below the plot level. The burgage cycle in relation to plot repletion was introduced. Plot subdivision occurred, and the yard became a recognized public right of way. A further comparison between Teasdale's yard in Alwnick and Teasdale's Dye house lot in Cincinnati supported the definition of the burgage cycle in a different context (M. P. Conzen, 2002). This plot analysis provided a method to understand micro-form changes and their social condition at the plot level tracing through several generations. It can be employed in this case in relation to the changes of family structure and landholding system.

Four or five generations and their built activities have been traced from 1949 to 2016 based on residential records and plot-by-plot field surveys. The general relationship between building types and the ownership redistribution, and further plot changes influenced by redistributed property ownership, is demonstrated for three families indicating three changing types: sample A is for the traditional courtyard plot; sample B is for the new courtyard plot; and further plot changes are invested in sample C (Figure 7). With the same measurements of the *jian*, the building plans and property ownership could be reconstructed through the residential records for 1949 and 1992, the building plans for 1992, and field surveys.

In 1948, property ownership redistribution was directly influenced by the 1947 Outline Land Law. In this land reform, 172 buildings were redistributed (J. Wang, 2001). After the 1960s, property ownership redistribution was decided by family subdivision when family structure changed from joint family to nuclear family. Each new family inherited some property from their parents.

The building activities of the Cao family were traced through four generations. Based on oral surveys, the first generation traced was active in one traditional courtyard house (Courtyard Ru) before 1949. The second generation contained 2 families (2a and 2b in Figure 7) and shared the same courtyard when



Figure 7. The location of selected houses, based on the 2006 settlement plan and the 2016 satellite image. A. The redistribution of property ownership in traditional courtyard houses and further building activities. B. The redistribution of property ownership in new courtyard houses. C. Plot changes in traditional courtyard houses. Note that there was no new built-up area in 1949–78.

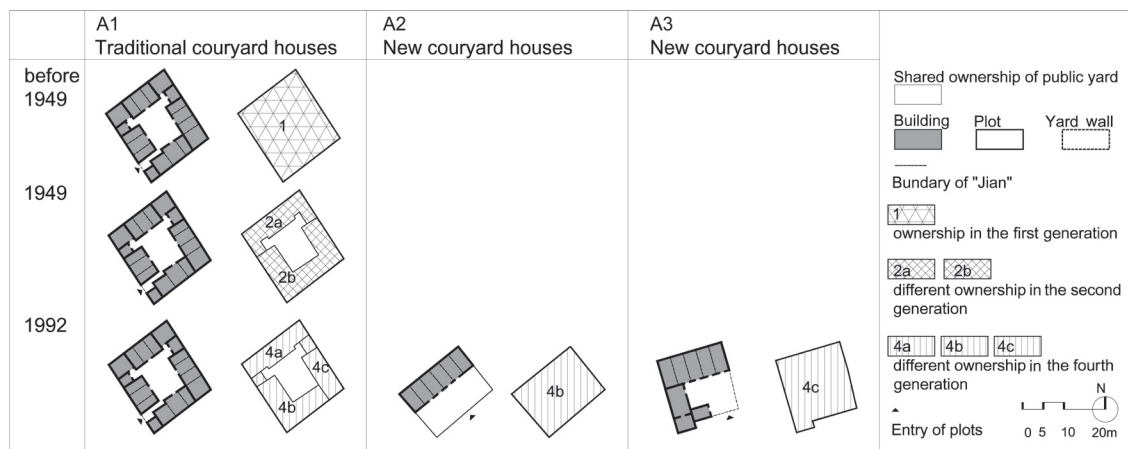


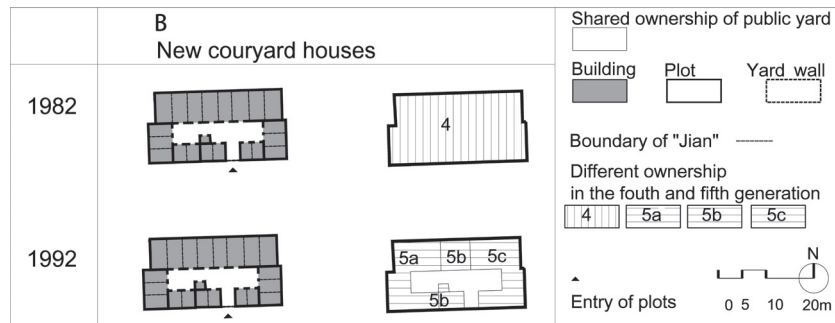
Figure 8. Sample A. Transformation of house and ownership of the Cao family (source: based on the residential records for 1949, 1992 and Guo’s field surveys).

land policy stipulated a property redistribution because of political changes in 1949. One of them (2a in Figure 8 and Table 2) had another house recorded in 1949. The ownership redistribution was based on the standard 3-*jian* buildings and 1-*jian* auxiliary building in 1949. There is a lack of information about the third generation during the time of less building activity; however, there might be some ownership changes in between generations. The fourth generation gradually changed from a joint family to a nuclear and linear family by family subdivision. There were three families (4a, 4b and 4c in Figure 8) in this plot in the

fourth generation recorded in 1992. The three families were subdivided in the last generation and continued living in a portion of the original courtyard house to the date of the research. This property ownership redistribution was also based on the standard of 3-*jian* buildings and 1-*jian* auxiliary building. There was no evidence of ownership changes after 1992. Each family had a secondary residence. One was part of another traditional courtyard house and the other two were the new courtyard house type with a double 3-*jian* building to the north (4b and 4c in Figure 8 and Table 2). However, for these new courtyard house

Table 2. Family information for 4 generations of the Cao family. Source: based on residential records for 1949, 1992 and Guo's field surveys

Generation	Owner	Recording date	Family members and structure	House quantities	Property number	Property quantities in <i>jians</i>
1	Unknown	Field survey	Unknown, composite	Unknown	Courtyard Ru	No records
2	Antai Cao (2a)	1949	8, Joint	2	29773	6
	Taicang Cao (2b)	1949	5, Nuclear	1	29747	18
3	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
4	Suoqing Cao (4a)	1992	6, Nuclear	2	20515099	8 (124 m ²)
	Quanyi Cao (4b)	1992	7, linear	2	20515101	9 (57 m ²)
	Qiulian Cao (4c)	1992	4, Nuclear	2	20515067	12 (243 m ²)
					20515099	12 (106 m ²)
					20515003	12 (259 m ²)

**Figure 9. Sample B. Transformation of the house and ownership of the Liu family (source: based on the residential records for 1992).**

plots, there were no records of property ownership redistribution and family subdivision. The changes of property ownership were common in traditional courtyard houses in order to serve the social requirements (Table 5).

The general principle of ownership divisions in the traditional courtyard houses is exemplified in the building activities of the Cao family. The ownership redistributions in the new courtyard house types were not available in this case. In the new courtyard house types, ownership redistributions commonly occurred in the fifth generation after the family subdivision in the 1980s. House B (No. 20515012), occupied by the Liu family, was built in concrete in 1980 by the fourth

generation. When family subdivision occurred between generations, the property was subdivided into three ownerships in 1992 based on the *jian* (Figure 9 and Table 3). Jianyu Liu's family (5b in Figure 9 and Table 3), also had additional houses because of the larger family size. There was no evidence about ownership changes after 1992. This type of change was not common (Table 5), because the new generation tended to build a new house when they married after 1978. However, this type of change indicates the detailed mechanism of property ownership redistribution inherited from the traditional courtyard house types. *Jians* were still the basic unit for property redistribution.

Table 3. Family information for the fifth generations of the Liu family. Source: based on residential records for 1992

Generation	Owner	Family members and structure	House quantities	Property number	Property quantities in <i>jians</i>
4	Lianzhu Liu (4)	8, Joint	1	20515012	26
5	Xiaoyu Liu (5a)	3, Nuclear	1	20515012-3	8 (150 m ²)
		5, Linear	3	20515012-2	5 (94 m ²)
	Jiayu Liu (5b)			20515110-3	4 (47 m ²)
				20515112-1	5 (101 m ²)
Shuangyu Liu (5c)	3, nuclear	1	20515012-1	8 (155 m ²)	

In some new courtyard building types, and in semi-detached houses and multi-storey flats in about 2000, family subdivision between generations did not trigger property redistribution because of the increase in the number of new houses and rural-urban migration.

It is clear that building types regulated property ownership redistribution through the basic unit of the *jian* accompanying family subdivisions after 1949, except in the case of house types after about 2000 when plot redistribution was rare. But there is the question of whether the redistributed property ownership further influenced shapes of plots. After plot-by-plot investigation, it seems that the redistributed property ownership might trigger changes of plot shapes. It is true in traditional courtyard plots. However, the influence had not occurred in other plot types. This interaction between shapes of plots and property ownership can be exemplified by tracing the building activities of the Cheng family, the Wang family and another unrecorded family who had lived in the same courtyard house (Figure 10 and Table 4). Hypothetically, this courtyard house was in one ownership before 1949 in the first generation. The second generation of the Cheng family lived with two other families in this traditional courtyard house after ownership redistribution in 1949. The original courtyard house plot had been subdivided to form three plots in 1992, according to residential

records. The residential records for 1949 indicate that the Cheng family owned the south-west corner where the building had been demolished, and another parcel attached in this corner (2a in Figure 10). Between 1990 and 2006 the Cheng family gradually built houses on the south-west parcel to form an individual courtyard house with an individual plot. The building in the north-east corner of the courtyard house belonged to another, unrecorded, family. It also had been demolished in about 1949 and a new building had been built in about 1992. The new building had an individual entry facing the outside of the courtyard, thus forming another individual plot (2c in Figure 10). The rest of the original courtyard house was continually occupied by the Wang family and the Cheng family to form a plot (2a and 2c in original plot in Figure 10). The three plots were developed and influenced by the redistributed property in the original plots. The new boundaries of these metamorphosed plots were based on the spatial organization of each of the courtyard houses and former redistributed ownership boundaries. The interlocking ground plan patterns were formed in this process (Figure 10 and Table 4). There was no evidence of ownership changes after 1992 or of building activities after 2006. The information for the Cheng family was well documented and the information of the other two families was not recorded. This type of change was common in traditional courtyard plots when there were

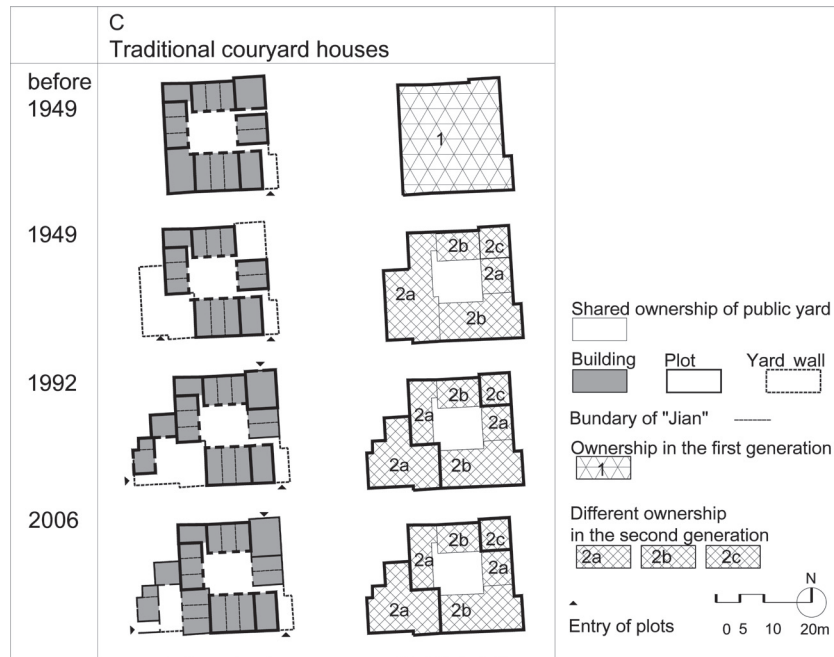


Figure 10. Transformation of built form and ownership of the Cheng family (source: based on residential records for 1949 and 1992 and plan for 2006).

Table 4. Family information in the second generation of the Cheng family. Source: based on residential records for 1949 and 1992

Generation	Owner	Recording date	Family members and structure	House quantities	Property number	Property quantities in <i>jian</i>
2	Tiecheng Cheng (2a)	1949	2, nuclear	1	29751	14
2	Tiecheng Cheng (2a)	1992	3, nuclear	2	20515030 20515033	3 6

new constructions after property redistribution (Table 5), because each family tended to build their own courtyard.

In these three samples (Figure 11), it is evident that the family subdivision and land system changes influenced the property ownership redistribution that impacted further plot metamorphosis. This process was regulated by building types. The process of plot change in all the development phases can be clarified based on documentary records and field surveys (Table 5 and Figure 12).

Conclusion

In summarizing the development process of settlement form as it is affected by changes to family structure and the system of land-holding, two aspects relate to the *jians* and the courtyard pattern. As the components of building types, *jians* and the courtyard pattern are the inherited elements affected by the family organism in the building typological process. They regulated new plot shape and size. *Jians* also regulated property ownership



Figure 11. Property ownership division and location of sampling plot.

Table 5. Building activities of individual family in different building types. Source: based on residential records for 1949, 1992 and authors' field surveys

Date	House types	Numbers of plots	Plots with multi-ownership	Metamorphosed plots
Before 1978	Traditional courtyard houses	39	38	7
1978–2000	New courtyard houses in 1980s	53	5	0
	New courtyard houses in 1990s	62	0	0
2000–2006	Semi-detached houses	66	0	0
	Multi-storey flats	2	0	0

redistributions and further plot changes influenced by family subdivision and the changes to the landholding system. In general, morphological changes can be largely understood by considering the typological process and plot changing process below the plot level.

Related to the changing system of landholding and family structure, the character of

the *3-jian* and courtyard pattern was retained in several building types in different periods from the traditional courtyard houses and the new courtyard houses to the semi-detached houses, but not the multi-storey flats, where modern functional rooms were introduced. The *3-jian* and courtyard pattern reflected the basic living unit and life style. Through the



Figure 12. Redistributions of property ownership in three phases.

arrangement of the *3-jian* and courtyard pattern, the changing building plans reflected the changing of family structures and their organization, except in the case of the multi-storey flats. However, both the *3-jian* unit and courtyard pattern, and modern functional rooms, are evident in the case of the semi-detached houses. The semi-detached house type can be recognized as the transitional phase between the multi-storey flats and the former courtyard houses. Before this transitional phase, these inherited characteristics from the typological process reflected the unchanged ideal living mode and affected the shape of new plots and the planned plot size. After this transitional phase, this relationship did not exist.

By tracing the building activities of successions of families in individual plots and buildings, it is evident that the first rearrangement of property ownership was triggered by the

changing land policy, whereas the succeeding redistributions of property ownership were influenced by frequent family subdivisions between generations. That redistribution was common in traditional courtyard plots from 1949 to 1978 when there were no building activities. From 1978 to 2000, the redistribution of property ownership was evident in new courtyard houses. However, it did not occur in the case of semi-detached houses and multi-storey flats when more people migrated to the cities after 2000 and the character of *jians* gradually became lost. In these plots with ownership redistribution, the configuration of building types has restricted the redistribution of ownership based on the standard of the *jian*. In traditional courtyard plots, the redistribution of property ownership affected further changes of plot shapes based on the standard of the *jian*. Metamorphosis of plots

with interlocking patterns in traditional courtyard plots was common. The traditional building types disappeared.

This research demonstrates that the investigation of the typological process contributes significantly to understanding the form of settlement, particularly in relation to the system of landholding and the structure of families.

Acknowledgements

This research on which this paper is based was funded by National Natural Science Foundation of China (No. 51538005). The authors are indebted to J. W. R. Whitehand, Susan M. Whitehand, Kai Gu, Peter J. Larkham and the anonymous referees for their detailed comments.

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